

CITY OF ROXBORO



STANDARD SPECIFICATIONS AND DETAIL DRAWINGS FOR WATER DISTRIBUTION SYSTEMS WASTEWATER COLLECTION SYSTEMS

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PREFACE

The Standard Specifications and Detail Drawings along with the Supplemental Specifications were adopted by the City Council of the City of Roxboro on _____.

The purpose of these Specifications and Detail Drawings is to establish a standard for the design and construction of public water and sanitary sewer utilities owned, operated and maintained by the City of Roxboro.

Updates to these Standards may occur periodically through action by the City Council of the City of Roxboro. It will be the responsibility of the holder of these documents to be fully apprised of any updates or amendments to these documents prior to performing any construction.

Copies of these documents may be purchased at the following address:

Public Services – City of Roxboro
779 Mountain Road
Roxboro, NC 27573

Any questions about the content or meaning of these documents shall be directed to the Public Service Director at 336-503-0489.

SECTION 02000
WATER DISTRIBUTION SYSTEMS

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02010 WATER DISTRIBUTION PIPE

A. DESIGN

1. Standard Specifications and Detail Drawings

- a) The following Standard Specifications and associated Detail Drawings will apply to all water system extensions and development of the City of Roxboro's Water Distribution System. The Standard Specifications and Detail Drawings included herein will apply to all aspects of the City of Roxboro's Water System that extend inside the corporate City Limits and any other areas outside the corporate limits in which the water distribution system is otherwise owned, operated and maintained by the City of Roxboro.
- b) Described in this Section are the general design standards which are to be followed by all parties in preparing utility extension and utility replacement plans for the City of Roxboro. These design standards will ensure that the citizens of Roxboro will continue to have good water facilities.
- c) All engineering plans for public and private water systems must meet State and City of Roxboro minimum design standards as indicated in the most recent amended Rules Governing Public Water Supplies and Public Wastewater Collection Systems by the N.C. Dept. of Environment and Natural Resources and/or the City of Roxboro Standard Specifications, whichever is the most stringent. All projects must be certified by a licensed professional engineer of record in the State of North Carolina.
- d) Plan and profile drawings will be prepared by a registered professional engineer signed, sealed and dated showing the various elements of the utility mains and will include an overall utility plan layout on a single sheet with scale no smaller than 1 inch =200 feet. The utility drawings will be on separate sheets, free of landscaping and other details not pertinent to the utility plans. All utility engineering drawings will be on paper 24 inches by 36 inches. All drawings will show all structures which will include but not be limited to drainage ditches, storm drains, streams, ponds, lakes, buildings, streets, driveways and other existing utilities. Plan/profile drawings will be prepared with a scale no smaller than 1 inch =50 feet.
- e) No plans will be approved for construction until all off-site easements have been obtained. All plans will show the existing utilities and their size with the existing easements. Off-site drainage will be indicated on the plans along with the proposed utilities. These plans will include service connections for the individual lots to be served.

- f) Once installed, "as-built" plans in paper form and digital form will be provided to the City of Roxboro showing the utilities. The digital form will be specified by the City of Roxboro. "As-built" drawings for the utilities will be submitted to the City of Roxboro at the time of acceptance of the project by the City. All service connections will be shown on the "as-built" plans and will be referenced to the property lines.

2. Location:

- a) Water transmission lines will be located and sized in accordance with the current "Water System Master Plan" or as directed by the City of Roxboro, and will extend across the full road frontage of a piece of property to the adjacent property to provide an adequate network. All public water mains will be located within dedicated right-of-way or dedicated easements with a minimum width of 20 feet. Dedicated easements for water mains and appurtenances will be recorded as "City of Roxboro Utility Easement." City of Roxboro Water Easements will contain only City of Roxboro utilities unless otherwise approved by an encroachment agreement.
- b) Larger size easements will be determined by the City of Roxboro if depths of piping exceed eight feet.
- c) All contiguous water line easements will be constructed in a fashion so that maintenance equipment and vehicles can travel from one end to the other without having to turn around or enter from a different point. Access to any easement will not have to be made using a private owner's driveway or property. This may require driveway pipe to be installed at creek/stream crossings. If driveway pipes are required, they will be placed the entire width of the easement.

3. No permanent structures, equipment, retaining walls, embankments, impoundments, or other elements that would inhibit maintenance operations will be constructed within a water main easement unless a written request for waiver is approved by the City of Roxboro. The request for waiver will describe all special conditions and include all appropriate measures to assure protection of the water main and access for maintenance. Fences may be allowed across easements provided appropriate access gates have been installed to allow utility maintenance. Fill or cut slopes greater than 5:1 are not allowed to extend into easements except by specific approval of the City of Roxboro.

4. Sizing:

- a) Major transmission lines will be sized in accordance with the "Water System Master Plan" or as directed by the City of Roxboro. Six (6) inch mains may be used only when a good grid exists. The total maximum

length of 6 inch and 8 inch lines, without connecting to a larger main, is 1200 feet and 2000 feet, respectively. Four (4) inch water mains are permitted on residential cul-de-sacs less than 400 feet long. Where a good grid does not exist, lines will be upsized to provide adequate fire flow as directed by the City of Roxboro. All lines will be designed to provide a minimum 40 psi residual pressure and a 20 psi residual pressure in conjunction with a 750 gpm fire flow at required hydrant locations.

5. Installation:

- a) All utility extension permits must be obtained prior to construction.
- b) All water mains will have a minimum cover of 3 feet measured from the top of the pipe to the finished grade. When water lines are installed along a roadway they will be installed at sufficient depth to maintain four (4) feet of cover to the subgrade of any future road improvements including potential vertical alignment changes.

6. Restraint:

- a) All water distribution mains for the City of Roxboro Water System will be restrained at valves, fittings, bores and length of piping connected to valves, fittings and bores as determined by calculations submitted to the City of Roxboro for review. The standard joint restraint will consist of stainless steel rodding and concrete blocking and wedge action retainer glands as specified herein. All valves will be restrained in a manner consistent with operation as a dead end, which includes restraining the valve to the pipe and restraining a sufficient number of pipe joints on both sides of the valve to accommodate dead end valve restraint. These Specifications allow for several options to achieve required pipeline restraint, such as wedge action retainer glands, stainless steel rods, concrete blocking, and manufacturer provided restrained joint pipe. All joint restraint products that include the means of restraint within the joint gasket will be prohibited by the City of Roxboro.
- b) All plans submitted will include the pipe restraining plan including the number of joints restrained at fittings, valves, etc. Project designers will include sufficient detail on the plan and profile drawings that make it clear to contractors what is required to meet the engineered restraining system specified. The pipe restraint plan will be included under the design responsibility of a Professional Engineer in the State of North Carolina sealing the drawings. Restraining systems not included within this Specification will require approval from the City of Roxboro prior to utilization.

7. Relationship to Sanitary Sewers and Storm Sewers:

a) Separation between Potable Water Mains and Sanitary Sewer Mains or Storm Sewers are as follows:

- Parallel Installations: 10-ft lateral separation (pipe edge to pipe edge) or minimum 3-ft lateral separation and water line at least 18-inches above sewer line measured vertically from top of sewer pipeline to bottom edge of water main. In unique cases where the sewer line and the water main are installed with at least 3-ft of lateral separation but less than 10-ft of horizontal separation, and less than 18-inches of vertical separation, both the water main and sewer line will be constructed of ductile iron pipe with joints in full compliance with water main standards.
- Crossings (Water Main Over Sewer): All water main crossings of sewer lines will be constructed over the sewer line in conformance with City of Roxboro Specifications. At a minimum, 18-inches of clearance will be maintained between the bottom edge of the water main and the top edge of the sewer main. If 18-inches of clearance is not maintained, the water main and sanitary sewer main will both be constructed of ductile iron pipe with joints in conformance with water main standards. The sewer pipe will be ductile iron the entire run from manhole to manhole or junction box to junction box. When the separation between pipelines is 18-inches or less, the void space between the pipes will be filled with minimum 500-psi, quick setting, non-excavatable flowable fill extending 3-ft on both sides of the crossing. Regardless of pipe material, at least 12-inches of vertical separation is required for both sanitary and/or storm sewer crossings of potable water mains.
- Crossings (Water Main Under Sewer Line): Allowed only as approved by City of Roxboro, when it is not possible to cross the water main above the sewer line. At a minimum, 18-inches of separation will be maintained, (measured from pipe edge to pipe edge) and both the water main and sewer will be constructed of ductile iron in conformance with water main construction standards. The sewer pipe will be ductile iron the entire run from manhole to manhole or junction box to junction box. If local conditions prevent providing 18-inches of clearance, then at least 12-inches of clearance will be provided and the void space between the pipes will be filled with minimum 500-psi, quick setting, non-excavatable flowable fill extending at least 3-ft on both sides of the crossing.

B. MATERIALS

1. General:

All water main distribution pipe 4 inches and larger will be ductile iron. The City of Roxboro will maintain a list of approved manufacturers for all water distribution products. New manufacturers must submit requests for approval to the City of Roxboro.

2. Ductile Iron Pipe

a) Ductile iron pipe will be designed and manufactured in accordance with AWWA C-150 and C-151 and provided in nominal 18-ft or 20-ft lengths. The minimum required pressure ratings for ductile iron pipe and required laying conditions are listed in Chart 1 for the City of Roxboro. For all other installations other than specified, the laying condition, bedding requirements or the minimum pressure class rating and/or thickness class will be increased in accordance with AWWA C-151. In all cases, pipe thickness will meet or exceed the required pressure class plus 100 psi water hammer and a minimum external load of earth of at least 2 feet of cover with a live truck superload of ASHTO H-20 with a 1.5 impact factor. All ductile iron water piping will be installed meeting Standard Laying Conditions Type 2 or Type 4 based upon the depth of cover or trench conditions. All ductile iron water pipe will meet the following minimum physical grade requirements:

Tensile Strength ----- 60,000 psi
 Yield Strength ----- 42,000 psi
 Minimum Elongation ----- 10%

Other pipe diameters, laying conditions, pressure class requirements and maximum depth of cover not shown in Chart 1 may be reviewed and approved by the City of Roxboro provided piping meets AWWA C-151 Standards.

CHART 1

Pressure Class, Max. Depth and Laying Condition for DI Water Mains

Pipe Diameter	AWWA C-150, Laying Condition	Pressure Class Requirement	Maximum Depth of Cover
4-8 -inch	Type 2	350 psi	20 feet
4-8 -inch	Type 4	350 psi	34 feet
10-12 -inch	Type 2	350 psi	15 feet
10-12 -inch	Type 4	350 psi	28 feet

14-20 -inch	Type 2	250 psi	10 feet
14-20 -inch	Type 4	250 psi	22 feet
24-inch	Type 2	250 psi	11 feet
24-inch	Type 4	250 psi	20 feet
30 -inch	Type 2	250 psi	11 feet
30-inch	Type 4	250 psi	19 feet

- b) Pipe joints will be mechanical joint or push-on type per AWWA C-111, except where restrained joints are required. Pipe lining will be cement mortar with a seal coat of bituminous material in accordance with AWWA C-104. All buried ductile iron pipe will have a bituminous exterior coating in accordance with AWWA C-151.
- c) Waterline joints 24 inches and smaller that are to be restrained will be mechanically restrained using wedge action retainer joint glands that are U.L. listed and F.M. approved. Glands will be rated for 350 psi for pipe diameters 16 inches and less and 250 psi for pipe diameters 18 inches to 24 inches. All restraint glands will have a safety factor of 2:1. Restraint glands will conform with standard mechanical joint bells conforming to AWWA C-111. Restrained joint glands will be made from high strength ductile iron conforming to ASTM A-536, Grade 65-45-12. Wedges will be ductile iron, heat treated to a hardness of 370 BHN minimum. Twist off nuts will be incorporated in the design of the wedge screws to insure proper torque. **NO RESTRAINT GLAND WILL BE INSTALLED ON PLAIN END FITTINGS.**

Mechanical joint restraint wedge action retainer glands may be used in ductile iron piping larger than 24 inches only after approval has been granted by the City of Roxboro.

All joints inside steel encasement piping such as a carrier pipe in a bore, will be restrained such as "Flex-Ring" by American, "Snap-Lok" by Griffin or "TR Flex Restraint Joint" by U.S. Pipe.

- d) All ductile iron water pipe will be manufactured using AWWA Standards that insure that the water pipe is acceptable for use as a water main for conveying potable water that is safe for drinking by the public. The City of Roxboro will be furnished an affidavit from the manufacturer that the pipe supplied is acceptable for installation as a water main and complies with these Specifications. All pipe will bear the label, stamp and other markings of the manufacturer.

3. Ductile Iron Fittings

- a) All ductile iron fittings will be provided in conformance with AWWA C-110 for standard ductile iron fittings and AWWA C-153 for compact ductile iron fittings. All fittings will be pressure rated for a minimum 350-psi through 24 inches in diameter and 250 psi for fittings greater than 24-inches in diameter. In cases where minimum pressure standards are less than the pipe specification, fittings will always be pressured rated to meet or exceed the pressure ratings for the specified pipe. All fittings for potable water service will be provided with cement mortar linings and asphaltic seal coats in accordance with AWWA C-104. All ductile iron fittings will have an asphaltic exterior coating in accordance with AWWA C-151. All ductile iron fittings will be provided with mechanical joint end connections and restrained with standard concrete blocking and rodding or wedge action retainer glands with concrete blocking. Gaskets will be provided in conformance with AWWA C-111.

All fittings will be sized to receive and accept the thickness of pipe to which it connects.

- b) Fitting joints 24 inches and smaller will be restrained by using both mechanical joint wedge action retainer glands and concrete blocking. Mechanical joint wedge action retainer glands will be U.L. listed and F.M. approved. Glands will be rated for 350 psi for pipe diameters 16 inches and less and for 250 psi for pipe diameters 18 inches to 24 inches. All restraint glands will have a safety factor 2:1. Restraint glands will conform with standard mechanical joint bells conforming to AWWA C-111. Restrained joint glands will be made from high strength ductile iron conforming to ASTM A-536, Grade 65-45-12. Wedges will be ductile iron, heat treated to a hardness of 370 BHN minimum. Twist off nuts will be incorporated in the design of the wedge screws to insure proper torque. Restrained fitting joints larger than 24 inches will be restrained such as "Flex-Ring" by American, "Snap-Lok" by Griffin or "TR Flex Restrained Joint" by U.S. Pipe.
- c) All fittings will be installed according to AWW C-600. Spigot ends of connecting pipes will be properly installed into fittings and to full depth of the receiving bell. All bolts will be properly tightened to preclude any joint leakage. Concrete blocking will be placed at all fittings, and will be poured between the fitting and solid earth material not damaged from excavation with sufficient bearing area to prevent fitting or connecting pipe moving when subjected to internal pressure. All blocking will be sufficient to withstand test pressures. Concrete will be allowed sufficient curing time prior to any backfilling or pressure being placed on fittings.
- d) Concrete blocking for all fittings will have a minimum 3000 psi compressive

strength after 28 days. The size of concrete blocking will be determined by a licensed professional engineer in the State of North Carolina. Calculations will be submitted to the City of Roxboro for approval for the proposed sizing of any concrete blocking. The sizing of concrete blocking will be based upon a 1000 lbs./ft² bearing capacity of the soil and a 200 psi test pressure. All blocking will be sized with a 2:1 safety factor. All concrete blocking will be poured against undisturbed earth.

- e) Additional restraint such as rodding may be required by the City of Roxboro particularly at hydrants and where field conditions warrant vertical bends (fittings). All rodding, including bolts, nuts, washers etc... will be 316 stainless steel with rodding sized similar in diameter as the bolts for the fittings. A minimum of 2 rods will be installed and connected at each joint. The City of Roxboro reserves the right to require additional rodding as hereinafter specified. No joints in rodding will be allowed.

C. INSTALLATION OF DUCTILE IRON PIPING

1. Ductile iron water pipe will be installed in accordance with the requirements of AWWA C-600 and the Ductile Iron Pipe Handbook published by the Ductile Iron Pipe Research Association. Materials at all times will be handled with mechanical equipment or in such a manner to protect them from damage. At no time will pipe and fittings be dropped or pushed into ditches.
2. Pipe and fitting interiors will be protected from foreign matter and will be inspected for damage and defects prior to installation. In the event foreign matter is present in pipe and fittings, it will be removed before installation. Open ends of pipe will be plugged or capped when pipe laying is not in progress.
3. All pipe will be constructed with at least 36 inches of cover below the finished surface grade. Pipe will be laid on true lines as shown on approved Drawings by the City of Roxboro. Trenches will be sufficiently wide to adjust the alignment. Bell holes will be dug at each joint to permit proper joint assembly. The pipe will be laid and adjusted so that the alignment with the next succeeding joint will be centered in the joint and the entire pipeline will be in continuous alignment both horizontally and vertically. Pipe joints will be fitted so that a thoroughly watertight joint will result. All joints will be made in conformance with the manufacturer's recommendations for the type of joint selected.
4. Pipes will generally be laid on a reasonably uniform grade, with proper alignment, as dictated by existing conditions and shown on the Drawings. Where deflection of pipe is required, such deflection will not exceed 50

percent of that allowed for the size of pipe being laid and the manufacturer's recommendation for such pipe and type of joint being used.

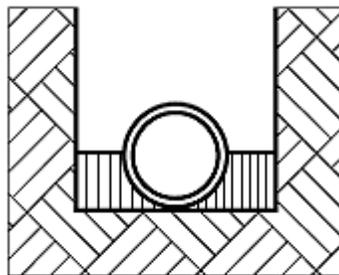
5. The Contractor will have an experienced pipe man in charge of all pipe work. This individual will be at the Site anytime pipe is being installed. Should this individual need to leave the Site for any reason, pipe laying operations will cease until said individual returns to the Site.
6. No pipe will be laid within ten feet of excavation in earth or within thirty feet of rock that must be blasted for removal. The open end of all pipes will be plugged when pipe laying is not in progress, and all pipe will be protected against injury from falling rock when blasting.
7. Prior to being lowered into the trench, each pipe will be inspected by the pipe foreman with all faulty pipe rejected and removed from the job site. Each joint of pipe will be placed in the trench with the bell end receiving the spigot end of the next joint of pipe being laid. **The barrel of the pipe will be uniformly supported on the foundation.** Joints will be made up as recommended by the manufacturer of the pipe.
8. No pipe will be laid in the trench until the City of Roxboro has been notified of the intention of the Contractor to lay pipe, giving the City of Roxboro sufficient time to check the lines and grades before pipe laying operations commence. The City of Roxboro may order the removal and relaying of any pipe without such notice given and notice from the City of Roxboro received to proceed with pipe laying operations.
9. Excavation or trenching will be performed with equipment of the proper size and type for the work. The Contractor will open no more trench in advance of pipe laying than is necessary to expedite the work. Steps will be taken to avoid excessive damage to any existing curbs, gutters, pavements, etc. Sides of excavated trenches will be as straight as possible, and of sufficient width to allow for proper placement of the pipe and subsequent backfilling operations. Excessive width of excavation for trenches will not be permitted. Excavation will be of sufficient depth to allow a minimum cover of three feet from the top of placed pipe to the existing ground surface over the pipe. Where deeper excavation is required to place pipe under existing utilities, such excavation will be as required by conditions. Bell holes will be excavated at each pipe joint to prevent point loading at the bells or couplings.
10. The width of the trench in rock excavation will be at least two feet greater than the nominal diameter of a pipe. All trench rock excavation will be carried six inches below the invert of the pipe. The excavated area will be brought back to grade with crushed stone (#67 as directed by the City of Roxboro) that provides a proper bed for piping. Stone bedding will extend to the springline of the pipe. All trench rock will be disposed off-site. No trench rock

will be allowed as backfill underneath the pavement or other structures or as backfill over piping. Select compactable fill material will be brought to the site as acceptable backfill for the void created by the excavation of rock that previously existed above the springline of the pipe. Installation of pipe in rock will comply with Type 4 bedding as shown below.

11. In trenches with unstable bottoms, crushed stone will be placed under and around the pipe as necessary and as directed by the Engineer for a stable trench. Type 4 laying conditions will be utilized. For severe unstable soil conditions where undercut excavation is required, an engineer designed foundation plan will be provided to the City of Roxboro prior to pipeline installation.
12. All trenching operations will meet or exceed OSHA requirements for shoring, blasting, and the safety of the workers. When conditions require it, the Contractor will use a manufactured steel trench box in accordance with OSHA Specifications and manufacturer's instructions.
13. Laying conditions for ductile iron pipe will be as described in AWWA C-151 and the Ductile Iron Pipe Research Association. Laying conditions and bedding requirements will be defined and required at a minimum for all waterline installations as follows for the City of Roxboro.

Type 2 Bedding

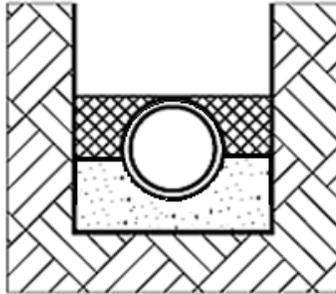
Flat-bottom trench (undisturbed earth). Pipe resting on stable earth. Backfill lightly consolidated to centerline of pipe, 80% Standard Proctor.



Type 2

Type 4 Bedding

Pipe bedded in #67 stone to a depth of 1/2 pipe Diameter, with a minimum of 6 inches below pipe invert. Backfill compacted to top of pipe, 95% Standard Proctor



Type 4

- NOTE: 1. Type 4 laying condition required by the City of Roxboro will be determined by Chart 1 based upon depth of cover over the pipe. Other types of laying conditions are acceptable only after special approval has been granted by the City of Roxboro.
2. Type 4 bedding will be required when the trench bottom for the waterline is in rock or unstable conditions. For severe unstable soil conditions where undercut excavation is required, an engineer designed foundation plan will be provided to the City of Roxboro prior to pipeline installation.
14. Prior to beginning construction, the Contractor will contact local utility companies and verify the location of existing utilities. The Contractor will be completely and solely responsible for locating all existing buried utilities inside the construction zone before beginning excavation. The Contractor will be solely responsible for scheduling and coordinating the utility location work. When an existing utility is in conflict with construction, it will be exposed prior to beginning construction to prevent damage to the existing utility.
15. Valves in the existing City of Roxboro water system will not be operated without a minimum notice of 24 hours to the City of Roxboro. All valves that are under the ownership and acceptance of the City of Roxboro will be operated only by personnel of the City of Roxboro. Contractor's personnel will only be responsible for operating valves within new construction areas that are not directly connected with the existing City's water supply. At such time when the valves in new construction areas are connected with the City's water supply, the valves will only be operated by City of Roxboro personnel or in limited circumstances by contractor's personnel after receiving authorization from the City of Roxboro.

D. BACKFILLING OF TRENCHES

1. After the pipe has been laid, backfilling will be done as follows: Backfilling along the sides of the pipe above the springline and to a level 12 inches above the pipe will be carefully done by hand using select material placed in layers not more than 6 inches thick and thoroughly compacted with mechanical tamping equipment using care to insure that pipe alignment and grades are not disturbed. Except for lines under drives or paved areas, backfilling from this elevation up may be placed in layers not exceeding 12 inches thick, kept reasonably level and compacted to 95% of maximum density as determined by ASTM Specification D-698 latest revision (Standard Proctor Test). Compaction under drives and pavements where dirt backfill is allowed, will be 100% according to ASTM Specification D-698. Should settlement occur, the Contractor will bring the ditch back to grade, including reseeding as necessary.
2. Where a waterline is installed across a N.C.D.O.T. maintained road by open-cutting, the trench will be backfilled to within 13 inches of finish grade by pouring an N.C.D.O.T. approved grout mix (flowable fill) or compacting an N.C.D.O.T. aggregate base material complying with Sections 520 and 1010 of the North Carolina Department of Transportation Standard Specifications. Aggregate used will be Type B. Steel plates or other approved structures to bridge the flowable fill or aggregate base course will be installed temporarily to allow the passage of vehicular traffic until asphalt base and topping can be installed. Finish grades in roads will be obtained by installing asphalt mixes per N.C.D.O.T. Standards which is 11 inches of B-25 Asphalt Base and 2 inches of S9.5B Topping. All asphalt thicknesses represent a thickness after compaction.
3. Backfill will not be permitted when trenches are flooded, or material is too wet (or dry) for proper compaction.
4. Undesirable material, whether rock, muck, or other will not be allowed in the backfilling of trenches. If additional material is needed for the proper filling of trenches, it will be procured and hauled to the site in sufficient amounts to complete the backfill process. Excess and/or unsuitable material will be removed from the job site and properly disposed.
5. Excavated rock will not be used as backfill, except soft sand rock that disintegrates completely on removal from the ditch may be used above the top of the pipe. Rock excavated from trenches, which is not used for backfill, will be hauled away and properly disposed. "Select Backfill" to complete backfilling operations for a final grade acceptable to the City of Roxboro and to fill voids created by rock excavation will be brought to the site as necessary. All "Select Backfill" will be free of debris, stumps, large rocks, and other deleterious material unsuitable for backfilling over the pipe and achieving the desired proper compaction. All "Select Backfill" delivered to the site used for final grading will be acceptable for seeding and mulching operations as specified.

6. All "Select Backfill" will comply with NCDOT Standards, Section 1016, Class I Material.

E. BLASTING

1. All blasting operations will be conducted in strict accordance with existing ordinances and accepted safe practice relative to the storage and use of explosives. Only experienced men will do blasting, and extreme care and precautions will be used to prevent injury to workmen, to existing pipes, buildings, or other structures either below or above the surface of the ground. Sufficient warning will be given to all persons in the vicinity of the blasting.
2. Rope or wire mats are required to be used in all blasting operations. Trench overburden may be used as a substitute for wire mats. Protective measures, whether rope, wire mats or trench overburden will be adequate to assure that there will be no projection of loose materials or objects that leave the blasting area.
3. Blasting operations will be done in such a manner that damage to existing utilities and structures, whether above or below ground, is prevented. The Contractor will monitor the blasting operations as necessary to insure that the operations are conducted safely and without excessive air or ground pressures or displacements. Monitoring all blasting operations will include measuring air and ground pressures by the use of two seismographs. When blasting, the acceptable level of vibration will be no higher than 2 inches per second at any structure. One seismograph will be located near the closest existing residential structure on the same side of the street nearest the blast.
4. All blasting operations will be conducted in complete accordance with applicable federal, state and local laws. These laws include but are not limited to applicable occupational safety and health standards of the North Carolina Department of Labor.
5. The Contractor will secure the necessary permits required to conduct blasting operations. These include, but are not necessarily limited to a permit from the Fire Prevention Bureau or Fire Marshall.

F. PVC PRESSURE PIPE

1. General

All water main distribution piping smaller than 4 inches will be Schedule 80 PVC. Piping, fittings and solvents will comply with the following:

ASTM Standard D-1784	Rigid Vinyl Compounds
ASTM Standard D-1785	PVC Plastic Pipe, Schedule 80

ASTM Standard D-2464	PVC Threaded Fittings, Schedule 80
ASTM Standard D-2467	PVC Plastic Fittings, Schedule 80
ASTM Standard D-2564	Solvent Cements For PVC Pipes and Fittings
NSF Standard 14	Plastic Piping Components and Related Materials
NSF Standard 61	Drinking Water System Components – Health Effects

- a) All PVC piping will bear the stamp of NSF for potable water.
- b) PVC piping will only be allowed if the working pressure is less than 100 psi and the surge pressure is less than 35 psi. Maximum allowable pressure must be less than the sum of the working pressure and the surge pressure which is 135 psi. The above pressures must be substantiated by calculations from a licensed professional engineer in the State of North Carolina.
- c) Minimum cover over PVC Piping will be 4 feet to the top of the pipe. All PVC water main piping will be bedded in No. 78 stone 4 inches below the pipe invert to the top of the pipe.
- d) All Schedule 80 PVC pipe will be furnished with a SOLVENT CEMENT type joint, and the appropriate fittings will be furnished with each length of pipe.
- e) All pipes and materials are to be tested according to the requirements of ASTM D-1785. Certified test results are to be provided to the City of Roxboro when requested. These tests will be performed by an independent testing laboratory at the expenses of the pipe manufacturer.
- f) All PVC fittings will be Schedule 80 and conform with the above requirements. Connections to other pipes of different material, yokes, copper setters and valves will be made by mechanical joints or threaded coupling.
- g) Solvent cements for joining PVC piping will comply with ASTM D-2564, including a primer that complies with ASTM F-656.

02020 FIRE PROTECTION

A. FIRE HYDRANTS

1. Location

- a) All fire hydrants will be installed on a minimum 6 inch water line. There will be at least one fire hydrant at each street intersection. The minimum acceptable flow for fire hydrants is 750-gpm at a minimum 20-psi residual unless the overall system cannot meet this demand demonstrated by calculations from a licensed professional engineer in the State of North Carolina. The City of Roxboro reserves the right to upsize water main piping to meet this fire flow demand from a developer; or accept another fire flow demand that is consistent with fire flows available from the system serving surrounding properties. Hydrants at intersections will be located in accordance with the Standard Details. Valves provided on the fire hydrant branch supply line will be located within 5-ft of the main line.
- b) In residential districts the maximum distance between hydrants, measured along street centerlines, will be 500 feet. When residential intersections are less than 700 feet apart, a hydrant is not required between the intersections.
- c) In business, office and institutional, and industrial zoning the maximum distance between hydrants, measured along street centerline, will be 300 feet. When business, office and institutional, and industrial intersections are less than 450 feet apart, a hydrant is not required between intersections
- d) On major thoroughfares and collector streets with access points only at street intersections, hydrants will be located at each street intersection and at 800 foot intervals along the street. New buildings, or additions which result in a total building area of 10,000 square feet, require hydrants to be installed at 300 foot intervals along all sides of the building that are accessible to fire pumpers. These hydrants will be at least 40 feet away from the building.
- e) Where sprinkler systems are used, a fire department connection will be within 50 feet of an accessible fire hydrant.

2. Hydrant Specification:

- a) Hydrants will be Mueller Super Centurion 250-A423, and will in all respects conform to AWWA Standards C-502, latest revision. Each hydrant will have two hose nozzles and one steamer nozzle, all in

National Standard Threads. Hydrants to conform to City of Roxboro Standards with no substitutes allowed.

- b) The hydrant will have a five and one-quarter inch (5-1/4") valve opening. The hydrant will have two (2) two and one-half inch (2-1/2") hose nozzles with cap, and one (1) four and one-half inch (4-1/2") pumper and nozzle cap. All end caps will be chained to the hydrant body. The operating and cap nuts will be one and one-half inch (1-1/2") pentagon. The hydrant will open left (counter-clockwise). The hydrant inlet connection will be six (6) inch mechanical joint. The color of the hydrant body will be red with a silver top and silver caps. All painting will consist of two (2) coats of a high quality enamel paint.

3. Installation:

- a) Hydrants will be set plumb, properly located with the pumper nozzle facing the closest curb of a fire lane or street. The back of the hydrant opposite the pipe connection will be firmly blocked against the vertical face of the trench with 1/2 cubic yard of concrete. Double restraint rods will be connected from the tee to the hydrant. Rods will not be less than 3/4 inch diameter and made of 316 stainless steel rod stock. A minimum of 10 cubic feet of stone will be placed around the drains. The backfill around the hydrants will be thoroughly compacted and closely match the elevation on the approved plans. Hydrant extensions will not be allowed on new or retrofit installations.
- b) The City of Roxboro reserves the right to modify the location of all hydrants as local terrain or field conditions warrant. The Developer will be required to stake the location of each hydrant and receive approval from the City Roxboro for the location of each hydrant prior to installation. Where required, hydrants will be located at the high point along all waterlines for release of air during pressure testing and chlorination or the bleeding off of the main as required. All hydrants will be blocked and rodded as required by these Specifications.
- c) After installation, all hydrants with damage to the coating will receive two coats of paint over the damaged areas using a "touch-up" paint recommended by the hydrant manufacturer. Final acceptance of all hydrant painting will be made by the City of Roxboro.
- d) Hydrants will be installed according to AWWA C-600.

4. Depth of Bury:

- a) *Typical 90-Degree Hydrant Shoe Installations:*
The maximum depth of bury for all new fire hydrants with 90-degree

hydrant shoes will be 6-ft from the breakaway flange connection. The breakaway flange or safety coupling will be oriented vertically just above finished grading and bolted directly to the fire hydrant in compliance with manufacturer standards. The breakaway flange or safety coupling will not be buried.

b) *Vertical Shoe Hydrant Installations:*

For installations requiring depth of bury greater than 6-ft, the fire hydrant will be equipped with a vertical shoe arrangement that provides for full extension of the lower valve plate against a stopping mechanism located inside the vertical shoe to maximize hydraulic flow conditions through the hydrant. The vertical shoe will be equipped with flanged connections. The maximum depth of bury for vertical shoe installations will not exceed 4-ft measured from the breakaway flange to the bottom of the vertical hydrant shoe. The vertical shoe and all piping included in the hydrant supply line will be restrained with blocking and rodding or blocking with wedge action retainer glands.

- c) In all cases where the vertical shoe is utilized, typical washed stone bedding extending at least 12-inches on all sides of the central axis and extending from the top of the vertical shoe downward to at least 12-inches below the vertical shoe will be provided surrounding the vertical hydrant shoe assembly to assure positive drainage. Piping below the vertical shoe will be provided in a flanged by plain end configuration and restrained with wedge action retainer glands to the lower mechanical joint fitting and the lower fitting will be blocked and rodded to the vertical shoe connection. The entire assembly will be restrained and support blocking will be provided under the vertical bend assembly.

5. Hydrant Relocations:

- a) For installations where hydrants will be relocated, all hydrants with greater than 12-years of operational service, as indicated by the date of manufacture provided on the hydrant, will be replaced with new fire hydrants. The existing fire hydrant will be turned over to the City of Roxboro.

B. AUTOMATIC FIRE SPRINKLER SYSTEMS

1. General:

- a) Four (4) complete sets of working plans and calculations for all fire sprinkler systems and standpipe systems will be submitted as required by the City of Roxboro for review and approval. If 20 sprinkler heads or more are modified or added to an existing sprinkler system, if any

modifications occur in the hydraulically calculated remote area, or the hazard classification changes, a plan submittal including complete calculations and a permit will be required. All fire sprinkler systems will be installed with an alarm check valve installed in each riser with all required appurtenances (example: retard chamber, water motor gong, pressure gauges, etc.). Exception: NFPA 13D and 13R residential sprinklers when approved by the Fire Marshall. All installations, minor repairs, or minor replacements will be performed by a licensed fire sprinkler contractor.

2. Design:

- a) Approved working plans will be in complete compliance with NFPA No. 13, 13D, 13R, 14, 231, 231C, 231D, 231F and City of Roxboro Specifications. An NFPA above ground material and test certificate and NFPA underground material and test certificate are required after completion of designated, approved work.

3. Hydraulic Design:

If a system is hydraulically designed, the following design criteria must be followed:

- a) Safety Margin: In all cases, a fixed minimum safety margin of at least 12-psi will be applied to the design calculations. (Example: Demand = 70 psi, Supply \geq 82 psi)
- b) Hose Allowances: Both exterior and interior hose allowances will comply with NFPA 13 requirements.
- c) Water Supply Pressure: The sprinkler system designer will be responsible for verifying system pressure.

4. Backflow Prevention:

- a) When a fire protection system is proposed with a Fire Department Connection or as otherwise required by the Cross Connection Ordinance, a reduced pressure principle detector assembly (RPDA) will be installed on the supply side of the sprinkler fire protection line. These backflow prevention devices must be UL listed and/or listed by Factory Mutual Research Corporation. Reduced pressure principle detector assemblies will not be arranged vertically. For all RPDA's, a relief valve fill cup piped outside the building will be provided. The relief valve drain may be piped to the main building drain.

5. Post Indicator Valve:

- a) A post indicator valve with electronically controlled tamper switch will be provided at the right of way or edge of easement (preference: listed indicating valves at each connection into the building at least 40 feet from building if space permits). The top of the PIV will be 36 inches above finished grade and 36-inches of unobstructed access perimeter will be maintained around the PIV. The City of Roxboro will maintain up to the post indicator valve. All PIV(s) will be made of DIP construction and will be UL listed and FM approved. The stand pipe of all PIV's will be painted red.

6. Fire Department Connection:

- a) Where automatic fire sprinkler systems or standpipe systems are used, a fire department connection with National Standard threads will be provided within 50-ft of a fire hydrant, except for homes and apartment buildings. When a sprinkler system serves only part of a large structure, the fire department connection will be labeled, with minimum 2 inch letters on a permanent sign, as to which section of the structure that sprinkler riser serves

7. Dedicated Riser Room:

- a) A dedicated sprinkler riser room is required providing an entry door to the room from the exterior of the building. All dedicated riser rooms will be equipped with a floor drain sized appropriately to prevent flooding. The floor drain will be piped to storm system or main building drain. The floor drain will be provided with a circular raised ring/hub around the floor drain to prevent debris and/or chemicals from entering the drain during an emergency spill. The hub will be fabricated of cast iron or other corrosion resistant material and extend at least 3-inches above floor elevation.

8. Alarm Communication:

- a) All sprinkler systems are to have alarm communication equipment to fully comply with NFPA 72. Equipment must be fully functional and reporting to a UL listed central receiving station before a Certificate of Occupancy is issued for the facility.

9. Access:

- a) All buildings which have a fire alarm system monitored by a central receiving station or a fire sprinkler protection system will provide a "Knox Box" key entry system. This "Knox Box" will be mounted on

the exterior entrance to the dedicated riser room. Mount "Knox Box" on wall at 5 feet above finished floor A.F.F. on door handle side of dedicated riser room door. This "Knox Box" will be ordered through the City of Roxboro Fire Department and will be in place before a Certificate of Occupancy is issued. Forms are available from the Fire Department. Average delivery time is 5 to 6 weeks. Keys to access the facility will be provided to the Fire Department by the owner/manager.

10. Identification:

- a) The exterior door leading to the dedicated sprinkler riser room will be labeled with minimum 2 inch lettering designating "SPRINKLER RISER ROOM" in a contrasting color. Durable vinyl lettering is suggested.

11. Fire Alarm Panel Location:

- a) When a building is protected by an automatic sprinkler system and has a fire alarm system, the fire alarm control panel or a remote annunciation of the fire alarm control panel will be placed in the sprinkler riser room. This control panel will have the capacity of silencing and resetting. Adjacent to the fire alarm control panel will be a framed zone map. Nomenclature will correspond with the zone map. Submit four sets of plans and specifications to the City of Roxboro for approval prior to installation of equipment or wiring.

C. FIRE PROTECTION DURING CONSTRUCTION

- 1. The fire protection water supply system, including fire hydrants, will be installed and be in at least the functional status prior to placing combustible materials on the project site. If phased construction is planned, coordinated installation of the fire protection water system is permitted. Coordination of the water system will be done through the City of Roxboro.

02030 VALVES AND APPURTENANCES

A. VALVES

1. General

- a) Valves will be installed on all branches from feeder mains and hydrants according to the following schedule: 3 valves at crosses; 2 valves at tees; one valve on each hydrant branch and elsewhere as directed by the City of Roxboro. When a loop section of water line is connected back into the feeder main within a distance of 200 feet or less, only one valve will be required in the feeder main. In all cases where new water mains are connected to an existing water distribution line, valves will be located at all end points and at intermediate points throughout the new system extension to assure testing requirements can be met without interfering with the operation of the existing system. Testing standards when connecting to an existing system may require that 4 valves ultimately be located at crosses, 3 valves at tees, etc. beyond the minimum standard to assure adequate testing can be achieved. In such cases, the valves will be shown on the plan drawings and included in the testing plan submitted by the Engineer of record.
- b) Where no water line intersections exist, a main line valve will be installed at every 100 feet per 1 inch diameter main up to a maximum distance of 2000 feet between valves.
- c) All valves will be restrained to the main line or other fittings or appurtenances within close proximity. Valves will be properly located, operable and at the correct elevation. All valves and reducers will be rodded to the tee or cross if one is located within 10 feet as shown in the Drawings. If valves or reducers are located more than 10 feet from a fitting and cannot be rodded, wedge action restraint retainer glands as specified for fittings will be required. All valve installations utilizing wedge action restraint retainer glands will be restrained on both sides of the valve and include sufficient pipe restraint to allow the valve to operate under dead end pressures without movement.
- d) Pipe joint restraints of the feeder main into and out of a valve will be determined by calculations submitted to the City of Roxboro for approval. Calculations will be prepared by a licensed registered professional engineer in the State of North Carolina. The maximum depth of the valve nut will be 6 feet without an extension kit. When valve extension kits are used, they must be manufactured by the same company which manufactured the valve.

2. Valve Installation

- a) Valves will be installed where specified or required by the City of Roxboro. All valves will be installed according to AWWA C-600. Valves will be properly supported, and a screw-type valve box as specified will be installed over the operator of each valve. Valve boxes will be properly supported to prevent settlement over time. All valve boxes will be placed so as not to transmit shock or stress to the valve and be centered and plumbed over the operator of the valve. All valve boxes will be protected by a 6 inch thick x 2 foot square Class B Concrete Collar.

3. Combination air-valves

- a) Combination air valves will be provided to purge air from the system at startup, vent small pockets of air while the system is being pressurized and running, and prevent critical vacuum conditions during draining. Combination air valves rated for potable water use will be installed at all high points on water lines 8 inches in diameter or larger and at other locations such as major changes in grade as directed by the City of Roxboro. A high point will be determined as any high location where the difference between the high elevation and adjacent low elevation exceeds 5-ft, unless otherwise determined by the City of Roxboro based on special circumstances. For waterlines 8 inches in diameter, fire hydrants may be installed in lieu of combination air-vacuum valves.
- b) All combination air-valves will be provided in conformance with AWWA C-512. The combination air valve will automatically exhaust large volumes of air from the system when it is being filled and allow air to re-enter the pipe when the system is being drained. The water main will be installed at a grade which will allow the air to migrate to a high point where the air can be released through an air valve. A minimum pipe slope of 1 foot in 500 feet should be maintained. Combination air release valves will be designed to function when water main pressures are less than 50 psi.
- c) The combination air valve will be sized by a licensed professional engineer in the State of North Carolina, and approved by the City of Roxboro. Combination air valves will be of the single body, double orifice style that combines the operation of both an air/vacuum and air release valve for ductile iron conforming to ASTM A-536. For ductile iron bodies exterior final coating will be a fusion-bonded epoxy meeting AWWA C-550 acceptable to FDA for use in potable water. The valve will have a minimum two (2) inch NPT inlet and the inlet body will be rated for minimum 300 psi working pressure. Combination air valves sized from 2-inches to 4-inches will be provided with NPT inlets and outlets unless otherwise submitted for approval with flanged connections. The combination air valve will be

provided with cylindrical shaped floats and anti-shock orifice made of high density polyethylene.

- d) The float will be Type 304 or 316 stainless steel conforming to ASTM A-240. The float will be hermetically sealed, designed to withstand a minimum of 1000 psi. The top plug will be center guided through hex bushings for positive shut-off. The Buna-N seat, must be fastened to the valve cover without distortion, for drop tight shut-off.
- e) The combination air valve will be installed in a standard precast flat-top manhole as specified and shown in the Detail Drawings. All combination air valve assemblies will be installed to a restrained mechanical joint tee with a minimum outlet size of 8 inches or larger depending on tap size. Outlet for the tee will be flanged tapped for the size inlet required for the combination air valve. The combination air valve assembly will be isolated with a gate valve of the same size. The isolation gate valve will be provided with NPT threads and connected with “no lead” brass (meeting UNS C89833 as per ASTM B-584) or bronze piping. “No lead” brass or bronze ball valves may be used in lieu of gate valves for installations 2-inches or smaller. The isolation valve will be rated for 200-psi service or greater. Isolation valves will have a bronze body, bonnet and stem. Hand wheel nut will be stainless steel with hand wheel made form malleable iron conforming to ASTM A-47. Wedge will be solid alloy.

4. Gate Valves Less than 4-inches for Blowoff Assemblies

- a) Gate valves for blowoff installations sized smaller than 4-inches, will be resilient seated wedge type with a non-rising stem and a 2 inch operating nut in compliance with AWWA C-509. The smaller diameter gate valves will be provided with triple O-ring seals and threaded end connections in compliance with ANSI B2.1. Gate valves smaller than 2 inches will be identified “no lead” and consist of brass components designated under UNS C89833 as per ASTM B-584. The small diameter gate valves will be rated for a minimum pressure rating of 200-psi.

5. Gate Valves 4-inches to 12-inches

- a) All valves for potable water applications, 12-inches in diameter and smaller, will be resilient seated, iron body, bronze mounted, wedge gate valves in conformance with the requirements of AWWA C-509. All coating materials used in the construction of gate valves for potable water applications must comply with NSF 61 to assure lead free construction. All gate valves will be designed for a working pressure of 250-psi with a minimum ULFM rating of 200-psi working pressure. Gate valves will be fusion bonded epoxy, (FBE) coated both interior and exterior at a minimum of 10mils and the FBE coating will be provided in conformance with AWWA C-550 and ASTM D-1763 Standards. The epoxy

coating used will be acceptable for use with potable water according to EPA and PDA guidelines.

- b) All gate valves 12-inches in diameter and smaller will be installed in the vertical position and will be provided with mechanical joints complying with AWWA C-111. Gate valves will be restrained by wedge action retainer glands as previously specified and stainless steel rodding where required. In all cases, the valve and piping will be restrained on both sides to sufficiently allow the valve to function as a dead end.
- c) All gate valves will open left with a non-rising stem and be provided with a 2-inch square operating nut. All gate valves will be constructed with triple o-ring seals in which 2 o-rings are located above the thrust collar and 1 o-ring is located below the thrust collar. The two upper o-rings will be replaceable with the valve fully open and subjected to full rated working pressure.
- d) The gate valve wedge will be cast iron fully encapsulated in rubber complying with ASTM D-2000. All valves will be rated for bi-directional flow. All sealing gaskets will be made of EPDM rubber materials.

6. Butterfly Valves – 16 Inches to 24 Inches:

- a) Butterfly Valves will be used on ductile iron piping between 16 inches and 24 inches in diameter. Butterfly valves will be Class 250B and will conform to the latest AWWA Standards C-504 latest revision, as manufactured by Clow, Mueller, Kennedy, Pratt, or American for rubber sealed butterfly valves and valve operating assemblies. “O” ring seals will also be used exclusively with worm gear. All rubber seals and gaskets will be made of EPDM rubber.
- b) Valve end connections will be restrained mechanical joint. Restraint will be provided by wedge action retainer glands as previously specified. Valve seats will be stainless steel, bronze mating or resilient material. Resilient seat will be mechanically attached to the valve disc, or mechanically retained in the valve body. Resilient seat will be fully field adjustable by mechanical means. Valve disc shaft will be stainless steel with either stub or thru-shaft design. Shafts will be provided with two-way disc thrusters that are fully adjustable from the outside. Valve shaft bearings will be heavy duty bronze or chemically inert nylon, properly fitted into hubs integrally cast in the body of the valves.
- c) Butterfly valve operators will be worm gear type as manufactured by Philadelphia Gear Works or EPI. The valve operator will be furnished with a two-inch square operating nut, and be so mounted that the valve will open-left (counter-clockwise). The butterfly valve operator will be AWWA stops, be suitable for submersible service and be sized in accordance with AWWA

torque requirements for full 250 B rated valve. The valve operator will be mounted on extended yoke legs so that adjustable main valve shaft packing may be serviced without removal of the operator. Cover plates will be provided on the yoke legs to prevent dirt from reaching the packing gland.

