

Engineering Department  
Manual Of  
Practice



Life. Well Crafted.

500 Water Systems

## Section 2660 – WATER SYSTEM

### 1.1 INTRODUCTION

The scope of this section is to furnish all labor, equipment, materials and all other items that are customary and normally required to install and complete installation of ductile iron, polyvinyl chloride (PVC) and copper water lines in accordance with the plans. All pipe and incidental material shall be of the type specified in the plans and these specifications unless written variance is granted by the Engineer. All pipe storage/handling, excavation, bedding, laying, jointing and backfilling shall be accomplished as specified herein. Payment shall be made as depicted in the unit prices and measured as the actual laying length with no deduction for valves or fittings.

### 1.2 CATALOG CUTS SUBMITTALS

Contractor shall submit 4 copies of catalog cuts to Engineer for review for all materials that are required to complete the work as described in the associated plans. Engineer will retain two sets of original submittals and return two sets to the Contractor with the appropriate response annotated.

### 1.3 STORAGE AND HANDLING

The Contractor shall inspect the materials upon receipt for visible defects prior to off loading. The Contractor shall unload pipe so any deformation or other injury to the pipe is avoided. The Contractor shall implement appropriate measures during storage such that no storm water may pass through or encumber the materials. Pipe shall not be rolled or dragged over gravel, rock, asphalt or concrete during handling or staging. In the event of damaged material, the damaged section may be cut away from the undamaged section and disposed of with the undamaged portion being used. The Engineer may reject material that is severely damaged or injured in whole or part. In no event shall any pipe or material be placed along the project site by rolling off a truck or trailer and allowed to strike the ground. Stringing pipe or material in this manner will damage the pipe, material, lining or casting of same and will be deemed defective and rejected by the Engineer.

If defective material is discovered after installation, it shall be removed and replaced or repaired with acceptable materials by the Contractor at their sole expense.



CITY OF HICKORY

GENERAL NOTES FOR  
WATER SYSTEMS

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## 1.1 MATERIALS

- A. Pipe size less than 3" diameter that is installed below grade and outside building shall comply with one or more of the following:
1. Seamless Copper Tubing: Type "K" roll form to comply with ASTM B 88-62 and installed with wrought copper (95-5 Tin Antimony solder joints) fittings in accordance with ANSI B16.22.
  2. Polyvinyl Chloride Water Pipe: Pipe shall conform to ASTM D 2241 with SDR 21 rating or SDR 13.5 and shall be continually marked with manufacturer's name, pipe size, cell classification, SDR rating and ASTM
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3. D 1784 classification. Pipe joints shall be integrally molded bell ends in accordance with ASTM D 3139 with factory supplied elastomeric gaskets and lubricant.
  4. PVC pipe in this classification shall be stamped with current NSF marking for "Potable Water Use".
- B. Pipe size larger than 3" that is installed below grade and outside building shall comply with one of the following as depicted on the plans:

1. Ductile Iron Pipe:

All materials shall be true to theoretical form throughout, first quality with smooth interior and exterior and free from imperfections. All materials shall be available for inspection by the Engineer/Owner at any point from production to installation for the purpose of rejecting defective materials or altering to meet intended specification. All rejected material shall be immediately removed from the project site upon written notice from the Engineer.

All cited or referenced specifications or standards shall be the latest revisions under that identification or in the case of abandoned standards any such superseding standard. This shall be true for all specifications or standards except such requirements that clearly are not applicable.

Ductile iron pipe shall be manufactured in accordance with AWWA Standard C 151. All Ductile iron pipe shall be class 350 psi unless specified differently on the plans and shall contain a cement mortar lining, unless specified differently on the plans, not less than 1/16" thick as specified in AWWA Standard C 104. Wall thickness for all ductile iron pipes shall be in conformance with AWWA Standard C 150. Standard laying conditions shall be assumed to be type 2 unless specified differently

on the plans. The exterior of pipe shall be coated to a thickness of not less than 5 mils, as specified in AWWA Standards C 110 & C 115, with an asphaltic material.