- d) The manufacturer of the butterfly valve will be fully responsible for the satisfactory performance of the assembled valve and operator unit. The specified operators will be factory mounted by the valve manufacturer and shipped to the job site as an operating unit. External painting, hydrostatic testing, travel stop adjustments and crafting for shipment will be in complete compliance with the latest AWWA specification for butterfly valves.
- e) All butterfly valves will be installed in a standard precast flat-top manhole (diameter appropriate with size valve) as specified and shown in the Detailed Drawings.

7. Insertion Valves:

- a) Insertion valves will only be used as permitted by the City of Roxboro. Insertion valves will be fabricated to ensure a full circumferential seal around the main line and rated for a test pressure of 150 psi or greater. All insertion valves will be made of fabricated steel minimum 16 gauge in conformance with ASTM A-36, with 304 stainless steel valve body. In cases where insertion valves are being installed to shut down water to a work zone area, the insertion valve will be located a minimum of 100-ft from the work zone or greater as determined by the City of Roxboro to assure the insertion valve can safely operate as a dead end without dislodging from the pipeline or otherwise causing the existing pipeline to shift.
- b) Valve gate will be made of SBR rubber providing a resilient seat sealing wedge. Valve stem will be heavy-duty conforming to AWWA C-500. Stem will be surrounded by a bronze collar. Valve will be equipped with a standard 2 inch square operating nut. Top housing for the valve will be heavy-duty flange.
- c) All connecting hardware will be 304 stainless steel. Gasket for the sleeve will provide a full encirclement.

8. Valve boxes

- a) Valve Boxes will be cast iron, screw or telescopic type, with a 5-1/4 inch opening and "water" stamped on the cover. All valve box assemblies and covers will be cast from Class 35 cast iron conforming to ASTM A-048 and domestically made and manufactured in the USA.

All valve boxes will consist of two (2) sections. All valve boxes will comply with AWWA M-44.

- b) Valve boxes will be centered over the wrench nut and seated on compacted backfill without touching the valve assembly. All valve boxes will be encased in a trowel finished 2' x 2' x 6" pad of 3000-psi concrete beneath the asphalt with the cover flush with the top of the pavement or flush with the finished grade. Precast concrete valve box encasements are not allowed.

9. Actuators:

- a) All valves will be provided with standard 2-inch operating nuts. Unless otherwise specified, the direction of rotation to open the valves will be to the left, (counterclockwise), when viewed from the top. Each valve body or actuator will have cast thereon the word "OPEN" and an arrow indicating the direction to open.
- b) Actuators for piping 12 inches in diameter or smaller will be housed in a valve box. Actuators for piping 16 inches in diameter and larger will be housed in a precast concrete manhole as specified.

B. APPURTENANCES

1. Blowoffs:

- a) Blowoffs will be a minimum of 3/4 inch for waterlines 6 inch and smaller and 2 inch for waterlines 8 inches, and 12 inches. Blow-off size for waterlines larger than 12 inches will be determined by the City of Roxboro on a case-by-case basis. Blow-offs will be installed at the end of all dead-end water lines. Where there is not sufficient pressure or fire hydrants to thoroughly flush the system, a larger blowoff may be required than what is specified. Hydrants may be installed at the end of a waterline and be considered as the blow-off provided the hydrant is located within 50 feet of the end of the water line.
- b) Blowoff Assemblies will be constructed as shown in the Details. For 3/4 inch blow-offs, valving will be an angle ball valve Ford AV21-444 or equal. Valving will have a 3/4 inch inlet and a 1 inch outlet. Outlet will be equipped with female iron pipe threads. Inlet will be connected through a copper flared nut. Valve will be provided with a padlock wing for locking in the closed position. Angle ball valve will be constructed of all brass conforming to AWWA C-800 and ASTM B-62 and B-584. Valve will be rated for 300 psi working pressure. For 2 inch blow-offs, the valves will be gate type with a non-rising stem and a 2 inch operating nut, O-ring seals and screwed ends. 2 inch valves will meet AWWA C-509. Valve will be iron body epoxy fusion coated 10 mils on interior and exterior surfaces.

Valve will be UL Listed and FM approved suitable for a 250 psi working pressure.

- c) Blowoff Assemblies installed in cul-de-sacs with 6-inch and smaller water mains not planned for roadway extension may be constructed with a self-contained blowoff assembly as shown in the Detail Drawings.

2. Reaction Blocking:

- a) Thrust restraint blocking for all fittings or components subject to hydrostatic thrust will be securely anchored by the use of concrete thrust blocks poured in place. No concrete will interfere with the removal of fittings. Material for reaction blocking will be 3000 psi concrete. A minimum 4 mil plastic will cover the fitting to ensure that no concrete will interfere with removal of the fitting.

3. Rodding:

- a) All rodding will be constructed from type 304 stainless steel rods at the number and sizing specified in the following table. Rod coupling will not be allowed.

Stainless Steel Rod Requirements are as follows:

4-inch branch	2, ¾-inch stainless steel rods
6-inch branch	2, ¾-inch stainless steel rods
8-inch branch	4, ¾-inch stainless steel rods
12-inch branch	6, ¾-inch stainless steel rods
16-inch branch	8, ¾-inch stainless steel rods
24-inch branch	10, ¾-inch stainless steel rods

4. Wedge Action Retainer Glands:

- a) Wedge action retainer glands may be used as a substitute for rodding, but is not a substitute for typical reaction concrete blocking. All wedge action restraint retainer glands will be manufactured as a one piece retainer gland for use with mechanical joint fittings and will be rated to provide restraint up to 350-psi pressure rating for sizes through 16-inches. For sizing above 16-inches, the wedge action retainer gland will be rated to provide restraint up to 250-psi. Approved wedge action retainer glands will be made of ductile iron, coated with a manufacturer applied epoxy coating or polyester powder coating. Wedge action restraint retainer glands will be U.L. listed and F.M. approved. Glands will conform to ASTM A-536, Grade 65-45-12. Twist off nuts will be incorporated in the design of the wedge screws to insure proper torque.
- b) Wedge action retainer glands for fire hydrant supply lines will be used only

after approval has been granted from the City of Roxboro. If approved, wedge action retainer gland will be joined with a mechanical joint pipe bell and the entire hydrant supply line will be restrained in a similar manner.

5. Precast Reinforced Concrete Manholes for Butterfly Valves and Combination Air-Valves

- a) All manholes will be precast reinforced concrete conforming to ASTM Standard C-478 and AASHTO M-199. All manholes will be a flat top. All flat tops will be traffic bearing. Manholes will be constructed with a monolithic base with the sidewall extending at least 48 inches above the base unless invert/rim elevations require a shorter base. The Portland Cement used to fabricate precast manholes will conform to ASTM Standard Specification C-150-78a, Type III, with the concrete developing a minimum strength of 4,000 psi at 28 days. Metal reinforcement will be billet steel, Grade 60, conforming to ASTM Standard Specification C-33, latest revision. Standard joints will be o-ring conforming to ASTM Standard Specification C-443 or butyl rubber seals that meet or exceed the requirements of Federal Specification (GSA-FSS) SS-S-00210A and AASHTO M-198B. Exterior joints for all base and riser sections below grade will be wrapped with a butyl resin sealant with polyolefin laminate that meets Federal Specification SS-S-0210A and AASHTO M-198B. Wrap will be minimum of six (6) inches wide applied according to manufacturer's recommendations with the use of a primer.
- b) All manhole frame and covers will be watertight for butterfly valves and vented with four 1 inch holes for combination air release valves. All manhole frames and covers will be rated heavy duty. Frames and covers will be constructed of cast iron conforming to ASTM A-48 Class 35. Tensile strength will be a minimum of 35,000 psi. All castings will be of superior quality free of any defects. Frames and covers will be machined at contact points to make even and smooth contact between the frame and cover and will be coated with a hot application of quick drying asphalt base dip.
- c) Frames and covers for butterfly valve manholes and combination air-release manholes will be cast-in-place flush with the flat manhole top. The frame will be cast in the concrete top with the flange up. Covers for butterfly valve manholes will be solid, watertight secured to the frame with a minimum of 4 stainless steel bolts. Cover for the combination air release valve will be the same as for the butterfly valves except perforated with four 1 inch vent holes. Covers will be cast with the word "Water" stated across its top. Covers will have a minimum weight of 140 pounds while the frame will have a minimum weight of 165 pounds. Minimum depth dimension for the frame will be 4 inches.

- d) Manhole steps will be reinforced molded polypropylene plastic-steel construction. All manhole steps will be reinforced with a single #6 steel bar ASTM designation A-615 Grade 60. Plastic manhole steps will be installed 12 inches on center and staggered.
- e) Manhole size for the following appurtenances will be as follows:
- Butterfly Valves
16 Inch to 24 Inch – 6 Foot Diameter Manhole
 - Combination Air-Valves
Water Main Size 8 Inch to 12 Inch – 5 Foot Diameter Manhole
 - Combination Air-Valves
Water Main Size 16 Inch to 24 Inch – 6 Foot Diameter Manhole
 - Valves and Piping Greater Than 24 Inches in Diameter – Manhole Sized by City of Roxboro

02040 WATER SERVICE TAPS

A. DESIGN

1. Individual water services will be provided from the main to each water meter for single family residences in accordance with these Specifications and the Detailed Drawings. Multiple branch services are prohibited unless otherwise approved by the City of Roxboro. All connections will be made by wet taps. Service connections will be made perpendicular to the main and will run straight to the meter.
2. All water service lines will be installed with a minimum depth of cover of 30-inches or greater.
3. All water meter boxes and vaults will be located at the edge of the serviced lot's right of way or easement. Water meter boxes will not be placed in streets, sidewalks, parking areas or obstructed by fencing or buildings. Exceptions to these conditions will be at the direction of the City of Roxboro.
4. Provisions for backflow prevention will be in accordance with existing City of Roxboro policies and the NC Plumbing Code.
5. The water meter will be sized based on water demand. All water service lines will be minimum 3/4 inch diameter. Multiple branches up to a maximum of 2 potable water services per multiple branch assembly for residential use will be sized by a licensed professional engineer in the State of North Carolina in accordance with AWWA M22, but will not be less than 1.5-inches in diameter.
6. Service taps 2 inches or less to existing water lines will be made by the City of Roxboro. Service taps greater than 2 inches to existing water lines will be made by the Developer after obtaining applicable permits and paying applicable fees to the City of Roxboro.
7. Service taps to new water lines will be made by the Contractor in accordance with these Specifications after obtaining applicable permits and paying applicable fees.
8. Any water service consumer which has a water static pressure greater than eighty (80) psi is required by North Carolina State Building Code to install and maintain a pressure reducing valve. The pressure reducing valve will be installed on the building service line after the meter. Such device must be installed before the City of Roxboro will allow the actual water connection. This installation is covered by the Plumbing Code and is not maintained by the City of Roxboro.

B. MATERIALS

1. Mechanical Joint Tapping Sleeves and Tapping Valve:

- a) Mechanical joint tapping sleeves may be used on all water distribution piping diameters where applicable. MJ tapping sleeves will be fabricated of ductile iron construction in a full body two-piece assembly with mechanical joint connections to the main line and flanged connection to the tapping valve. Outlet flange will be drilled conforming to ANSI B16.1, Class 125. All MJ tapping sleeves will be rated for a working pressure of 250-psi or greater and provided with a ¾-inch test plug for testing. All tapping sleeves will be hydrostatically tested up to 200-psi before a tap is made. Tapping sleeves will not be air tested.
- b) All mechanical joint tapping sleeves will be manufacturer fabricated and approved for installation on the specific main line pipe material. Tapping sleeve will be equipped with rubber gaskets to provide a leak-proof seal. Mechanical joint bolts and nuts are to conform to AWWA C-111. The sleeve will include end joint accessories and split glands necessary to assemble sleeve to an existing waterline.
- c) All interior and exterior surfaces of tapping sleeves and valves will be epoxy coated, minimum 10 mil thickness. Epoxy coatings will meet or exceed AWWA C-550 and ASTM D-1763 Standards. The epoxy coating will be acceptable for use with potable water according to E.P.A. and F.D.A. guidelines.
- d) Outlet end of tapping valve will be specially constructed to receive a standard tapping machine for the purpose of making a wet tap to an existing waterline. This outlet end will be mechanical joint from which to extend new piping. Tapping valve will conform to Specifications herein provided. Tapping valve will be resilient seated, gate type, rated for not less than 250 psi.

2. Stainless Steel Tapping Sleeves, 4-inch, 6-inch and 8-inch main lines only:

- a) 304 Stainless steel tapping sleeves may be used in lieu of mechanical joint tapping sleeves for ductile iron water mains through 8 inches in diameter at sizing as shown in the following table. All stainless steel tapping sleeves will be manufactured in conformance with AWWA C-223. All SS tapping sleeves will be provided in a two piece assembly with a full circumferential gasket with tabbed gasket holding assembly and ¾-inch test plug. The back band will be a minimum 14 gauge stainless steel and the front band (where the outlet is located) will be a minimum 12 gauge stainless steel. The bolt bars will be a minimum 7 gauge stainless steel. All SS tapping sleeves will be manufacturer rated for a working pressure of 250-psi or greater and hydrostatically tested to 200-

psi before a tap is made. Stainless steel tapping sleeves will NOT be air tested.

Stainless Steel Tapping Sleeve Sizes

Nominal Main Size (inches)	Nominal Branch Size (inches)
6	4
8	4
8	6

3. Tapping Saddles:

- a) Tapping saddles will be used on all ductile iron water mains for taps 1 inch or larger up to 2 inches. Tapping saddles will be double bale, bronze equipped with corporation cock threads. The saddle will be cast bronze conforming to ASTM B-584 using Grade 60 Buna N gaskets. Bale and nuts will comply with B-98. Washers will be silicon bronze conforming to ASTM B-36. Tapping saddles will be rated for 250 psi working pressure.
- b) Larger taps may be allowed only after approval has been granted by the City of Roxboro.

4. Service Line Taps:

- a) The maximum size of direct taps for ductile iron water mains 4 inches or larger without a fitting, tapping sleeve or saddle will be 3/4-inch. Any taps larger than 3/4-inch will be provided with a saddle tap.

5. Corporation Stops:

- a) All corporation stops installed will be ¾ inch for both the inlet and outlet sides. Inlet will be AWWA / CC taper thread. Outlet will be compression type, threaded, with a grip joint nut that is sealed with a EPDM rubber gasket. Ends of the corporation stop will be integral to prevent unintentional disassembly. Construction of corporation stops will be brass that conforms to AWWA Standard C-800, ASTM B-62 and ASTM B-584. Corporation stops will be rated for 300 psi working pressure. Corporation stops will be equipped with double o-ring stem seals and a stainless steel reinforced seat o-ring. Corporation stops will be ballcorp stops FB 1000-3-G by Ford, B-25008 by Mueller or equal.
- b) Taps will be located at 10:00 or 2:00 o'clock on the circumference of the pipe. Service taps will be staggered alternating from one side of the water main to the other and at least 12 inches apart. The taps must be a minimum of 24 inches apart if they are on the same side of the pipe.

- c) No burned taps will be allowed and each corporation stop will be wrapped with Teflon tape for ductile iron pipe water mains. No taps are allowed on a fire hydrant line. No tapping will be made where rodding is placed.

6. Copper Service Tubing:

- a) Copper service tubing will be type K soft copper tubing per ASTM B-88, annealed (0) with compression fittings. No union will be used in the installation of the service connection of 100-feet or less. Service lines more than 100 feet will use a three (3) piece compression coupling. Only one (1) compression coupling will be used for each 100 feet or fraction thereof.
- b) All above ground copper will be hard drawn, Type K complying with ASTM B-88M. Joints will be silver solder type or suitable compression fittings.
- c) All soldered joints will be constructed using a water flushable flux that complies with ASTM B-813, latest revision. Construction of such joints will be according to ASTM B-828, latest revision using lead free solder alloy complying with ASTM B-32, latest revision, Grade 95TA. Soldered joints will have a working pressure rating of 625 psi at 150 degrees F.

7. Copper Fittings:

- a) All copper fittings will comply with ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze. Cast copper will be made from C84400 Alloy and wrought copper will be made from commercially pure copper mill products per ASTM B-75, C12200 Alloy. Joints will be solder type, according to ASTM B-828, Grade 95TA complying with ASTM B-32 or suitable compression fittings. Soldered joints will have a working pressure rating of 625 psi at 150 degrees F.

8. Meter boxes for 3/4 and 1 inch services:

- a) Meter boxes for all service connections will be a standard commercial grade box with nominal dimensions of 14" x 19" with a minimum depth of 12". Boxes will be equipped to accommodate a single automatic meter reader, bottom mount. Meter boxes will be molded of structural foam polyolefin material with a melt index between 10 and 12. Coloring and UV stabilizers will be added during the making of the boxes. Meter boxes will be black with a drop-in cover. Cover will be equipped with a cast iron flap and lockable. Cover will be labeled with the words "Water Meter". Meter boxes will be mounted on solid concrete bricks with the bottom of the meter box graveled with washed stone, minimum four (4) inches thick. Meter boxes will be NDS or equal.

- b) One adjuster may be used when needed to meet final grade. Grade adjusters will be plastic when approved by the City of Roxboro. Grade adjuster and box will be by the same manufacturer.
- c) In isolated cases and when approved by the City of Roxboro, meter boxes may be located in driveways, alleys and/or parking areas. In these cases, a street rated box capable of withstanding a 40,000 lbs proof load will be required.

9. Meter Boxes for 1 ½ and 2 inch Water Services:

- a) 1-1/2 inch and 2 inch meter boxes will be light weight polymer concrete as indicated in the Standard Details. Meter boxes for 1 ½ and 2 inch water services will provide a cover opening of 24 X 35 5/8 inches and boxes will measure at least 30-inches in depth and provided in straight wall arrangement. Standard meter box covers will bolt down to the box, and all polymer cement covers will be provided in solid configuration with a 2 inch diameter transmitter hole, and with the words, "Water Meter" cast into the lid. The meter box covers will be provided with 2 stainless steel bolts in penta head configuration for security. Custom setter piping and fittings for 1 ½ and 2 inch water meters will be constructed from "no lead" brass (meeting UNS C89833 as per ASTM B-584) and copper tubing and will be equipped with angled check valve outlets and by-pass flanged valve or by-pass flanged ball valve inlets. To ensure positive discharge, the box should be tied into the existing storm drain system, or will have an open bottom to all drainage through a 12-inch clean stone base. All meter box covers for potable water service will be provided in standard concrete gray or black color.

10. Meter Vaults:

- a) Meter vaults and access doors within street right of way will meet HS-20 loading requirements and will be located outside of travel areas. Pedestrian rated covers of 300-psf will not be accepted regardless of where they are located. The access double doors will be aluminum with a flush drop lift handle, stainless steel hinges and bolts, a stainless steel slam lock, an automatic hold open arm, and compression springs to allow for easy opening. To ensure positive drainage, the vault will be tied into the existing storm drainage system. If positive drainage is unobtainable, a sump pump will be located and operated in the vault. Standard meter vaults for meters 3 inch and larger are illustrated in the Detail Drawings.

11. Water services greater than 2-inches:

- a) A strainer will be provided upstream of the meter on service lines greater than 2-inches.

12. Meter Setter for 3/4 and 1 Inch Service:

- a) All meter setters will be copper installed to receive a 5/8" x 3/4" or 1" meter. The meter setter will be equipped with a ball angle key valve and an angle dual check valve. Minimum height for the setter will be 7 inches. All meter setters will be equipped with a bracing eye. Inlets and outlets will have double purpose 3/4" or 1" union swivels. Saddle nuts will be provided to hold the meter in place for tightening. All setters will be assembled with lead-free solder.

All brass for the setter will conform to AWWA Standard C-800, ASTM B-62 and ASTM B-584. All copper will conform to ASTM B-75.

Meter setters will be Ford VHH 72-7W-11-33, Mueller No. H-1404-2 or equal.

13. Water Meters for 3/4 Inch and 1 Inch Service:

- a) All water service meters 5/8 inch x 3/4 inch or 1 inch installed will be magnetic driven, positive displacement and conform to AWWA C-700. Water meters will be Neptune T-10 Series.
- b) All installed meters sized 5/8 inch x 3/4 inch and 1 inch will have an accuracy range +/- 1.5 percent rated for flows between 1/2 to 20 gpm and 20 gpm to 50 gpm respectively.
- c) All installed water service meters will be calibrated to read U.S. gallons. Direct reading will be possible. Register cups will be copper and covered with a high strength, impact resistant flat glass lens. Register boxes and lids will be of a high-strength synthetic polymer. All registers will have the size, model and date of manufacture stamped on the dial face. All maincase bolts will be 300 series non-magnetic stainless steel.
- d) All water service meters will be equipped with a remote reading system that is a self-contained, solid state, absolute encoder register metering system designed to obtain remote simultaneous water meter registration that is guaranteed to match the registration on the register odometer. Encoders will be directly mounted to the water meter. The register will provide at a minimum a nine-digit visual registration at the meter. The remote reading system will be a Neptune E-Coder) R 900i encoder designed with a whip antenna for above-ground reading with a hand-held data collector. Encoders will be housed in a rolled, sealed copper shell with a glass lens. Units will be designed for a pit installation. The register will be attached to the meter case by a bayonet attachment. A tamper-proof seal pin will be required to secure the register to the maincase. Encoders will comply with AWWA C-707 and meet all AWWA C-700 performance standards.

C. BACKFLOW / CROSS CONNECTION PREVENTION

1. Policy

- a) All backflow/cross connection devices and installations must meet State and City of Roxboro minimum design standards/guidelines as indicated in the most recent Rules Governing Public Water Supplies by the N.C. Dept. of Environmental and Natural Resources and/or the City of Roxboro Standard Specifications, whichever is the most stringent. All assemblies approved for use must have prior approval by Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California (USC), or the American Society of Sanitary Engineering (ASSE).
- b) All water services will be provided with backflow prevention devices adjacent to the meter box or vault. All backflow preventers must be installed above ground with an insulated box and will be reviewed by the City of Roxboro.
- c) All above ground enclosures must have adequate drainage provided for (depending on the size of the device). All residential service meter assemblies will be installed in a single (standard or modified) meter box. All residential service meter yokes will have a double check valve incorporated as a standard part of the yoke assembly.

2. Installation

- a) There will also be strict enforcement of the 12 inch minimum distance above the floor or ground and a 60" maximum height above the floor or ground for backflow prevention devices.
- b) Backflow prevention device(s) must be readily accessible at all times. Readily accessible means that only a one piece cover must be removed to test the device or perform maintenance on that device. There must also be a minimum clearance around the device of 18 inches.
- c) Defacing a backflow prevention device will not be allowed. Defacing would include anything that might obscure pertinent information on that device (i.e.) name plate, serial number, etc. Any device that is missing a name tag or information stamped in the body will not be considered to be an acceptable device installation and must be replaced upon notification by the City of Roxboro.

3. Testing

- a) Backflow prevention devices must be installed, tested maintained by certified persons that have completed an approved Cross Connection School. It is also required that all devices be tested at the time of installation and annually thereafter. All devices must also have the rubber parts changed every five years. Testing Certificates will be mailed to the City of Roxboro.

02050 IRRIGATION SYSTEMS

1. All irrigation systems will be provided with privately maintained reduced pressure principle backflow prevention installed in accordance with the NC Plumbing Code and the Foundation for Cross Connection Control and Hydraulic Research. Reduced pressure zone backflow preventers will be installed above ground in an insulated box as shown by the details.
2. All irrigation systems within public street right of way require an encroachment agreement from the City of Roxboro or NCDOT prior to installation. Plans designating the location, size, material, and depth will be submitted with the agreement application to the City of Roxboro. If there is an approved site plan, it will be referenced with the encroachment submittal to the City of Roxboro.
3. Pipe material for the mainline proposed to be used within the public right of way will be Schedule 40 PVC or greater. A distance of at least 2 feet will be provided from the back of curb. A minimum depth of 2 feet of cover will be provided.
4. The irrigation mainline pipe system will be hydrostatically tested per Section 02060 with a minimum pressure of 200-psi or 50-psi above working pressure.
5. All street crossings of irrigation systems will be encased in ductile iron or steel conduit. Irrigation systems installed in the medians of City of Roxboro maintained roadways must also have french drains installed behind the curb and gutter which are piped to a storm system.

02060 TESTING AND INSPECTIONS

A. GENERAL

1. All materials must be approved by the City of Roxboro prior to installation. Materials rejected by the City of Roxboro will be immediately removed from the job site.
2. The Developer will furnish all materials, labor, and equipment to perform all testing and inspections to the satisfaction of the City of Roxboro. The City will provide water for testing purposes on water mains at no cost.
3. The Engineer-of-Record will have a representative present during construction and testing. The representative must be present at least 50% of the time during construction and 100% of the time during all testing procedures. The cost associated with inspections will be paid by the developer.

B. TESTING

1. Hydrostatic Testing

- a) No valve in the City of Roxboro water system will be operated without authorization from the City of Roxboro. A section of line that is to be hydrostatically tested, will be slowly filled with water at a rate which will allow complete evacuation of air from the line. Hand pumps will not be used for the pressure testing of water mains. Taps used for testing purposes will be removed after testing and repaired using a stainless steel full circle repair clamp.
- b) When filling the pipeline, it is very important to fill the line slowly to avoid undue impacts associated with surge and to allow air to evacuate the pipeline. After all air has been expelled from the water main, the line will be tested to a pressure of 200 psi as measured at the lowest elevation of the line for a duration of 3 hours. The testing period will not commence until all air has been evacuated and the pressure has stabilized. The pressure gauge used in the hydrostatic test will be calibrated in increments of 10-psi or less. The pressure gauge will be liquid-filled and indexed for an operating range of 300-psi or less with a minimum dial size of 3-1/2 inches. At the end of the test period, the leakage will be measured with an accurate water meter.
- c) Any measured leakage not within the allowable limits as specified in the following table will require repair of the water main and additional testing until the standards are met. For pipe sizes other than those shown, the Developer will test within the allowable leakage amounts as

specified by AWWA C-600. All visible leaks will be repaired regardless of the amount of leakage.

Maximum Leakage Allowed with Hydrostatic Testing

Pipe Size (Inches)	Allowable Leakage at 200-psi Gal./Hr. per 1000 feet of pipe)
4	0.38
6	0.57
8	0.76
10	0.96
12	1.15
16	1.53
20	1.91
24	2.29
30	2.87

- d) The City of Roxboro reserves the right to require multiple pressure tests on a waterline depending on its length. Multiple pressure tests will generally be required from in-line valve to in-line valve if distances are greater than 2000 feet.

2. Disinfection

- a) All additions or replacements to the water system will be disinfected with chlorine in conformance with AWWA C651 and in accordance with the requirements of NCAC Title 15A Subchapter 18C Section 1003 in Disinfection of Storage Tanks and Distribution Systems before being placed in service under the supervision of the City of Roxboro’s Inspector in the following manner:
 - i. Taps will be made at the control valve at the upstream end of the line and at all extremities of the line including valves.
 - ii. A solution of water containing 70% HTH available chlorine will be introduced into the line by regulated pumping at the control-valve tap.

The solution will be of such a concentration that the line will have a uniform concentration of not less than 50-ppm and not more than 100-ppm total chlorine immediately after chlorination. The chart below shows the required quantity of 70% HTH compound to be contained in solution in each 1000 feet section of line to produce the desired concentration from 50-ppm to 100-ppm.

Required Hypochlorite Concentration

Pipe Size (inches)	Pounds of High Test Hypochlorite (70%) to reach 50-ppm <i>per 1,000 feet of line</i>	Pounds High Test Hypochlorite (70%) to reach 100-ppm <i>per 1000 feet of line</i>
6	0.88	1.76
8	1.56	3.12
10	2.42	4.84
12	3.50	7.00
14	4.76	9.52
16	6.22	12.44
20	9.76	19.52
24	14.00	28.00

- iii. The HTH Solution will be circulated in the main by opening the control valve and systematically manipulating hydrants and taps at the line extremities. The HTH solution must be pumped in at a constant rate for each discharge rate so a uniform concentration will be produced in mains.
- iv. HTH solution will remain in lines for no less than 24 hours or as directed by the City of Roxboro.
- v. Extreme care will be exercised at all times to prevent the HTH solution from entering existing mains.
- vi. Free residual chlorine after 24 hours will be at least 50 ppm or the Inspector will require that the lines be re-chlorinated.

3. Flushing

- i. Flushing of lines may only proceed after 24 hours of disinfection contact time and as directed by City of Roxboro staff, provided the free residual chlorine analysis is satisfactory.
- ii. At the completion of disinfection, chlorinated water flushed from the water main will be disposed of in conformance with all Federal, State and local regulations.
- iii. In accordance with all applicable regulations, a neutralizing chemical will be applied to minimize chlorine residual in the flushing water

before discharging from the water main, unless an alternate plan is submitted in writing and approved by the City of Roxboro.

- iv. Water used for disinfection will be flushed from the water main until the chlorine residual concentration is below 5-ppm before initiating sampling.

4. Bacteriological and Turbidity Sampling

- a) Bacteriological sampling will be utilized to verify disinfection prior to placing a newly constructed water main in operational service. Bacteriological sampling will consist of 2 consecutive sets of acceptable samples taken at least 24-hours apart and collected from each 1,200-ft section of water main and all dead ends and branches as outlined by ANSI/AWWA C-651.
- b) For the first round of sampling, the requested laboratory analysis will be specified as follows: "Bacteriological Test and Turbidity." For the second round of testing, the laboratory analysis will be specified as, "Bacteriological Test Only."
- c) Samples for laboratory analysis will be collected and performed by the City of Roxboro after flushing is completed. The Developer will furnish the sample bottles. Samples will only be taken by the City of Roxboro from Monday till noon on Thursday.
- d) All sample bottles for bacteriological sampling provided will be sterilized and treated with a dechlorinating agent, such as sodium thiosulfate. Samples for turbidity will be taken in plain sterilized bottles from the lab, which are separate from the bottles provided for bacteriological testing. The sample bottles will be provided with tamper proof seals that will be adhered to the bottles. The City of Roxboro will provide a sample identification number, job title and an identification of Phase 1 or Phase 2 sampling that will be provided on the tamper proof custody seal. All sample identification numbers, job titles, and Phase 1 or Phase 2 testing identification from the custody seal will be recorded on chain of custody forms by the City of Roxboro.
- e) All samples will be collected in compliance with the sampling protocols and processed for delivery under the direct supervision of the City of Roxboro. The samples will be collected by the City of Roxboro and kept in a cooler provided by the Contractor at approximately 40-degrees Fahrenheit or 4- degrees Celsius and delivered to the Roxboro Water Treatment Plant Laboratory as soon as possible. The time at which the sample is taken will be recorded on the chain of custody form by the City of Roxboro.

- f) All first round samples will be tested for bacteriological quality and turbidity in accordance with standards established by NCDENR and AWWA. If turbidity exceeds 0.8 NTU, the sample will fail and the system will be reflushed before initiating a new round of testing.
- g) If the phase 1 sample results for bacteriological quality and turbidity are acceptable, then a second set of samples can be collected at least 24-hours following the first sample collection. No additional flushing other than required to obtain a representative sample will be allowed prior to collecting the second set of samples.
- h) The second set of samples will be tested for bacteriological quality only. All custody seals and chain of custody forms will identify the second round samples as "Phase 2" testing to notify the lab that the first set of samples have already been evaluated and received a satisfactory laboratory analysis.
- i) At the completion of sampling, the total chlorine concentration will be at least 2-mg/L and no higher than 4-mg/L before the system can be made operational.
- j) If test results are unsatisfactory, the Contractor will immediately rechlorinate lines and proceed with such measures as are necessary to properly disinfect the lines.
- k) The new water system will be valved off from the existing system until a satisfactory bacteriological laboratory analysis has been obtained and the City of Roxboro has authorized the use of the new water system.

5. Hydrants

- a) After pressure testing and disinfection of the waterlines, all hydrants will be tested individually by opening and flowing water in the presence of the City of Roxboro. During the testing of individual hydrants, fire flow gauges provided by the City of Roxboro will be mounted by the City of Roxboro to each hydrant and adjacent hydrants as necessary to obtain fire flow measurements for the City of Roxboro. Representatives from the City of Roxboro will be present to record fire flows for each hydrant at the time of testing. The Developer will be responsible for coordinating and scheduling the testing of all hydrants with the City of Roxboro.
- b) During testing operations, each fire hydrants will be visually inspected to insure that no leaks occur in branch piping or at the hydrants and that each hydrant is capable of handling pressures, forces and flows while in operation. Should a leak occur or be noticed, or operation of valving and the hydrant demonstrate

problems, the Contractor will uncover all piping as necessary to correct any leaks or operational problems on the hydrant, associated valving and piping. After all problems have been corrected, the hydrant will be tested as hereinbefore specified.

02070 REPAIR AND REHABILITATION

1. Joint leaks of Ductile Iron Pipe will be repaired by using a bell joint leak repair clamp approved by the City of Roxboro or by replacing the damaged pipe and reconnecting with a mechanical joint sleeve connection.
2. Line Breaks or Punctures will be repaired by a full circle repair clamp as approved by the City of Roxboro or by replacing the damaged pipe and reconnecting with a mechanical joint sleeve connection.
3. Line Splits or Blow Outs will be repaired by replacing the damaged section with ductile iron pipe with a restrained sleeve connection at each end.
4. For pipe transitions of different materials use a Hymax style coupling with different end diameters sized specifically for the pipe materials and pipe outside diameter at each end.
5. All water main point repairs will be replaced with DIP in accordance with these specifications and backfilled with crush and run stone compacted to 95% maximum dry density as specified elsewhere in the Standard Specifications.
6. Water Service Line Repairs
 - a. A water service line severed between the water main and the water meter will be repaired using new type K copper tubing and bronze or “no lead” brass 3 piece compression unions.
 - b. A corporation stop pulled out of a PVC pipe water main will have a new service saddle and a new “no lead” brass corporation stop installed on the water main.
 - c. A corporation stop pulled out of a ductile iron pipe will have a full circle repair clamp placed over the old tap hole. A new tap will be made and a new “no lead” brass corporation stop installed on the water main.

END OF SECTION 02000

02000-46

City of Roxboro Standard Specifications and Details: Adopted _____

SECTION 03000
WASTEWATER COLLECTION SYSTEMS

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03010 GRAVITY SEWER

A. DESIGN

1. Standard Specifications and Detail Drawings

- a) The following Standard Specifications and associated Detail Drawings will apply to all sanitary sewer system extensions and development of the City of Roxboro's Wastewater Collection System. The Standard Specifications and Detail Drawings included herein will apply to all aspects of the City of Roxboro's Wastewater Collection System that extend inside the corporate City Limits and any other areas outside the corporate limits in which the wastewater collection distribution system is otherwise owned, operated and maintained by the City of Roxboro.
- b) Described in this Section are the general design standards which are to be followed by all parties in preparing utility extension and utility replacement plans for the City of Roxboro. These design standards will ensure that the citizens of Roxboro will continue to have a safe wastewater collection system.
- c) All engineering plans for public and private wastewater collection systems must meet State and City of Roxboro minimum design standards as indicated in the most recent amended Rules Governing Public Water Supplies and Public Wastewater Collection Systems by the N.C. Dept. of Environment and Natural Resources and/or the City of Roxboro Standard Specifications, whichever is the most stringent. All projects must be certified by a licensed professional engineer of record in the State of North Carolina.
- d) Plan and profile drawings will be prepared by a registered professional engineer signed, sealed and dated showing the various elements of the utility mains and will include an overall utility plan layout on a single sheet with scale no smaller than 1 inch =200 feet. The utility drawings will be on separate sheets, free of landscaping and other details not pertinent to the utility plans. All utility engineering drawings will be on paper 24 inches by 36 inches. All drawings will show all structures which will include but not be limited to drainage ditches, storm drains, streams, ponds, lakes, buildings, streets, driveways and other existing utilities. Plan/profile drawings will be prepared with a scale no smaller than 1 inch =50 feet.
- e) No plans will be approved for construction until all off-site easements have been obtained. All plans will show the existing utilities and their size with the existing easements. Off-site drainage will be indicated on

the plans along with the proposed utilities. These plans will include service connections for the individual lots to be served.

- f) Once installed, “as-built” plans in paper form and digital form will be provided to the City of Roxboro showing the utilities. The digital form will be specified by the City of Roxboro. “As-built” drawings for the utilities will be submitted to the City of Roxboro at the time of acceptance of the project by the City. All service connections will be shown on the “as-built” plans and will be referenced to the property lines.

2. Main Location

- a) All public sanitary sewer mains will be installed in dedicated street right-of-way or in dedicated utility easements. Mains installed in new subdivision streets will be located in the center of pavement. If the sewer main cannot practically be located in the center of the pavement it will be located within the south or west side of the street right-of-way. Mains within easements will be centered within the easement unless otherwise approved by the City of Roxboro. Mains located within NCDOT right-of-way will be placed in accordance with NCDOT Standards.
- b) In preparing engineering design plans for sanitary sewer mains, all elevations will be tied to NC Grid System and the benchmark will be shown on the plans for each plan/profile drawing.
- c) Gravity mains will be installed in dedicated public right-of-way or in dedicated utility easements as follows:

Standard Easement Width for Sanitary Sewer Mains

<u>Pipe Size</u> (diameter)	<u>Pipe Depth</u> (feet)	<u>Easement Width</u> (feet)
8-inch to 12-inch	10-ft or less	20-ft
8-inch to 12-inch	10-ft – 12.5-ft	25-ft
8-inch to 12-inch	12.5-ft – 15-ft	30-ft
8-inch to 12-inch	15-ft to 17.5-ft	35-ft
8-inch to 12-inch	17.5-ft to 20-ft	40-ft
12-inch to 24-inch	15-ft or less	30-ft
12-inch to 24-inch	15-ft – 17.5-ft	35-ft
12-inch to 24-inch	17.5-ft – 20-ft	40-ft
Greater than 24-inch	Any Depth	Determined by City of Roxboro
Any Size	Deeper than 20-ft	Determined by City of Roxboro

Dedicated easements for sewer mains and appurtenances will be recorded as "City of Roxboro Utility Easement". City of Roxboro sewer easements will contain only City of Roxboro utilities unless otherwise approved by an encroachment agreement.

- d) No permanent structures, equipment, retaining walls, embankments, impoundments, or other elements that would inhibit maintenance operations will be constructed within a sewer main easement. Fences may be allowed across easements provided appropriate access gates have been installed to allow utility maintenance. In all cases, City of Roxboro will have access to secured access gates. Fill or cut slopes are not allowed to extend into easements without full development plan approval or an approved encroachment agreement from the City of Roxboro. All such pre-existing or planned conditions as noted herein that would impact operations and maintenance within the noted sewer main easement will be noted and disclosed during the approval process. Pre-existing conditions that are not disclosed during the approval process may nullify the approval and require relocating the sewer easement where there are no existing conflicts.
- e) Sewer line easements will be graded smooth, free from rocks, boulders, roots, stumps, and other debris, and seeded and mulched upon the completion of construction. Easements across sloped areas will be graded uniformly across the slope no steeper than a 5 to 1 ratio.
- f) Mains paralleling a creek will be of sufficient depth to allow lateral connections below the stream bed elevation. The top of the sewer main and laterals will be at least one foot below the stream bed. Concrete encasement and ductile iron pipe will be required when the cover between the top of the pipe and the stream bed is less than 3 feet.
- g) Mains will not be installed under any part of water or stormwater impoundments.
- h) The following minimum horizontal separations will be maintained:
 - i. 100 feet from any private or public water supply source, including wells, WS-1 waters or Class I or Class II impounded reservoirs used as a source of drinking water
 - ii. 50 feet from any waters (from normal high water) classified WS-II, WS-III, B, SA, ORW, HQW or SB (except as noted below)
 - iii. 25 feet from any other stream, lake, or impoundment
 - iv. 25 feet from private wells (with no exceptions)
 - v. 50 feet from sources of public water supply (with no exceptions)

Where the required minimum separations cannot be obtained, ductile iron sanitary sewer pipe with joints equivalent to water main standards will be used.

- i) Sewer mains will always be extended along natural drainage courses to the adjacent property line.
- j) Gravity sewer mains will be deep enough to serve the adjoining property and allow for sufficient slope in lateral lines, and will have the following minimum covers. These requirements may be waived at the direction of the City of Roxboro, in which case ductile iron pipe will be installed.
 - 4 feet from the top of pipe to finished subgrade in roadways.
 - 3 feet from the top of pipe to finished grade outside roadways.
- k) Sewer mains over 20 feet deep require ductile iron for the entire run between manholes. In all cases where fill material is added above existing sewer mains, the Engineer of Record will prepare a structural analysis of the existing pipeline and determine if it is capable of supporting additional loading. If the additional fill material exceeds AWWA, DUCTILE IRON PIPERA, UNIBELL and/or manufacturer standards for loading, the pipeline will either be reinforced to adequately support the additional loading or replaced with a ductile iron pipe rated to support the added loading.
- l) Separation Between Sanitary Sewer and Storm Water Pipes:
 - Sewer mains will have a minimum vertical separation of 24 inches between storm pipes when the horizontal separation is 3 feet or less. Where sanitary and storm sewers cross with a vertical separation of less than 24 inches, the entire leg of sanitary sewer will be made of standard ductile iron pipe with joints rated for water main service and the void space between the pipe crossing backfilled with 3000- psi concrete or quick setting, minimum 500-psi, non-excavatable flowable fill that meets or exceeds NCDOT Specifications.
- m) Separation Between Sanitary Sewer and Sewer Force Main:
 - There will be a minimum 7 foot horizontal separation between parallel gravity and/or force mains when the depth of installation is 8-ft or less. Otherwise, the minimum horizontal separation between pipelines will be 10-ft up to 10-ft depth of installation. Otherwise, a project specific design will be implemented

n) Separation Between Sanitary Sewer and Water Main

- Parallel Installations: 10-ft lateral separation (pipe edge to pipe edge) or minimum 4-ft lateral separation, and water line at least 18-inches above sanitary sewer line measured vertically from top of sewer pipeline to bottom edge of water main. In unique cases where the sanitary sewer and the water main are installed with at least 4-ft of lateral separation but less than 10-ft of horizontal separation, and less than 18-inches of vertical separation, both the water main and sanitary sewer will be constructed of ductile iron pipe with joints in full compliance with water main standards.
- Crossings (Water Main Over Sewer): All water main crossings of sewer lines will be constructed over the sewer line in conformance with City of Roxboro specifications. At a minimum, 18-inches of clearance will be maintained between the bottom edge of the water main and the top edge of the sewer main. If 18-inches of clearance is not maintained, the water main and sanitary sewer main will:
 - i) Both lines will be constructed of ductile iron pipe with joints in conformance with water main construction standards.
 - ii) The ductile iron sanitary sewer pipe will extend 10-ft on both sides of the crossing. The ductile sewer must extend at least 10-ft away from the crossing on both sides or to the nearest manhole connection, whichever is greater.
 - iii) The void space between the pipes will be filled with minimum 500-psi, quick setting non-excavatable flowable fill extending 3-ft on both sides of the crossing.

Regardless of pipe material, at least 12-inches of vertical separation is required for both sanitary sewer crossings of potable water mains.

- Crossings (Water Main Under Sewer Line): Allowed only as approved by City of Roxboro, when it is not possible to cross the water main above the sewer line. At a minimum, 18-inches of separation will be maintained, (measured from pipe edge to pipe edge) and both the water main and sanitary sewer will be constructed of ductile iron in conformance with water main construction standards to a minimum of 10-ft on both sides of the crossing. If local conditions prevent providing 18-inches of clearance, then at least 12-inches of clearance will be provided and the void space between the pipes will be filled with minimum 500-psi, quick setting, non-excavatable flowable fill extending at least 3-ft on both sides of the crossing.

3. Main Size, Slope and Design Criteria

- a) Public gravity mains will be a minimum of 8 inches in diameter.
- b) Major interceptors will be sized in accordance with the "City of Roxboro Wastewater Collection System Master Plan". In areas not included in the master plan, interceptors will be designed based on the proposed land use (according to the City's Comprehensive Growth Plan), using the following flow factors. At a minimum, all gravity sewer mains will be designed and sized to serve the ultimate tributary buildout of the drainage basin.

i) Residential average daily flow rates:

Land Use	Flow Factor
Single Family Residential	360 gpd per dwelling unit
Multi-Family Residential	120 gpd per bedroom

ii) Non-residential flow rates:

Use flow factors as required by the North Carolina Department of Environment and Natural Resources (at the time of this Specification, these flow rates are contained in 15A NCAC 2H .0219).

iii) For all other flow rates not listed above, use:

Land Use	Flow Factor
Office and Institutional	0.09 gpd/sq.ft bldg. space
Commercial	0.12 gpd/sq.ft bldg. space
Industrial	0.20 gpd/sq.ft bldg. space

- c) The ratio of peak to average daily flow will be 3.5.
- d) Sanitary sewers will be designed to carry the projected peak flow at no more than 1/2 full. The minimum velocity for sanitary sewer lines will be 2.0-fps.
- e) Sanitary sewers will be sized based on the Manning's Equation with Manning's roughness coefficient "n" = 0.013 or greater. Pipe diameter sizes used in the calculation of Manning's Equation will be nominal pipe sizes.

- f) The minimum grades for public sanitary sewers will be as follows:

Minimum Slopes for Gravity Sewer Mains

Main Size (diameter in inches)	Minimum Slope (feet per 100 foot)
8	0.50
10	0.28
12	0.22
14	0.17
15	0.15
16	0.14
18	0.12
21	0.10
24	0.08
30	Determined by City
36	Determined by City

Note1: All minimum slopes based on Manning's Equation

Note2: Manning's coefficient n = 0.013 used for all computations

- g) The minimum grade for the uppermost reach of a sanitary sewer line will be 1% regardless of sewer line size.
- h) The maximum grade for sanitary sewers is 10%. The maximum velocity in sanitary sewers is 15 ft/sec. These limits may only be exceeded with the approval of the City of Roxboro and the incorporation of the following provisions, which apply to all sewers either designed or installed at grades equal to or exceeding 10%:
- i. All sewers with a grade of 10% or higher must have the downstream run of pipe installed with ductile iron pipe.
 - ii. High velocity manholes will be used on all sewers with a grade of 10% or higher. High velocity lines cannot tie directly to an existing line and must proceed 180° through the invert into the downstream line.
 - iii. Concrete thrust collars will be installed on all sewers designed at grades of 10% or higher. The anchors will be installed at the following spacing:
 - Not over 36' center to center on grades from 10% to 25%
 - Not over 24' center to center on grades from 25% to 40%
 - Not over 16' center to center on grades exceeding 40%

- iv. The City of Roxboro reserves the right to require all high velocity requirements outlined herein for sewer lines either designed or installed at grades of 10% or greater, regardless of the flow velocity. In cases where the design grade established on the sewer design plan is exceeded during construction and the 10% threshold is exceeded, all high velocity requirements will apply without waiver.
- i) Sewer extensions will be designed for projected flows. Diameter of receiving sewers which are less than the diameter of the proposed extension will be upgraded to provide a receiving sewer equal to the diameter of the extension.
- j) All pipe diameter changes will occur only in manholes, with the invert of the larger pipe lowered sufficiently to maintain the same energy gradient. The crown of the incoming pipes may be designed for an elevation at or above the crown of the outgoing pipe.
- k) All transitions of pipe material, pipe separations, grade changes and all angular deflection changes will occur only at manholes.