1.a. Flanged Joints

Flanged pipe shall have flanges with long hubs, shop fitted on the threaded end of pipe, shall be 125 lb. rated and accurately faced at right angles to the pipe axis so a complete fit is readily obtained. When required, flanges shall be tapped for stud bolts. The face of all flanges shall be drilled smooth and true and completely coated with coal tar finish, varnish or other approved anti-corrosion agent. Immediately prior to installation, flange faces shall be cleaned with a wire brush until the face is significantly consistent of bare metal.

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Ductile iron flanged joint pipe shall conform to AWWA Standards C 110 & C 115 and shall have a minimum thickness of Class 53. Flanged end pipe shall be accurately measured and ordered so that not field cutting of pipe is necessary unless specifically approved by the Engineer. Unless approved no field alteration of flanged pipe will be allowed. Attempts to field cut pipe shall result in immediate rejection of all material affected. All flanged joints shall be properly aligned with no external force applied to the pipe or flange to achieve alignment. All bolts and gaskets shall be furnished by the Contractor installing the pipe for all joints, including such joints as the Contractor may be connecting to equipment or appurtenances which they did not supply or install.

Flanged joints shall be jointed with properly sized and type bolts as recommended by the manufacturer. Stud or tap bolts shall be used only as indicated on the plans. Steel or tap bolts shall be cadmium plated with true and sound fitting threads. Cadmium plating shall be by an approved process with a thickness of 3 to 5/ 10,000 of an

inch. The Contractor upon request shall supply written confirmation of plating to the Engineer.

1.b. Mechanical Joints:

All mechanical joint pipe shall be manufactured in accordance with AWWA Standard C 111, C 151 and C150 as applicable with a rating of class 350 psi.

All bolts shall be finish tightened by means of a torque wrench to the specified torque as recommended by the manufacturer in such a manner as the pipe is sealed evenly around to the joint. If effective sealing is not obtained by following the above procedures then the joint shall be disassembled, cleaned and reassembled following the above procedures.

Bolts shall be high-grade steel, low alloy type with tee head and American Standard threads. Mechanical joint gland shall be cast iron and gasket shall be plain rubber.

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1.c. Slip Joints:

Slip joint pipe shall be manufactured in accordance with AWWA Standards C 151 & C 150 as applicable with a rating of class 350 psi.

Bells of pipe shall be contoured to receive a bulb shaped circular rubber gasket and spigot end shall have sufficient taper to facilitate installation. Jointing shall be achieved by lubricating joint with approved lubricant, guiding spigot end of pipe into bell end of

enough compressive force to drive the spigot forward into the bell until they achieve full contact. No joint shall exceed the maximum deflection allowed by the manufacturer, normally 8" in an 18' joint.

1.d. Restrained Joint:

Restrained joints shall consist of standard ductile iron slip bell with gaskets containing metal wedges. Wedges shall be manufactured of stainless steel and the gasket rubber shall be manufactured in accordance with ANSI/AWWA C 111/A21.11. Bells shall be manufactured in accordance with ANSI/AWWA C 153/A21.53. The joints shall be designed for a working pressure of 200 psi. Restrained joints shall be American "Fast Grip", U.S. Pipe "Field-Lok", or approved equal.

1.e. Ball and Socket Joints:

When specified ductile iron ball and socket joint pipe shall conform to AWWA Standards C 150 & C 151 as applicable and shall have a minimum thickness class of 55. The spherical socket shall be manufactured with applicable material requirements of ASTM A 536 and threaded onto the ductile iron pipe barrel with threads conforming to ANSI B2.1 adapted to standard ductile iron pipe. The ball end of joint shall be integrally cast with the pipe barrel and accurately machined to fit into the adjoining pipe socket and provide constant compression of the gasket through deflection of up to 15 degrees of the assembled joint and shall maintain a watertight joint in all directions. The inside surface of the ball shall be shaped so that the waterway shall not be significantly impacted at any degree of deflection. A substantial external locking ductile iron gland shall prevent longitudinal separation.

Ball and Socket joints shall be American "Flex-Lok", U.S. Pipe "USIFLEX", or approved equal.