B. MATERIALS

Materials specified herein are acceptable for sewer service as described herein.

1. DUCTILE IRON PIPE

a) Material Specifications

Ductile Iron Pipe will be designed and manufactured in accordance with AWWA C-150 and C-151 and provided in nominal 20-ft lengths. The minimum requirements for ductile iron pipe and required laying conditions are tabulated in the following chart. For all other installations other than specified, the laying condition, bedding requirements or the minimum pressure class rating and/or thickness class will be increased in accordance with AWWA C-151. A pipe thickness design will be submitted for external loading in all cases where the pipe depth exceeds the specified range of depths outlined in the following chart:

CHART 1

Pressure Class, Max. Depth and Laying Condition for DI Sewer Mains

Pipe Diameter	AWWA C-150, Laying Condition	Pressure Class	Maximum Depth of Cover
8 -inch	Type 2	350 psi	3-16 feet
8 -inch	Type 4	350 psi	16-34 feet
10-12 -inch	Type 2	350 psi	3-14 feet
10-12 -inch	Type 4	350 psi	14-28 feet
10-12 -inch	Type 5	350 psi	28-44 feet
14-20 -inch	Type 4	250 psi	3-22 feet
14-20 -inch	Type 5	250 psi	22-30 feet
14-20 -inch	Type 5	350 psi	30-38 feet
24-30 -inch	Type 4	250 psi	3-19 feet
24-30 -inch	Type 5	250 psi	19-27 feet
24-30 -inch	Type 5	350 psi	27-33 feet

Note: For cases not specified, a ductile iron pipe and bedding design certified by a Professional Engineer licensed in the State of North Carolina will be required in compliance with AWWA C-150 and the Ductile Iron Pipe Research Association.

The corresponding minimum special thickness class designations are also required by the City of Roxboro in addition to meeting the requirements of Chart 1 for all ductile iron sanitary sewers:

Ductile Iron Pipe Thickness Class

Pipe Diameter	Nominal Thickness (inches)	Minimum Corresponding Thickness Class
4	0.26	51
6	0.25	50
8	0.27	50
10	0.29	50
12	0.31	50
14	0.33	50
16	0.34	50
18	0.36	Pressure Class 350
Larger Than 18	Determined by City	Determined by City

Pipe joints will be of the push-on type per AWWA C-111.

For 12-inch diameter and smaller gravity sewer mains, pipe lining will be cement mortar with a seal coat of bituminous material, all in accordance with AWWA C-104.

For ductile iron pipes larger than 12-inch diameter, all pipes and fittings for sewer construction will receive an interior ceramic epoxy coating, consisting of an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment, such as manufactured by Protecto 401. The interior coating will be applied at a nominal dry film interior thickness of 40-mils. All ductile iron pipe bells and spigots will be lined with 8- mils of joint compound by Protecto 401 or approved equal applied by brush to ensure full coverage. All pipe supplied with Protecto 401 interior lining will be provided free of holidays. Pipe installed with defects in the lining will be rejected and required to be replaced. Patching of Protecto 401 coating defects after installation will not be approved.

All buried ductile iron pipe and fittings will have bituminous coating on the exterior surface in accordance with AWWA C-151. Pipe will be supplied in minimum 20-ft lengths unless otherwise approved by the City of Roxboro.

All ductile iron pipes will be marked in conformance with ASTM A-746.

2. **SOLID WALL PVC PIPE**

a) **Material Specifications**

PVC Pipe will be solid wall and made of PVC plastic having a cell classification of 12454-B as defined by ASTM D-1784. PVC pipe will have integral wall bell and spigot joints for the conveyance of domestic sewage and will be supplied in minimum 13 or 20 foot lengths. Fittings will be made of PVC plastic having a cell classification of 12454-B, as defined in ASTM D-1784. All PVC gravity sewer pipe and PVC fittings up to 15-inches in diameter will be manufactured in accordance with ASTM D-3034. All solid wall PVC pipe installed at diameters from 18-inches to 27- inches in diameter will be manufactured in conformance with ASTM F-679 and provided at minimum pipe stiffness of PS-115. Fittings must be manufactured by pipe supplier or approved equal, and have bell and/or spigot configurations compatible with that of the pipe. Compounds with superior properties are also acceptable. PVC pipe will be installed in accordance with the requirements of this Specification and ASTM D-2321.

All PVC pipe up to and including 15 inches in diameter will have a maximum Standard Dimension Ratio (SDR) of 35 for depth of installation no less than 4-ft of cover from the pipe crown and no deeper than 14- ft measured from the bottom of the pipe. All solid wall PVC pipe for depth of

installation greater than 14-ft will have a maximum Standard Dimension Ratio (SDR) of 26. Solid wall PVC pipe will not be approved for depths of installation greater than 20-ft. All solid wall PVC pipe will be marked and certified in conformance with ASTM D-3034 or ASTM F-679.

PVC Pipe Sizing and Minimum Wall Thickness

Nominal Pipe Diameter (inches)	Outside Diameter (inches)	Minimum Wall Thickness SDR 35 (inches)	Minimum Wall Thickness SDR 26 (inches)
8	8.400	0.240	0.323
10	10.500	0.300	0.404
12	12.500	0.360	0.481
15	15.300	0.437	0.588
18	18.701	-----	0.719
21	22.047	-----	0.849
24	24.803	-----	0.954
27	27.953	-----	1.077

Note: SDR 35 not approved for pipe diameters greater than 15-inches and for depths greater than 14-ft.

All PVC piping will have an integral bell end with gasket seal. Gaskets will be reinforced with steel ring, band or other rigid material that permanently locks the gasket in place during manufacturing. The joint will be in compliance with ASTM D-3212. All gaskets will be lock-in type meeting the requirements of ASTM F-477.

C. SEWER MAIN INSTALLATION

1. General Requirements

- a) Pipe trench excavation and backfilling will be performed in accordance with Specifications.
- b) Transitions of pipe material, pipe separations, grade changes and all angular deflection changes will occur only at manholes.
- c) All sewer mains installed with less than 4 ft of cover and deeper than 20-ft will be ductile iron pipe.
- d) Pipe and fitting interiors will be protected from foreign matter and will be inspected for damage and defects prior to installation. In the event foreign matter is present in pipe and fittings, it will be removed before installation. Open ends of pipe will be covered and protected when pipe laying is not in progress to prevent debris from entering the pipe.
- e) All pipes will be constructed with at least 48 inches of cover below the finished grade. Pipe will be laid on true lines. Trenches will be sufficiently

wide to adjust the alignment. Bell holes will be dug at each joint to permit proper joint assembly. The pipe will be laid and adjusted so that the alignment with the next succeeding joint will be centered in the joint and the entire pipeline will be in continuous alignment both horizontally and vertically. Pipe joints will be fitted so that a thoroughly watertight joint will result. All joints will be made in conformance with the manufacturer's recommendations for the type of joint selected.

- f) Prior to beginning construction, the Contractor will contact local utility companies and verify the location of existing utilities. The Contractor will be completely and solely responsible for locating all existing buried utilities inside the construction zone before beginning excavation. The Contractor will be solely responsible for scheduling and coordinating the utility location work. When an existing utility is in conflict with construction, it will be exposed prior to beginning construction to prevent damage to the existing utility.
- g) The Contractor will have an experienced pipe man in charge of all pipe work. This individual will be at the Site anytime pipe is being installed. Should this individual need to leave the Site for any reason, pipe laying operations will cease until said individual returns to the Site.
- h) No pipe will be laid within ten feet of excavation in earth or within thirty feet of rock that must be blasted for removal. The open end of all pipes will be plugged when pipe laying is not in progress, and all pipe will be protected against injury from falling rock when blasting.
- i) Prior to being lowered into the trench, each pipe will be inspected by the pipe foreman with all faulty pipe rejected and removed from the job site. Each joint of pipe will be placed in the trench with the bell end receiving the spigot end of the next joint of pipe being laid. **The barrel of the pipe will be uniformly supported on the foundation.** Joints will be made up as recommended by the manufacturer of the pipe.
- j) No pipe will be laid in the trench until the City of Roxboro has been notified of the intention of the Contractor to lay pipe, giving the City of Roxboro sufficient time to check the lines and grades before pipe laying operations commence. The City of Roxboro may order the removal and relaying of any pipe without such notice given and notice from the City of Roxboro received to proceed with pipe laying operations.
- k) Excavation or trenching will be performed with equipment of the proper size and type for the work. The Contractor will open no more trench in advance of pipe laying than is necessary to expedite the work. Steps will be taken to avoid excessive damage to any existing curbs, gutters, pavements, etc. Sides of excavated trenches will be as straight as possible, and of sufficient width to allow for proper placement of the pipe

and subsequent backfilling operations. Excessive width of excavation for trenches will not be permitted. Excavation will be of sufficient depth to allow a minimum cover as specified from the top of placed pipe to the existing ground surface over the pipe. Where deeper excavation is required to place pipe under existing utilities, such excavation will be as required by conditions. Bell holes will be excavated at each pipe joint to prevent point loading at the bells or couplings.

- l) The width of the trench in rock excavation will be at least two feet greater than the nominal diameter of a pipe. All trench rock excavation will be carried six inches below the invert of the pipe. The excavated area will be brought back to grade with crushed stone (#67 as directed by the City of Roxboro) that provides a proper bed for piping. Stone bedding will extend to the springline of the pipe. All trench rock will be disposed off-site. No trench rock will be allowed as backfill underneath the pavement or other structures or as backfill over piping. Select compactable fill material will be brought to the site as acceptable backfill for the void created by the excavation of rock that previously existed above the springline of the pipe.
- m) In trenches with unstable bottoms, crushed stone will be placed under and around the pipe as necessary and as directed by the City of Roxboro for a stable trench. Pipe laying in unstable bottoms will meet or exceed Type 4 bedding conditions as hereinafter specified.
- n) All trenching operations will meet or exceed OSHA requirements for shoring, blasting, and the safety of the workers. When conditions require it, the Contractor will use a manufactured steel trench box in accordance with OSHA Specifications and manufacturer's instructions.

2. Bedding and Embedment Material Classifications

- CLASS I - Angular, (1/4 to 1 inch) graded stone. The use of No. 57, 67, or 78 clean, washed stone.
- CLASS II - Coarse sands and gravels with maximum particle size of 1-1/2 inch, including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil types GW, GP, SW and SP are included in this class.
- CLASS III - Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures, Soil Types GM, GC, SM, and SC are included in this class.
- CLASS IV - Silt, silty clays, and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil Types MH, ML, CH and CL are included in this class. **These materials will not be used for embedment.**

Class I foundation material consisting of ¼-inch to 1-inch graded stone will be required in addition to standard bedding and embedment for all sewer installations, regardless of pipe material, when the trench bottom is unstable due to water, rock, infiltration or soils that require undercutting.

3. Backfilling of Trenches

- a) After the pipe has been laid, backfilling will be done as follows: Backfilling along the sides of the pipe above the springline and to a level 12 inches above the pipe will be carefully done by hand using select material placed in layers not more than 6 inches thick and thoroughly compacted with mechanical tampering equipment using care to insure that pipe alignment and grades are not disturbed. Except for lines under drives or paved areas, backfilling from this elevation up may be placed in layers not exceeding 12 inches thick, kept reasonably level and compacted to 95% of maximum density as determined by ASTM Specification D-698 latest revision (Standard Proctor Test). Compaction under drives and pavements where dirt backfill is allowed, will be 100% according to ASTM Specification D-698. Should settlement occur, the Contractor will bring the ditch back to grade, including reseeding as necessary. In instances where compliance with compaction requirements is questionable as determined by the City of Roxboro, testing will be provided by the Contractor and a reputable licensed Engineer to verify compliance.
- b) Where a sanitary sewer is installed across a N.C.D.O.T. maintained road by open-cutting, the trench will be backfilled to within 13 inches of finish grade by pouring an N.C.D.O.T. approved grout mix (flowable fill) or compacting an N.C.D.O.T. approved aggregate base material complying with Sections 520 and 1010 of the North Carolina Department of Transportation Standard Specifications. Aggregate used will be Type B. Steel plates or other approved structures to bridge the flowable fill or aggregate base course will be installed temporarily to allow the passage of vehicular traffic until asphalt base and topping can be installed. Finish grades in roads will be obtained by installing asphalt mixes per N.C.D.O.T. Standards which are 11 inches of B-25 Asphalt Base and 2 inches of S9.5B Topping. All asphalt thicknesses represent a thickness after compaction.
- c) Backfill will not be permitted when trenches are flooded, or material is too wet (or dry) for proper compaction.
- d) Undesirable material, whether rock, muck, or other will not be allowed in the backfilling of trenches. If additional material is needed for the proper filling of trenches, it will be procured and hauled to the site in sufficient

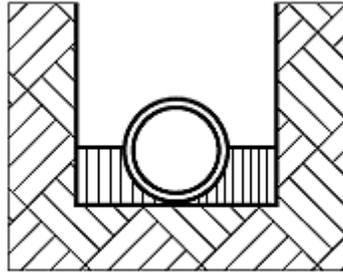
amounts to complete the backfill process. Excess and/or unsuitable material will be removed from the job site and properly disposed.

- e) Excavated rock will not be used as backfill, except soft sand rock that disintegrates completely on removal from the ditch may be used above the top of the pipe. Rock excavated from trenches, which is not used for backfill, will be hauled away and properly disposed. "Select Backfill" to complete backfilling operations for a final grade acceptable to the City of Roxboro and to fill voids created by rock excavation will be brought to the site as necessary. All "Select Backfill" will be free of debris, stumps, large rocks, and other deleterious material unsuitable for backfilling over the pipe and achieving the desired proper compaction. All "Select Backfill" delivered to the site used for final grading will be acceptable for seeding and mulching operations as specified.
- f) All "Select Backfill" will comply with NCDOT Standards, Section 1016, Class I Material.
- g) In any area where the pipe will be installed below existing or future ground water levels or where the trench could be subject to inundation, additional Class I material will be used for bedding.
- k) If hydraulic jack shoring is utilized for trench walls, it will be restricted to the area just above the top of the pipe. This will ensure the embedment materials and pipe will not be disturbed when the shoring is removed.

4. Ductile Iron Pipe Specific Installation Requirements

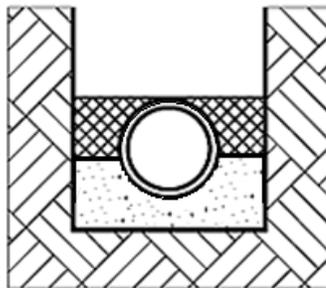
- a) Ductile iron pipe will be installed in accordance with the requirements of AWWA C-600 and the Ductile Iron Pipe Handbook published by the Ductile Iron Pipe Research Association. Materials at all times will be handled with mechanical equipment or in such a manner to protect them from damage. At no time will pipe and fittings be dropped or pushed into ditches.
- b) Pipe will be installed according to laying conditions and bedding requirements as specified herein and identified by the plan drawings. Laying conditions for ductile iron pipe will be as described in AWWA C-151 and the Ductile Iron Pipe Research Association or as required by the City of Roxboro, whichever is more stringent. Laying conditions and bedding requirements will be defined as follows:

Type 2: Flat Bottom Trench with Pipe Resting on Stable Undisturbed Earth. Pipe resting on stable earth. Backfill lightly consolidate to centerline of pipe, 80% Standard Proctor.



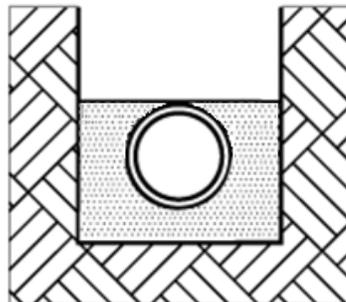
Type 2

Type 4: Unstable conditions such as wet trench bottoms, intermediate rock layering, partially weathered rock, and other unsuitable soil conditions will require Type 4 bedding. For severe unstable soil conditions, undercut excavation will be provided prior to pipeline installation. Where undercut excavation is required, the bedding foundation will be approved by the City of Roxboro prior to any pipe laying. Type 4 bedding conditions require that the pipe be installed in Class 1 material, No. 67 or No. 78 crushed stone, to a depth of 1/2 pipe diameter with a minimum of 6-inches below pipe invert. Embedment material consisting of Class 1, Class 2 or Class 3 materials will be compacted to the top of the pipe greater than 95% Proctor. Careful attention must be allocated to compacting embedment material under the bottom edges of the pipe.



Type 4

Type 5: Bedding conditions for Type 5 will require that the pipe will be installed in Class 1 material, No. 67 or No. 78 crushed stone extending a minimum of 6-inches below pipe invert. Embedment consisting of Class 1 materials compacted to greater than 95% Proctor, will be installed to the top of the pipe. Type 5 laying conditions will be required primarily to meet "Depth of Cover" guidelines illustrated in Chart 1.



Type 5

5. PVC Specific Installation Requirements

- a) The installation of PVC Pipe will satisfy the requirements of the manufacturer, and/or the following, whichever is more stringent:
- b) For PVC pipe, the pipe will be produced with bell and spigot end construction. Joining will be accomplished by rubber gasket in accordance with manufacturer's recommendation, unless otherwise directed or approved by the City of Roxboro. Flexible watertight elastomeric seals in accordance with ASTM D-3212-1 may also be used. Each pipe length will be clearly marked with information including pipe size, profile number and class number.
- c) Installation of PVC pipe will follow the recommendations of ASTM D-2321 "Underground Installation of Thermoplastic Pipe for Sewers and other Gravity-Flow Applications". For PVC pipe installation, bedding and embedment material will be Class I, typically No. 67 or No. 78 washed stone. Bedding and embedment materials for PVC gravity sewers other than No. 67 or No. 78 washed stone must be approved by the City of Roxboro prior to use.
- d) Typical Bedding and Embedment for SDR35 PVC Gravity Sewers, 4-ft to 14-ft in Depth.

Bedding will consist of minimum 6-inches of No. 67 or No. 78 stone installed under the pipe extending up to the springline. Bedding and embedment will be compacted to 95% standard proctor density. Careful attention will be placed on compacting embedment under the haunches of the pipe to prevent any potential voids.

- e) Typical Bedding and Embedment for SDR26 PVC Gravity Sewers, 14-ft to 20-ft in Depth.

Bedding will consist of minimum 6-inches of No. 67 or No. 78 stone installed under the pipe extending 6-inches above the crown of the pipe. Bedding and embedment will be compacted to 95% standard proctor density. Careful attention will be placed on compacting embedment under the haunches to prevent any potential voids.

- f) The bedding and embedment materials will be in accordance with ASTM D-2321. The embedment materials will be installed from trench wall to trench wall.
- g) The maximum allowable deflection after installation will BE LESS THAN 5% for PVC pipe.

- h) All PVC pipe will be stored properly to prevent UV damage prior to installation. Any PVC pipe with visible fading caused by UV radiation from sunlight will be rejected.
- l) All PVC pipe will be free from nicks, scratches and gouges at the time of installation. Such defects can impact the strength of PVC pipe and all pipes with visible gouges will be rejected.

6. Blasting

- a) All blasting operations will be conducted in strict accordance with existing ordinances and accepted safe practice relative to the storage and use of explosives. Only experienced men will do blasting, and extreme care and precautions will be used to prevent injury to workmen, to existing pipes, buildings, or other structures either below or above the surface of the ground. Sufficient warning will be given to all persons in the vicinity of the blasting.
- b) Rope or wire mats are required to be used in all blasting operations. Trench overburden may be used as a substitute for wire mats. Protective measures, whether rope, wire mats or trench overburden will be adequate to assure that there will be no projection of loose materials or objects that leave the blasting area.
- c) Blasting operations will be done in such a manner that damage to existing utilities and structures, whether above or below ground, is prevented. The Contractor will monitor the blasting operations as necessary to insure that the operations are conducted safely and without excessive air or ground pressures or displacements. Monitoring all blasting operations will include measuring air and ground pressures by the use of two seismographs. When blasting, the acceptable level of vibration will be no higher than 2 inches per second at any structure. One seismograph will be located near the closest existing residential structure on the same side of the street nearest the blast.
- d) All blasting operations will be conducted in complete accordance with applicable federal, state and local laws. These laws include but are not limited to applicable occupational safety and health standards of the North Carolina Department of Labor.
- e) The Contractor will secure the necessary permits required to conduct blasting operations. These include, but are not necessarily limited to a permit from the Fire Prevention Bureau or Fire Marshall.

03020 MANHOLES

A. DESIGN

1. Manhole Location, Siting and Design

- a) Manholes will be spaced at a maximum distance of 400 feet.
- b) Manholes will be installed at each deflection of line and/or grade. The flow channel through manholes will have a uniform and smooth finish free of irregularities or obstructions. The invert channel will conform to the shape and slope of the entering/exiting sewer line. Either pre-cast or brick and mortar inverts may be used.
- c) The incoming and outgoing invert elevations will be given on the plan/profile drawings. Each manhole will be numbered and stationed on plan/profile drawings.
- d) The maximum flow deflection angle in a manhole will be dependent upon pipe size as shown in the following table. Sufficient drop will be provided in the manhole to compensate for energy loss caused by the change of alignment. A minimum drop of 0.1-ft is required. Minimum drop for multiple incoming sewers is 0.2-ft.

Maximum Allowable Flow Deflection

Pipe Size (largest pipe controls)	Maximum Deflection Angle per Manhole
8-10 inch diameter	90 degrees
12-20 inch diameter	75 degrees
>20-inch diameter	60 degrees

- e) Free falls of wastewater flow into the manhole invert from incoming sewer mains will not be allowed.
- f) In certain isolated circumstances standard free drops may be allowed, not exceeding 18-inches, when pipe diameter changes occur at a manhole. In these cases, the smaller diameter pipe crown will be positioned no higher than the larger diameter pipe crown to limit the drop. When free drops are necessary due to pipe size changes, the Contractor will take preventive measures to prevent free drops into the manhole invert, such as building a flume or trough up to the incoming invert.
- g) Drop manholes are not allowed without the written approval of the City Roxboro. While certain physical constraints may dictate the need for drop manholes, they may not be used merely to decrease trenching depth. Upstream slope changes will be used to

avoid the need for drop manholes.

- h) In the event that drop manholes are required, they will be constructed with an outside drop connection. The entire incoming sewer main leading to the drop will be made of ductile iron pipe. Drops will be concrete encased and constructed in accordance with the Standard Details.
- i) Inside drop manholes will only be allowed in unique circumstances on a limited basis and only after approval from the City of Roxboro.
- j) Manholes will not be obstructed from view or access. It is illegal to bury or obstruct access to manholes.
- k) Manhole covers will be elevated as follows:
 - Roadways: Manholes installed in roadways will be installed with the cover flush with the top of pavement. Manholes installed in roadway shoulders will be installed with the cover elevated 0.1 foot above finish grade.
 - Outside of Roadways: Manholes installed outside of roadways will be elevated at least 1-ft above the surface grade unless otherwise noted.
 - Wooded Outfalls: All manholes installed in wooded, forested or brushy areas will be elevated at least 2-ft above the surface elevation.
 - 100-Year Flood Zone: All manholes located within the 100-year flood elevation will be elevated at least 24 inches above the 100-year flood elevation unless watertight covers and vents that extend at least 24 inches above the 100-year flood elevation are approved by the City of Roxboro.
 - Well Maintained Areas: All manholes installed in well maintained areas, such as yards, sidewalks or otherwise inside an improved right-of-way will be installed flush with the finished surface.
- l) Manholes higher than 30 inches above finished grade will be constructed with a flat top.
- m) When connecting a new sewer main to an existing main, the connection will be established with a "Doghouse" type of manhole inserted over the existing main. In designing a manhole connection with a doghouse manhole, the angular separation between any incoming or outgoing mains will be greater than 35 degrees and in

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accordance with manufacturer recommendations.

2. Manhole Sizing

- a) Manholes will be sized as shown in the following table. The next larger size will be required if the pipe size, depth, drop connection or number of main line connections warrants a larger size. In consideration of main line connections, all will be considered regardless of type, whether inside drop, outside drop, force main or standard connection.

Manhole Sizing Guide

Manhole Size <i>(diameter, feet)</i>	Maximum Allowable Pipe Size <i>(diameter, inches)</i>	Maximum Depth of Cover <i>(invert to surface)</i>	Maximum Depth with Extended Base <i>(invert to surface)</i>	Frame and Cover Size (outside of paved areas) <i>(inches)</i>
4-ft	8-12 inches	12-ft	25-ft	24
5-ft	14-24 inches	12-ft	35-ft	24
6-ft	27-42 inches	12-ft	35-ft	24

** Four connections may be permitted in a 4-ft diameter manhole when the separation between each incoming connection is at least 85°*

*** Additional smaller diameter connections that meet the spacing requirements of Section C "Installation", may be approved by the City of Roxboro.*

All manholes 4-ft and 5-ft in diameter will be extended to surface elevation with no further reduction in diameter until the eccentric cone section is required.

- b) Manhole transitions for 6-ft and larger diameter manholes are only allowed in the top 5-ft of the manhole. In no case will the smallest barrel size be less than 5-ft diameter. At least 5-ft of vertical clearance will be maintained above the pipe crown before transitioning to a smaller diameter riser, or transition will not be utilized. An eccentric flat slab reducer from 6-ft diameter or larger manhole base sections to 5-ft diameter risers (non-paved areas) or eccentric cones (paved areas) will be used to make any transition.

- c) Manholes outside of paved areas that are 6-ft in diameter and greater and are too shallow to maintain 5-ft of vertical clearance above the crown of the pipe will maintain the full manhole diameter up to the design surface

elevation and be provided with a flat top slab cover with eccentric hole.

- d) Manholes inside of paved areas that are 6-ft in diameter and greater will be constructed with an eccentric, flat top reducer to 5-ft diameter and provided with a 5-ft diameter eccentric, tapered cone at the finished grade. When the depth of the manhole is too shallow to maintain 5-ft of vertical clearance above the crown of the pipe a 3-ft tall eccentric, tapered cone will be used without any additional 5-ft diameter risers.

B. MATERIALS

1. Concrete Manholes

- a) Manholes will be precast concrete with a minimum compressive strength of 4000-psi at 28 days and in compliance with ASTM C-478. The Portland Cement used to fabricate precast manholes will conform to ASTM C-150, Type III. Metal reinforcement will be billet steel, Grade 60, conforming to ASTM C-33. All 4-ft and 5-ft diameter manholes and all 6-ft diameter manholes in paved areas will be provided with eccentric cone sections. Flat top manholes are required in outfall areas for 6-ft and larger diameter manholes.
- b) Precast concrete manholes will meet all design and manufacturing requirements of ASTM C-478 and all H-20 loading requirements. Minimum wall thickness will be 5-inches and will increase with depth and diameter in accordance with ASTM standards. The standard joint will be sealed with a plastic cement putty meeting Federal Specification SS-S-00210, such as Ram- Nek or a butyl rubber sealant. O-ring joints are allowed conforming to ASTM C-443. All lift holes must be plugged with non-shrinking grout after installation. Exterior joints for all base and riser sections below grade will be wrapped with a butyl resin sealant with polyolefin laminate that meets Federal Specifications SS-S-0210A and AASHTO M-198B. Wrap will be a minimum of six (6) inches wide applied with use of a primer.
- c) All manholes will have minimum 8-inch, 4,000 -psi concrete bottoms resting on a minimum of 12 inches of # 57 stone. Sewer mains will enter and exit radially through the manhole. Inverts will be constructed with a width and height equal to 1/2 that of the effluent pipe and will be so finished with sufficient drop across the manhole to compensate for all resulting energy loss across the invert. Flat invert channels will not be allowed. At each inlet and outlet of 8 inches or greater resilient connectors or manhole boots will be provided in conformance with ASTM C-923. Rings and clamps are to meet standards of ASTM A-167 and/or ASTM C-923.

- d) Manhole flat slab, eccentric reducers provided for 6-ft diameter and larger manholes will be provided with minimum slab thickness of 12-inches. Flat slab, eccentric reducers will not be allowed for manhole diameters less than 6-ft.
- e) Manhole flat top slab covers for outfall manholes 6-ft diameter and greater will be designed and manufactured for H-20 loading and provided in minimum slab thickness of 8-inches.
- f) Manhole benches will slope upwards from the spring line of the pipe to the projected level of the pipe crown at the manhole wall, or at least 8-inches above the spring line, whichever is less. Bowl type inverts recessed inside of precast benches will not be accepted.

2. Manhole Frame and Cover Materials

- a) Manhole Frames and Covers will be Class 35 gray cast iron with "Sanitary Sewer" and the City symbol forged into the cover as indicated in the Detail Drawings. Frame and covers will be stamped with make and model. All manhole frames and covers will be domestically made and manufactured in the USA from domestic iron. Manhole frames and covers will be provided in typical nominal height of 8-inches unless low profile assemblies are otherwise approved. Manhole frame and covers will conform with ASTM A-48 and will be perforated with four 1 inch vent holes. The cover will have a minimum weight of 135 pounds and the frame will have a minimum weight of 180 pounds. Frame and cover will be coated with a hot application of quick drying asphalt base dip.

- b) Manhole Frames and Covers in Paved Areas:

For all installations in roadways, covers will be provided with 1 vent hole. Covers will be designed for a proof load of 40,000 lbs. and provided in Class 35B gray iron in conformance with ASTM A-48 with "Sanitary Sewer" and the City symbol forged into the cover. At a minimum, manhole frames will weigh 180 lbs. and the cover will weigh 135 lbs. Frame and cover will be coated with a hot application of quick drying asphalt base dip.

- c) Manhole Frames and Covers for Outfalls:

Manhole frame and covers for four (4) foot and five (5) foot diameter manholes along outfalls or in wooded areas will be as hereinbefore specified with four (4) vent holes.

Areas that are subject to flooding or when the manhole top elevation is below the 100 year flood elevation requirement, the frame and cover will be water tight, sealed with a 1/8 inch thick continuous neoprene gasket at the

mating surface of the frame and cover, and have four (4) stainless steel lock-down bolts. Frame and cover will be cast into a manhole flat top with the flange up. The frame will have a minimum weight of 165 pounds while the cover will have a minimum weight of 140 pounds. Frame and cover will conform to ASTM A-48 Class 35 with "Sanitary Sewer" and the City symbol forged into the cover. Frame and cover will be coated with a hot application of quick drying asphalt dip.

d) Manhole Frames and Covers for Large Diameter Outfall Manholes:

All manhole frames and covers for manhole diameters 6 feet and larger will be rated for heavy duty. Frames and covers will be constructed of cast iron conforming to ASTM A-48 Class 35 with "Sanitary Sewer" and the City symbol forged into the cover. Tensile strength will be a minimum of 35,000 psi. All castings will be of superior quality free of any defects. Frames and covers will be machined at contact points to make even and smooth contact between the ring and cover and will be coated with a hot application of quick drying asphalt base dip.

Frames and covers will be cast-in-place flush with a flat manhole top. The frame will be cast in the concrete top with the flange up. Covers will be perforated with four 1 inch vent holes. Covers will have a minimum weight of 140 pounds while the frame will have a minimum weight of 165 pounds. Minimum depth dimension for the frame will be 4 inches.

In areas subject to flooding or when the manhole top is below the 100 year flood elevation requirement, the frame and cover will be solid, water tight, sealed with a 1/8 inch thick continuous neoprene gasket at the mating surface of the frame and cover, and have four (4) stainless steel lock-down bolts.

- e) All castings will be machined to give even and continuous bearing on the full length of the frame. Castings will be free of porosity and blow holes. All manhole frames will be bolted to the manhole, except in paved streets. Manhole ring and cover will be coated with a hot application of quick drying asphalt ductile iron pipe.
- f) All manhole rings in roadways will be encased in a concrete collar of 4000-psi concrete beneath the asphalt, with the cover flush with the top of pavement.

3. Manhole Step Materials

- a) Manhole steps will be furnished with the precast manhole sections. Steps will be of polypropylene material reinforced with a 1/2 inch diameter reinforcing rod. Manhole steps will be designed for a vertical load of 400 pounds and a horizontal pull out load of 1000 pounds. Steps will be set

12 inches on center. Holes for the installation of manhole steps will not project through the manhole wall, but will stop a minimum of one inch from the outside wall. Steps will be at least 12 inches clear width and will project at least 5 inches from the wall into which they are embedded. Manhole steps will be staggered. Steps will be located along the effluent side of the manhole. The eccentric cone will be oriented so that the steps are vertical over the downstream invert of the primary flow path to allow ease of access for maintenance, camera or cleaning operations.

C. INSTALLATION

1. General Requirements

- a) The upstream side of the last manhole(s) of a sanitary sewer line extension under construction will be plugged by constructing a brick/block wall to prevent the passage of groundwater, runoff and sediment into the sanitary sewer system. All water upstream of the wall will be pumped out of the sanitary sewer line and all sediment and solids will be removed and properly disposed of by the Contractor. The wall will not be removed until the line has been inspected by the City of Roxboro to ensure that all possible points of inflow or infiltration have been eliminated. Failure to meet these requirements will be deemed a violation of the Sewer Use Ordinance with fines up to \$1,000.00 per day.
- b) Manholes will not be buried or hidden, which is a violation of the Sewer Use Ordinance and subject to penalty by fines.
- c) All manhole connections, whether incoming sewer main or service lateral, will be cored with a concrete coring machine. All pipe connections must be made with flexible watertight couplings or boots.

For new manholes, there shall be a minimum of 9-inches or $\frac{1}{2}$ the pipe outside diameter (OD), whichever is greater, between the pipe hole openings. When the adjacent pipes are different sizes, the OD of the smaller pipe will be used to determine the spacing requirement, but will never be less than 9-inches.

For connections to existing manholes, there will be a minimum of 9-inches or 3.5-inches plus $\frac{1}{2}$ the OD of the existing pipe, whichever is greater, between the pipe hole openings.

- d) All external manhole joints will be wrapped with an approved joint seal material.

2. Manholes Subject to Inundation

- a) Manholes subject to flooding will be watertight and vented 24 inches above the 100-YR flood elevation. In flood prone areas, the manholes will be vented at least every 1000-ft or every other manhole, whichever is greater.
- b) The exterior of all manholes within the 100-year flood elevation and in wetland areas will receive an exterior coating of an approved bitumastic coal tar epoxy or an approved epoxy coating at 40-mils to prevent weepage or attack by acidic soils.
- c) Anti-flotation design measures will be implemented as required in flood prone areas.

3. Manholes Located on Large Collection Mains

- a) The City of Roxboro reserves the right to require all manholes located on interceptor or outfall mains 24-inches in diameter and larger to have the manhole interior, and bench coated with an approved epoxy coating at 80-mils thickness. The preferred method of application is field application after the manholes are installed for a monolithic holiday free coating. Factory application will be allowed contingent upon the joints receiving a field application.

4. Force Main Discharge Manholes

- a) All manholes located on gravity mains that serve as discharge points for sanitary sewer force mains will receive an interior epoxy coating at 80-mils thickness. In addition to the receiver manhole, the City of Roxboro reserves the right to require epoxy coating of the next 2 consecutive manholes downstream of the receiver manhole or all downstream manholes within 1500-lf of the receiver manhole.

03030 SERVICE CONNECTIONS

A. DESIGN

1. General Requirements

- a) Direct sewer service taps will not be allowed on sewer interceptor or outfall mains 15-inches in diameter or larger, except by manhole connection.
- b) All residential subdivision lots will be served by gravity unless otherwise approved by the City of Roxboro. If a pump is approved, it will be privately maintained, must pump into a service connection placed on the lot, and must have a note on the recorded plat indicating that a private pump is required to serve the lot.
- c) Service connections to the main lines will be perpendicular to the main line and will extend to the edge of the right of way or easement line.
- d) Cleanouts are required on all services with a maximum spacing of 75 feet on 4 inch services and 100 feet on 6 inch services, and at the right of way line or edge of easement. All cleanouts will extend a minimum of 6 inches above finished grade with brass caps or meet the optional cleanout method requirements in accordance with the Standard Details.
- e) Sewer cleanouts located in paved areas, which bear vehicle loading, must have ductile iron risers, ductile iron fittings and traffic rated cast iron cover assembly.
- f) All 6 inch service connections will be into a manhole unless otherwise approved by the City of Roxboro.
- g) Service lines connected to manholes will not be through the cone section or manhole joints. Service lines will be installed 6" above, but no more than 30 inches above the invert or will be installed with a standard drop. Multiple service connections will not be maintained by the City of Roxboro. For 6-ft diameter and larger manholes no service is allowed in the reduced diameter riser sections of the manhole.
- h) The use of in-line wyes for service connections will be required for all new construction unless otherwise approved by the City of Roxboro. When connecting to existing sewer mains, service saddle taps will be allowable. Taps will be at the 10 or 2 position, and will not be top taps.

B. **MATERIALS**

1. **Pipe Materials**

a) PVC Pipe will be schedule 40 or greater supplied in minimum 18-ft lengths.

Schedule 40 PVC pipe will be manufactured with a cell classification of 12454 in conformance with ASTM D-1784. Schedule 40 pipes will be manufactured to dimensional tolerances as specified in ASTM D-1785 and rated for service conditions up to temperatures of 140- degrees Fahrenheit. The pipe may be joined by solvent weld in conformance with ASTM D-2564.

Schedule 40 PVC Service Pipe Sizing

Nominal Pipe Diameter (inches)	Outside Diameter (inches)	Inside Diameter (inches)	Thickness (inches)
4	4.50	4.02	0.24
6	6.62	6.03	0.28

PVC pipe for sewer services will require bedding based upon depth as follows:

- 4-8-ft Depth – 6-inches of stone bedding below pipe invert extended to springline
- 8-20-ft Depth – 6-inches of stone bedding below pipe invert extended 6-inches above pipe crown

b) Ductile Iron Pipe will be used for sanitary sewer services with less than 4 feet of cover or in excess of 20 feet of cover. Ductile iron services will also be used in all cases where a well is located within 100-ft of the sewer service line. Ductile iron service piping will be provided in conformance with the ductile iron piping standards outlined hereinbefore including cement mortar lining.

Ductile Iron Pipe Service Pipe Sizing

Nominal Pipe Diameter (inches)	Outside Diameter (inches)	Inside Diameter (inches)	Thickness (inches)
4	4.80	4.30	0.26
6	6.90	6.40	0.25

2. **Sewer Service Fittings, New Construction**

a) All sewer service connections for new construction will be provided with in-line wye fittings unless otherwise approved by the City of Roxboro.

b) Ductile Iron Pipe Main with Ductile Iron Pipe Service

In-line wye fittings for ductile iron main lines joined with ductile iron service lines will be typical ductile iron fittings as specified hereinbefore. All fitting sizes will conform to AWWA C-153. Wye fittings through 10-inches in diameter will

be provided with cement mortar lining in accordance with AWWA C-104 and provided with exterior asphaltic coating per AWWA C-151. Wye fittings for lines larger than 10-inches in diameter will be provided with Protecto 401 lining as specified hereinbefore for ductile iron pipe of the same sizing.

c) Ductile Iron Pipe Main with PVC Service

For ductile iron sewer mains to be joined with PVC service lines, the in-line wye fittings will be slip joint ductile iron with an IPS sized branch for PVC schedule 40 service lines. Ductile iron fittings for connecting PVC service lines will be deep bell, gasketed joint and air test rated. Gasket grooves will be machined. Bell depths will meet the minimum socket depth requirements of ASTM D-3034 and ASTM F-1336. Wall thickness will meet the requirements of AWWA C-153. Ductile iron wye fittings through 10-inches in diameter with IPS connections will be provided with cement mortar lining in accordance with AWWA C-104 and provided with exterior asphaltic coating per AWWA C-151. Ductile iron wye fittings for PVC lines larger than 10-inches in diameter will be provided with Protecto 401 lining as specified herein.

d) PVC Main with PVC Service

For PVC sewer mains to be joined with PVC service lines, PVC in-line wye fittings will be provided. Typical Schedule 40 PVC fittings will be provided at the cleanout wye and stack.

3. Service Saddle Connections, Existing Sewer Mains

a) PVC service saddles will be of the same material as the main, and will be solvent welded and fastened with double stainless steel bands.

b) For existing ductile iron main lines, ductile iron service saddles will be "ROMAC CB" type consisting of a virgin SBR gasket compounded for sewer service, a ductile iron saddle casting, a 304 stainless steel adjustable strap for fastening the gasket and the saddle casting to the sewer main and a 304 stainless steel adjustable circle clamp for securing the service line into the SBR gasket.

C. **INSTALLATION**

1. General Requirements

a) Sewer laterals will not be located in easements when gravity service can be provided to the property frontage at the street.

b) Each separately owned structure requires a separate tap to a public sewer.

c) All service lines with less than 3-ft of cover or deeper than 20-ft will be made of ductile iron pipe.

- d) Four inch lines will have a minimum slope of 1.0 ft./100 feet and 6 inch lines will have a minimum slope of 0.60 ft/100 feet.
- e) All service connections to existing sanitary sewer mains will be made by the City of Roxboro. Service connections to new mains may be made by the Contractor, but will include the use of wye (not tee) connections. Saddle taps onto new lines will not be allowed unless otherwise approved by the City of Roxboro.
- f) Saddle taps into existing PVC mains will be made on the top quarter of the main with the wye saddle angled 45-degrees towards the direction of flow in the main. Taps will only be made by a mechanical circular cutting saw providing a smooth and uniform cut for the saddle installation.
- g) Service connections made using a "ROMAC CB" sewer saddle will be made when the line 8", 10", or 12" diameter, ductile iron pipe.

03040 TESTING AND INSPECTIONS

A. GENERAL

The Developer will furnish all materials, labor, and equipment to perform all testing. Water for testing purposes may be provided by the City of Roxboro and arranged for by the Developer. The Developer will reimburse the City of Roxboro for all water used for construction at current utility rates.

B. SEWER MAIN AND SERVICE CONNECTION TESTING

1. Visual Testing and Observation

- a) All materials used must be approved by the City of Roxboro prior to installation. Rejected materials will be immediately removed from the job.
- b) Gravity sanitary sewer lines will be clean and free from obstructions, and will be visually inspected from every manhole. Lines which do not exhibit a true line and grade or which have structural defects will be corrected. Sanitary sewer service connections will be visually inspected prior to backfilling. All noticeable leaks will be repaired as directed by the City of Roxboro.

2. Air Testing

- a) Low-pressure air testing in accordance with ASTM F-1417 will be performed on all sewer mains before the laterals or stubs are installed on the line, and after the trench has been backfilled to finished grade. Plugs will be installed at each manhole to seal off the test section. The line will be pressurized with a single hose and monitored by a separate hose connection from the plug. Air then will be slowly introduced into the sealed line until the internal air pressure reaches 4.0 psig. The air pressure will then be allowed to stabilize for a minimum of 2 minutes at no less than 3.5 psig (plus groundwater pressure, if any). When the pressure reaches 3.5, the time required for the pressure to drop 1.0 psi will be observed and recorded. The line will be "acceptable" if the pressure does not drop more than 1.0 psi in the time prescribed for the test in the Sanitary Sewer Air Test table found in the Details. An abbreviated version of the air test table is shown in these Specifications.
- b) If the section fails to meet these requirements, the source of leakage will be repaired and the pipe section re-inspected
- c) The City of Roxboro may require that an infiltration test be performed that will not exceed 100 gallons per inch of diameter per mile of pipe per day (GPD / Inch / Mile).

SPECIFICATION TIME (MIN:SEC) REQUIRED FOR PRESSURE DROP FROM 3-1/2 TO 2-1/2 PSIG

		NOMINAL PIPE DIAMETER (INCHES)										
		8	12	15	16	18	21	24	27	30	36	42
LENGTH OF TEST SECTION	50	7:33	11:20	14:10	15:11	17:00	19:48	22:40	25:30	28:19	34:00	39:40
	100	7:33	11:20	14:10	15:11	17:00	19:48	22:47	28:51	35:37	51:17	69:48
	150	7:33	11:20	14:10	15:12	19:14	26:10	34:11	43:16	53:25	76:55	104:42
	200	7:33	11:24	17:48	20:16	25:39	34:54	45:35	57:42	71:13	102:36	139:36
	250	7:33	14:15	22:16	25:20	32:03	43:37	56:58	72:07	89:02	128:12	174:30
	300	7:35	17:06	26:43	30:23	38:28	52:21	68:22	86:32	106:48	153:54	209:25
	350	8:52	19:57	31:10	35:27	44:52	61:05	79:46	101:00	124:42	179:30	244:19
	400	10:07	22:48	35:37	40:31	51:17	69:48	91:10	115:24	142:30	205:06	279:13
	450	11:23	25:39	40:04	45:35	57:42	78:31	102:36	129:48	160:18	230:48	314:07
	500	12:39	28:30	44:31	50:39	64:06	87:15	114:00	144:12	178:06	256:24	349:02

3. Deflection Testing for PVC Pipe

- a) The mandrel (go/no-go) deflection test will be performed on each line prior to acceptance and no sooner than 30 days after installation. The pipeline will be thoroughly clean and free of debris and/or sediment prior to testing. The Developer will supply the mandrel used for this performance test. The mandrel device will be cylindrical in shape having 9 possible contact points with the pipe. The mandrel's length and diameter (ID of proving ring) will be in accordance with the following tables, and will be subject to the City of Roxboro's approval.

b) For flexible pipes such as PVC, the following will apply:

Nominal Diameter (inches)	Pipe Class	Average Inside Pipe Diameter (inches)	5% Deflection Mandrel Diameter (inches)	Length of Mandrel (inches)	Minimum Fins Included with Mandrel
8	SDR 26	7.715	7.329	10	9
8	SDR 35	7.891	7.496	10	9
10	SDR 26	9.644	9.162	10	9
10	SDR 35	9.864	9.371	10	9
12	SDR 26	11.480	10.906	10	9
12	SDR 35	11.737	11.150	10	9
15	SDR 26	14.053	13.350	10	9
15	SDR 35	14.374	13.655	10	9
18	SDR 26	17.261	16.398	24	9
21	SDR 26	20.349	19.332	24	9
24	SDR 26	22.891	21.746	24	9
27	SDR 26	25.799	24.509	24	9

Note: Calculated 5% deflection allowance does not include additional manufacturing tolerances provided by pipe manufacturers. For the purposes of testing, 5% deflection will be calculated from standard pipe inside diameter as published in ASTM D-3034 and ASTM F-679.