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1. Fittings:

All ductile iron fittings shall be in conformance with AWWA Standards C 110 & C 111 for underground piping as applicable and shall be mechanical joint type unless otherwise specified on the plan. If flanged pipe is specified then it shall be in conformance with AWWA Standard C 110 for exposed piping.

All fittings shall be manufactured in conformance with AWWA Standards C 111 & C 104 as applicable and shall be cement mortar lined unless otherwise specified on the plans. All fittings shall have rated working pressure of 250 psi unless otherwise specified on the plans.

2. Polyvinyl Chloride Pipe (PVC)

All materials shall be true to theoretical form throughout, first quality with smooth interior and exterior and free from imperfections. All materials shall be available for inspection by the Engineer/Owner at any point from production to installation for the purpose of rejecting defective materials or altering to meet intended specification. All rejected material shall be immediately removed from the project site upon written notice from the Engineer.

All cited or referenced specifications or standards shall be the latest revisions under that identification or in the case of abandoned standards any such superseding standard. This shall be true for all specifications or standards except such requirements that clearly are not applicable.

3.a PVC Pipe 4" Diameter and Larger:

All PVC pipe 4" and larger shall be manufactured in conformance with AWWA Standard C 900 and shall conform to the requirements of DR 18 class 150 psi or DR 14 class 200 psi. The exterior of all PVC shall bear a continuous stamp indicating the AWWA certification, DR ratio, size and manufacturer.

All PVC shall have a bell with integral rubber gasket and be slip joint manufactured in accordance with AWWA C 151.

Bells of pipe shall be contoured to receive a bulb shaped circular rubber gasket and spigot end shall have sufficient taper to facilitate installation. Jointing shall be achieved by lubricating joint with approved lubricant, guiding spigot end of pipe into bell end of adjacent pipe until contact is made with gasket and exerting enough compressive force to drive the spigot forward into the bell until they achieve full contact. No joint shall exceed the maximum deflection allowed by the manufacturer, normally 11" in a 20' joint.

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##### 1. Fittings:

All ductile iron fittings shall be in conformance with AWWA Standards C 110 & C 111 for underground piping as applicable and shall be mechanical joint type unless otherwise specified on the plan. If flanged pipe is specified then it shall be in conformance with AWWA Standard C 110 for exposed piping.

All fittings shall be manufactured in conformance with AWWA Standards C 111 & C 104 as applicable and shall be cement mortar lined unless otherwise specified on the plans. All fittings shall have rated working pressure of 250 psi unless otherwise specified on the plans.

### 1.1 INSTALLATION

#### A. Excavation

This section shall cover the excavation and proper disposal of any and all materials disturbed during the construction of trenches which is further defined as all excavation necessary for the proper installation storm or sanitary sewers and any appurtenances and waterlines and any appurtenances. This section shall further cover any work deemed appropriate by the Engineer.

Excavation shall be done to the lines and grades as depicted or detailed on the plans or as directed by the Engineer. All work involving this section shall be coordinated with any Grading, Site Utility work or other construction on the project site and shall be maintained satisfactorily so that adequate drainage is provided at all times. Any roots that protrude into the trench lines shall be trimmed flush with the trench walls.



All excavation shall be open cut unless otherwise depicted on the plans or specifically authorized by the Engineer. If after excavation the bottom of the proposed trench is found to contain rock, materials which can not be removed with standard and prudent construction equipment or is unsuitable for providing a uniform bearing surface then same material shall be removed to a depth not less than 8" below proposed depth, backfilled with approved material and compacted. Excavation widths shall be such that not less than one full diameter of the pipe is clear between the outside face of the pipe and each closest trench wall or inside face sheeting, shoring, or trench box as necessary.

Excavated materials to be used during backfill operation shall be suitable material, significantly free from debris and/or rocks and approved by the Engineer. Acceptable material which is excavated shall be neatly and compactly deposited at the sides of the trench where space provides but at no time closer than 2' 0" from the closest side of the trench. When stockpiling of material is required, the Contractor at his expense shall do so at an approved site and this site shall be kept and neat to avoid unsightly appearance. Stockpiling shall be arranged to allow for natural drainage without pollution of water by erosion.