The mandrel will be advanced through the pipeline to determine if bedding and embedment has been provided in compliance with ASTM D-2321 to assure joint deflection of less than 5%. If the mandrel becomes obstructed for any reason while being pulled through the line with less than 100-lbs of force, the location of the defect will be noted and the mandrel will be removed from the pipeline. Any section of piping that will not allow the passage of a mandrel will be removed and replaced until excessive deflection has been eliminated along the line. Under no circumstances will heavy equipment be utilized to force the mandrel through the pipeline. Deflection testing may be done concurrently with sewer televising inspections, provided the mandrel is kept within visible range of the camera.

4. Video Assessment and Cleaning

a) As a final measure required for acceptance, the Developer will clean and televise all newly installed sewer mains prior to acceptance by the City of Roxboro. The Developer will televise the sewer main and all lateral connections installed from the upstream to downstream manhole with no reverse setups or cutaways. Throughout shooting, the camera will be panned and tilted for a complete view of the main. Lighting will be adequate to view the entire sewer main and service connections from beginning to end. The video inspection will be submitted to the City of Roxboro on a CD and formatted with software compatible and readable by the City of Roxboro. The City of Roxboro will not be responsible for purchasing additional software necessary to view the CD's.

- b) The camera will be advanced at a uniform rate that allows a full and thorough inspection of the new sewer main. The camera will be a color, pan and tilt camera. The picture quality and resolution will be acceptable and sufficient to allow a complete inspection with no lapses in coverage. The length of the sewer main will be measured and recorded on the video screen. The distance counter will be calibrated before shooting the inspection video.
- c) The Developer will clean the sewer mains ahead of video inspection with a high-velocity water jet. The video inspection will take place within 2-hours of cleaning operations as witnessed by the City of Roxboro. All construction debris will be collected in the downstream manhole and will not be released into the sewer system.
- d) The City of Roxboro will be present throughout the cleaning and televising of the sewer mains to verify that the video work complies with the specifications.
- e) Prior to submitting the CD's to the City of Roxboro, the Developer will label the CD's with the following information:
 - Name of the Project/Development.
 - Name and contact information of responsible party.
 - Date of televising.
 - Manhole identification as shown on the design plans.

C. MANHOLE TESTING

1. Vacuum Testing

- a) All newly installed manholes will pass a vacuum test in accordance with ASTM C-1244. The Developer will supply all equipment and materials necessary to vacuum test the manholes.
- b) Vacuum Testing will not be initiated until the manholes and all specified coatings and lining materials have been cured in accordance with manufacturer recommendations.
- c) The City of Roxboro will be present and witness all vacuum testing.
- d) The following vacuum testing criteria will apply for compliance with the testing procedure.
 - A vacuum of 10-inches of mercury will be drawn with an approved vacuum testing unit.

- The testing time will not be measured until after the vacuum pump has been shut off.
- The time required for the vacuum to drop from 10-inches to 9-inches of mercury will meet or exceed the values listed in the following table.

Manhole Vacuum Testing Time

Depth (feet)	Manhole Diameter (inches)		
	48	60	72
	Time (seconds)		
8	20	26	33
10	25	33	41
12	30	39	49
14	35	48	57
16	40	52	67
18	45	59	73
20	50	65	81
22	55	72	89
24	59	78	97
26	64	85	105
28	69	91	113
30	74	98	121

2. Visual Inspection

- All noticeable leaks in Manholes will be repaired as directed by the City of Roxboro.
- All inverts will be smooth without any burrs or rough edges that could catch solids in the wastewater.

03050 AERIAL CROSSINGS

1. Design

- a) Aerial crossings will only be utilized in cases where buried crossings are prohibited due to stream crossings, compliance with riparian buffer standards, minimizing impacts to wetlands, preventing excessive depth of installation, or as otherwise directed by the City of Roxboro.
- b) In cases where aerial crossings are utilized to cross streams, the bottom of the pipe will be installed above the 25-year flood elevation of the stream. Piers will generally be located at a uniform spacing of 20-ft or 1 pier for every joint of pipe. Piers will be provided in accordance with the standard details or as otherwise designed by a licensed North Carolina Professional Engineer.
- c) All pier footings will be designed by a licensed NC Professional Engineer and the assumptions provided in the footing design will be included on the plans. At a minimum, the footing design will include: the allowable soil bearing capacity, 2) design concrete compressive strength, 3) plan for reinforcing steel with sizing and location of bars, 4) force diagram including buoyant forces, stream velocity impacts 5) depth of installation to prevent frost heaving, 6) bedding design to prevent differential settlement and 7) factors of safety for unanticipated loads such as trees falling across the aerial crossing.
- d) At a minimum all pier foundations will be constructed on a base of 12- inches of washed stone. The soil conditions under the pier will be evaluated by a licensed NC Geotechnical Engineer to determine if the allowable soil bearing capacity meets or exceeds the design assumptions included in the structural design. If the soil conditions fail to meet the specified bearing capacity requirements, a pile foundation will be provided or the soils will be undercut and replaced in conformance with the recommendations of the geotechnical engineer of record.
- e) Piers installed in stream beds will be avoided in lieu of spanned crossings. Spanned pipe crossings greater than 20-ft will be provided in accordance with manufacturer's specifications and will not exceed 40-feet for ductile iron pipe. Spanned pipe crossings will be designed such that all flanges and exterior pipe connections are located above the 25-year flood elevation.
- f) Spanned crossings greater than 40-ft without piers will be provided in a steel encasement pipe and the entire crossing including

piers, foundation, truss and/or beam supports and pipe thickness design will be provided by a licensed North Carolina Professional Engineer.

2. Pipe Materials

- a) Ductile iron pipe for aerial crossings will be interior lined with Protecto 401 at 40-mils regardless of pipe diameter. All joints for ductile iron pipe utilized in aerial crossings will be restrained with a bolt lock joint. Ductile iron pipe utilized for spanned crossings greater than 20-feet without a pier will be provided with flanged connections. All bolts and fasteners for flanged or bolt locking restraining systems will be provided in stainless steel and installed in a manner to prevent seizing.
- b) PVC pipe will not be allowed for aerial crossings.
- c) Steel pipe provided for aerial crossings will be fabricated with Grade B steel that has minimum yield strength of 35 KSI in accordance with ASTM A-139. Steel pipe for aerial crossings will be provided with minimum wall thickness consistent with a pressure class of 200-psi or greater. Steel pipe for aerial sewer crossings will be provided with 40- mils of interior ceramic coating, such as Ceramaline and provided with an exterior tape wrap approved by the manufacturer. All steel pipe joints will be welded in conformance with manufacturers' specifications.

3. Installation

- a) Aerial crossings are often utilized to span sensitive environmental areas and installation will be consistent with plans to preserve the sensitive areas.
- b) Joints of bolt lock restrained pipe will be located within 2-ft of each pier as outlined by the Detail Drawings.
- c) Pipe will be secured to each pier with 1/4-inch by 2-inch width steel straps fastened to 4-½ inch stainless steel lugs anchored and adhered with epoxy to the concrete pier. The steel straps will be hot ductile iron pipe galvanized.
- d) In cases where soil conditions cannot be sufficiently stabilized to provide an adequate foundation for concrete piers, a pile foundation designed by a licensed North Carolina professional engineer and approved by the City of Roxboro will be provided.

- e) Reinforcing steel for concrete piers will be Grade 60 and will be constructed in conformance with the latest edition of the “Recommended Practice for Placing Reinforcing Bars” or other documentation as published by the Concrete Reinforcing Steel Institute. All reinforcing steel will be epoxy coated according to ASTM A-775. Epoxy coating will be 10 mil thick.

- f) In cases where rock exists at the foundation elevation, the footing will be drilled and connected with dowels epoxied into the rock layer.

03060 REPAIRS

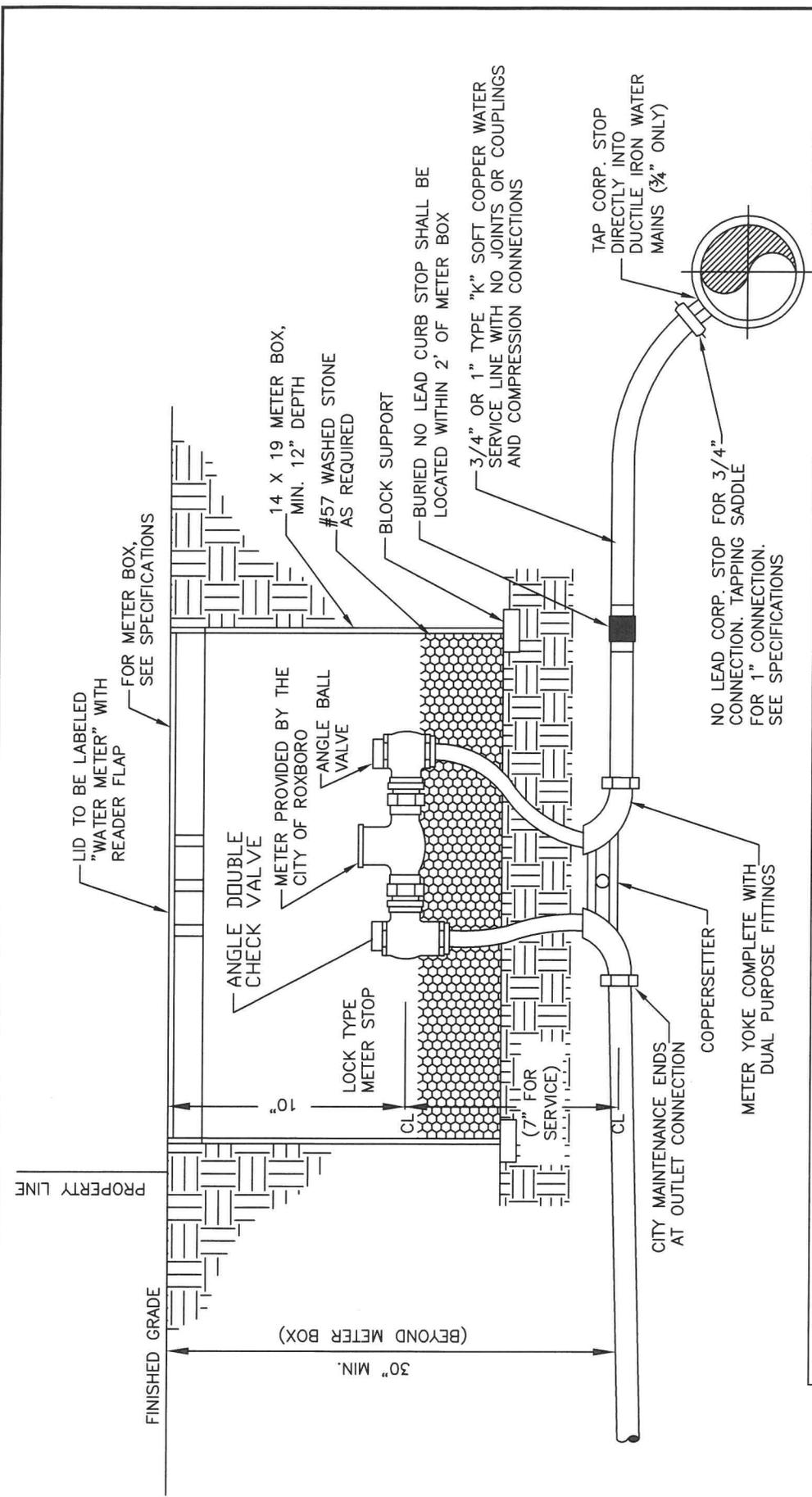
A. SEWER MAIN REPAIRS

1. V.C. Pipe - replace damaged section with ductile iron pipe and install a Fernco coupling at each end encased in concrete.
2. PVC Pipe - replace damaged section with PVC Pipe and install a Fernco coupling at each end encased in concrete.
3. ABS/PVC Truss Pipe - replace damaged section with ductile iron pipe and install a Fernco coupling at each end encased in concrete.
4. A.C. Pipe - Replace damaged section with ductile iron pipe and couplings encased in concrete.

B. INSTALLATION

1. All repairs to damaged sanitary sewer lines in paved areas will be backfilled with ABC stone (crusher run) to a density of 100 percent Standard Proctor.
2. All repairs to damaged sanitary sewer lines will be bedded with 6-inches of washed stone and compacted to a minimum of 95% Standard Proctor density before installing the new joint of ductile iron or PVC pipe.

DETAILED DRAWINGS
FOR
WATER DISTRIBUTION



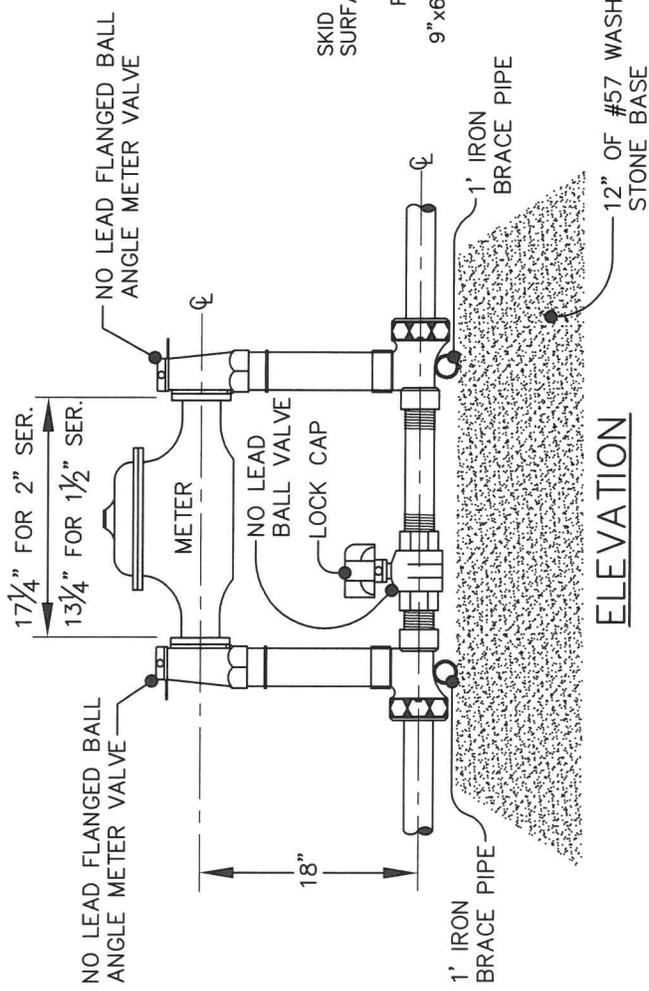
NOTES:
 1) WATER METER SHALL NOT BE LOCATED IN AREAS SUBJECT TO VEHICULAR TRAFFIC.
 2) ALL METER BOXES AND LIDS SHALL BE APPROVED BY THE CITY.
 3) ALL SERVICE LINES, VALVES AND FITTINGS SHALL COMPLY WITH AWWA C800.
 4) ALL BRASS COMPONENTS SHALL BE 'NO LEAD' BRASS MEETING UNS C89833 AS PER ASTM B584.
 5) METER YOKE TO BE FORD NO VHH-72-7W-11-33, MUELLER NO. H-1404-2 OR APPROVED EQUAL.

DETAIL No.
 02000.01
 SHEET 1 OF 1

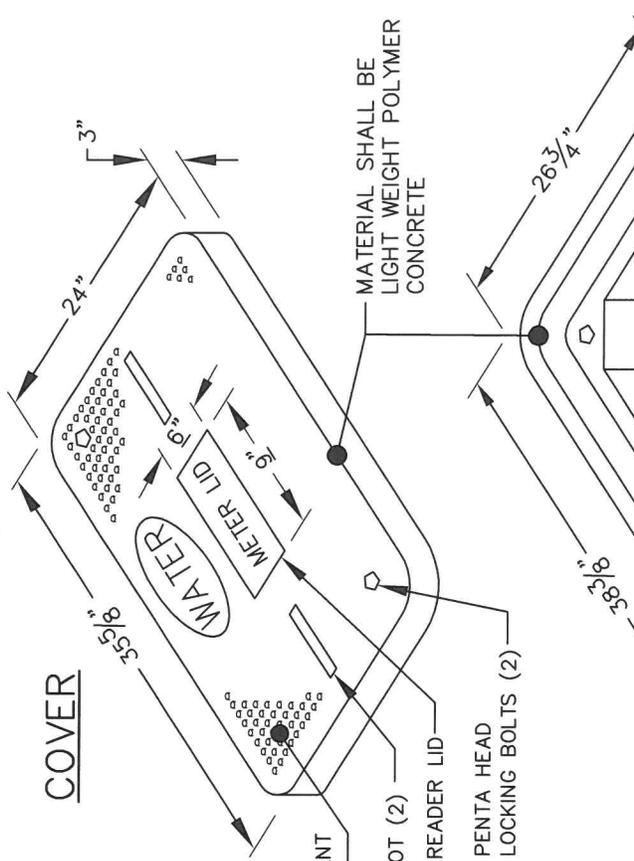
STANDARD 5/8" x 3/4" AND 1" WATER SERVICE & METER BOX INSTALLATION



EFFECTIVE:



ELEVATION

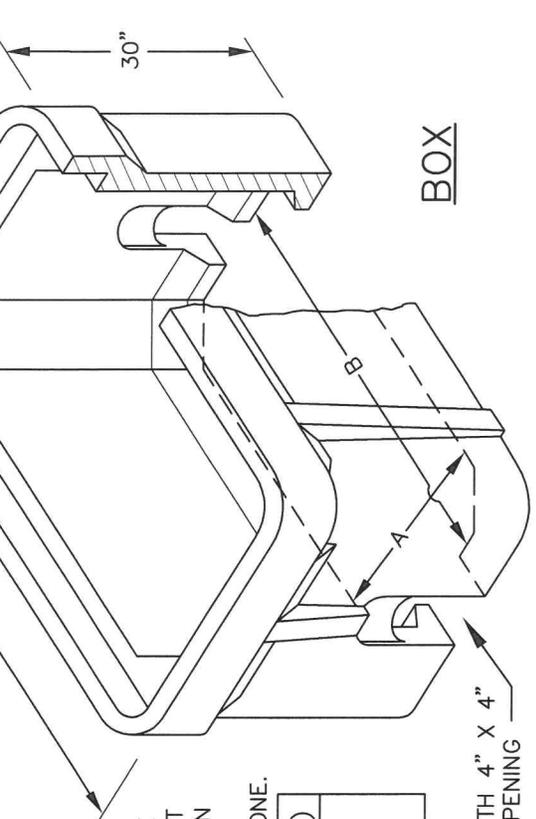


- NOTES:**
- 1) PIPING TO BE 'NO LEAD' BRASS AND COPPER TUBING. METER INLET AND OUTLET TO BE EQUIPPED WITH FLANGED BALL ANGLE METER VALVES.
 - 2) CUSTOM SETTERS SHALL BE EQUIPPED WITH STANDARD LOW BYPASS WITH BALL VALVE AND PADLOCK WINGS.
 - 3) CUSTOM SETTERS SHALL BE AS MANUFACTURED BY MUELLER, FORD OR APPROVED EQUAL.
 - 4) ALL BRASS COMPONENTS SHALL BE 'NO LEAD' BRASS MEETING UNS C89833 AS PER ASTM B584.
 - 5) ALL COMMERCIAL APPLICATIONS REQUIRE A SEPARATE ABOVE GROUND BACKFLOW PREVENTER.
 - 6) CUSTOM SETTER SHALL BE INSTALLED SUCH THAT METER REGISTER IS LOCATED 5 TO 8 INCHES BELOW METER BOX COVER.

NOTE:
TO ENSURE POSITIVE DRAINAGE, THE VAULT SHALL HAVE AN OPEN BOTTOM TO ALLOW DRAINAGE THROUGH STONE.

DIMENSIONS (INCHES)	
A	B
18 ³ / ₄ "	30 ³ / ₈ "

MOUSE HOLES (2)
4" X 4" OPENING WITH 4" X 4" KNOCKOUT ABOVE OPENING



DETAIL No.
02000.02
SHEET 1 OF 1

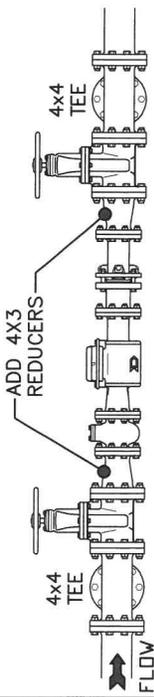
STANDARD 1 1/2" & 2" METER INSTALLATION & VAULT



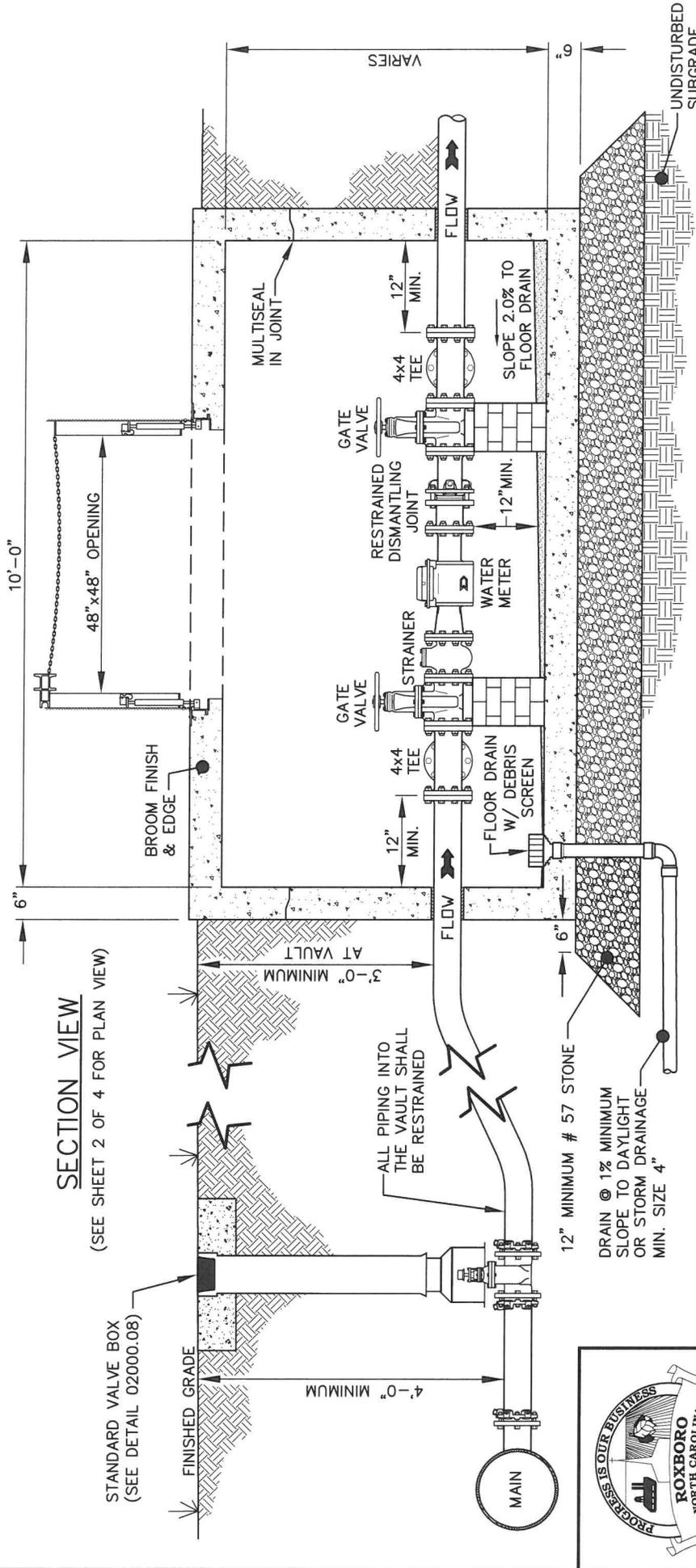
EFFECTIVE:

GENERAL NOTES:

- 1) METER AND BYPASS ASSEMBLY PIPING TO BE DUCTILE IRON FLANGED PIPE INSIDE THE VAULT.
- 2) METER FACE TO BE A MAXIMUM OF 3 FEET BELOW FINISHED GRADE.
- 3) ACCESS DOOR SHALL BE H-20 RATED ALUMINUM DOUBLE DOOR WITH A MINIMUM OPENING OF 48" X 48".
- 4) VALVES SHALL BE IRON BODY TYPE, RESILIENT WEDGE GATE VALVES WITH NON-RISING STEM, HANDWHEEL OPERATORS AND FLANGE CONNECTIONS. SUPPORTS SHALL BE EITHER SOLID BRICK, SOLID BLOCK, OR CMU. TO ENSURE POSITIVE DRAINAGE, THE VAULT SHALL BE TIED INTO THE EXISTING STORM DRAINAGE SYSTEM, IF POSITIVE DRAINAGE IS UNOBTAINABLE, A SUMP PUMP SHALL BE LOCATED AND OPERATED IN THE VAULT. PREVENTER.
- 6) ALL COMMERCIAL OR OTHER NON-RESIDENTIAL APPLICATIONS REQUIRE AN ABOVE GROUND BACKFLOW PREVENTER.
- 7) DOUBLE DOORS SHALL BE LOCKABLE WITH OWNER-SUPPLIED PADLOCK.



3" METER ASSEMBLY



SECTION VIEW

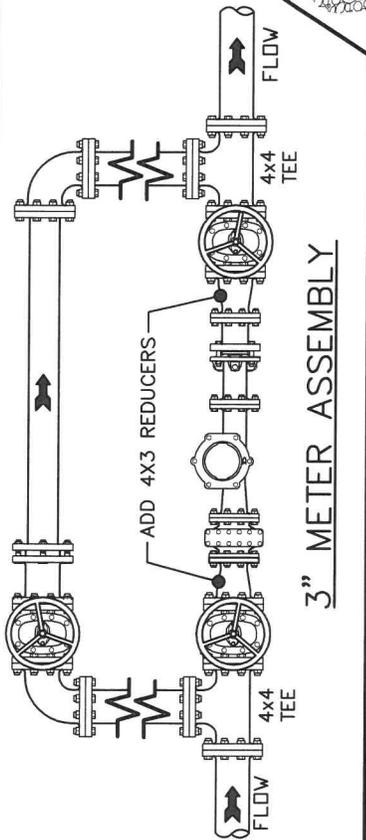
(SEE SHEET 2 OF 4 FOR PLAN VIEW)

DETAIL No.
02000.03
SHEET 1 OF 4

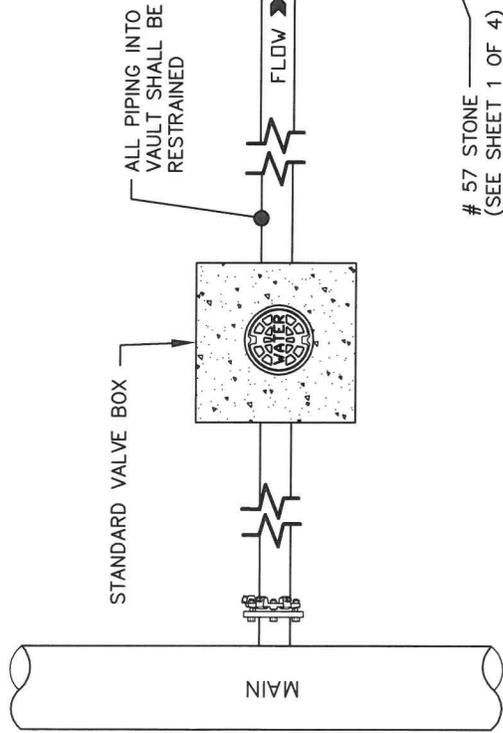
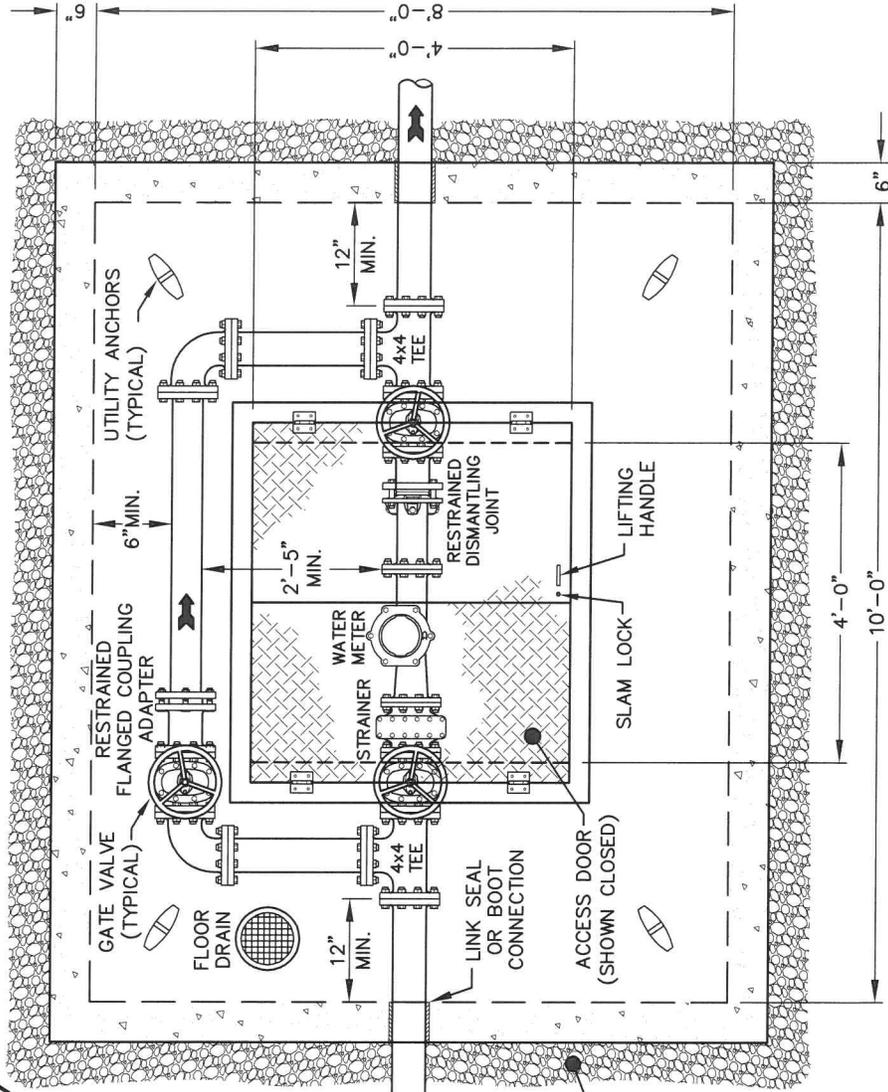
STANDARD 3" OR 4" METER INSTALLATION & VAULT



EFFECTIVE:

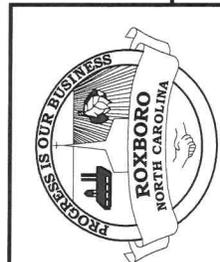


PLAN VIEW
(SEE SHEET 1 OF 4 FOR SECTION VIEW)

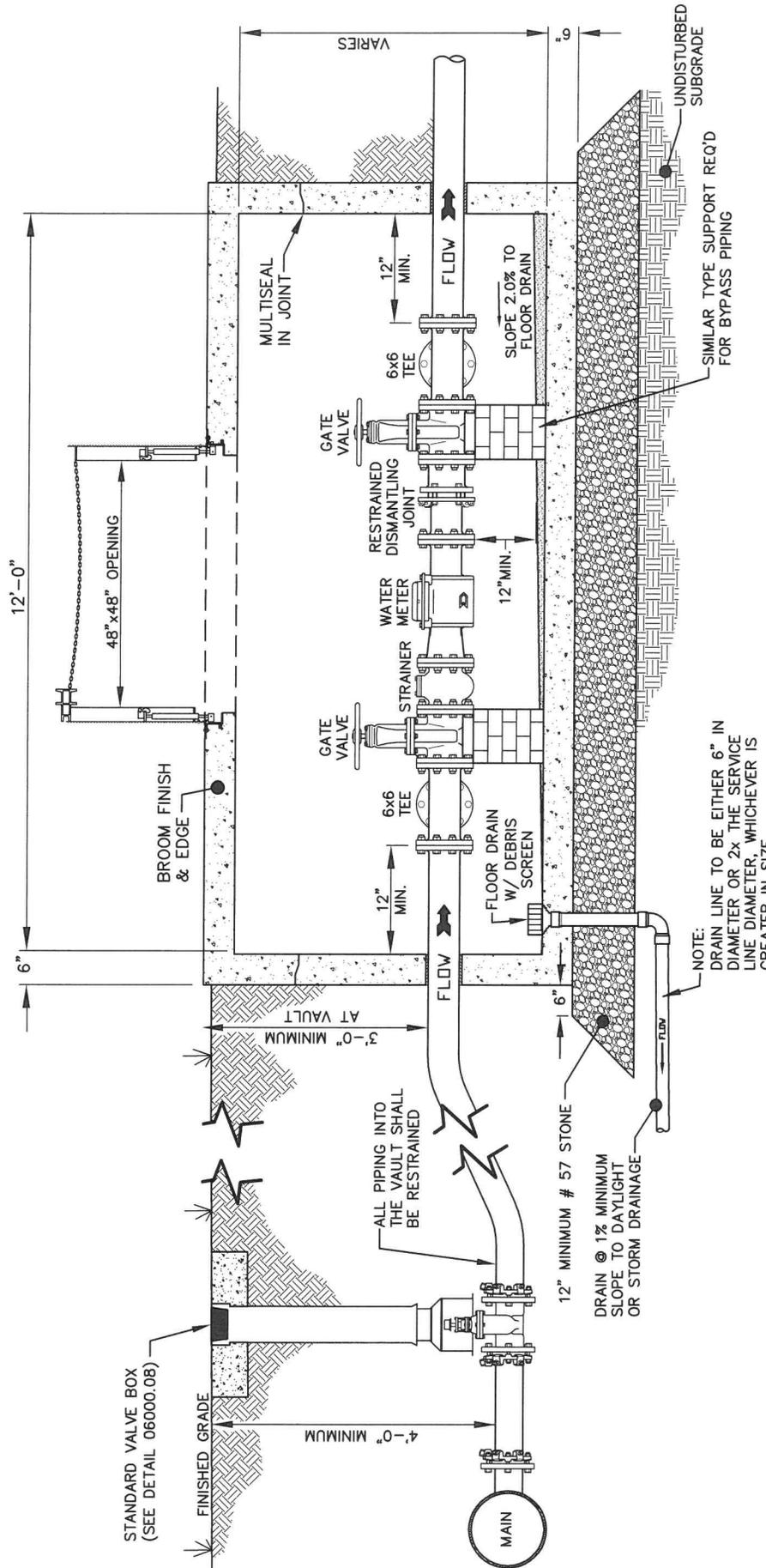


DETAIL No.
02000.03
SHEET 2 OF 4

STANDARD 3" OR 4" METER INSTALLATION & VAULT



EFFECTIVE:



SECTION VIEW

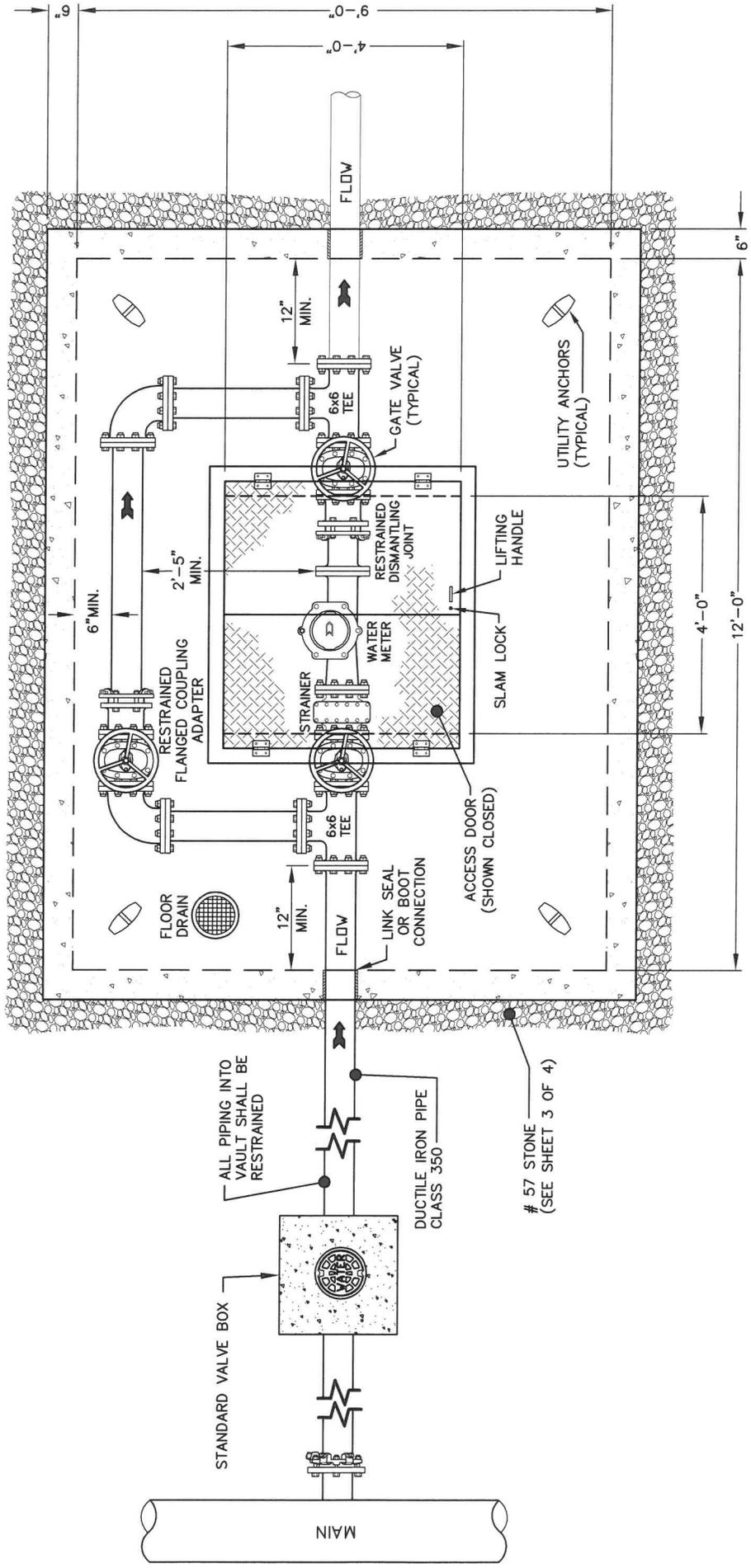
(SEE SHEET 4 OF 4 FOR PLAN VIEW)

DETAIL No.
02000.03
SHEET 3 OF 4

STANDARD 6" METER INSTALLATION & VAULT



EFFECTIVE:



PLAN VIEW

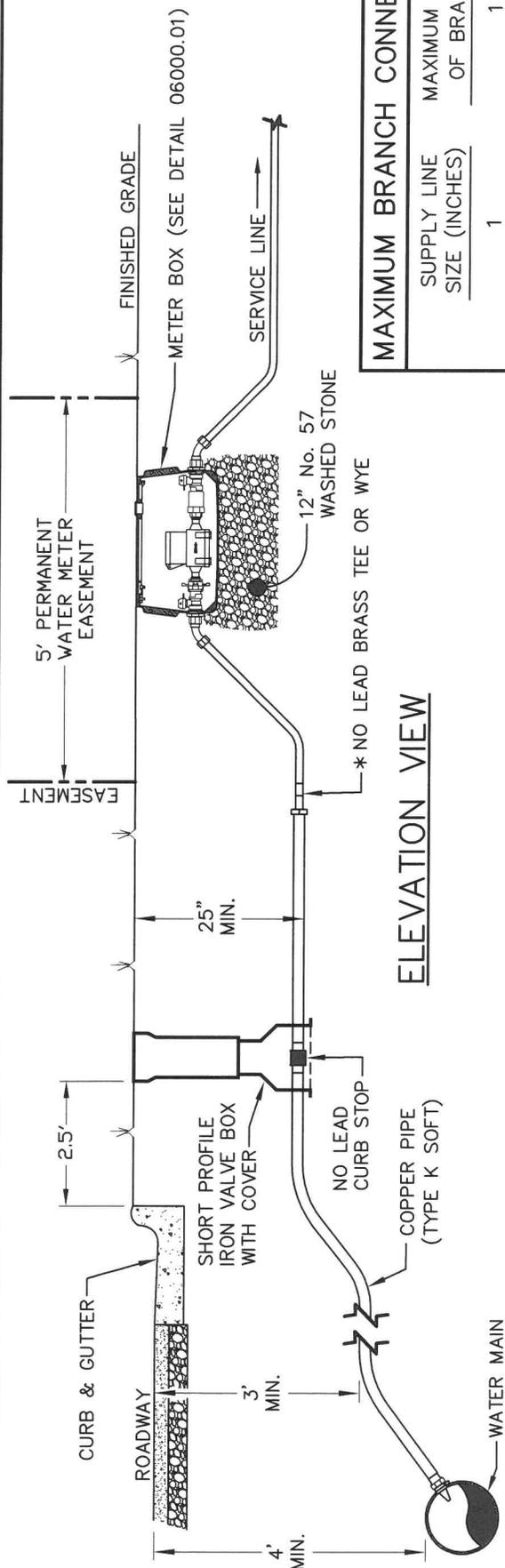
(SEE SHEET 3 OF 4 FOR SECTION VIEW)

DETAIL No.
02000.03
SHEET 4 OF 4

STANDARD 6" METER INSTALLATION & VAULT



EFFECTIVE:

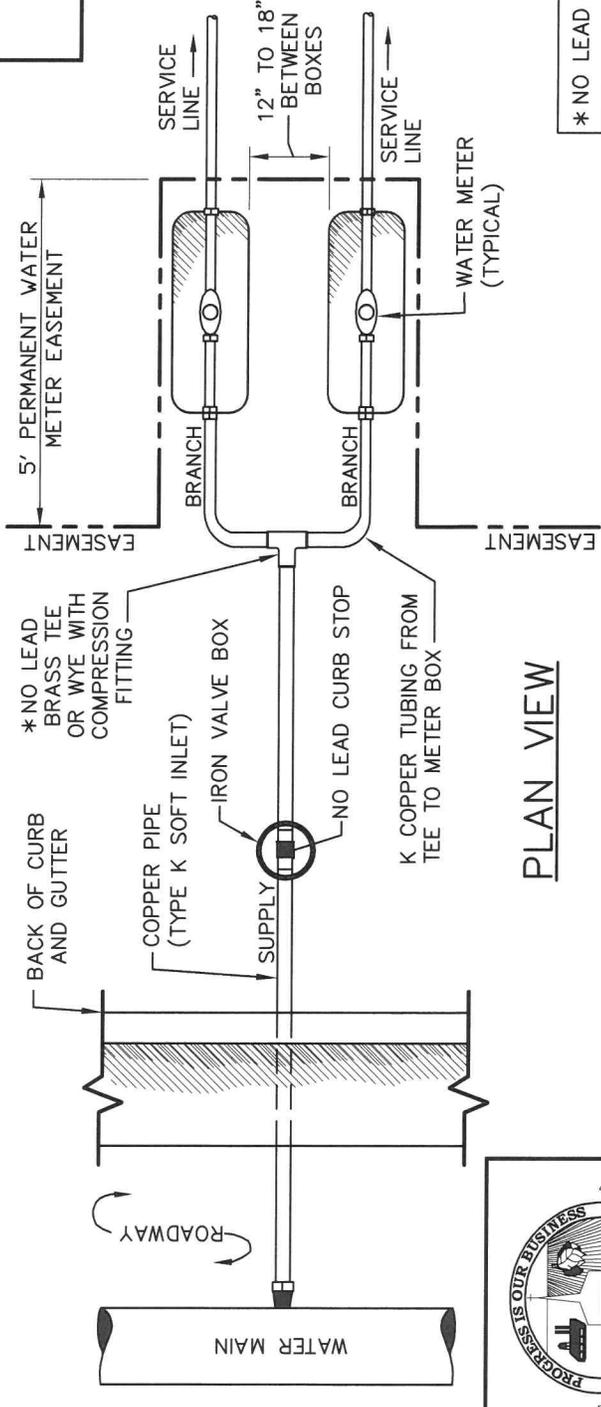


ELEVATION VIEW

MAXIMUM BRANCH CONNECTIONS

SUPPLY LINE SIZE (INCHES)	MAXIMUM NUMBER OF BRANCHES
1	1
1.5	2
2	2

- NOTES:**
- 1) THERE SHALL BE NO MULTIPLE CONNECTIONS FROM EXISTING 3/4 INCH SERVICE LINES.
 - 2) METER BOXES SHALL BE AS DESCRIBED IN THE STANDARD SPECIFICATIONS UNDER WATER DISTRIBUTION; METER BOXES SHALL NOT BE LOCATED IN AREAS SUBJECT TO VEHICULAR TRAFFIC.
 - 3) NO LEAD CURB STOP SHALL BE CENTERED ON MULTIPLE BRANCH SERVICE.
 - 4) ALL BRASS COMPONENTS SHALL BE 'NO LEAD' BRASS MEETING UNS C89833 AS PER ASTM B584.