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Protection of existing pavement structures from damage due to staining from excavated material and to improve cleanup shall be obtained by placing a 1" layer of sand or rock dust over all asphalt or concrete surfaces which are planned or reasonably anticipated to have excavated material directly on during construction.

#### A. Sheeting, Bracing and Trench Boxes

As appropriate reference to OSHA Regulation 1926.652(b), the Contractor will be required to keep the sides of excavation vertical by sheet, bracing or the use of trench boxes to prevent movement by slides or settling of the side, to prevent injury or displacement of pipe or appurtenance or diminished the required working space adjacent to pipe. Furthermore, the Contractor may be required, for the purpose of preventing injury to persons, property or adjacent structures, to leave sheeting or bracing in place.

All measures employed, when required, shall extend a minimum of 18” above existing grade and a maximum of 48” above grade. In no case shall timbers, beams or other sheeting/bracing materials be left in the trench, which may form or promote voids that cannot easily be corrected during the backfilling operation or compaction of backfill. It is agreed upon by these specifications that where it is necessary to leave sheeting or bracing intact and backfilled that the Owner is under no obligation to pay Contractor for time or materials involved in constructing such measures. Contractor shall assume and accept any and all risk associated with or encumbered by failure to implement proper and necessary sheeting, bracing or trench box use on any excavation and will be held responsible for caving, settlement and all other damages resulting there from.

A. Foundations

Trench foundation shall be “Type 2” as defined in AWWA Standard C 151 unless otherwise noted on the plans. Pipe bedding shall be as shown in the plans for the typical cross section for the type of pipe and location for which it is being installed. Pipe foundation shall be uniformly firm and compacted and shall be consistent with lines and grades as detailed on the plans.

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Trench bottom shall be formed to follow the bottom third of the pipe, where soil conditions allow. All installations shall conform to a uniform bearing surface throughout the length of the pipe to fully and evenly support the barrel of the pipe. Bell holes shall be excavated under each bell of each joint such that no undue stress is born by the bell of pipe thus leading to damage of the material. If undercut is required due to unsuitable soil, rock or through normal construction then suitable material shall be replaced and compacted with uniform support of the pipe provided for the entire length of the pipe. At no time shall undercut for rock be less than 8" from the proposed grade so to prevent future damage. Undercut limits for unsuitable material for supporting pipe loading shall be determined by and constructed according the Engineer. Continued unsuitable soil may require replacing bottom of trench to grade with washed stone or in extreme cases concrete cradles. If washed stone or concrete cradles are specified then the Engineer at unit price for materials shall allow additional compensation to the Contractor.

The Contractor shall remove all water that may be encountered or which may accumulate in the trenches by pumping or bailing and no pipe shall be laid until the water has been successfully removed from the trench. Water so removed from the trench shall be disposed of in a manner as not to cause injury to completed work, work in progress or any adjoining area.

**A. Installing Pipe:**

All installation practices should be in strict conformance with the manufacturers recommendations, AWWA Standard C 600 and the construction specifications. Where any conflicts exist the Contractor shall inform the Engineer immediately and AWWA Standard C 600 shall take precedence. The Engineer shall be furnished installation manuals for any such product that a discrepancy arises or they deem appropriate.

Customary and reasonable tools, implements and facilities satisfactory to the Engineer shall be provided and used for the safe and progressive installation of pipe. All pipe, fittings, valves and other materials shall be hoisted into trench by means which are acceptable and are not conducive to injury of pipe, fittings, valves, and any other materials or there protective coatings or dangerous to any personnel who may be in the trench or vicinity. All pipe hoisted into the trench shall be clean and free from defects. Pipe shall be laid on the prepared foundation so as a straight, uniform flow line exists upon completion.

When cutting pipe lengths are necessary, the Contractor shall practice normal and prudent care so that all cuts are at right angles to the flow line of the pipe. If a skewed cut is specified then the Contractor shall perform the cut as required by the plans. All slip joint pipe which is cut shall be ground to a taper on the cut end to match the manufacturers taper so pipe may be jointed as intended by the manufacturer.