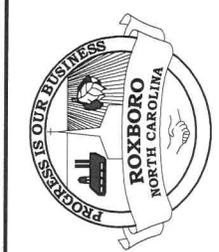


PLAN VIEW

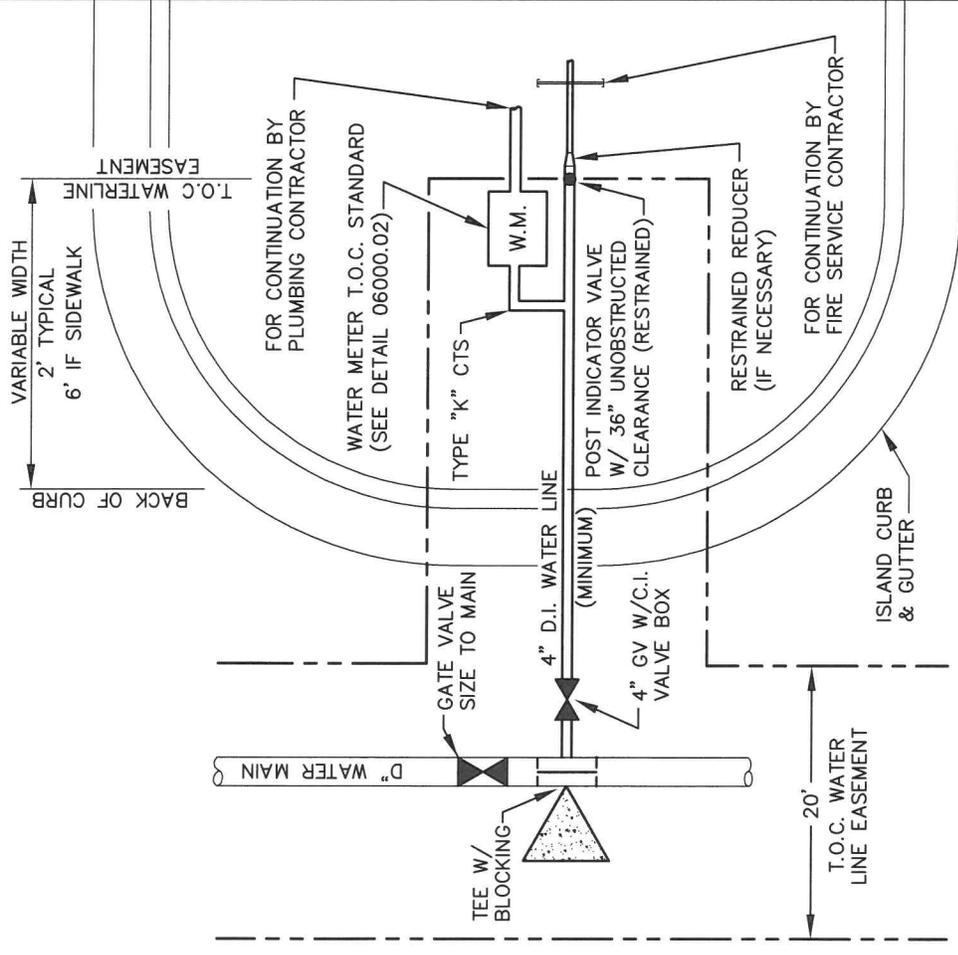
* NO LEAD BRASS TEE OR WYE: INLET SIZE X 1 INCH

DETAIL No.
02000.04
SHEET 1 OF 1

STANDARD MULTIPLE BRANCH SERVICES

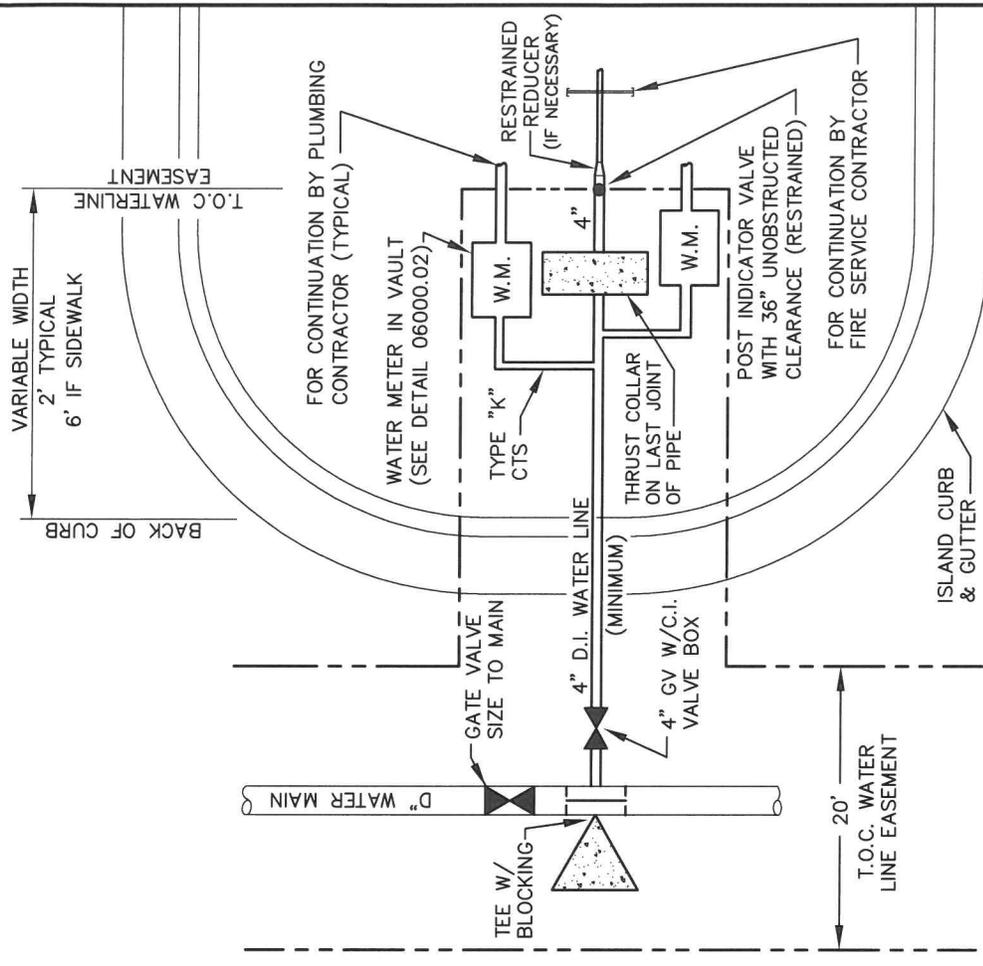


EFFECTIVE:



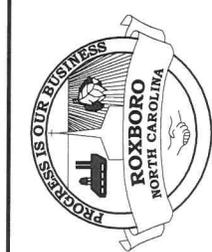
TYPE A - SINGLE SERVICE

NOTE: SYSTEM TO BE MAINTAINED BY THE OWNER PAST THE EASEMENT LINE.



TYPE B - DOUBLE SERVICE

NOTE: SYSTEM TO BE MAINTAINED BY THE OWNER PAST THE EASEMENT LINE.



EFFECTIVE:

STANDARD COMBINED FIRE & DOMESTIC WATER SERVICE

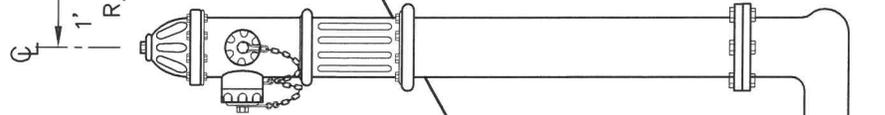
DETAIL No.

02000.05

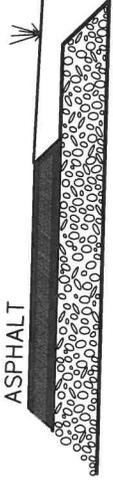
SHEET 1 OF 1

R/W LINE

1' OFF
R/W



ASPHALT



NOTE:

HYDRANT SHALL BE LOCATED BEHIND THE DITCH, 1' FOOT FROM R/W LINE UNLESS APPROVED OTHERWISE BY CITY OF ROXBORO.



EFFECTIVE:

DETAIL No.

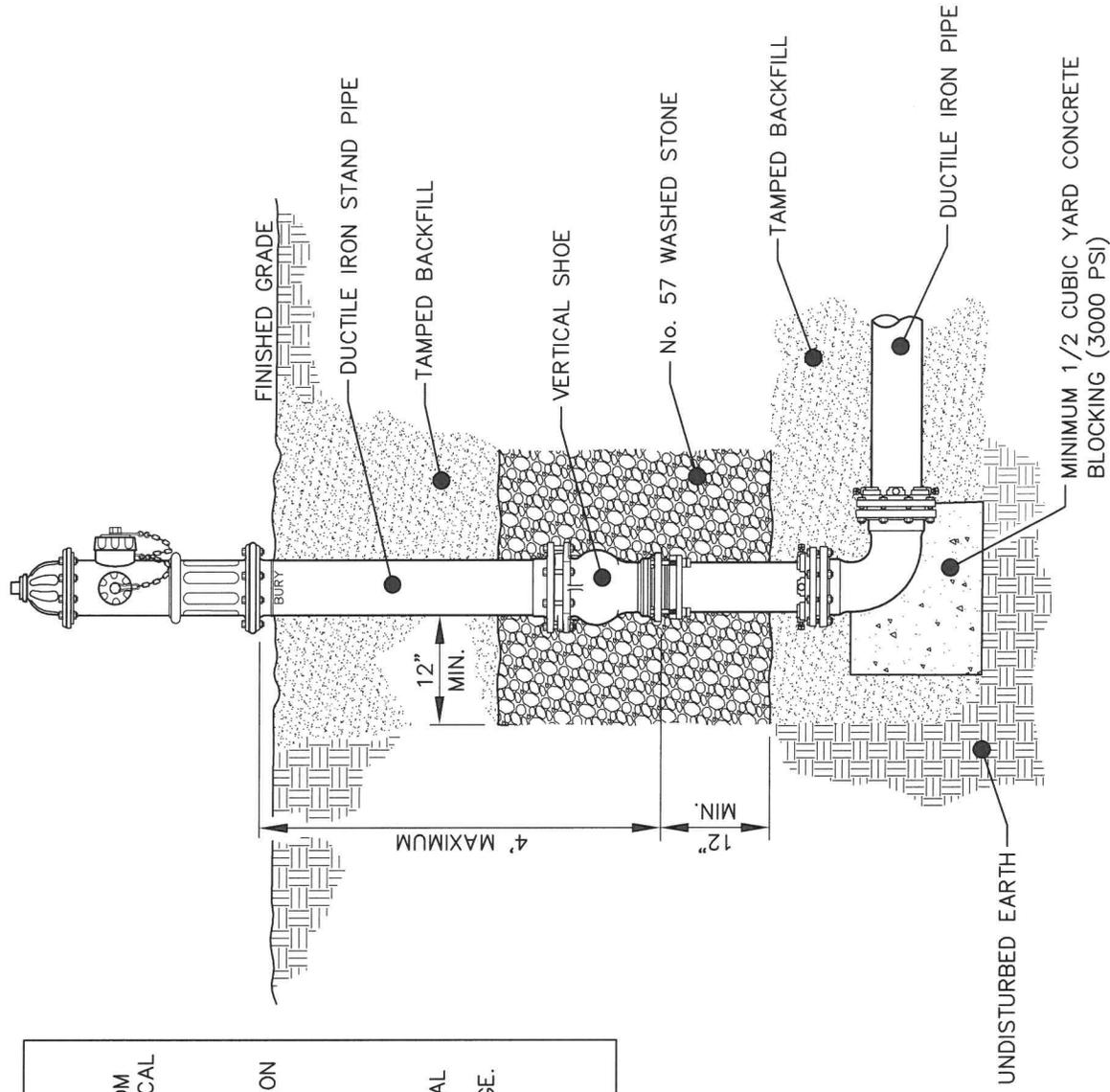
02000.06

SHEET 2 OF 3

STANDARD HYDRANT INSTALLATION FOR ROADS WITHOUT CURB & GUTTER

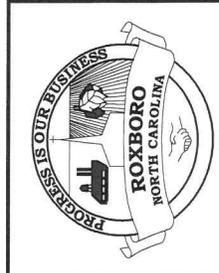
NOTES:

1. THE MAXIMUM DEPTH OF BURY FOR VERTICAL SHOE INSTALLATIONS SHALL NOT EXCEED 4-FT MEASURED FROM THE BREAKAWAY FLANGE TO THE BOTTOM OF THE VERTICAL HYDRANT SHOE.
2. THE VERTICAL SHOE AND ALL PIPING INCLUDED IN THE HYDRANT SUPPLY LINE SHALL BE RESTRAINED WITH BLOCKING AND RODDING, OR BLOCKING WITH WEDGE ACTION RETAINER GLANDS.
3. IN ALL CASES WHERE THE VERTICAL SHOE IS UTILIZED, TYPICAL WASHED STONE BEDDING EXTENDING AT LEAST 12-INCHES ON ALL SIDES OF THE CENTRAL AXIS AND EXTENDING FROM THE TOP OF THE VERTICAL SHOE DOWNWARD TO AT LEAST 12-INCHES BELOW THE VERTICAL SHOE SHALL BE PROVIDED SURROUNDING THE VERTICAL SHOE ASSEMBLY TO ASSURE POSITIVE DRAINAGE.
4. THE ENTIRE ASSEMBLY SHALL BE RESTRAINED AND SUPPORT BLOCKING SHALL BE PROVIDED UNDER THE VERTICAL BEND ASSEMBLY.

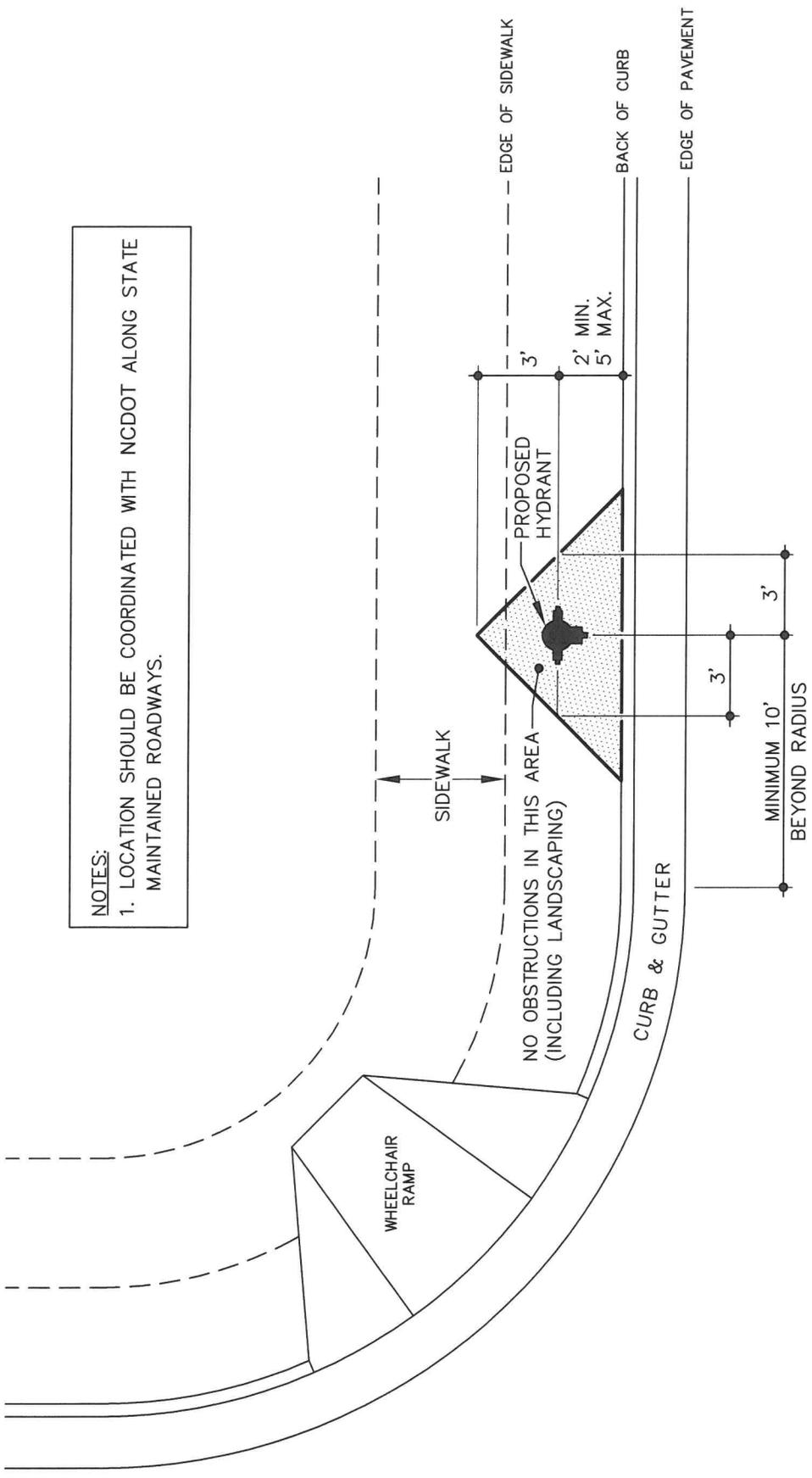


DETAIL No.
02000.06
SHEET 3 OF 3

DEEP FIRE HYDRANT INSTALLATION



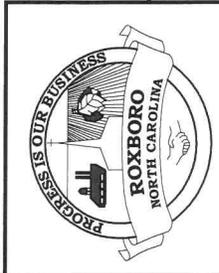
EFFECTIVE:



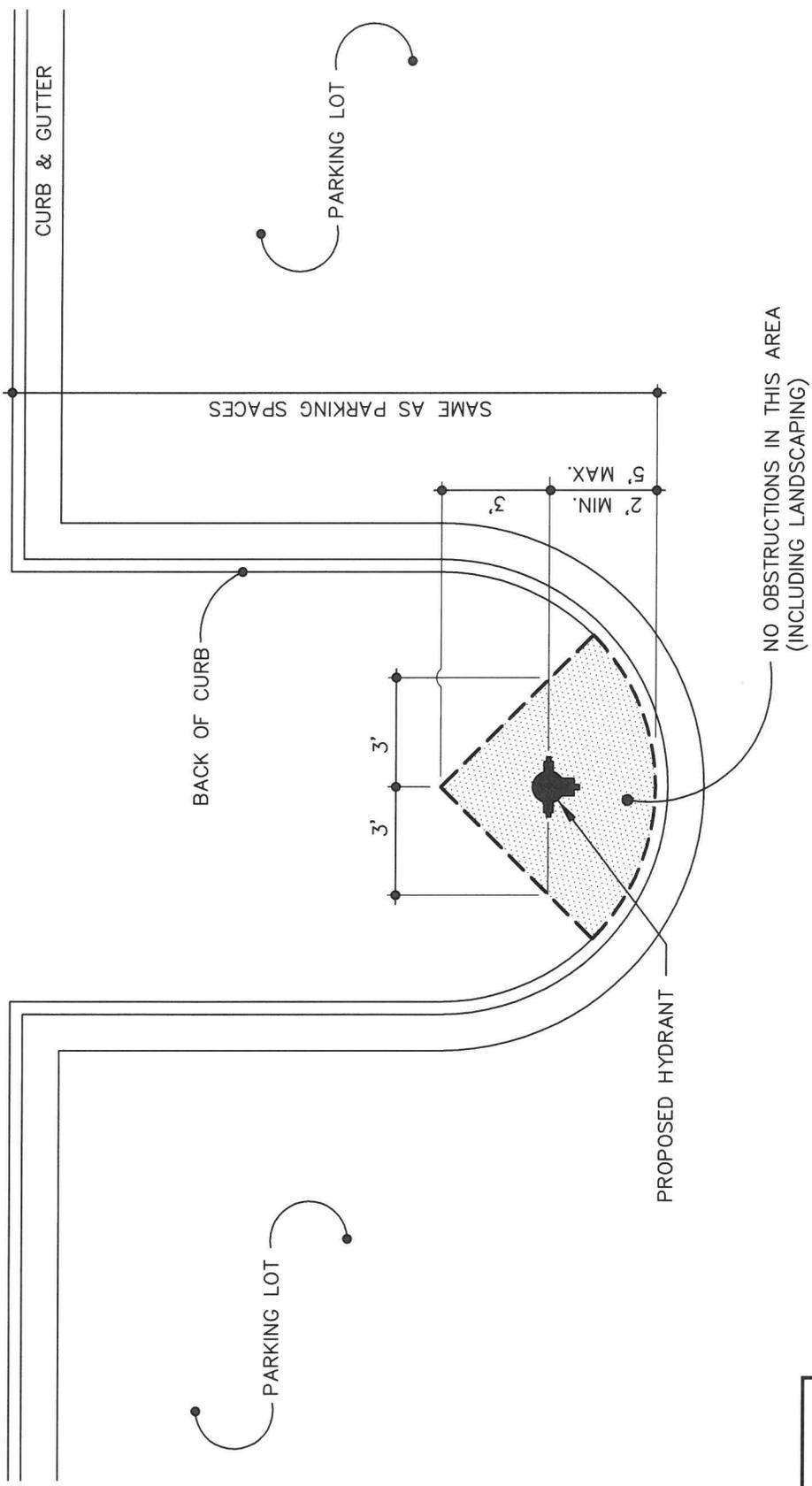
NOTES:
 1. LOCATION SHOULD BE COORDINATED WITH NCDOT ALONG STATE MAINTAINED ROADWAYS.

DETAIL No.
 02000.07
 SHEET 1 OF 2

STANDARD HYDRANT LOCATION



EFFECTIVE:

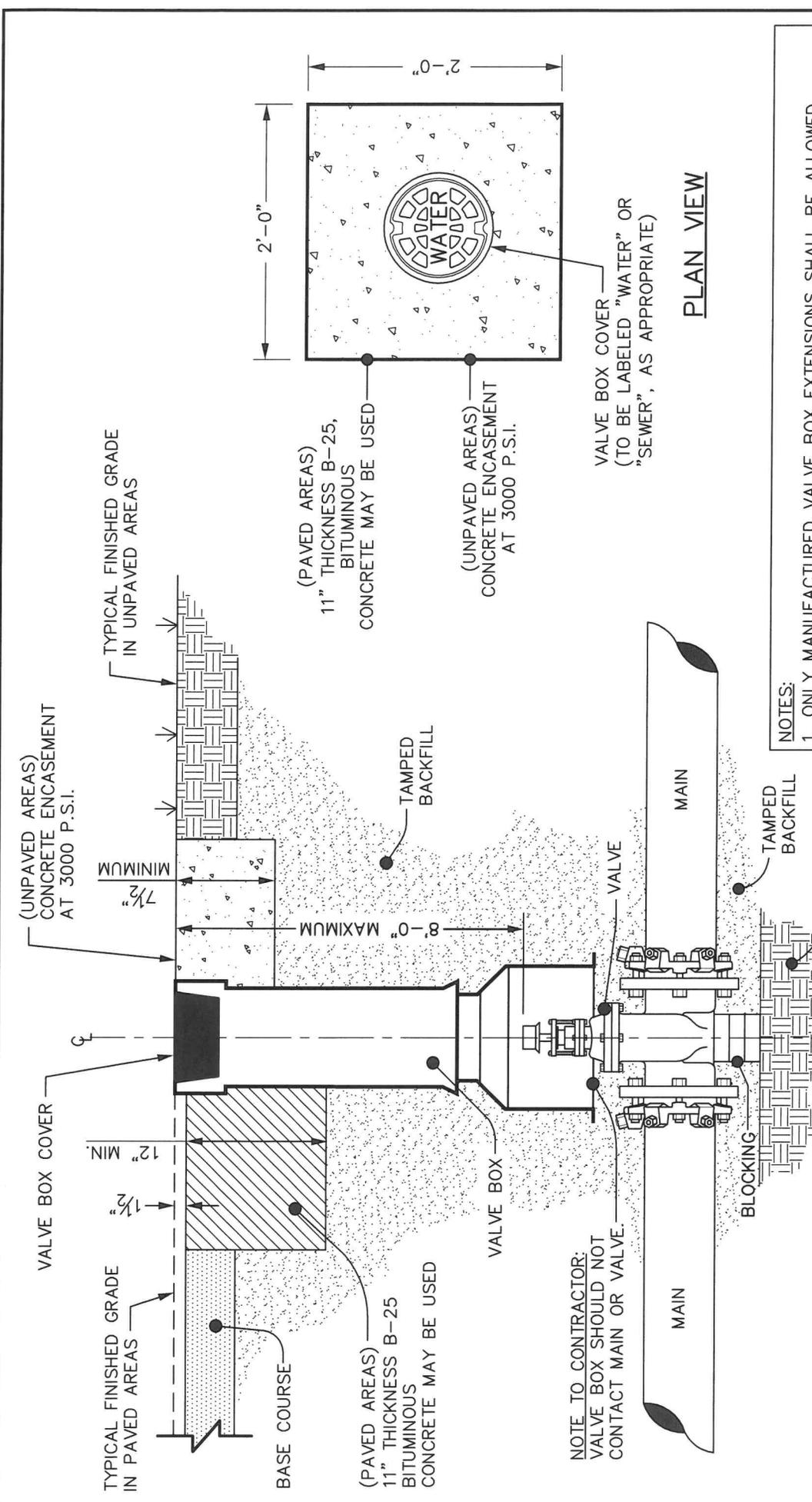


DETAIL No.
02000.07
SHEET 2 OF 2

STANDARD HYDRANT LOCATION (FOR PARKING LOT)



EFFECTIVE:



- NOTES:**
1. ONLY MANUFACTURED VALVE BOX EXTENSIONS SHALL BE ALLOWED.
 2. VALVE OPERATING NUT MUST BE EXTENDED SO THAT THE DEPTH IS NO GREATER THAN 8' (ft.) FROM THE SURFACE USING A MANUFACTURER APPROVED EXTENSION KIT.
 3. PRECAST CONCRETE ENCASMENT IS ALLOWED OUTSIDE OF PAVED AREAS.

PLAN VIEW

SECTION VIEW

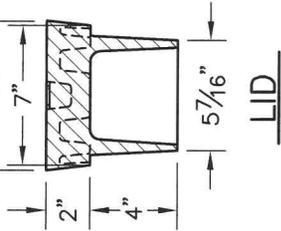
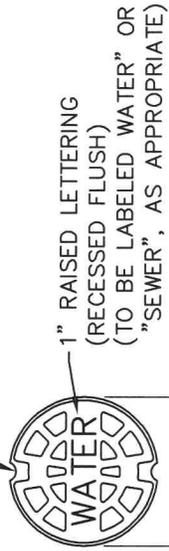
DETAIL No.
02000.08
SHEET 1 OF 2

STANDARD VALVE BOX INSTALLATION



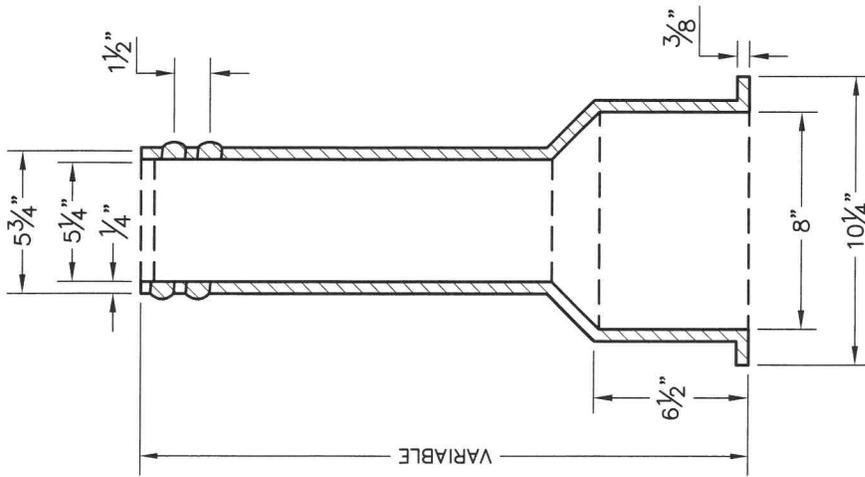
EFFECTIVE:

CLOSED PICKHOLES (2)

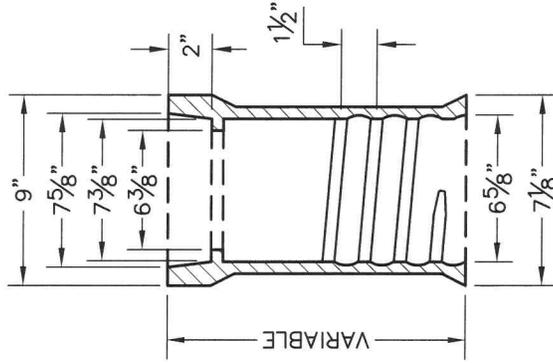


ALL PARTS SHALL BE OF THE SAME MATERIAL AND SUPPLIED BY THE SAME MANUFACTURER

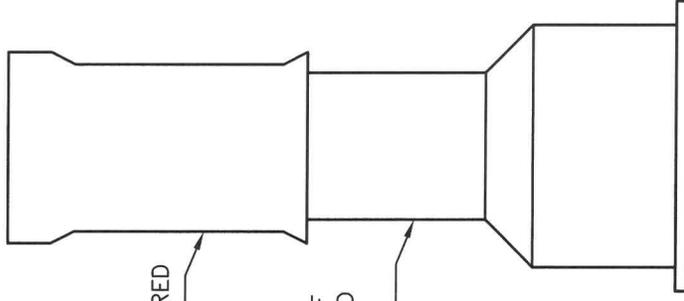
LID



BOTTOM SECTION



TOP SECTION



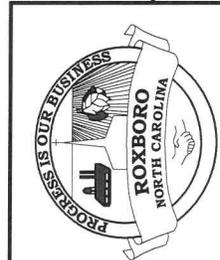
COMPLETE BOX

NOTES:

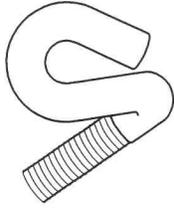
1. VALVE BOX COVER SHALL WEIGH A MINIMUM 26 lbs.
2. ENTIRE VALVE BOX ASSEMBLY & COVER SHALL BE CAST FROM CLASS 35 GRAY IRON.
3. ASSEMBLY SHALL BE DOMESTICALLY MADE AND MANUFACTURED IN THE U.S.A.
4. VALVE BOX SHALL NOT REST ON MAIN AND SHALL BE CENTERED OVER OPERATING NUT.

DETAIL No.
02000.08
SHEET 2 OF 2

STANDARD VALVE BOX INSTALLATION



EFFECTIVE:



TYPICAL EYE BOLT

3/4" ALL-THREADED, STAINLESS STEEL RODS (CUT TO LENGTH). FASTENERS SHALL ALSO BE STAINLESS STEEL.
NOTE: RODDING SHALL NOT EXCEED 10' (FT) IN LENGTH.

GATE VALVE

TYPICAL EYE BOLT CONNECTION

TYPICAL EYE BOLT CONNECTION

SEE DETAIL 02000.14 FOR THRUST COLLAR

TEE OR CROSS

CONCRETE BLOCKING

GENERAL NOTES:

1. SEE STANDARD THRUST BLOCK DETAIL.
2. CONCRETE SHALL NOT CONTACT BOLTS OR ENDS OF MECHANICAL FITTINGS.
3. RODS SHALL NOT BE COUPLED.

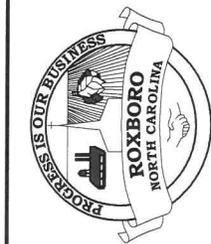
STAINLESS STEEL ROD REQUIREMENTS

BRANCH SIZE	No. OF RODS
4"	2
6"	2
8"	4
12"	6
16"	8
24"	10

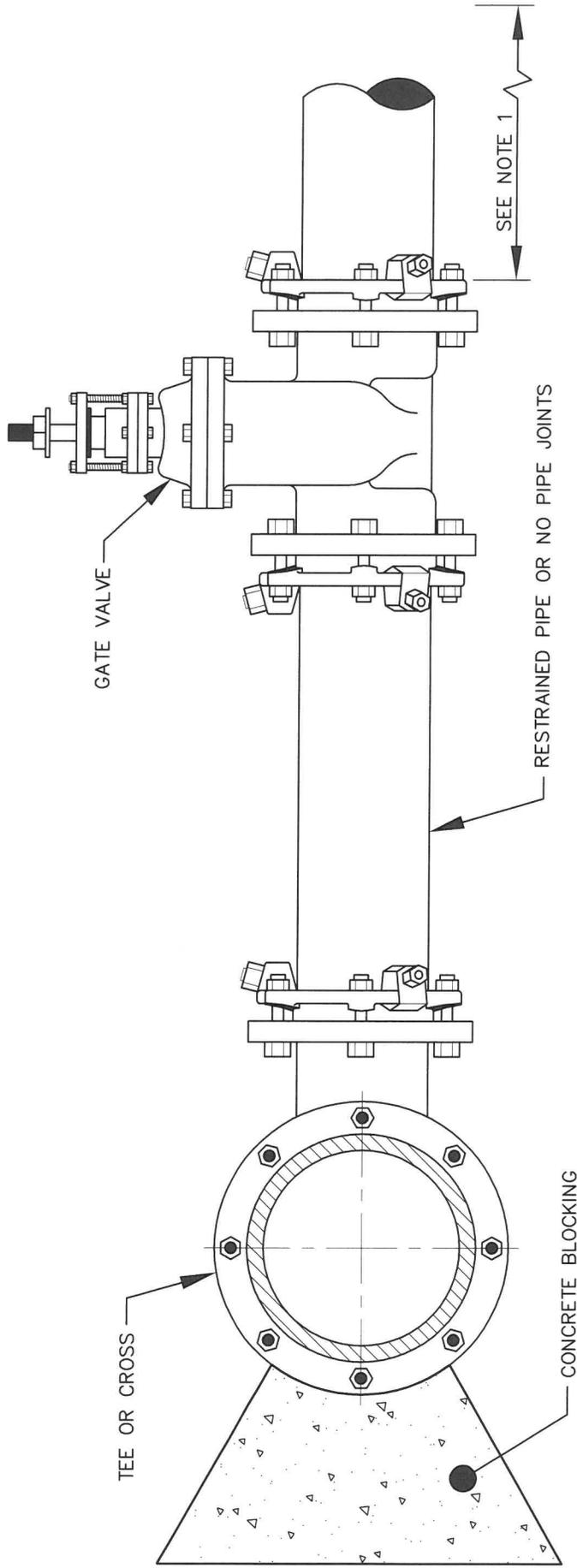
DETAIL No.

02000.09
SHEET 1 OF 2

STANDARD VALVE RESTRAINT



EFFECTIVE:



- GENERAL NOTES:**
1. ADDITIONAL RESTRAINT REQUIRED ON THE BRANCH LINE BASED ON SPECIFIC THRUST CALCULATIONS.
 2. CONCRETE SHALL NOT CONTACT BOLTS OR ENDS OF MECHANICAL FITTINGS.



EFFECTIVE:

DETAIL No.
 02000.09
 SHEET 2 OF 2

ALTERNATE VALVE RESTRAINT WITH WEDGE ACTION RETAINER GLANDS

FLOOR BOX CAST IN MANHOLE TOP
OVER EXTENSION STEM WITH
GROUND LEVEL INDICATOR

PRECAST MANHOLE SECTIONS
WITH O-RING GASKETS OR
BUTYL RUBBER SEALS

2" OPERATING NUT

EXTENSION
STEM (SEE SPECS)

16" BUTTERFLY
VALVE

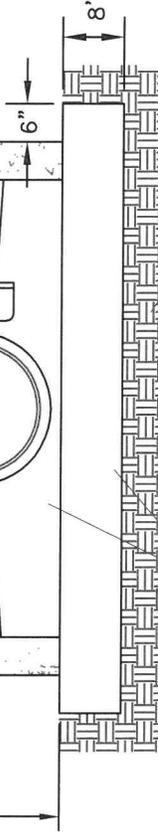
SOLID EARTH FOUNDATION - BEARING CAPACITY
VALIDATED BY GEOTECHNICAL ENGINEER

CLEAN #57 OR #67 CRUSHED
STONE AS REQUIRED FOR PIPE
SUPPORT

TOP ELEVATION
SEE PLAN/PROFILE DWGS

6' DIA.

DEPTH AS REQUIRED
SEE PLAN/PROFILE DRAWINGS



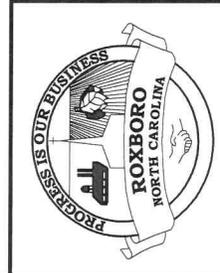
SECTION VIEW

DETAIL No.

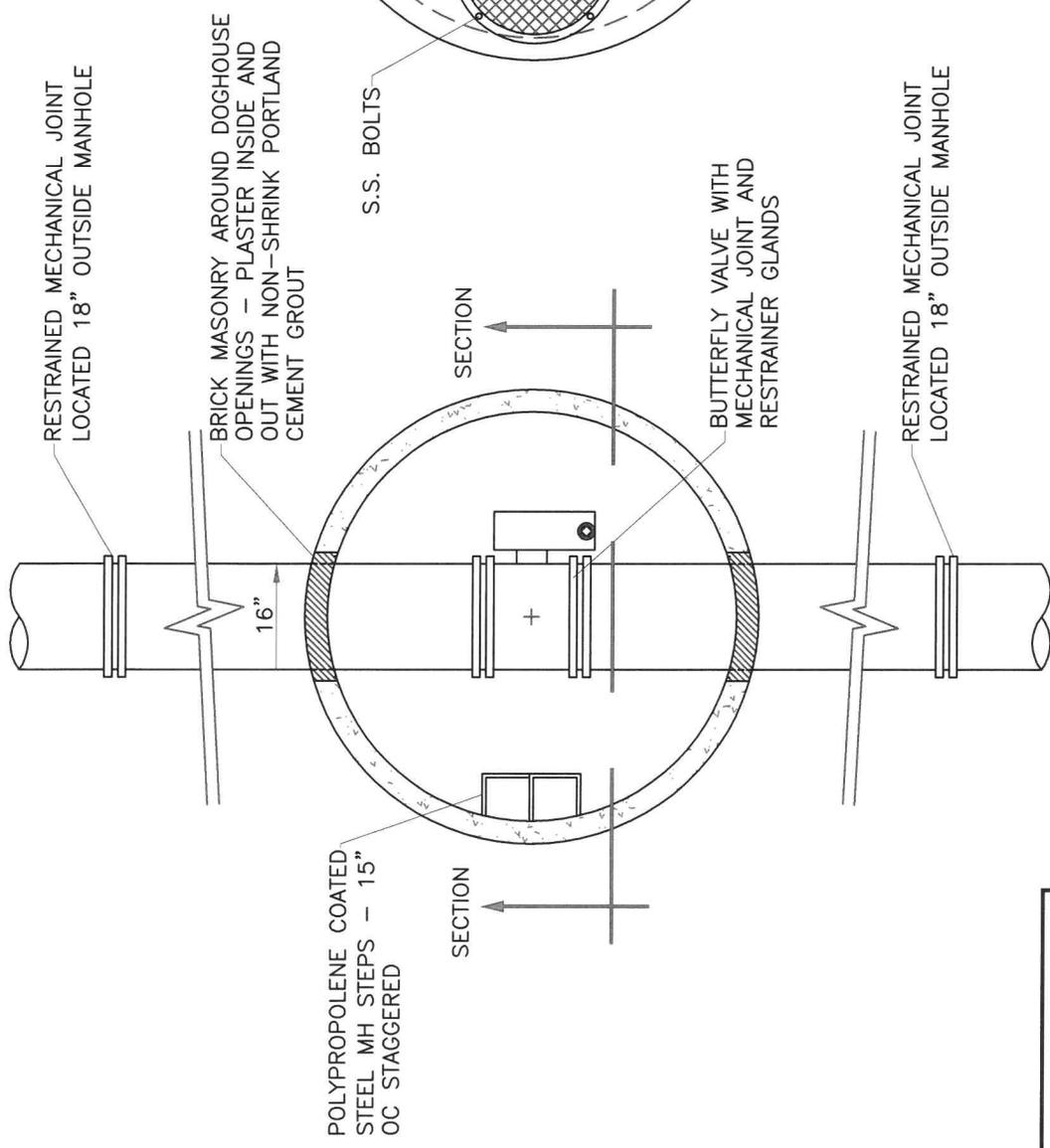
02000.10

SHEET 1 OF 2

BUTTERFLY VALVE



EFFECTIVE:



PLAN VIEW - WITH TOP

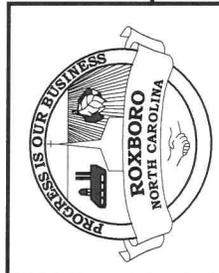
PLAN VIEW - TOP REMOVED

BUTTERFLY VALVE

DETAIL No.

02000.10

SHEET 2 OF 2

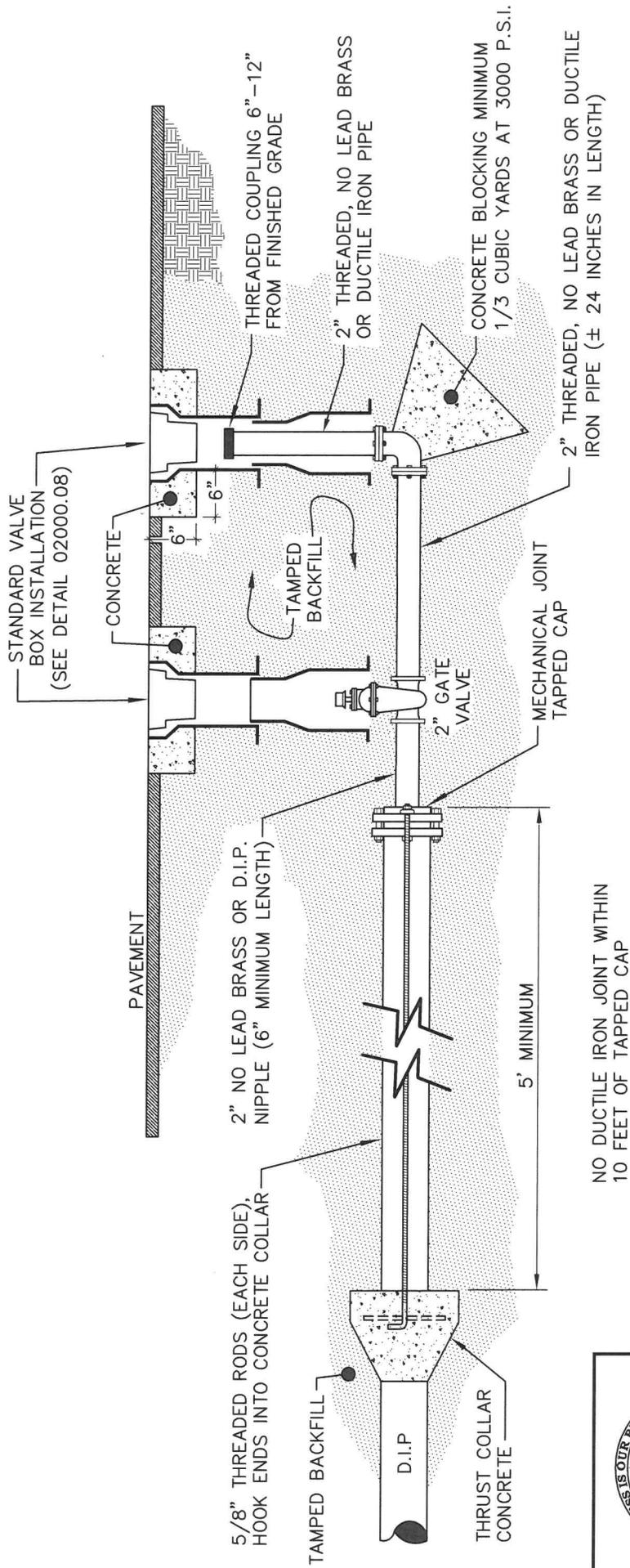


EFFECTIVE:

MAIN SIZE	END PIPE SIZE
4" - 12"	2" BLOW-OFF
16" & GREATER	AS APPROVED BY CITY ENGINEER

NOTES:

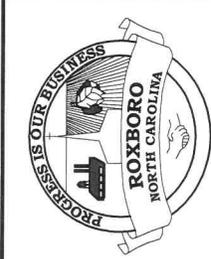
- FOR MAINS THAT ARE TO BE EXTENDED, USE A VALVE EQUAL TO THE MAIN SIZE AS THE BLOW-OFF VALVE AND THEN REDUCE TO THE 2" STANDPIPE.
- RODS SHALL BE "HOOKED" INTO THRUST COLLAR.



NO DUCTILE IRON JOINT WITHIN
10 FEET OF TAPPED CAP

STANDARD 2" BLOW-OFF ASSEMBLY

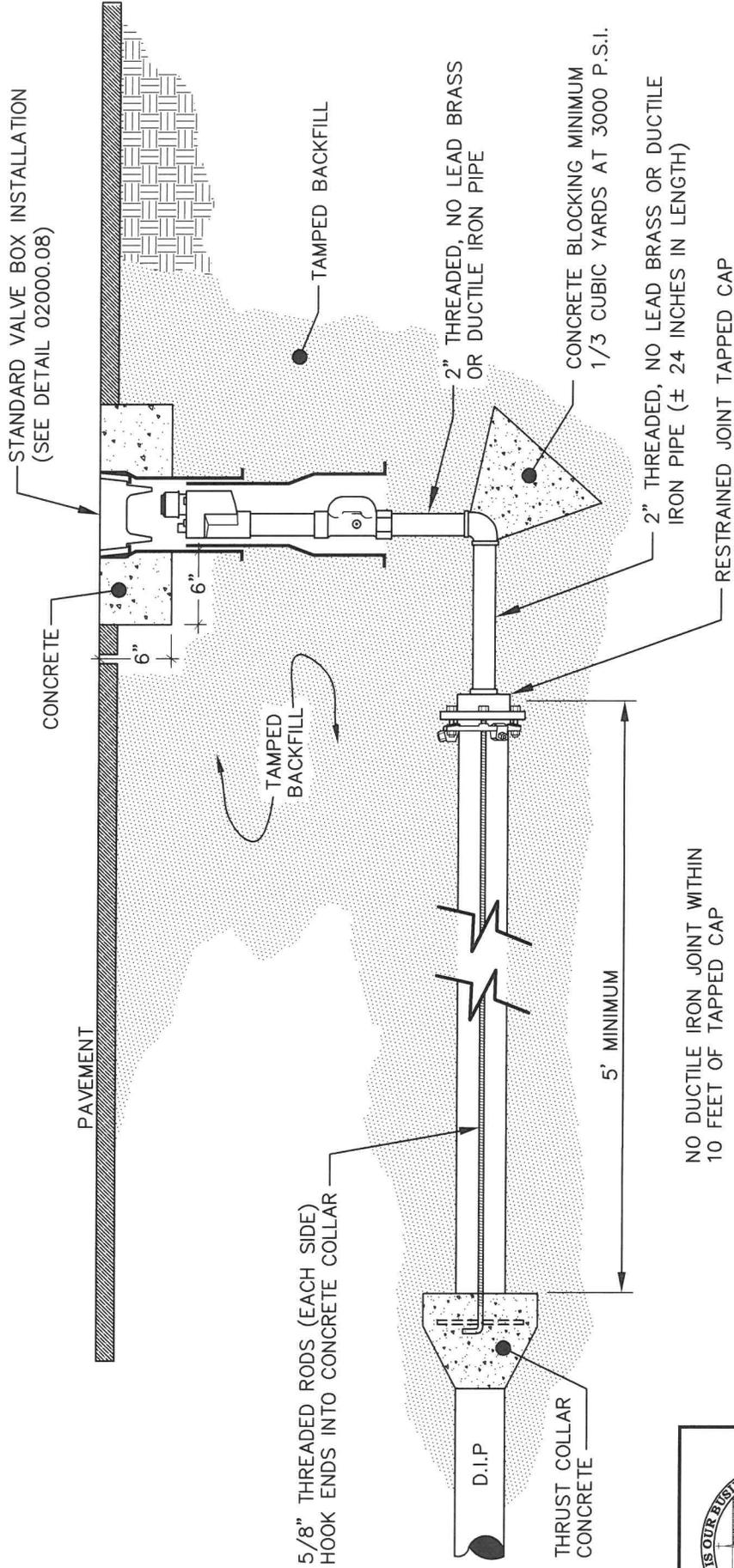
DETAIL No.
02000.11
SHEET 1 OF 2



EFFECTIVE:

MAIN SIZE	END PIPE SIZE
4"	2" BLOW-OFF

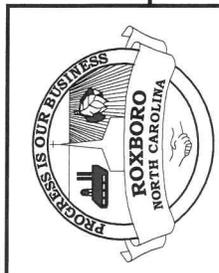
NOTE:
RODS SHALL BE "HOOKED" INTO THRUST COLLAR.



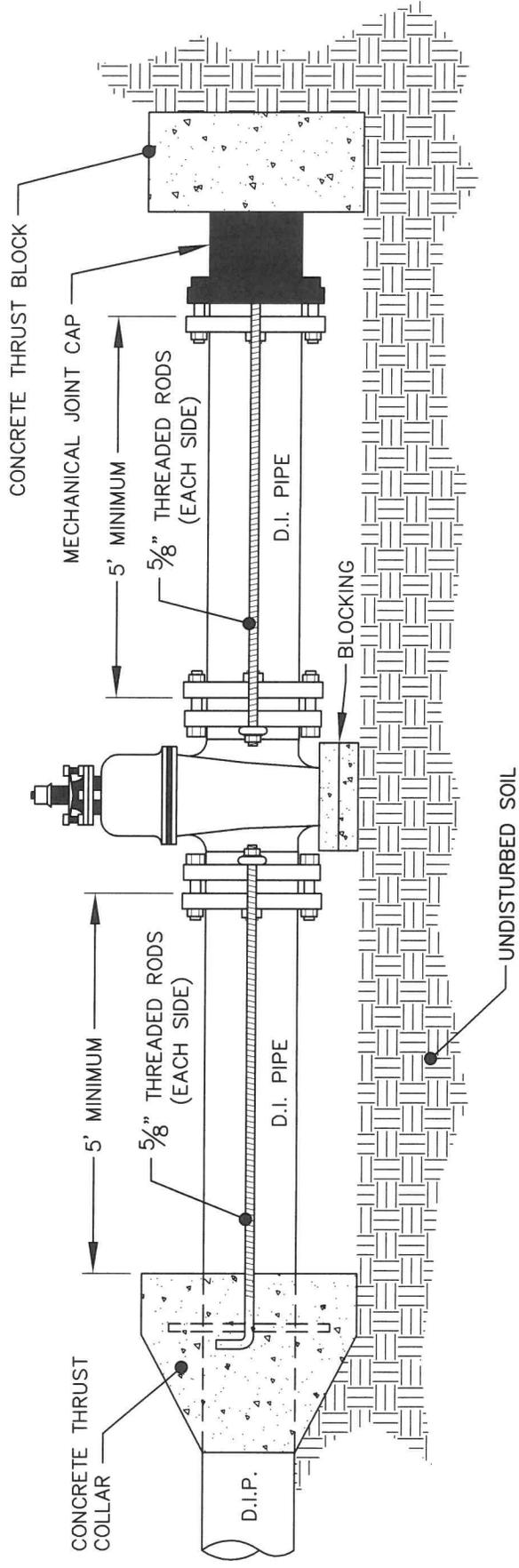
NO DUCTILE IRON JOINT WITHIN
10 FEET OF TAPPED CAP

ALTERNATE 2" BLOW-OFF ASSEMBLY, 4-INCH WATER MAINS

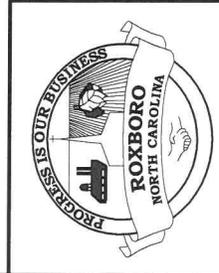
DETAIL No.
02000.11
SHEET 2 OF 2



EFFECTIVE:



NOTE:
 THIS DETAIL SHALL APPLY ONLY TO TEMPORARY CAPPING. PERMANENT
 DEAD END LINES TO BE IN ACCORDANCE WITH STANDARD DETAIL 02000.11



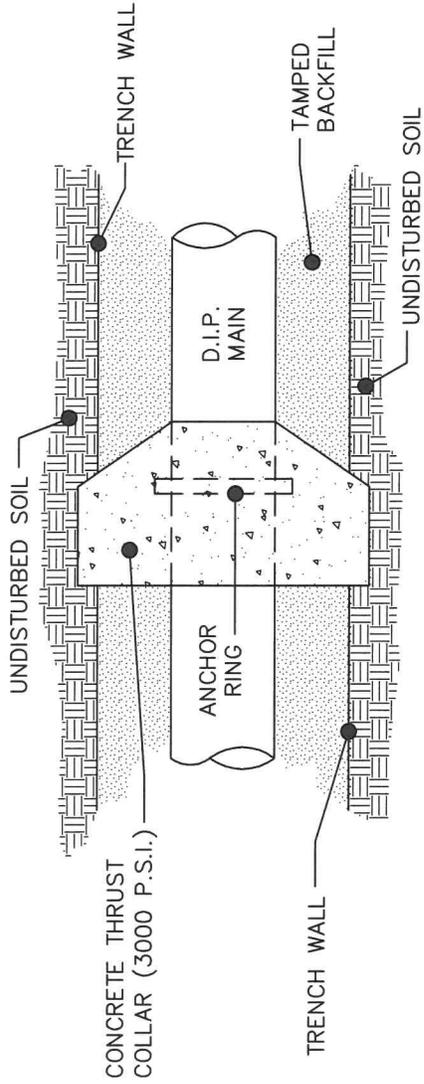
EFFECTIVE:

TEMPORARY CAPPING DETAIL

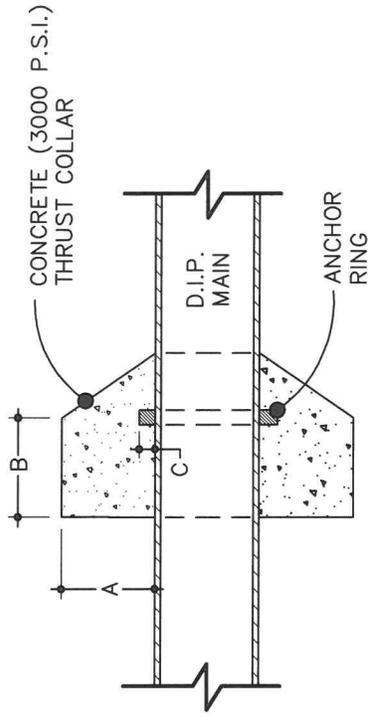
DETAIL No.

02000.12

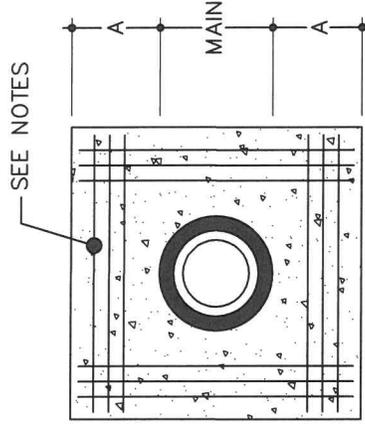
SHEET 1 OF 1



PLAN VIEW



SECTION VIEW



REINFORCING CROSS SECTION

SCHEDULE

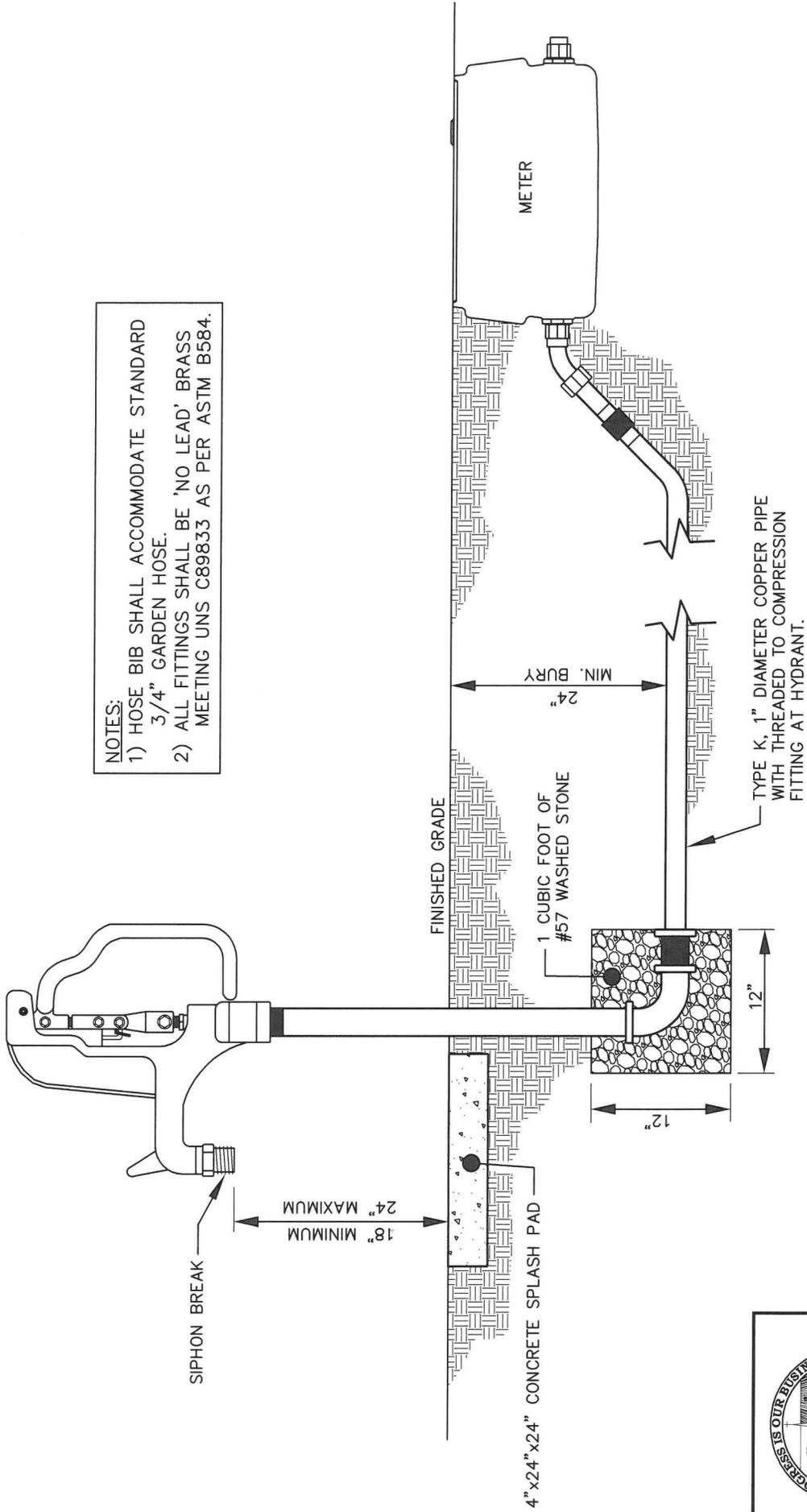
PIPE DIAMETER	CONCRETE THRUST COLLAR		ANCHOR RING	RINGS REQUIRED
	A	B		
6", 8", 12"	1'-0"	1'-0"	C	
16"	1'-4"	1'-0"	2"	ONE
20"	1'-4"	1'-0"	2"	ONE
24"	1'-4"	1'-0"	3"	ONE
30"	1'-4"	1'-0"	3"	TWO
36"	1'-4"	1'-2"	4"	TWO
	1'-4"	1'-4"	4"	TWO

NOTES:

- 6" TO 16" MAINS = 12-NO. 7 BARS
- 20" TO 36" MAINS = 12-NO. 8 BARS
- BARS PLACED AS SHOWN

DETAIL No.
02000.14
SHEET 1 OF 1

STANDARD THRUST COLLAR INSTALLATION



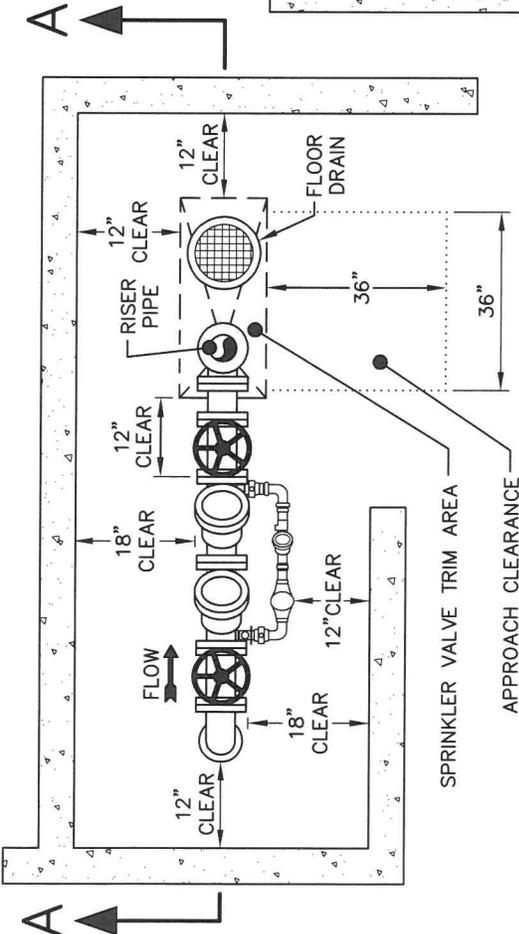
NOTES:
 1) HOSE BIB SHALL ACCOMMODATE STANDARD 3/4" GARDEN HOSE.
 2) ALL FITTINGS SHALL BE 'NO LEAD' BRASS MEETING UNS C89833 AS PER ASTM B584.



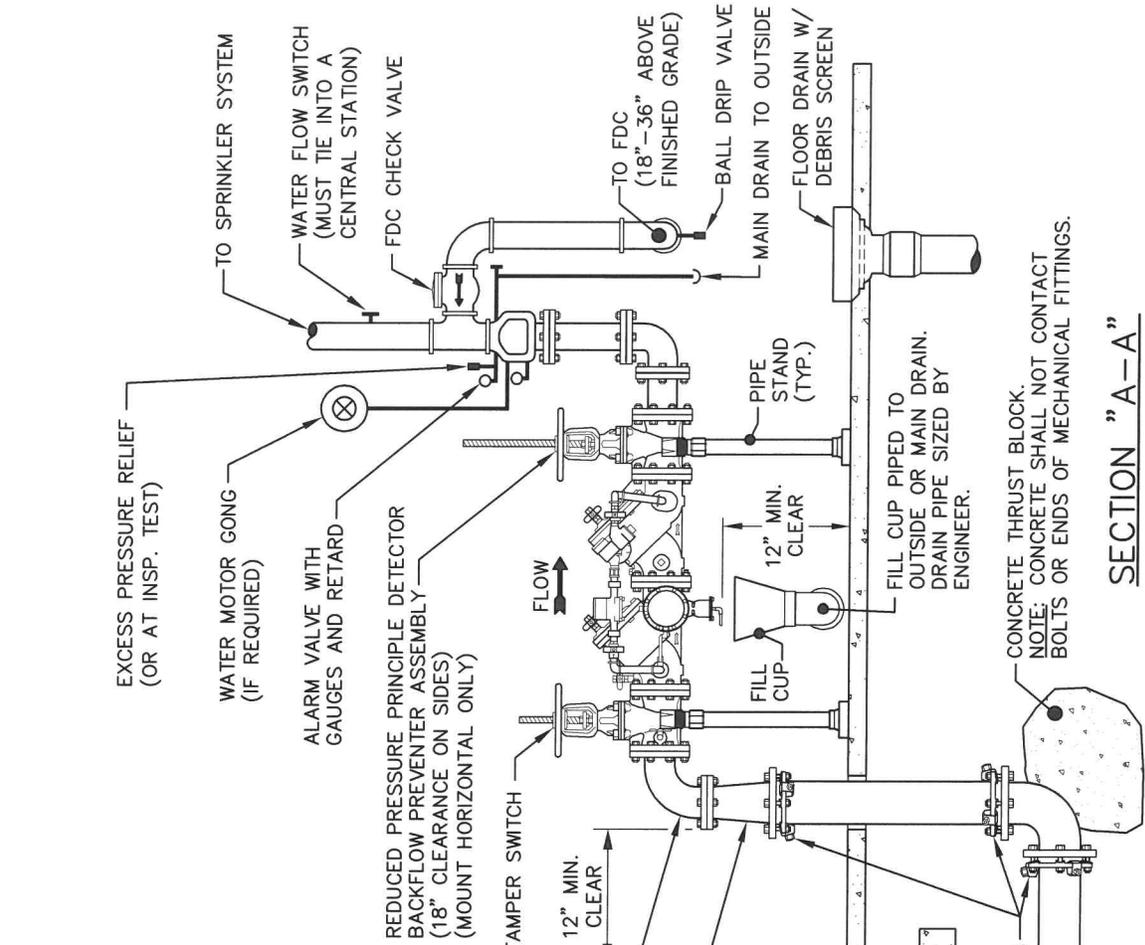
EFFECTIVE:

STANDARD YARD HYDRANT (NON-FREEZE)

DETAIL No.
 02000.16
 SHEET 1 OF 1



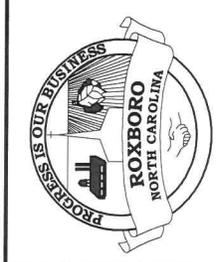
TOP VIEW



SECTION "A-A"

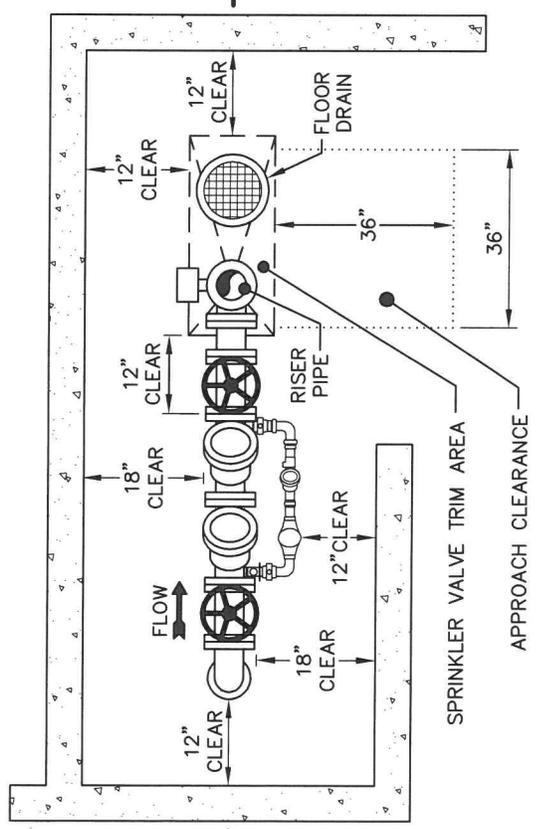
STANDARD SPRINKLER RISER, NFPA 13

DETAIL No.	02000.17
	SHEET 1 OF 2

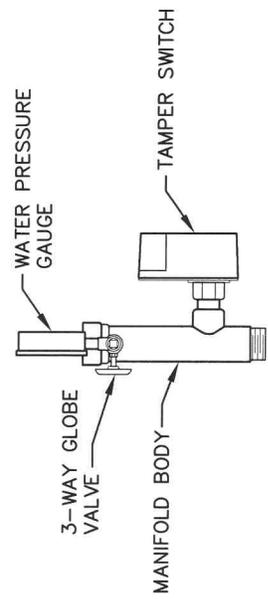


EFFECTIVE:

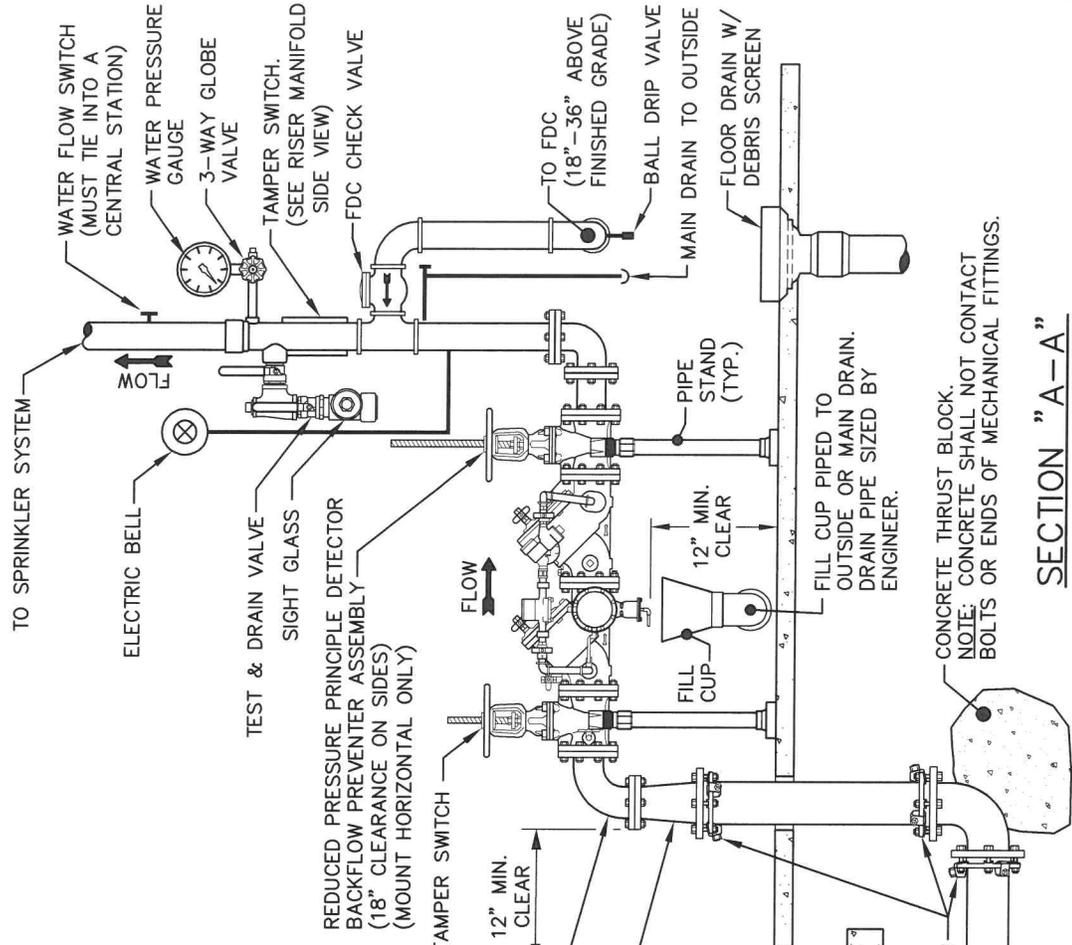
A



TOP VIEW



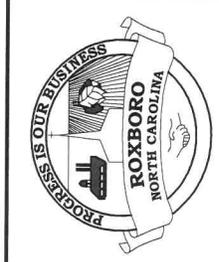
RISER MANIFOLD SIDE VIEW



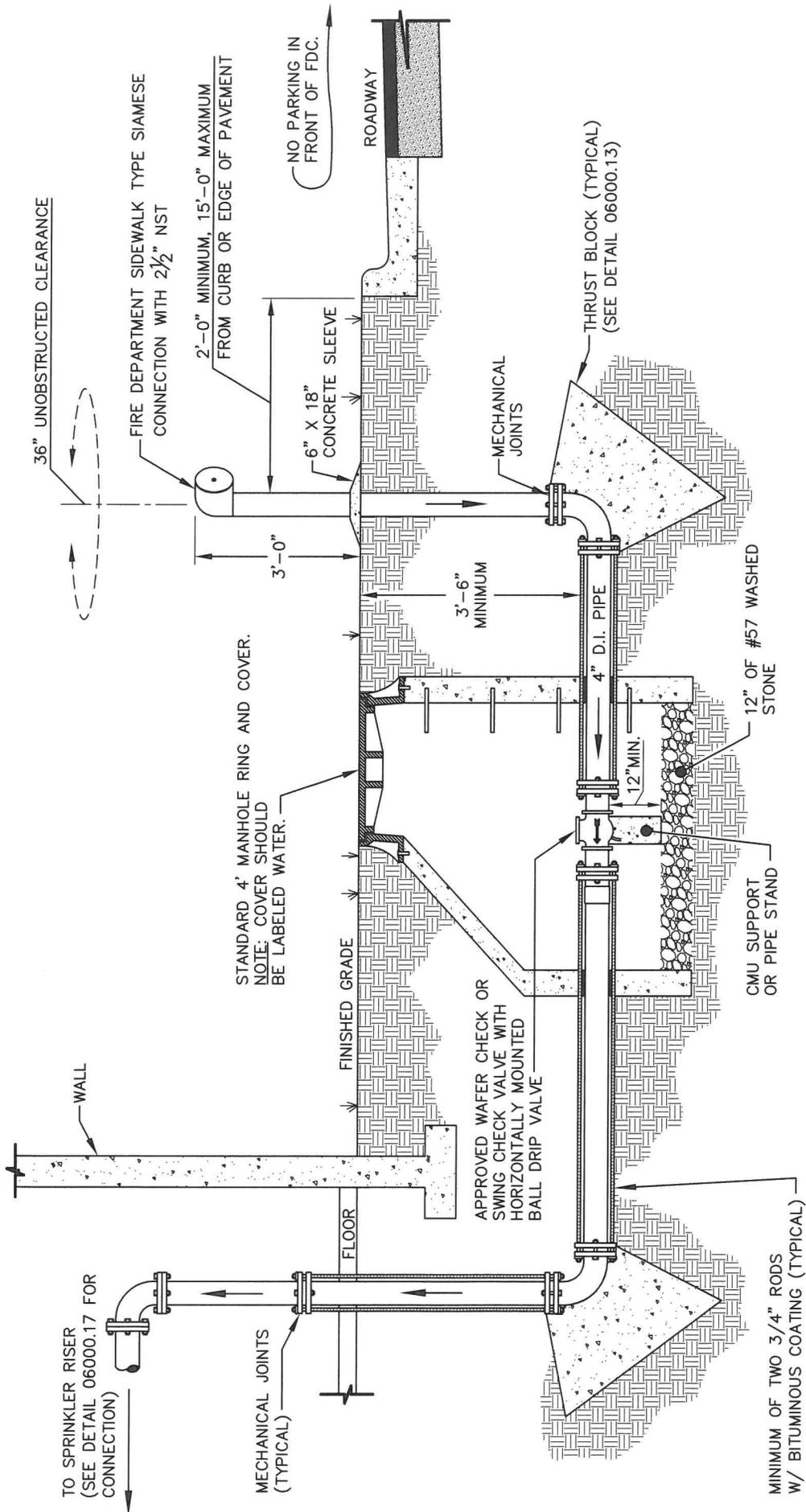
SECTION "A-A"

ALTERNATE SPRINKLER RISER, NFPA 13R RISER

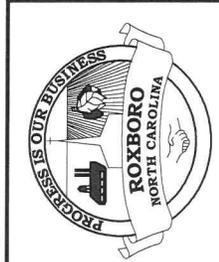
DETAIL No. 02000.17
SHEET 2 OF 2



EFFECTIVE:



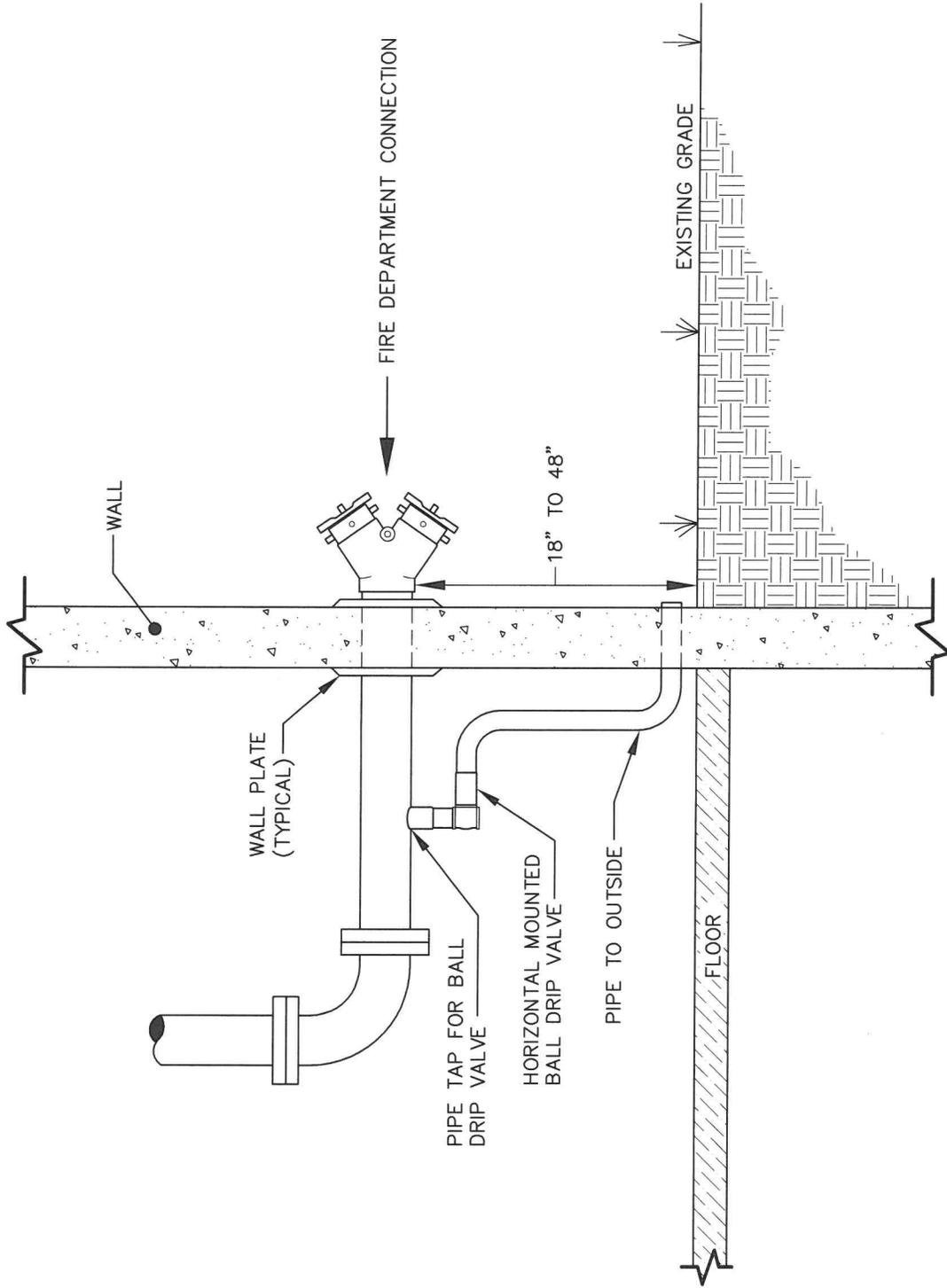
- NOTES:**
- 1) ALL SIAMESE CONNECTION'S MUST BE WITHIN 50 FEET OF A FIRE HYDRANT.
 - 2) SIAMESE CONNECTION CAN BE ATTACHED TO BUILDING.



EFFECTIVE:

CURB SIDE FIRE DEPARTMENT CONNECTION

DETAIL No.
02000.18
SHEET 1 OF 2

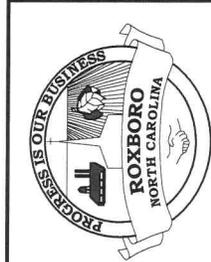


WALL MOUNTED FIRE DEPARTMENT CONNECTION

DETAIL No.

02000.18

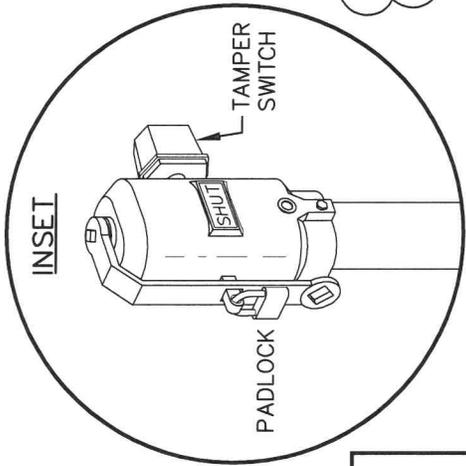
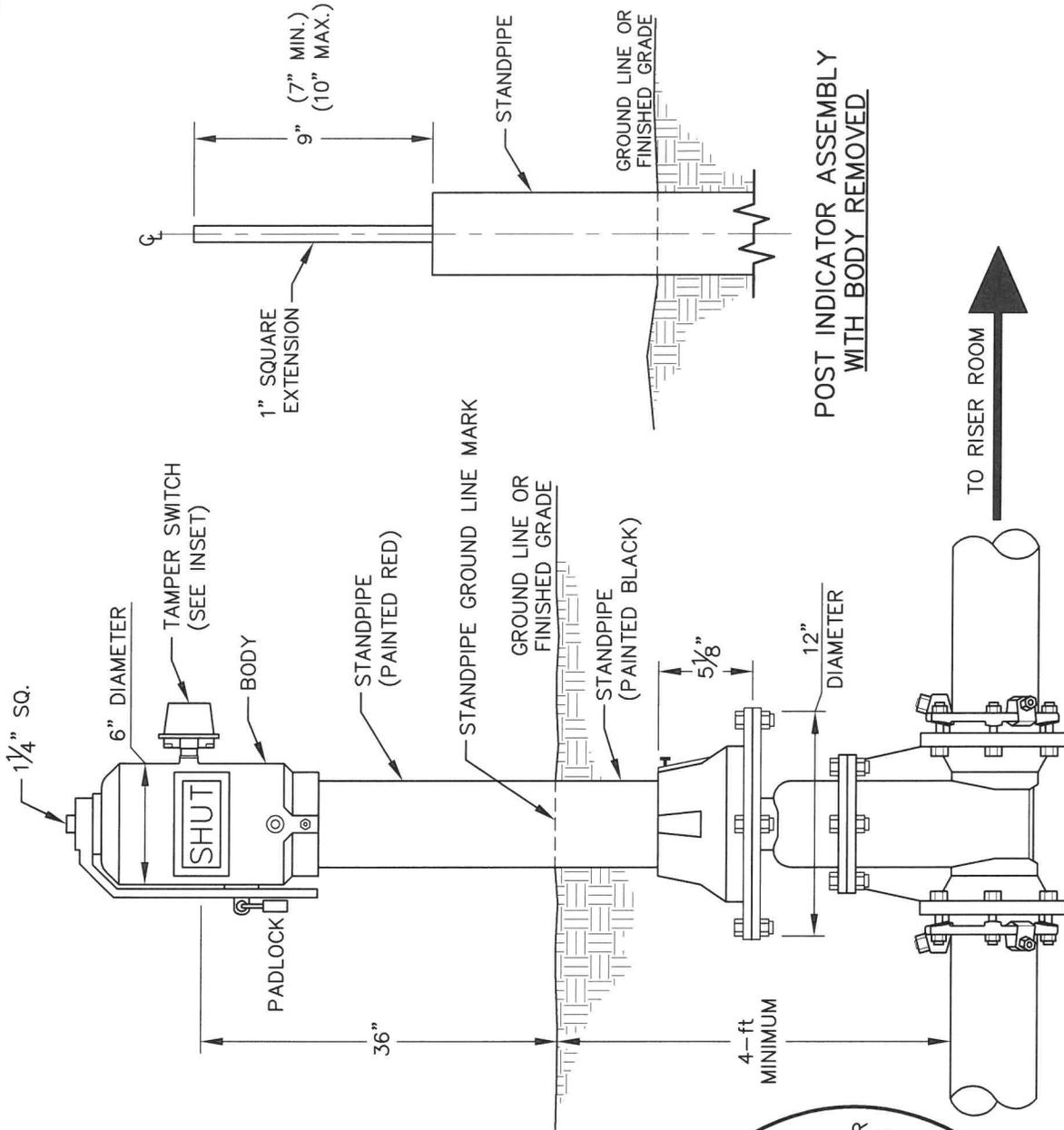
SHEET 2 OF 2



EFFECTIVE:

FIELD ADJUSTMENT INSTRUCTIONS

1. REMOVE THE BODY FROM THE TOP OF THE INDICATOR POST ASSEMBLY.
2. CUT THE REQUIRED LENGTH OFF THE BOTTOM OF THE STANDPIPE FOR THE GROUND LINE TO MATCH UP WITH STANDPIPE GROUND LINE MARK.
3. CUT THE 1" SQ. EXTENSION AT A DISTANCE OF 9" ABOVE THE TOP OF THE STANDPIPE.
4. SET THE "OPEN" AND "SHUT" TARGETS FOR THE APPROPRIATE VALVE SIZE.
5. RE-ATTACH THE BODY TO THE TOP OF THE INDICATOR POST ASSEMBLY.
6. ALL POST INDICATOR VALVES SHALL BE INSTALLED WITH AN ELECTRONIC UL LISTED TAMPER SWITCH.
7. THERE SHALL BE 36" OF UNOBSTRUCTED CLEARANCE AROUND THE PERIMETER OF ALL POST INDICATOR VALVES.
8. POST INDICATOR VALVE SHALL BE LOCATED AT A MINIMUM 5-ft FROM BUILDING.



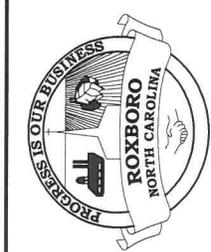
POST INDICATOR ASSEMBLY
WITH BODY REMOVED

STANDARD POST INDICATOR VALVE

DETAIL No.

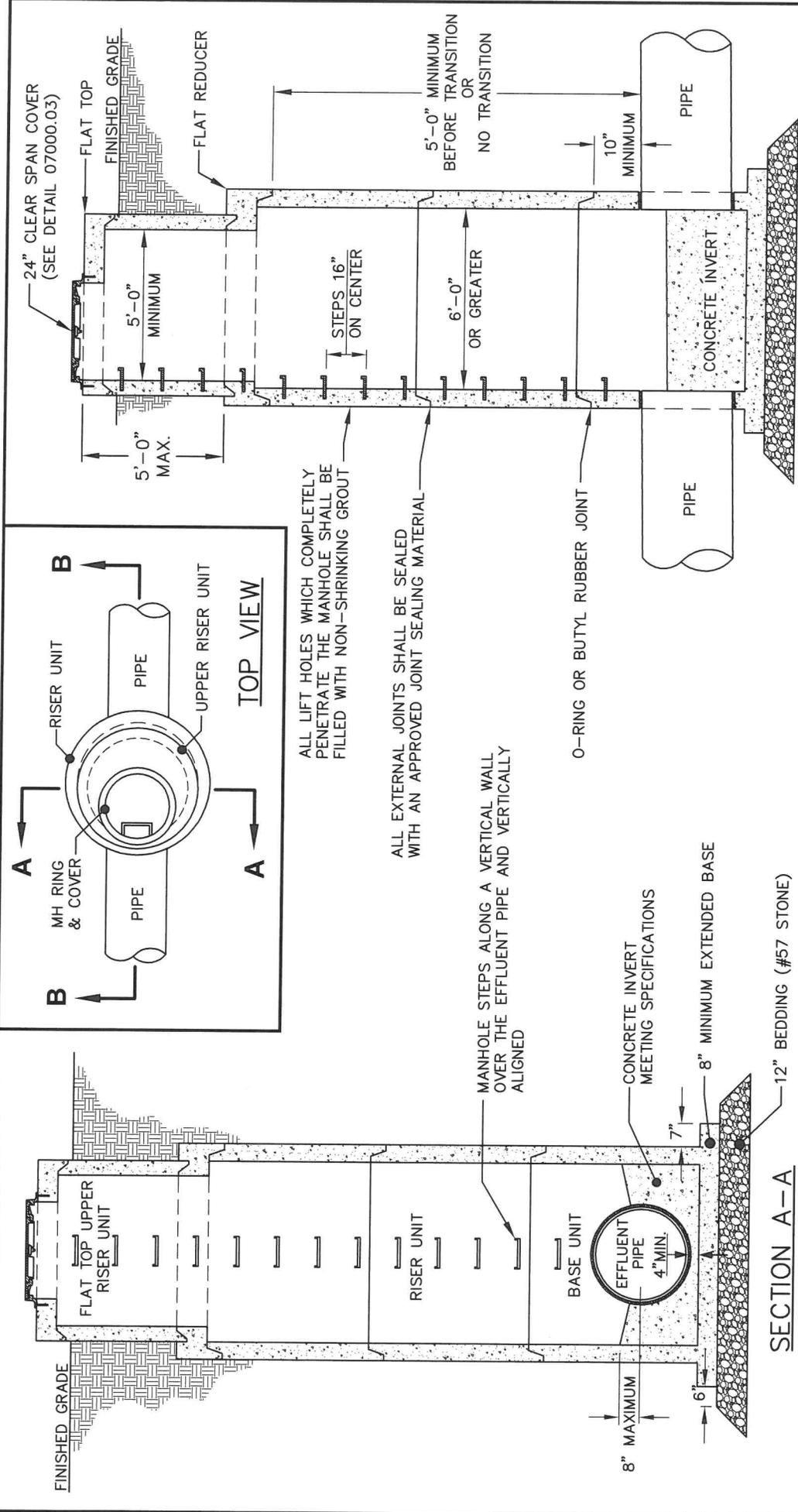
02000.19

SHEET 1 OF 1



EFFECTIVE:

DETAILED DRAWINGS
FOR
WASTEWATER COLLECTION



SECTION B-B

- NOTES:**
1. ALL MANHOLE CONNECTIONS SHALL BE PREFABRICATED OR CORED WITH A CONCRETE CORING MACHINE.
 2. ALL MANHOLES SHALL BE VACUUM TESTED.
 3. EXTENDED BASE REQUIRED FOR ALL MANHOLES WITH MORE THAN 12-FT DEPTH OF BURY.
 4. PROVIDE A MINIMUM 0.1 FOOT IN-OUT DROP FOR STRAIGHT RUNS AND 0.2 FOOT IN-OUT DROP FOR ANGLE RUNS.

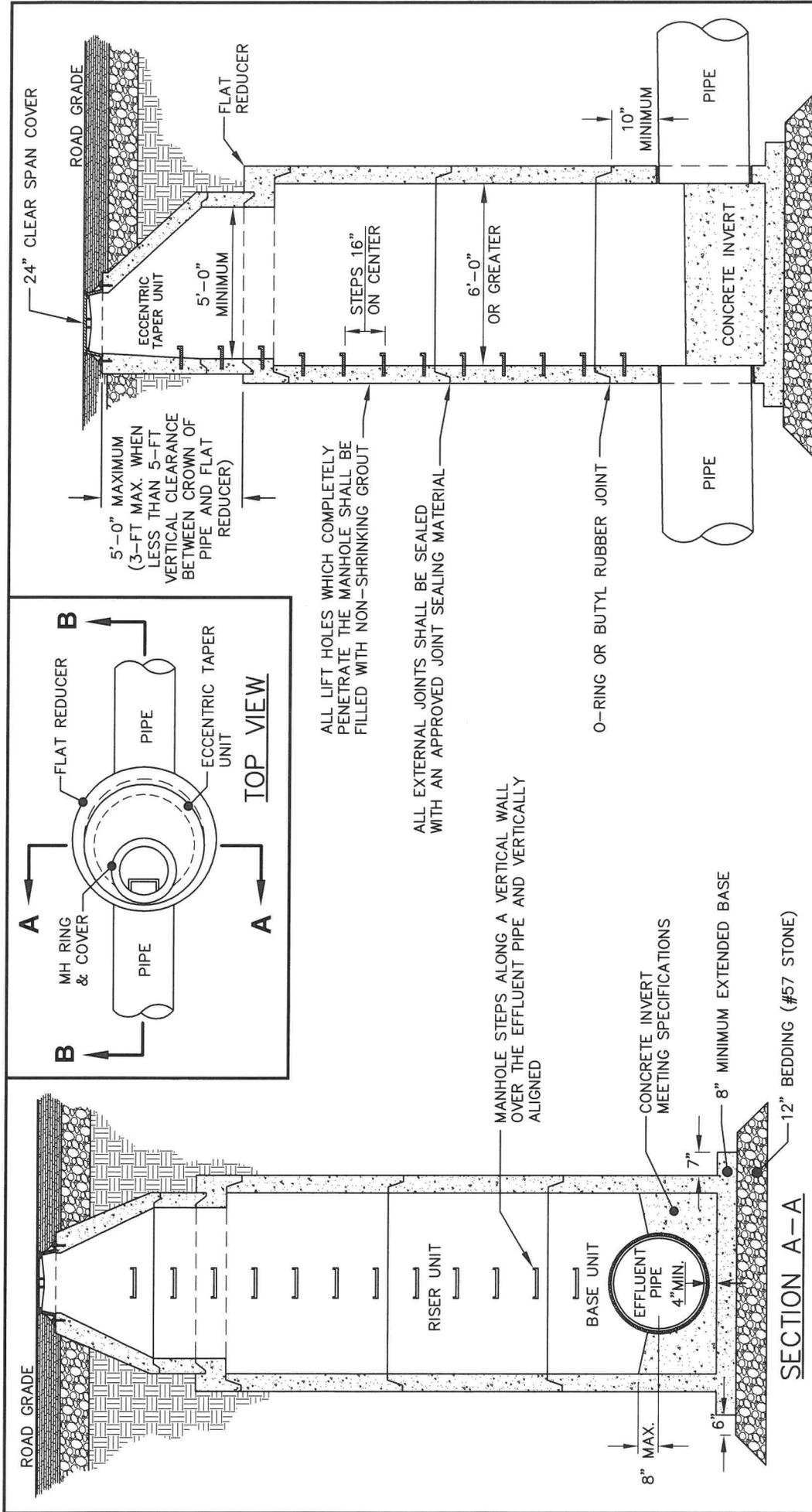
SECTION A-A

DETAIL No.
03000.01
SHEET 2 OF 3

**STANDARD PRECAST CONCRETE MANHOLE
6-FT DIAMETER OR LARGER FOR NON-PAVED AREAS**



EFFECTIVE:



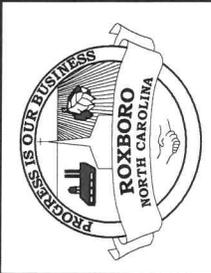
- NOTES:**
1. ALL MANHOLE CONNECTIONS SHALL BE PREFABRICATED OR CORED WITH A CONCRETE CORING MACHINE.
 2. ALL MANHOLES SHALL BE VACUUM TESTED.
 3. EXTENDED BASE REQUIRED FOR ALL MANHOLES WITH MORE THAN 12-FT DEPTH OF BURY.
 4. PROVIDE A MINIMUM 0.1 FOOT IN-OUT DROP FOR STRAIGHT RUNS AND 0.2 FOOT IN-OUT DROP FOR ANGLE RUNS.

SECTION B-B

SECTION A-A

**STANDARD PRECAST CONCRETE MANHOLE
6-FT DIAMETER OR LARGER FOR PAVED AREAS**

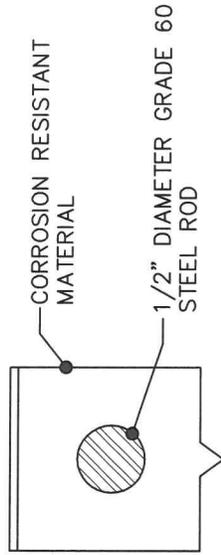
DETAIL No.
03000.01
SHEET 3 OF 3



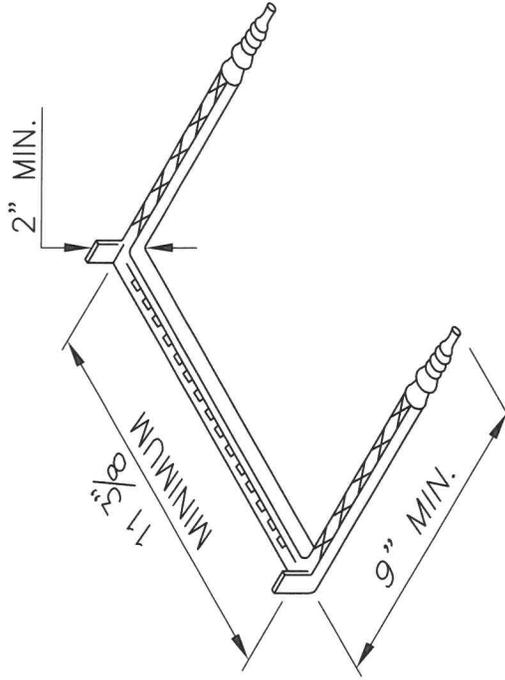
EFFECTIVE:

NOTES:

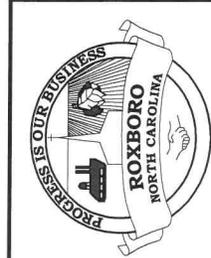
1. VERTICAL SPACING = 12" O.C., ON VERTICAL WALL ONLY.
2. STEPS TO PROTRUDE MINIMUM 5" FROM FACE OF STRUCTURE WALL.
3. STEPS SHALL MEET THE REQUIREMENTS OF ASTM C478 IN ADDITION TO A HORIZONTAL PULL-OUT LOAD OF 1000 LBS. WHEN INSTALLED.
4. ALL STEPS SHALL BE VERTICALLY ALIGNED IN A STRAIGHT LINE.
5. NO STEPS LOCATED INSIDE MANHOLE CHIMNEY.