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All PVC pipe installed shall be chased continuously with a 14 gauge stranded, coated copper wire with the coating being royal or light blue. Wire shall be pulled taunt so as to prevent damage from backfill and compaction operation or re-excavation in the future. Wire shall be taped no less than every 10 feet and at the taper of every bell end. Wire shall be pulled into every valve box with no less than 2x the depth of bury in length of wire left in the box for future connection to facilitate location. Wire shall be extended in an identical manner along fire hydrant legs and extended along the barrel to ground surface and looped around the base of the upper section at the flange.

Pipe joints shall be sound and in strict compliance with the manufacturers recommendations. Maximum deflection allowed shall be as allowed by the manufacturer but at no time should be greater than 2 degrees or 8" per 18' joint without special expanded deflection bells being provided. All pipe which is damaged, broken or will not join shall be removed immediately and stockpiled for inspection by the Engineer. Pipe that is damaged during backfill or compaction operations shall be removed and replaced or repaired as directed by the Engineer.

All water lines shall have a minimum 12" vertical separation from storm sewer and shall have a minimum vertical separation of 18" from sanitary sewer when crossing. When crossing sanitary sewer lines the waterline shall cross above the sanitary sewer line. Horizontal separation of 10' 0" shall be maintained from all sanitary sewers. If separations cannot be maintained then the Engineer shall be notified and both the waterline and sanitary sewer line shall be constructed of ferrous material such as ductile iron.



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Pipe shall not be installed except in the presence of the Engineer or at his specific direction. In the event pipe is installed without the specific direction of the Engineer, then the Contractor may be required to clean, test, uncover for inspection or remove the sections as directed by the Engineer.

#### 1.1 BACKFILL AND COMPACTION

A. Trenches shall be back filled immediately upon approval of pipeline construction.

#### B. Roadways and Crossing

Full depth and width of trench shall be back filled by placing material in uniform layers not to exceed 12" thick and shall be thoroughly compacted by approved mechanical compactors under optimum moisture conditions. Compaction of the trench shall be to 95% as determined by Standard Proctor Test for all areas outside the paved area and any depth exceeding 18" below finished surface of asphalt. The top 18" of any trench directly under pavement or within 36" of the edge of pavement shall be compacted to 100% as determined by Standard Proctor Test. If existing material is not suitable for obtaining compaction then select back fill shall be used when requested by the Engineer.

#### Section 2660-9

All paving and base course affected shall be removed and replaced with new material of equal or better quality with like texture and color as the adjacent pavement.

All backfill methods shall be in strict compliance with manufactures recommendations and all methods shall be instituted such that no damage, misalignment, or unjointing of the pipe or appurtenances is experienced. Backfill shall be kept free of organics (grasses, sticks, stumps, roots etc.), stones (all stones over 1" diameter within first 12" of backfill and all stones over 2.5" diameter for the remainder of the backfill), any frozen soil or other soil which is not suitable for backfill (highly plastic clay) or any other objectionable items. All back fill shall be installed and graded in a manner that erosion or saturation will not negatively affect the back filled area.

Heavy equipment shall not be operated over any pipe or appurtenance until it has been properly backfilled and has minimum cover as required by the plans. Where any part of the required cover is above proposed finished grade, the Contractor shall place, maintain and lastly remove such material at no additional cost to the Owner. Any pipe or appurtenance, which becomes mis-aligned, shows excessive settlement or has been damaged by the Contractor shall be corrected or replaced as deemed necessary by the Engineer/Owner at no additional cost to the Owner.

Prior to acceptance, the Contractor shall properly maintain all installations in such a manner that they will operate without failure.

A. Finish Grading

All areas disturbed shall be graded to a continuous finish without irregularities or abrupt changes and shall not consist of areas, which will retain water or cause foreseeable future maintenance. Prior to acceptance, all debris, excess material, trash or any unsightly occurrence shall be removed and the project site shall be in a neat and satisfactory condition.

Cleanup and seeding is part of the pipeline installation. No more than 4,000 lf of waterline may be laid prior to completion of cleanup of the first section of pipeline laid. During construction no more than 4,000 lf or 2 weeks time may pass before cleanup and seeding is performed.

END SECTION

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