SECTION VIEW



ENCAPSULATED STEEL STEP



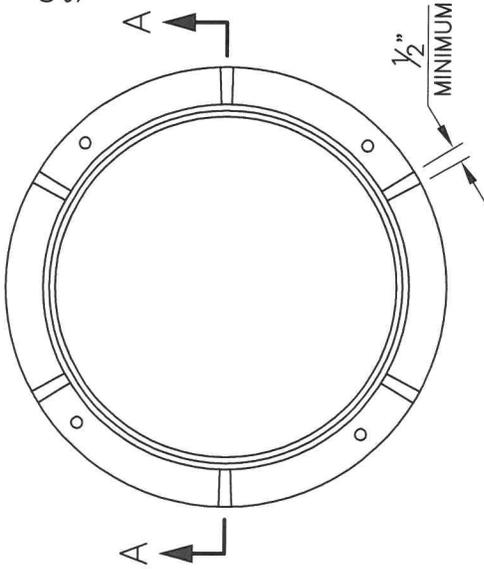
EFFECTIVE:

DETAIL No.

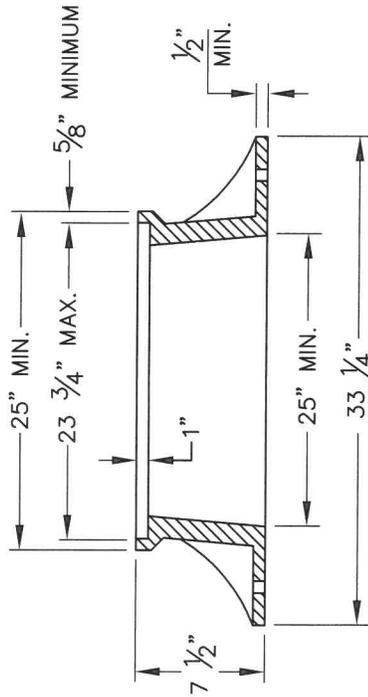
03000.02

SHEET 1 OF 1

MANHOLE STEPS

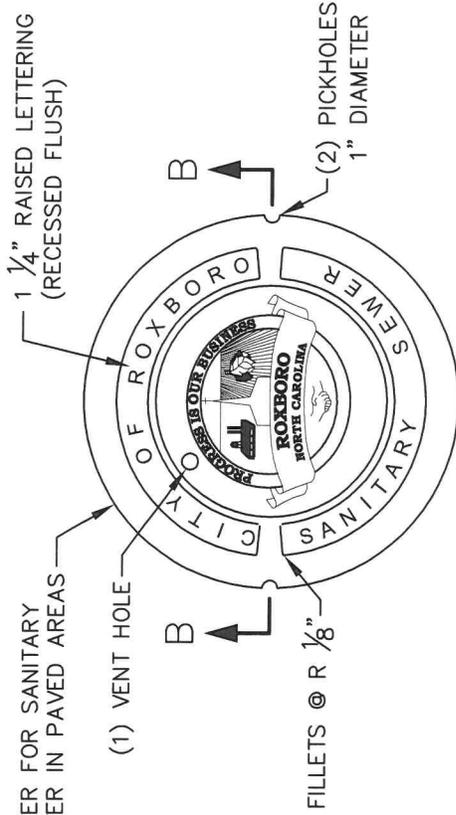


RING TOP VIEW

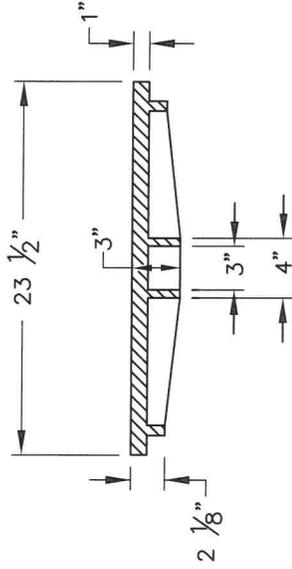


SECTION "A-A"

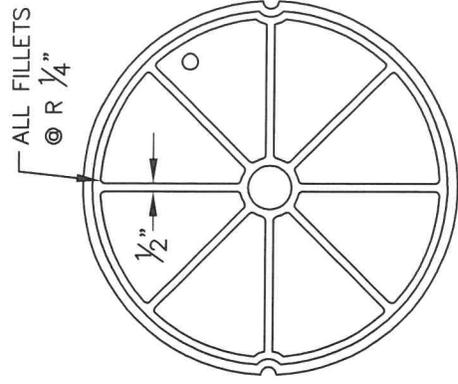
MINIMUM WEIGHTS	
RING	190
COVER	120
TOTAL	310



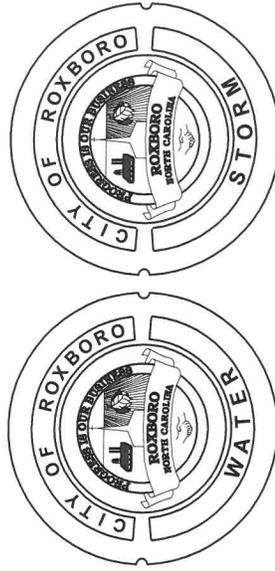
COVER TOP VIEW



SECTION "B-B"



COVER BOTTOM VIEW



ALTERNATE LETTERING

SPECIFICATIONS:

1. CLASS 35 GRAY IRON.
2. COMPLIES WITH ASTM A48 CL35B.
3. ALL LETTERING SHALL BE CLEAN, CRISP, AND CLEARLY LEGIBLE.
4. DOMESTICALLY MADE & MANUFACTURED IN THE USA.



EFFECTIVE:

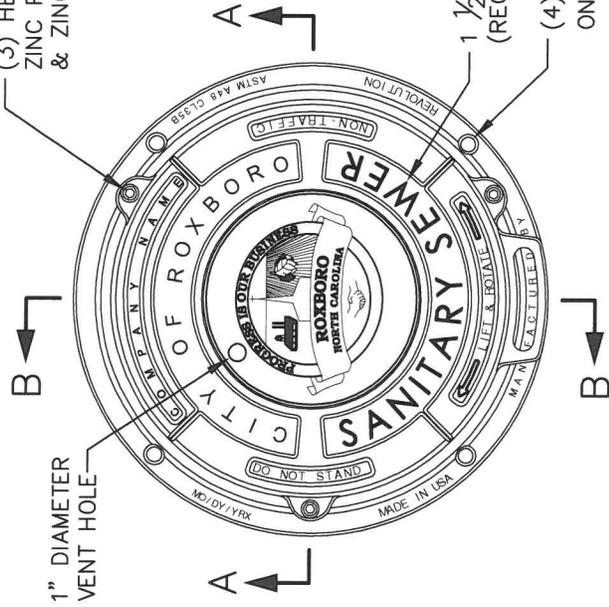
**STANDARD MANHOLE RING AND COVER
(TYPE 1 PAVED AREAS)**

DETAIL No.

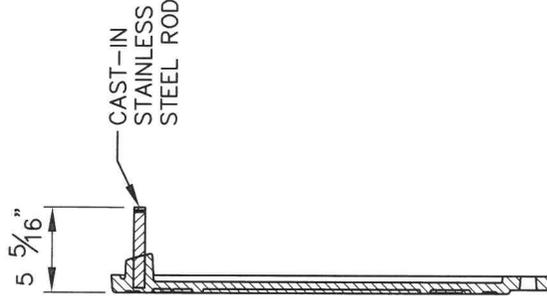
03000.03

SHEET 1 OF 4

(3) HEX HEAD $\frac{3}{8}$ "-16
ZINC PLATED BOLT WITH ZINC WASHER
& ZINC COATED STAINLESS STEEL NUT



- SPECIFICATIONS:**
1. GRAY IRON.
 2. COMPLIES WITH ASTM A48 CL35B.
 3. ALL LETTERING SHALL BE CLEAN, CRISP, AND CLEARLY LEGIBLE.
 4. DOMESTICALLY MADE AND MANUFACTURED IN THE USA.

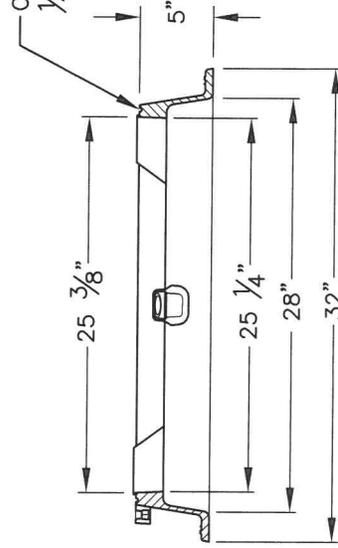


COVER SECTION
B-B

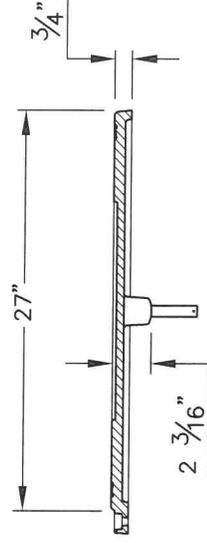
FRAME SECTION
B-B

COVER TOP VIEW

OPTIONAL CAST-IN GROOVE FOR
 $\frac{1}{4}$ " DIAMETER NEOPRENE GASKET

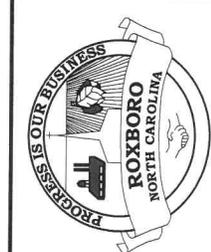


FRAME SECTION
A-A



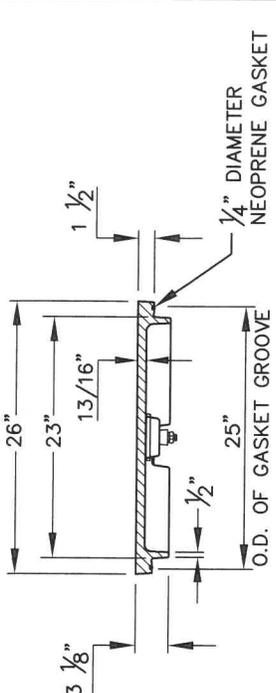
COVER SECTION
A-A

**STANDARD MANHOLE RING AND COVER (TYPE 2B FOR OUTFALLS
OR UNPAVED AREAS - NON-WATERTIGHT APPLICATIONS)**

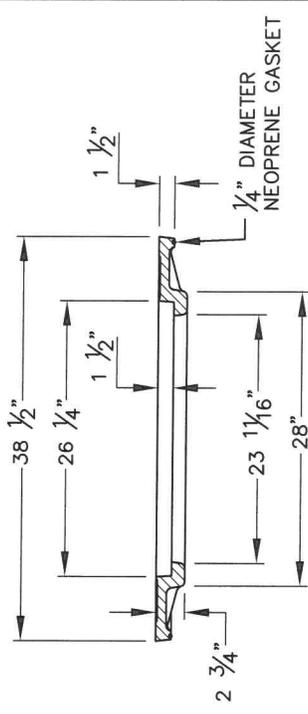


EFFECTIVE:

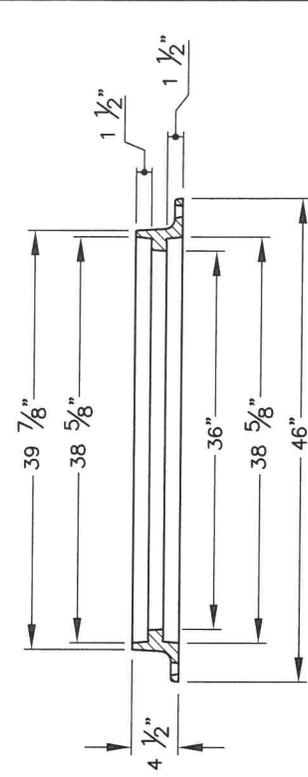
DETAIL No.
03000.03
SHEET 3 OF 4



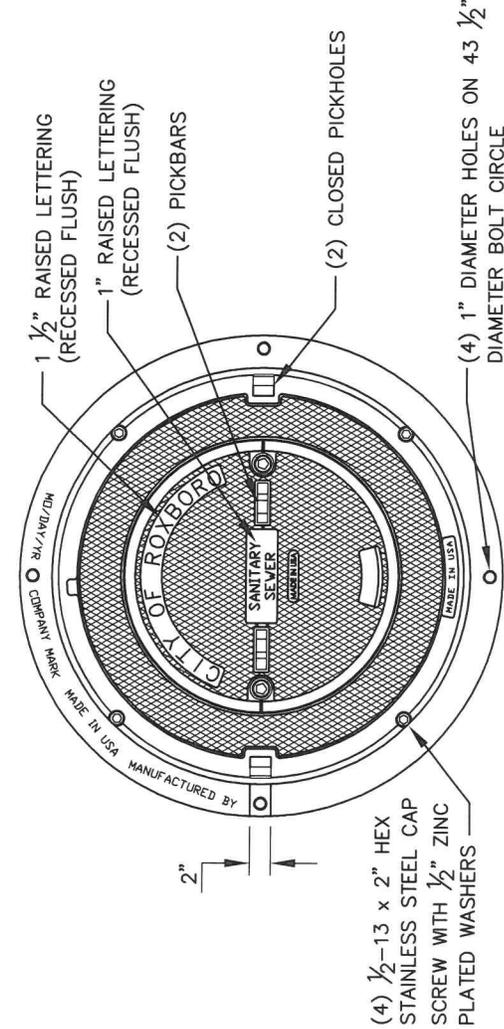
INNER COVER SECTION



OUTER COVER SECTION

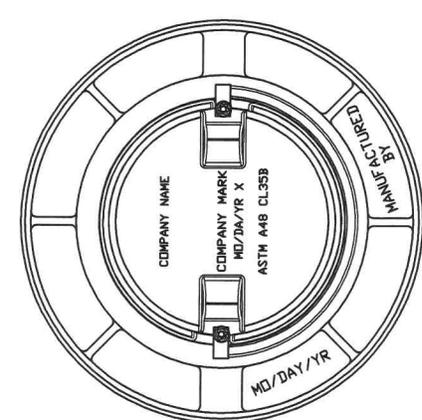


FRAME SECTION

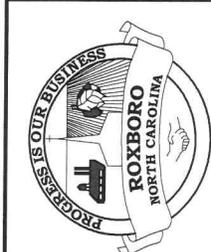


PLAN VIEW

SPECIFICATIONS:
 1. GRAY IRON.
 2. COMPLIES WITH ASTM A48 CL35B.
 3. ALL LETTERING SHALL BE CLEAN, CRISP, AND CLEARLY LEGIBLE.
 4. DOMESTICALLY MADE AND MANUFACTURED IN THE USA.



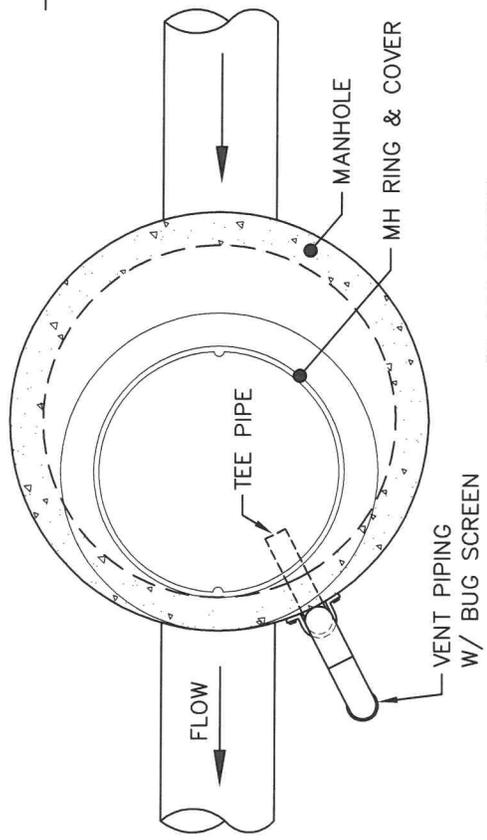
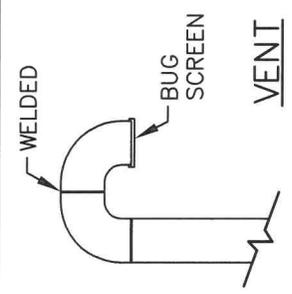
BOTTOM VIEW COVERS



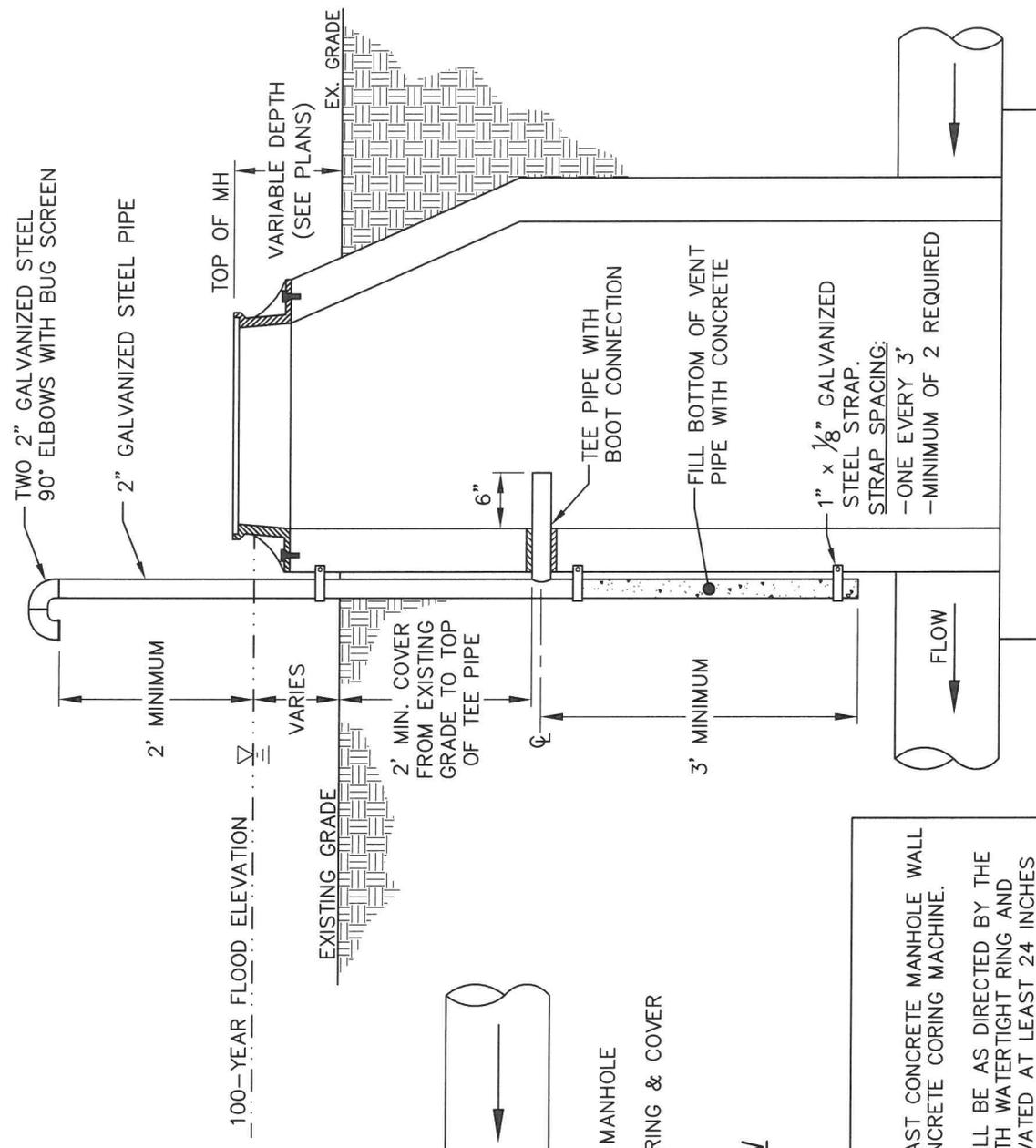
EFFECTIVE:

DETAIL No.
 03000.03
 SHEET 4 OF 4

**STANDARD MANHOLE RING AND COVER
 (TYPE 3 FOR 6' DIAMETER AND GREATER MANHOLES)**



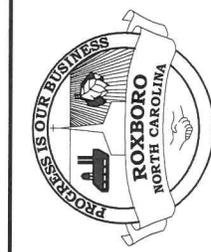
PLAN VIEW



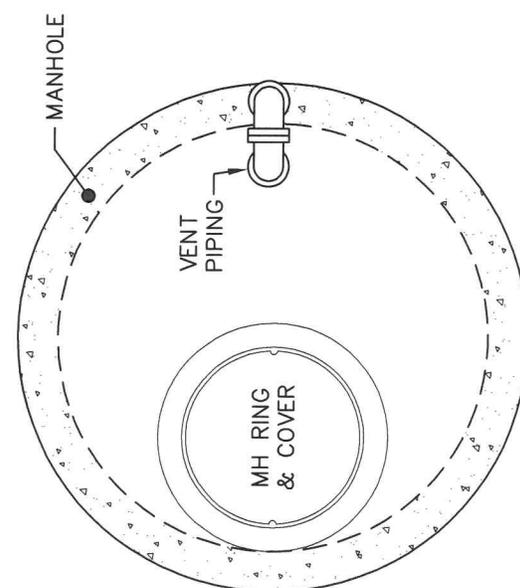
- NOTES:
1. VENT PIPE OPENING IN PRECAST CONCRETE MANHOLE WALL SHALL BE CORED WITH A CONCRETE CORING MACHINE.
 2. LOCATION OF VENT PIPE SHALL BE AS DIRECTED BY THE CONSTRUCTION INSPECTOR WITH WATERTIGHT RING AND COVER VENT TOP TO BE ELEVATED AT LEAST 24 INCHES ABOVE THE 100 YEAR FLOOD PLAIN ELEVATION.

DETAIL No.
03000.04
SHEET 1 OF 2

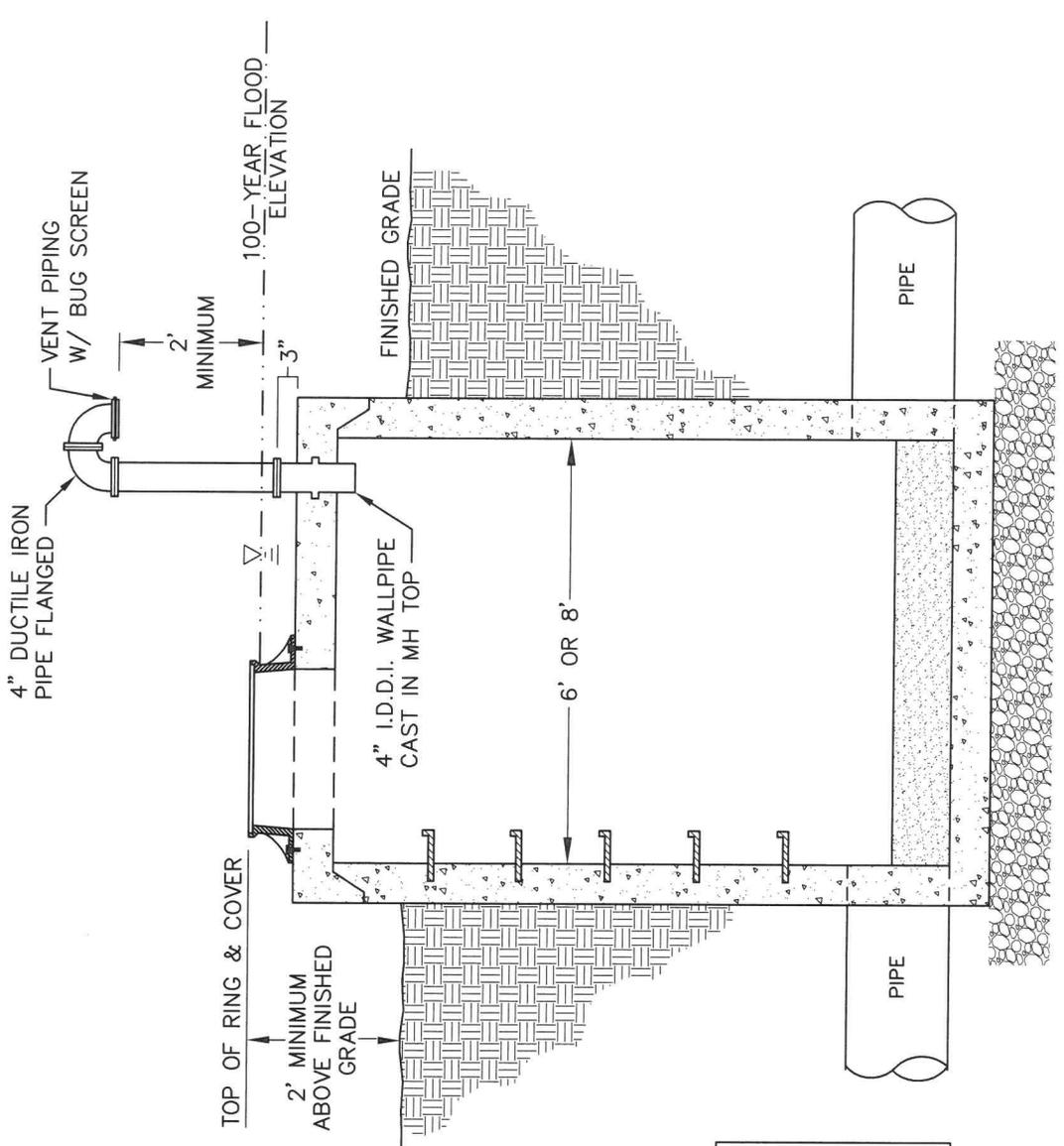
STANDARD MANHOLE VENT



EFFECTIVE:

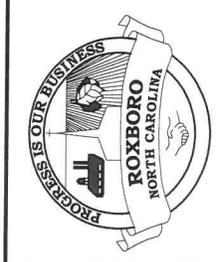


PLAN VIEW



ELEVATION VIEW

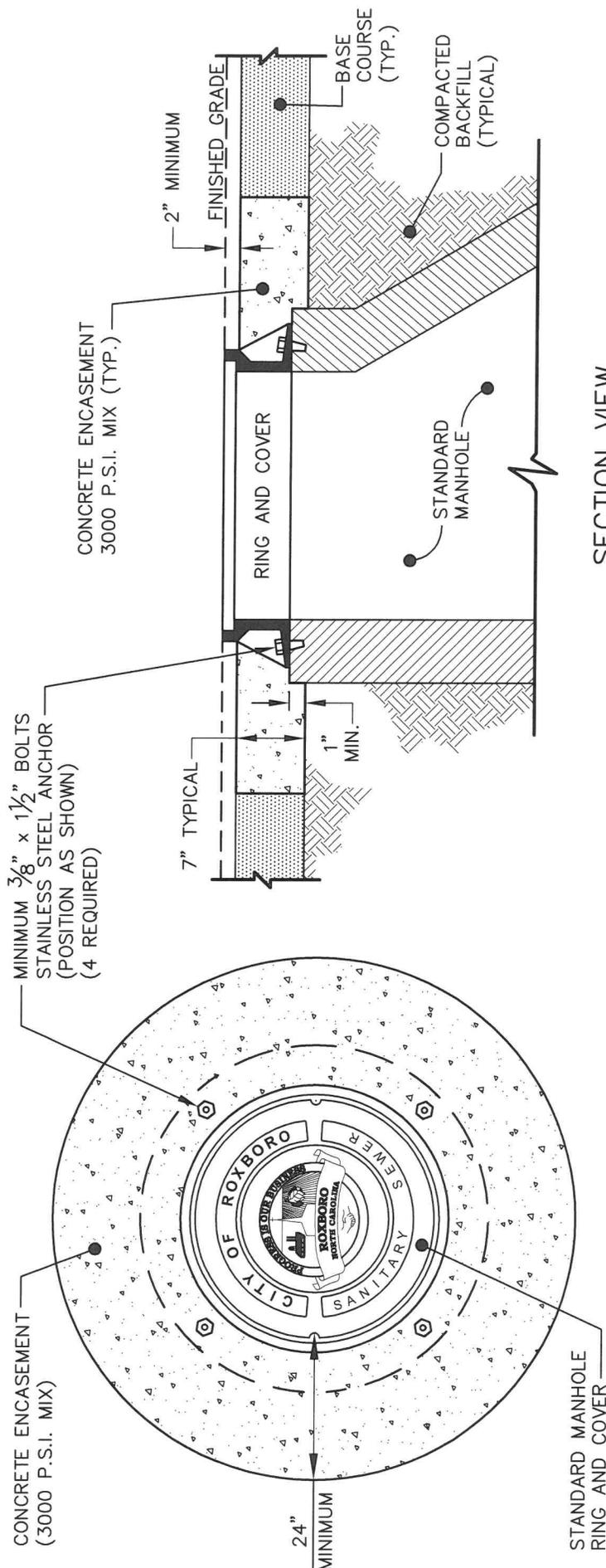
- NOTES:**
1. VENT PIPE OPENING IN PRECAST CONCRETE MANHOLE WALL SHALL BE CORED WITH A CONCRETE CORING MACHINE.
 2. LOCATION OF VENT PIPE SHALL BE AS DIRECTED BY THE CONSTRUCTION INSPECTOR WITH WATERTIGHT RING AND COVER VENT TOP TO BE ELEVATED AT LEAST 24 INCHES ABOVE THE 100 YEAR FLOOD PLAIN ELEVATION.



EFFECTIVE:

DETAIL No.
03000.04
SHEET 2 OF 2

STANDARD MANHOLE VENT WITH FLAT TOP MANHOLE

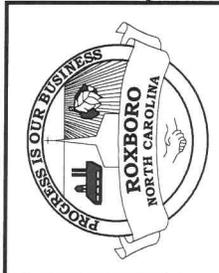


PLAN VIEW

SECTION VIEW

NOTES:

1. MANHOLE RING TO BE BOLTED AS SHOWN W/ ROPE MASTIC SEAL BETWEEN FRAME & SPACER.
2. INSURE CONCRETE ENCASUREMENT FORMS BOND AROUND LIP OF MANHOLE TOP.



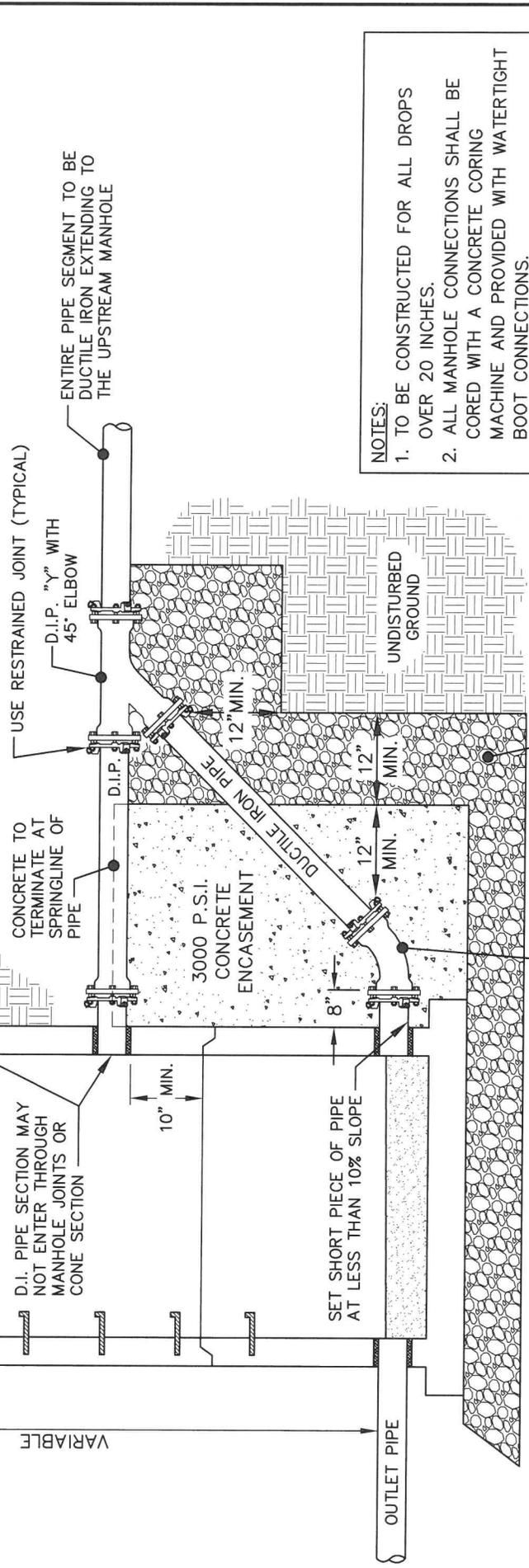
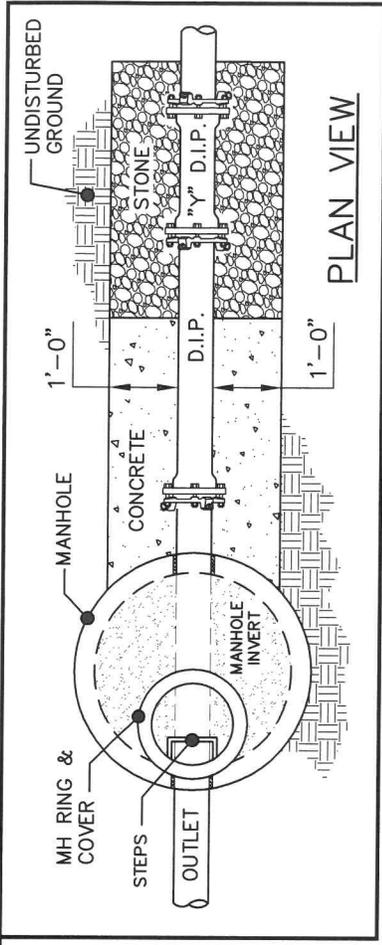
EFFECTIVE:

STANDARD MANHOLE RING AND COVER ENCASUREMENT

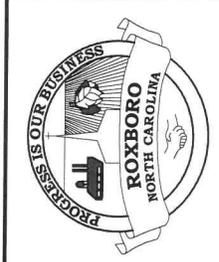
DETAIL No.

03000.05

SHEET 1 OF 1



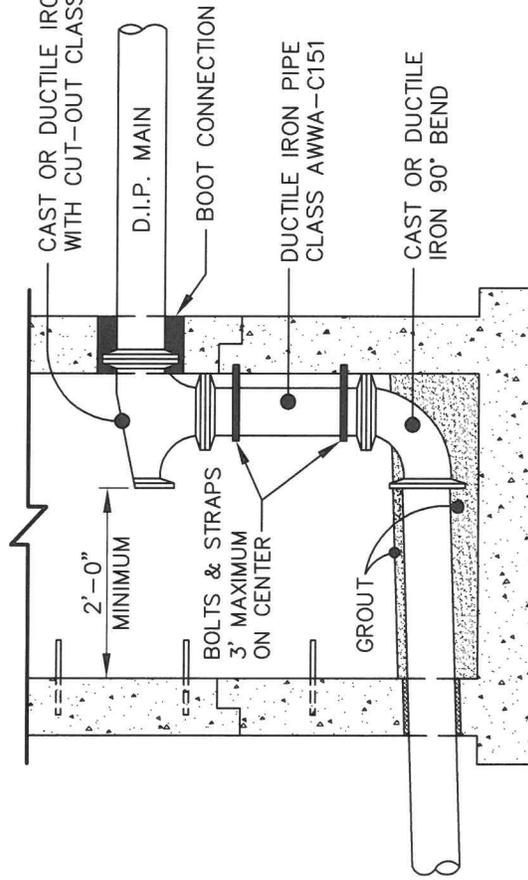
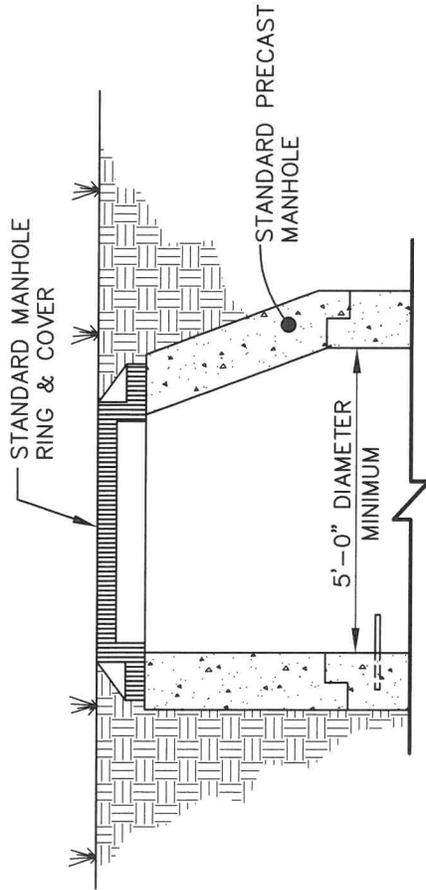
- NOTES:**
1. TO BE CONSTRUCTED FOR ALL DROPS OVER 20 INCHES.
 2. ALL MANHOLE CONNECTIONS SHALL BE CORED WITH A CONCRETE CORING MACHINE AND PROVIDED WITH WATERTIGHT BOOT CONNECTIONS.
 3. APPROVED PRECAST DROP MANHOLES MAY BE USED.



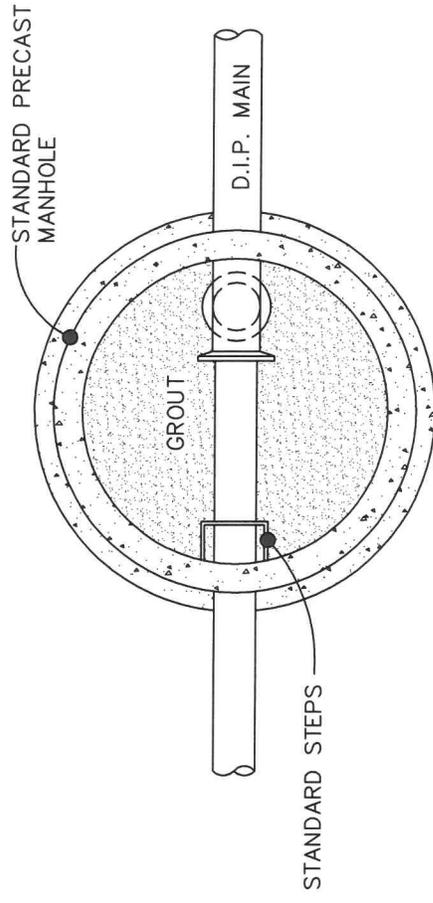
EFFECTIVE:

STANDARD OUTSIDE DROP MANHOLE

DETAIL No.
03000.06
SHEET 1 OF 1



SECTION



PLAN VIEW

NOTES:

1. INSIDE DROP MANHOLES SHALL ONLY BE ALLOWED BY WRITTEN PERMISSION.
2. ONE INSIDE DROP ALLOWED FOR 5' MANHOLE. A LARGER MANHOLE WILL BE REQUIRED FOR MORE.
3. PIPE SIZE FOR DROP TO EQUAL INFLOW SEWER PIPE SIZE.
4. MECHANICAL JOINT OR PUSH-ON FITTINGS, ALL BELL, TO BE USED.
5. SAW-CUT OR DRILL ALL HOLES FOR PIPE AND BOLTS.
6. DROP MANHOLE MANDATORY WHEN DIFFERENTIAL BETWEEN INVERTS IS GREATER THAN 20 INCHES.
7. STAINLESS STEEL STRAPS SHALL BE USED ON ALL DROPS GREATER THAN 5 FEET AT 18 INCH INTERVALS.

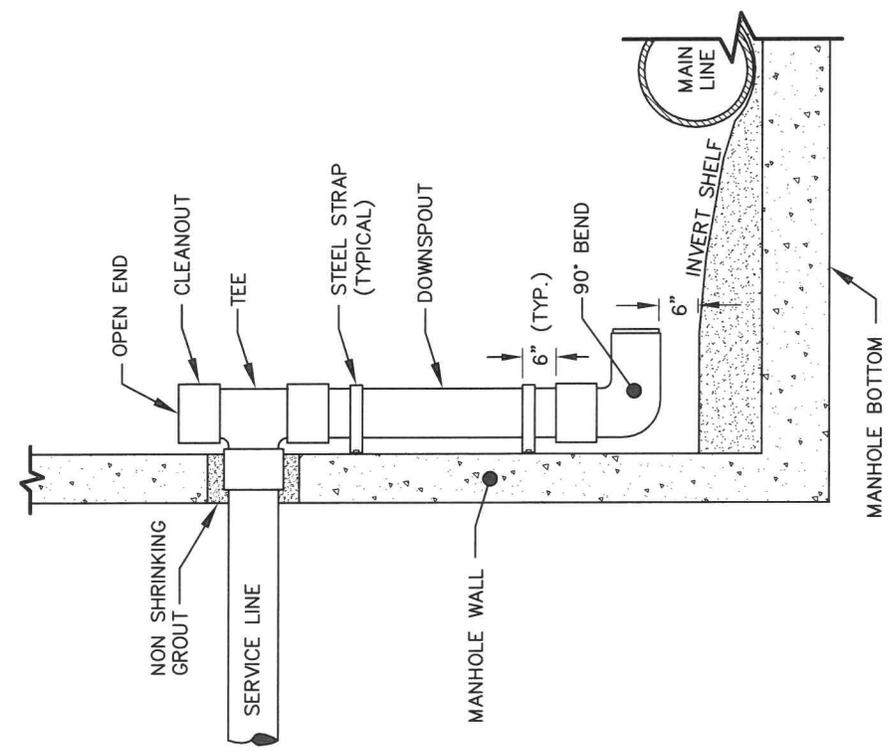
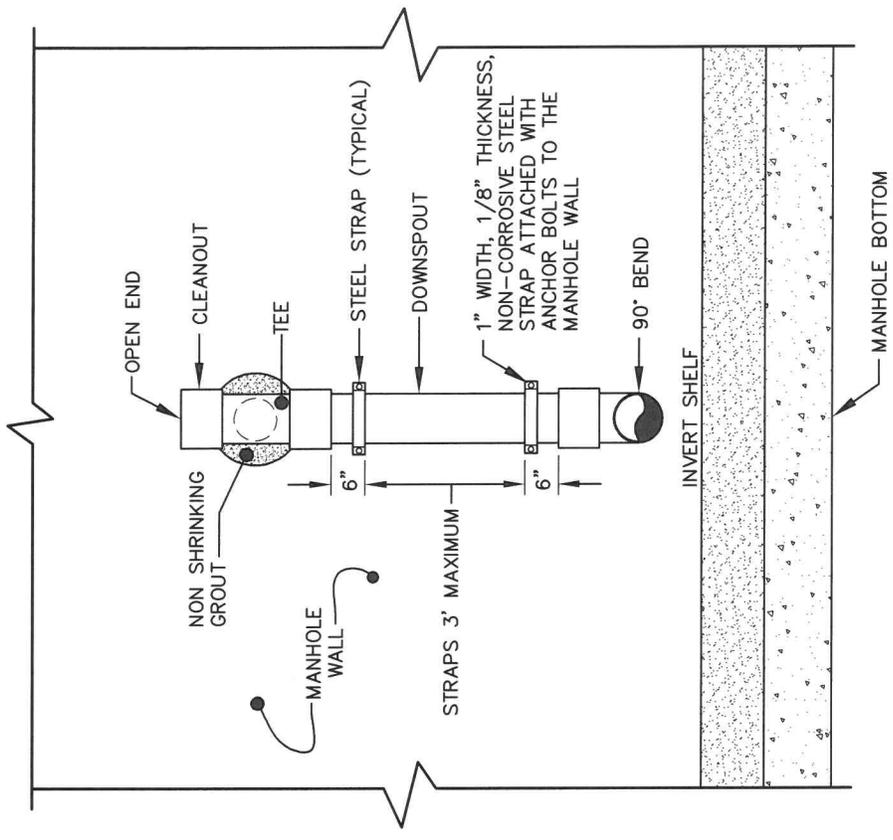
PROGRESS IS OUR BUSINESS

ROXBORO
NORTH CAROLINA

EFFECTIVE:

STANDARD INSIDE DROP MANHOLE

DETAIL No.	03000.07
	SHEET 1 OF 1



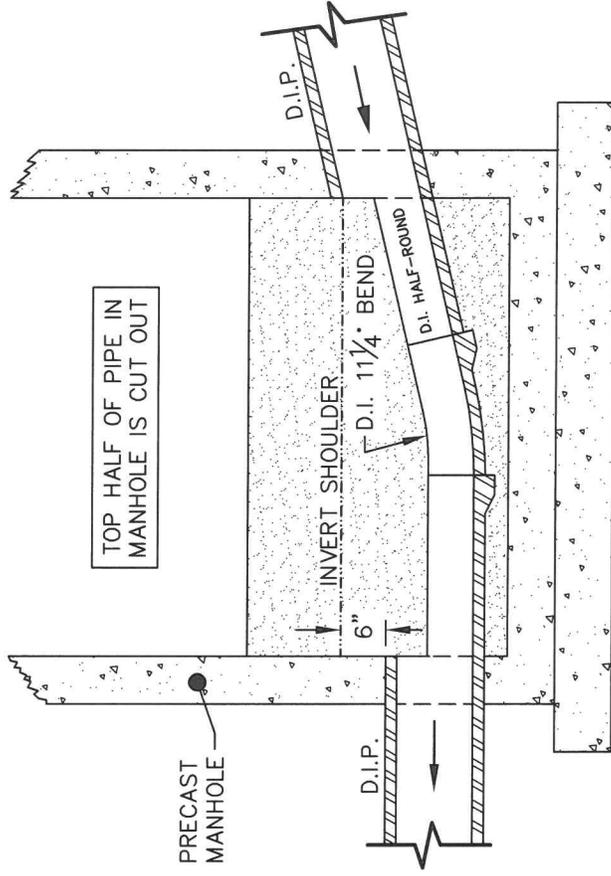
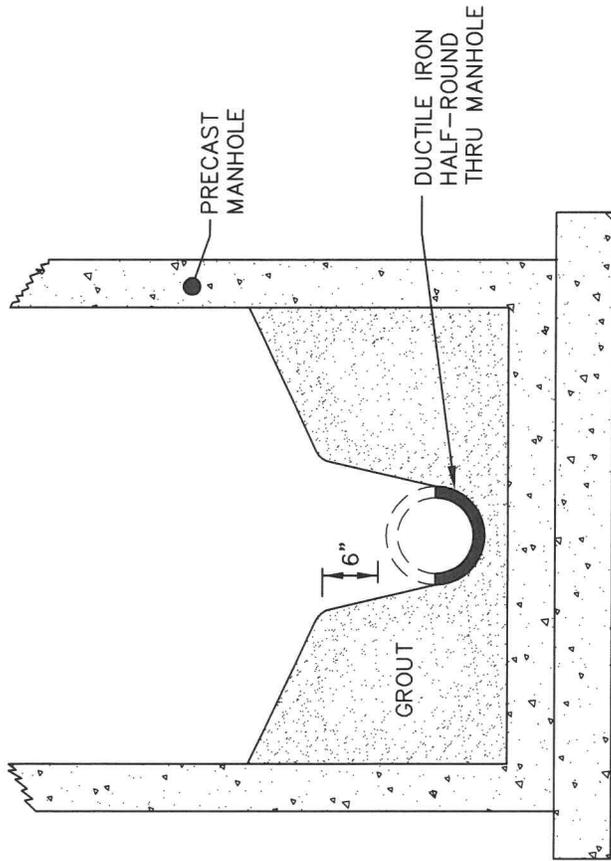
- NOTES:**
1. PIPING CONFIGURATION TO BE USED ON ALL DROPS OVER 20 INCHES.
 2. DROPS TO BE CONSTRUCTED OF DUCTILE IRON OR SCH. 80 PVC PIPE.
 3. SERVICE LINE MAY NOT ENTER MANHOLE THROUGH CONE SECTION OR ITS JOINT.
 4. THIS DETAIL SHALL NOT BE USED FOR FORCE MAINS.

DETAIL No.
03000.08
SHEET 1 OF 1

STANDARD INSIDE DROP FOR SANITARY SEWER SERVICE

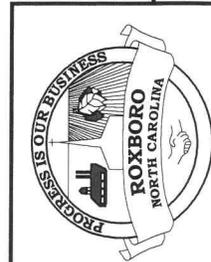


EFFECTIVE:



NOTES:

1. NO HORIZONTAL ALIGNMENT CHANGE CAN BE MADE WITHIN THIS MANHOLE TYPE. USE ON GRADES OF 10% OR GREATER.
2. EACH JOINT OF PIPE BETWEEN HIGH VELOCITY MANHOLE & MANHOLE UPGRADE SHALL HAVE A THRUST COLLAR (SEE STANDARD DETAIL 06000.14).



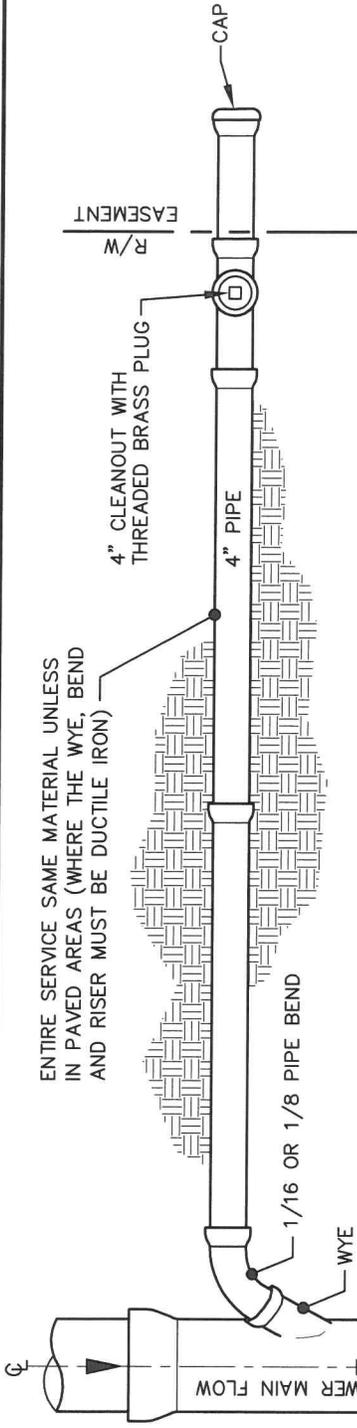
EFFECTIVE:

STANDARD HIGH VELOCITY MANHOLE INVERT

DETAIL No.

03000.09

SHEET 1 OF 1

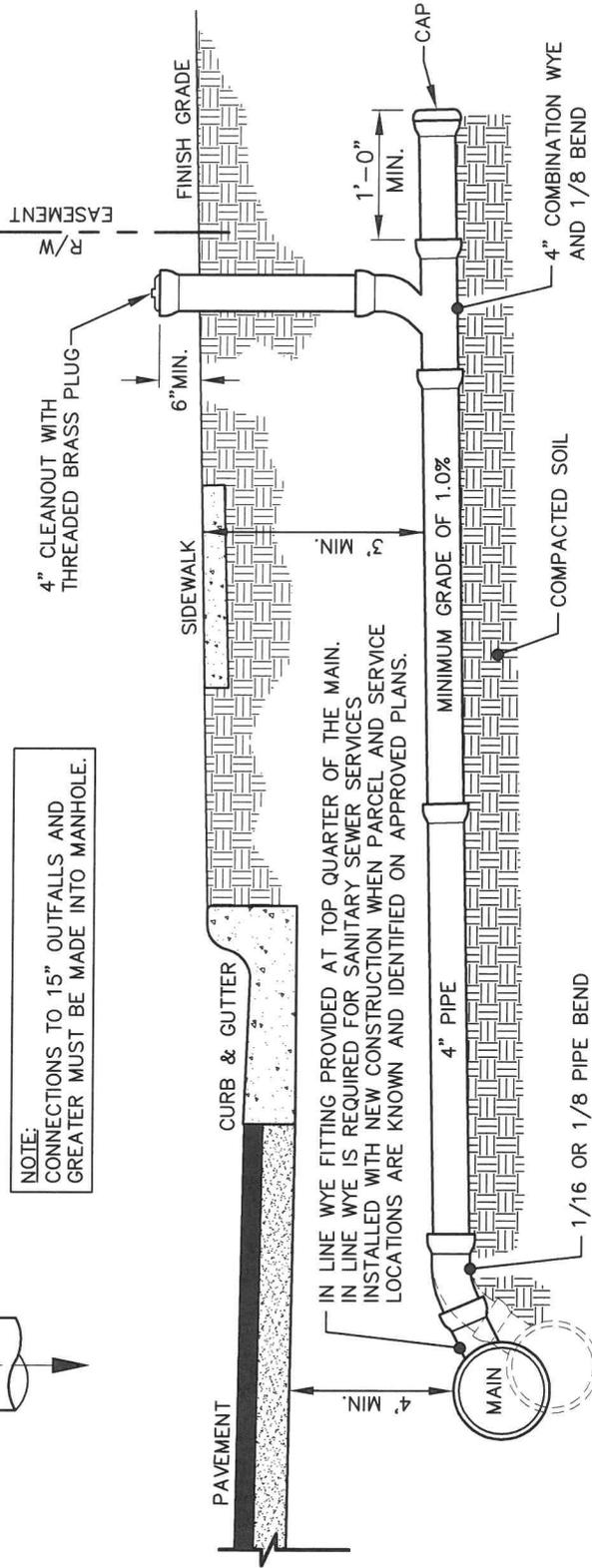


ENTIRE SERVICE SAME MATERIAL UNLESS
IN PAVED AREAS (WHERE THE WYE, BEND
AND RISER MUST BE DUCTILE IRON)

OVERHEAD PIPE VIEW

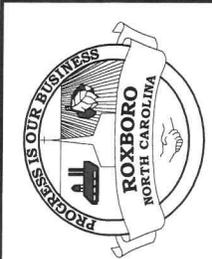
NOTES:
1) CLEANOUT SHALL BE PLACED AT
RIGHT-OF-WAY OR EDGE OF EASEMENT.
2) DO NOT INSTALL C.O. INSIDE A FENCE.

NOTE:
CONNECTIONS TO 15" OUTFALLS AND
GREATER MUST BE MADE INTO MANHOLE.



IN LINE WYE FITTING PROVIDED AT TOP QUARTER OF THE MAIN.
IN LINE WYE IS REQUIRED FOR SANITARY SEWER SERVICES
INSTALLED WITH NEW CONSTRUCTION WHEN PARCEL AND SERVICE
LOCATIONS ARE KNOWN AND IDENTIFIED ON APPROVED PLANS.

SECTION VIEW



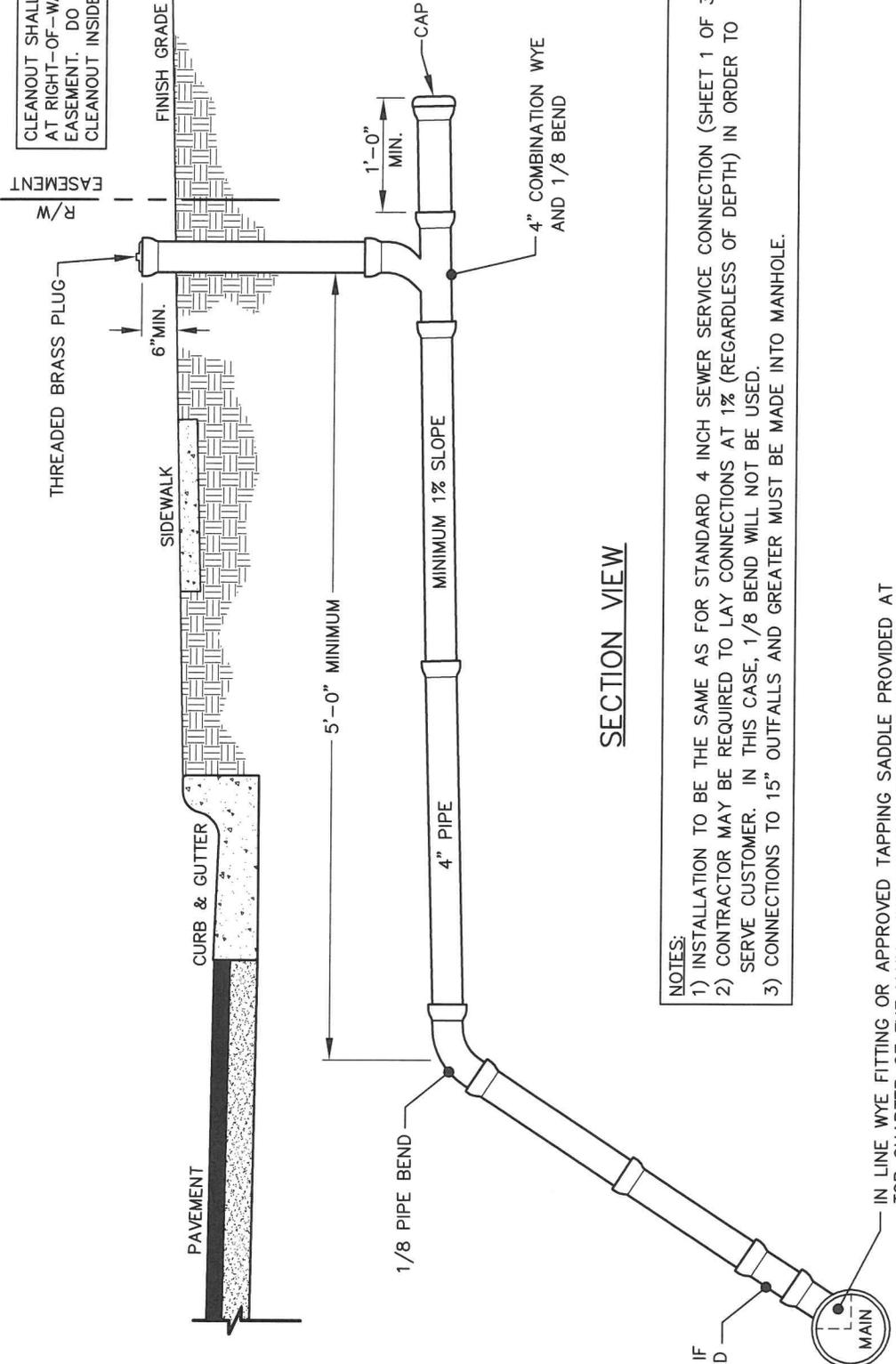
EFFECTIVE:

STANDARD 4 INCH SANITARY SEWER SERVICE WITH TAP

DETAIL No.

03000.10
SHEET 1 OF 3

CLEANOUT SHALL BE PLACED AT RIGHT-OF-WAY OR EDGE OF EASEMENT. DO NOT INSTALL CLEANOUT INSIDE A FENCE.

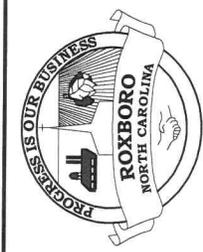


SECTION VIEW

- NOTES:**
- 1) INSTALLATION TO BE THE SAME AS FOR STANDARD 4 INCH SEWER SERVICE CONNECTION (SHEET 1 OF 3).
 - 2) CONTRACTOR MAY BE REQUIRED TO LAY CONNECTIONS AT 1% (REGARDLESS OF DEPTH) IN ORDER TO SERVE CUSTOMER. IN THIS CASE, 1/8 BEND WILL NOT BE USED.
 - 3) CONNECTIONS TO 15" OUTFALLS AND GREATER MUST BE MADE INTO MANHOLE.

IN LINE WYE FITTING OR APPROVED TAPPING SADDLE PROVIDED AT TOP QUARTER OF THE MAIN. IN LINE WYE IS REQUIRED FOR SANITARY SEWER SERVICES INSTALLED WITH NEW CONSTRUCTION WHEN PARCEL AND SERVICE LOCATIONS ARE KNOWN AND IDENTIFIED ON APPROVED PLANS.

1/16 BEND IF WYE IS USED



EFFECTIVE:

DETAIL No.
03000.10
SHEET 2 OF 3

DEEP 4 INCH SANITARY SEWER SERVICE WITH TAP

CLEANOUT SHALL BE PLACED AT RIGHT-OF-WAY OR EDGE OF EASEMENT. DO NOT INSTALL CLEANOUT INSIDE A FENCE.

R/W
EASEMENT

THREADED BRASS PLUG
6" MIN.

FINISH GRADE

STANDARD PRECAST MANHOLE

RISER STACK MAY BE 4"

6" TO NO MORE THAN 30" ABOVE INVERT.
FOR CONNECTIONS TO 15" AND LARGER MAINS PLACE SERVICE INVERT AT CROWN ELEVATION OF MAIN.

SLOPE FOR 4" PIPE IS 1% MINIMUM.
SLOPE FOR 6" PIPE IS 0.6%.

1'-0" MIN.

PVC CAP

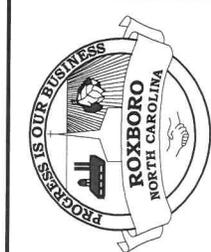
COMBINATION WYE AND 1/8 BEND

FLEXIBLE CONNECTOR

SECTION VIEW

CONCRETE TROUGH TO BE BUILT TO DIRECT FLOW FROM 6" CONNECTION TO EFFLUENT PIPE

NOTES:
1) INSTALLATION TO BE THE SAME AS FOR STANDARD 4 INCH SEWER SERVICE CONNECTION (SHEET 1 OF 3).
2) ALL 6 INCH SEWER SERVICES MUST GO TO A MANHOLE.

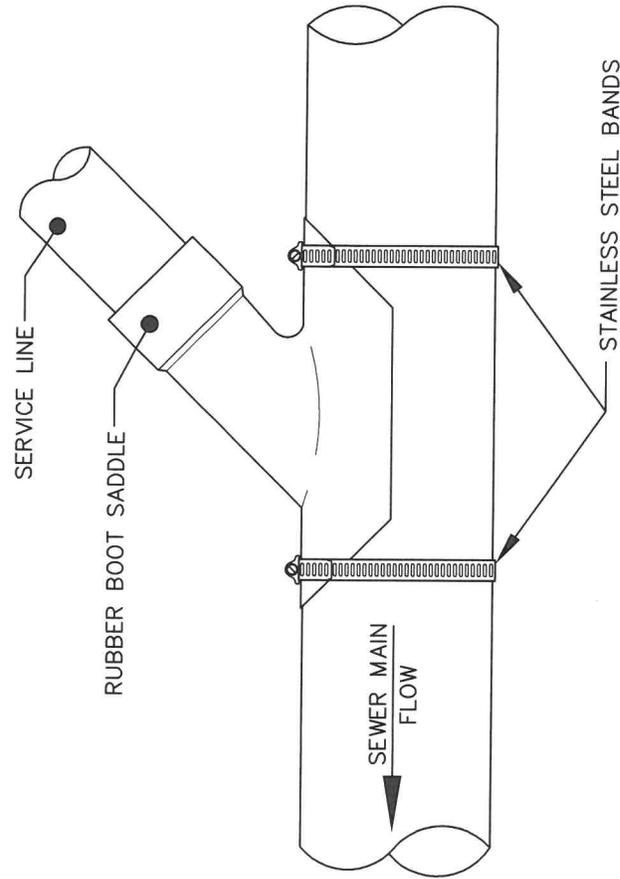


EFFECTIVE:

DETAIL No.

03000.10
SHEET 3 OF 3

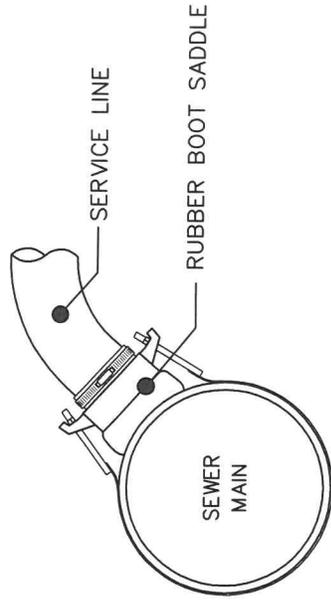
STANDARD SANITARY SEWER SERVICE MANHOLE TAP



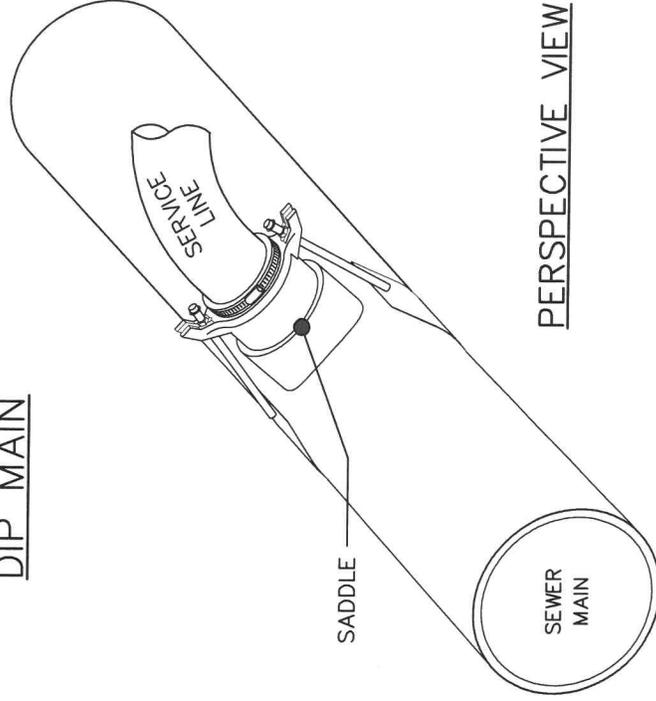
PVC MAIN

NOTES:

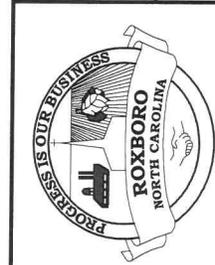
- 1) TRUSS SADDLES SHALL BE USED WITH TRUSS PIPE.
- 2) IN-LINE WYE FITTING TO BE PROVIDED WITH NEW CONSTRUCTION.



DIP MAIN



PERSPECTIVE VIEW



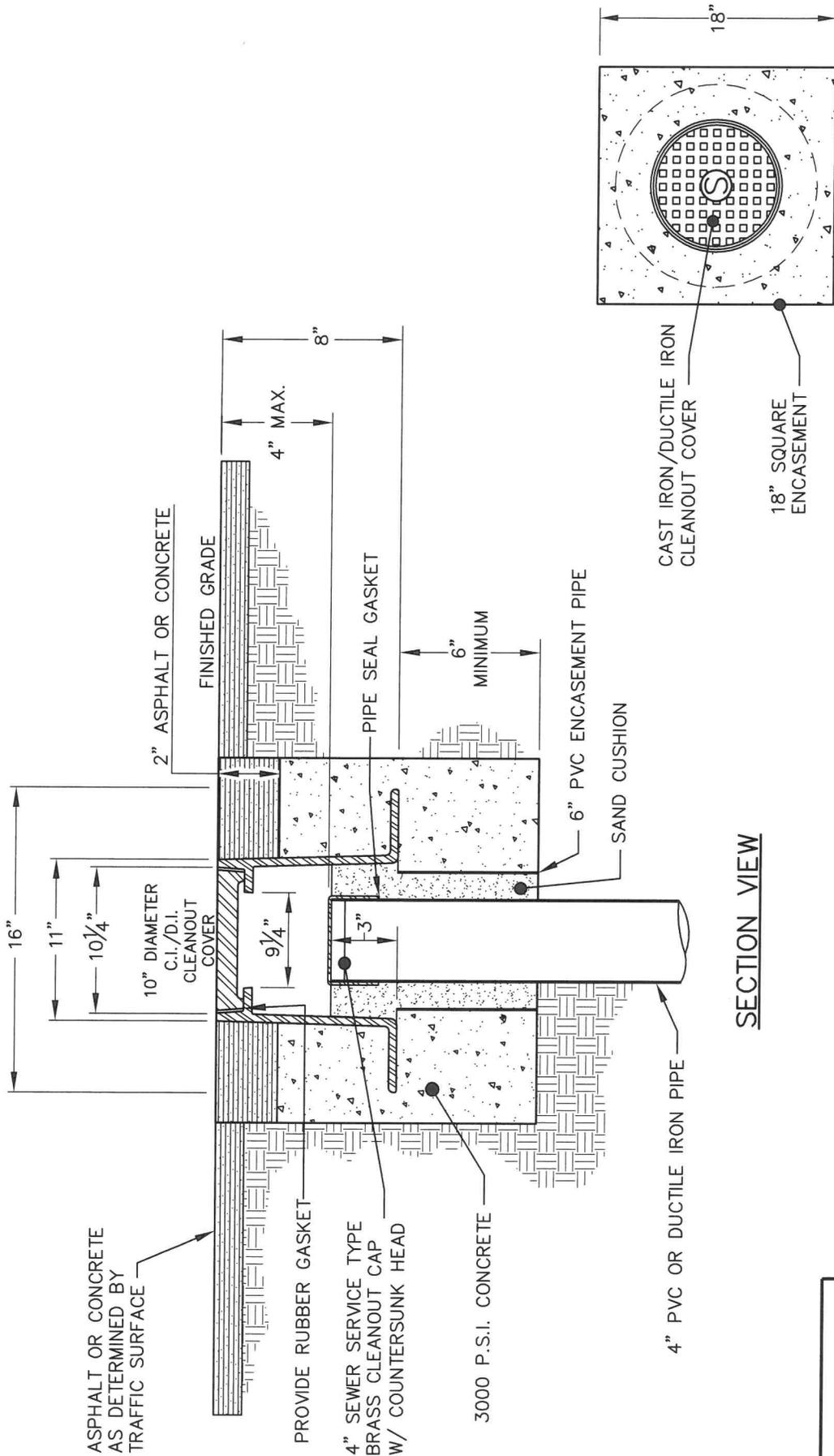
EFFECTIVE:

SANITARY SEWER LATERAL SADDLE CONNECTION TO EXISTING MAIN

DETAIL No.

03000.11

SHEET 1 OF 1

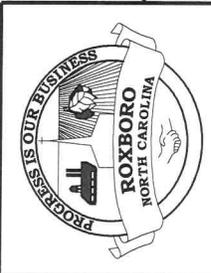


PLAN VIEW

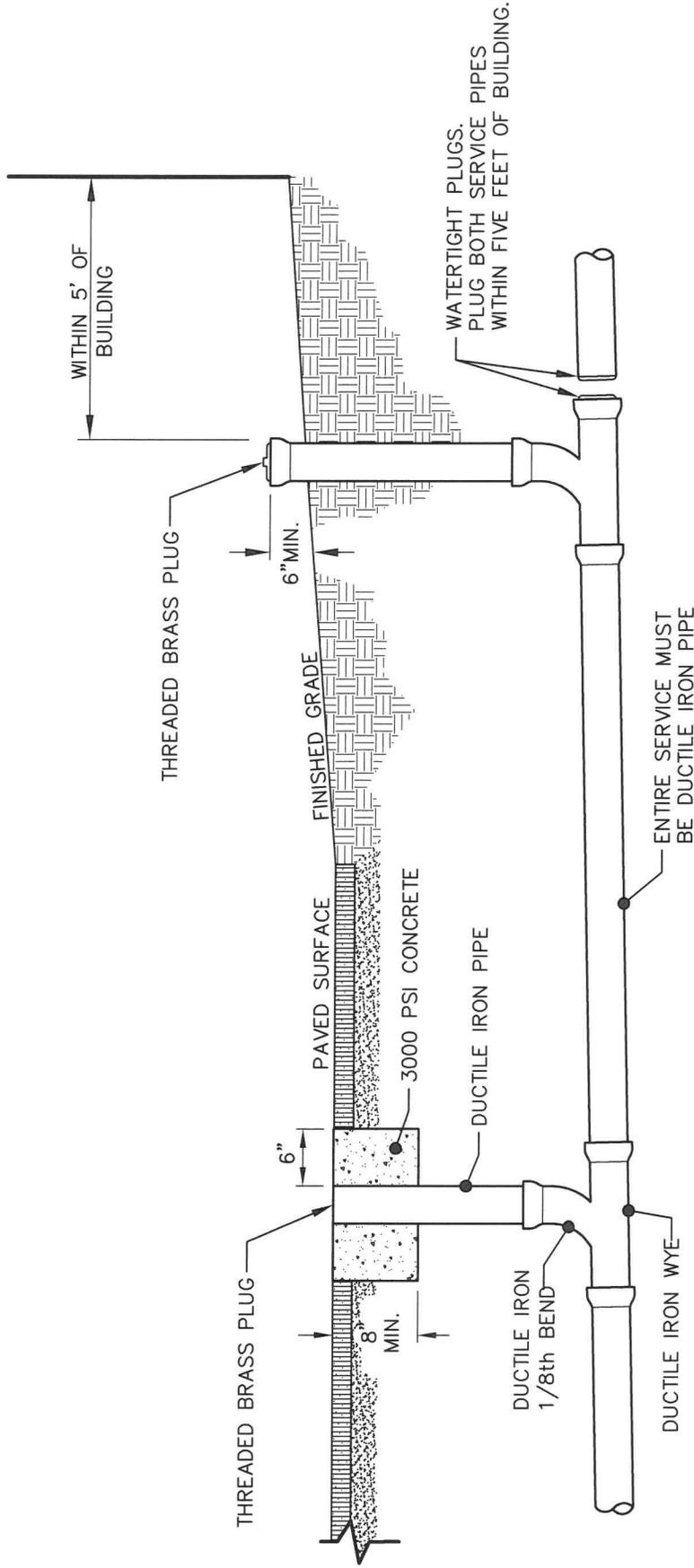
SECTION VIEW

DETAIL No.
03000.12
SHEET 1 OF 2

SEWER SERVICE CLEANOUT COVER ASSEMBLY IN TRAFFIC AREAS

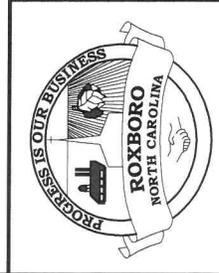


EFFECTIVE:



ALTERNATE CLEANOUT IN PAVED AREAS

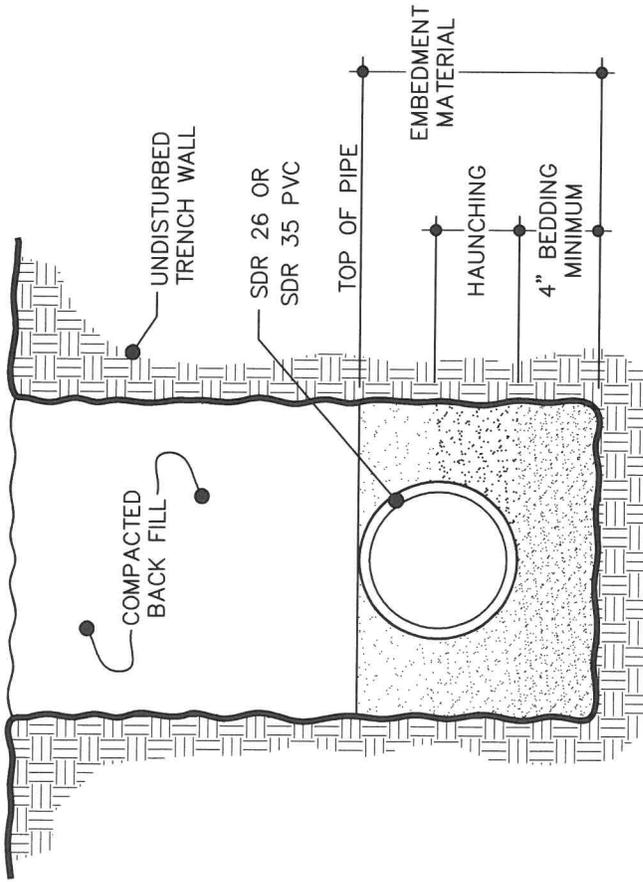
NOTE:
 EXTEND CLEANOUT TO RIGHT-OF-WAY OR UTILITY EASEMENT.



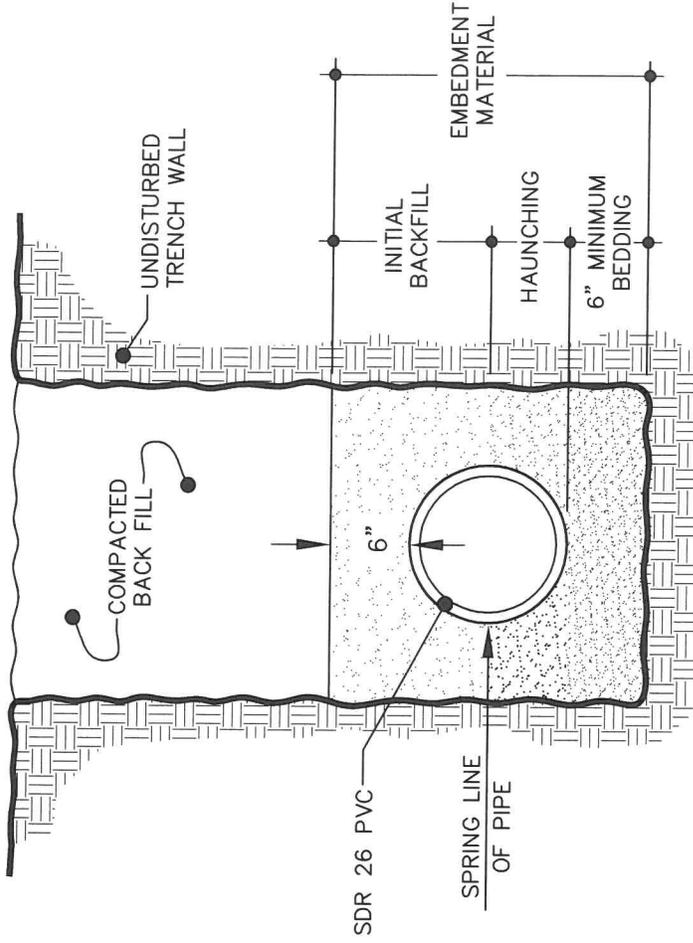
EFFECTIVE:

STANDARD SANITARY SEWER SERVICE

DETAIL No.
 03000.12
 SHEET 2 OF 2



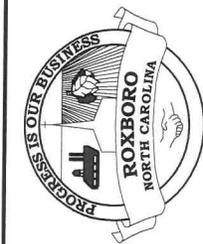
STANDARD BEDDING
FOR 3' TO 14' DEPTHS



SPECIAL BEDDING
FOR 14'-30' DEPTHS

NOTES:

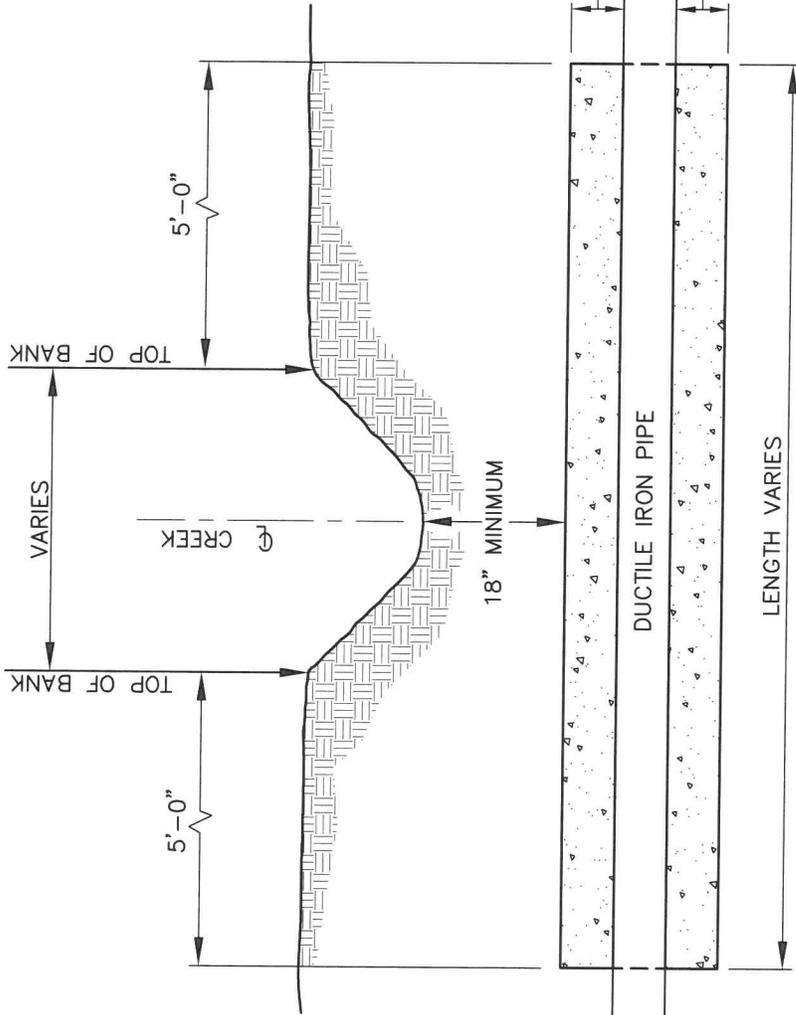
1. EMBEDMENT MATERIAL MUST BE CLASS I (#67 OR #78M WASHED STONE IS TYPICALLY USED).
2. EMBEDMENT MATERIAL SHALL BE COMPACTED TO A MINIMUM 95% STANDARD PROCTOR DENSITY FOR CLASS I MATERIAL.
3. STANDARD BEDDING SHALL BE UTILIZED FOR ALL CASES WHERE TRENCH BOTTOMS ARE UNSTABLE DUE TO SOIL TYPE OR MOISTURE CONDITIONS.
4. ALL SANITARY SEWER LINES LESS THAN 3 FEET AND OVER 30 FEET IN DEPTH MUST BE DUCTILE IRON PIPE.



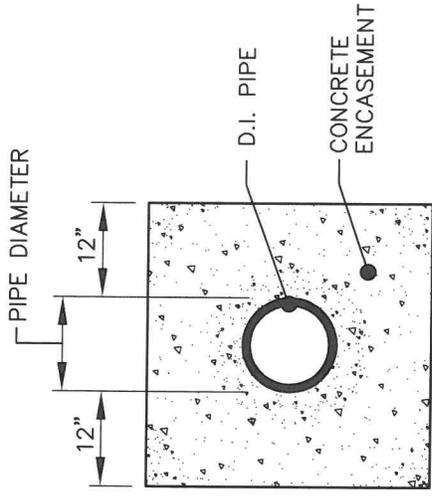
EFFECTIVE:

DETAIL No.
03000.13
 SHEET 1 OF 1

BEDDING FOR PVC SANITARY SEWER PIPE



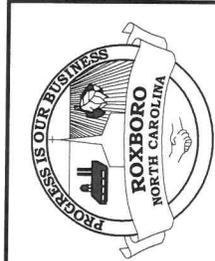
CROSS SECTION



END VIEW

NOTES:

1. CONCRETE SHALL BE 3000 P.S.I.
2. CONCRETE ENCASUREMENT NOT REQUIRED WHEN PIPE IS AT LEAST THREE (3) FEET UNDER CENTERLINE OF CREEK BOTTOM.



EFFECTIVE:

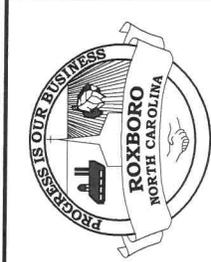
STANDARD CONCRETE ENCASUREMENT FOR STREAM CROSSING

DETAIL No.

03000.14

SHEET 1 OF 1

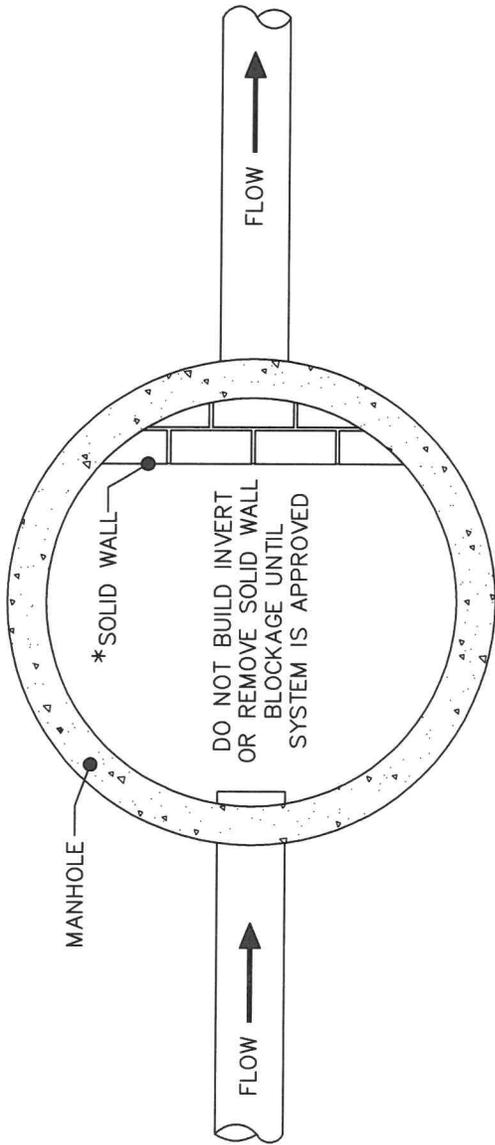
LENGTH OF TEST SECTION		SPECIFICATION TIME (MIN:SEC) REQUIRED FOR PRESSURE DROP FROM 3-1/2 TO 2-1/2 PSIG																
		NOMINAL PIPE DIAMETER (INCHES)																
		8	10	12	14	15	16	18	20	21	24	27	30	36	42			
25		7:33	9:26	11:20	13:13	14:10	15:11	17:00	18:53	19:48	22:40	25:30	28:19	34:00	39:40			
50		7:33	9:26	11:20	13:13	14:10	15:11	17:00	18:53	19:48	22:40	25:30	28:19	34:00	39:40			
75		7:33	9:26	11:20	13:13	14:10	15:11	17:00	18:53	19:48	22:40	25:30	28:19	34:00	52:35			
100		7:33	9:26	11:20	13:13	14:10	15:11	17:00	18:53	19:48	22:47	28:51	35:37	51:17	69:48			
125		7:33	9:26	11:20	13:13	14:10	15:11	17:00	19:47	21:48	28:29	36:03	44:31	64:06	87:15			
150		7:33	9:26	11:20	13:13	14:10	15:12	19:14	23:44	26:10	34:11	43:16	53:25	76:55	104:42			
175		7:33	9:26	11:20	13:34	15:35	17:44	22:26	27:42	30:32	39:53	50:28	62:19	89:45	122:10			
200		7:33	9:26	11:24	15:31	17:48	20:16	25:39	31:39	34:54	45:35	57:42	71:13	102:36	139:36			
225		7:33	9:26	12:49	17:27	20:02	22:48	28:51	35:37	39:16	51:17	64:54	80:08	115:24	157:03			
250		7:33	9:53	14:15	19:23	22:16	25:20	32:03	39:34	43:37	56:58	72:07	89:02	128:12	174:30			
275		7:33	10:52	15:40	21:20	24:29	27:52	35:16	43:31	47:59	62:40	79:19	97:56	141:00	191:57			
300		7:35	11:52	17:06	23:16	26:43	30:23	38:28	47:29	52:21	68:22	86:32	106:48	153:54	209:25			
350		8:52	13:51	19:57	27:09	31:10	35:27	44:52	55:24	61:05	79:46	101:00	124:42	179:30	244:19			
400		10:07	15:50	22:48	31:01	35:37	40:31	51:17	63:19	69:48	91:10	115:24	142:30	205:06	279:13			
450		11:23	17:48	25:39	34:54	40:04	45:35	57:42	71:13	78:31	102:36	129:48	160:18	230:48	314:07			
500		12:39	19:47	28:30	38:47	44:31	50:39	64:06	79:08	87:15	114:00	144:12	178:06	256:24	349:02			



EFFECTIVE:

STANDARD AIR TEST TABLE

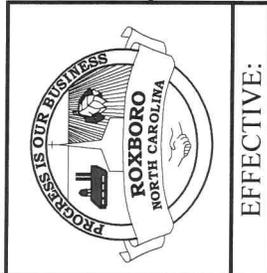
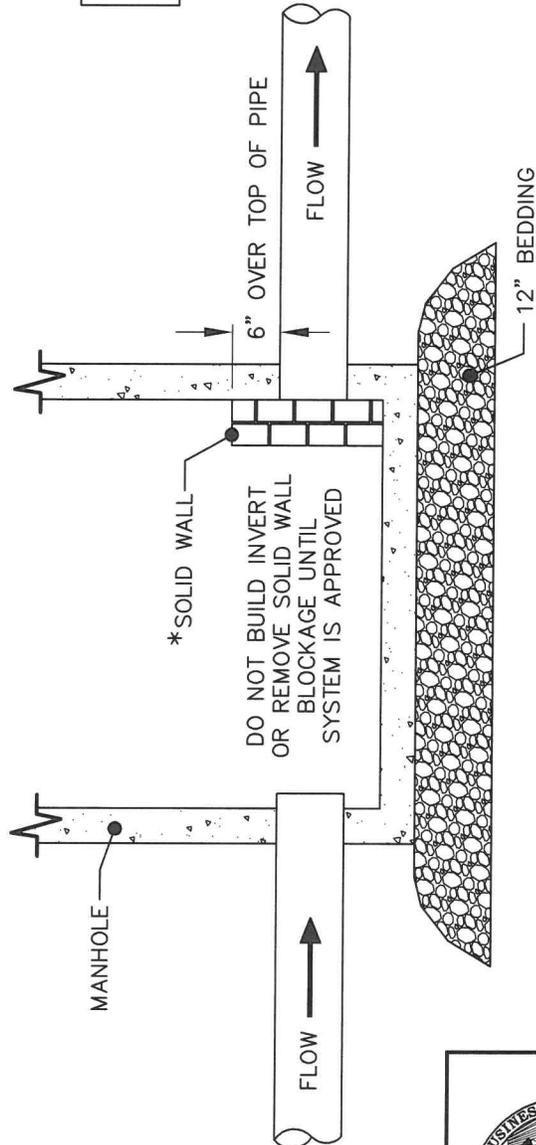
DETAIL No.
03000.16
SHEET 1 OF 1



USE SOLID BRICK/BLOCK & MORTAR

PIPE DIAMETER	MINIMUM WALL THICKNESS
8" - 12"	4"
16" OR GREATER	8"

*LOCATED IN FIRST MANHOLE FROM TIE-IN. SOLID WALL MUST BE BUILT BEFORE LAYING NEXT RUN OF PIPE.



SANITARY SEWER PROTECTION DURING CONSTRUCTION

DETAIL No.
03000.17
SHEET 1 OF 1

FINISH GRADE
LENGTH VARIES

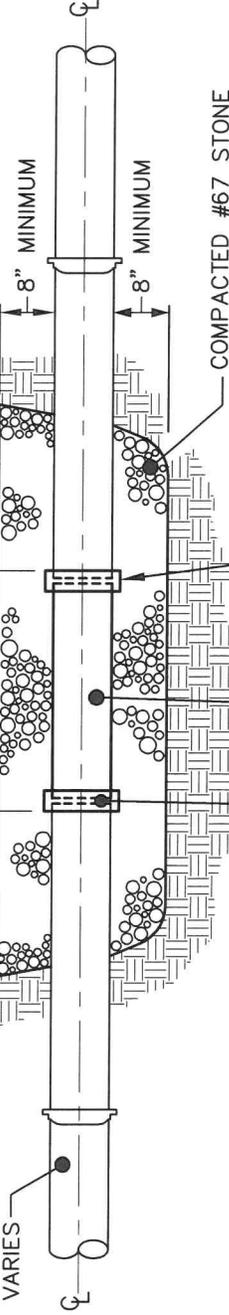
RESTORE FINISH GRADE TO MATCH
EXISTING CONDITIONS

UNDISTURBED SOIL
REMOVE EXCAVATED MATERIAL
UNDER PAVED SURFACES

COMPACTED SOIL IN GRASSED AREAS/
COMPACTED ABC STONE OR FLOWABLE FILL
IN PAVED AREAS. COMPACTION TO 95%
MAXIMUM DRY DENSITY.

POINT REPAIR
SEGMENT
2' MIN.
2' MIN.

EXISTING SEWER
PIPE VARIES



THE JOINT SHALL BE PREPARED BY
SAWCUTTING THE EXISTING PIPE TO
LEAVE A SMOOTH, STRAIGHT SURFACE

NEW DUCTILE IRON SEWER
PIPE. LENGTH VARIES.

RUBBER SLEEVE COUPLING WITH STAINLESS STEEL COMPRESSION
BANDS AND SHEAR RINGS AS MANUFACTURED BY MISSION
PRODUCTS, FERROCO, OR APPROVED EQUAL (TYPICAL EACH END).
COUPLING TO BE A MINIMUM 6 INCHES WIDE AND ENCASED IN
CONCRETE.

COMPACTED #67 STONE

STANDARD TYPICAL SEWER POINT REPAIR

DETAIL No.

03000.18

SHEET 1 OF 1



EFFECTIVE: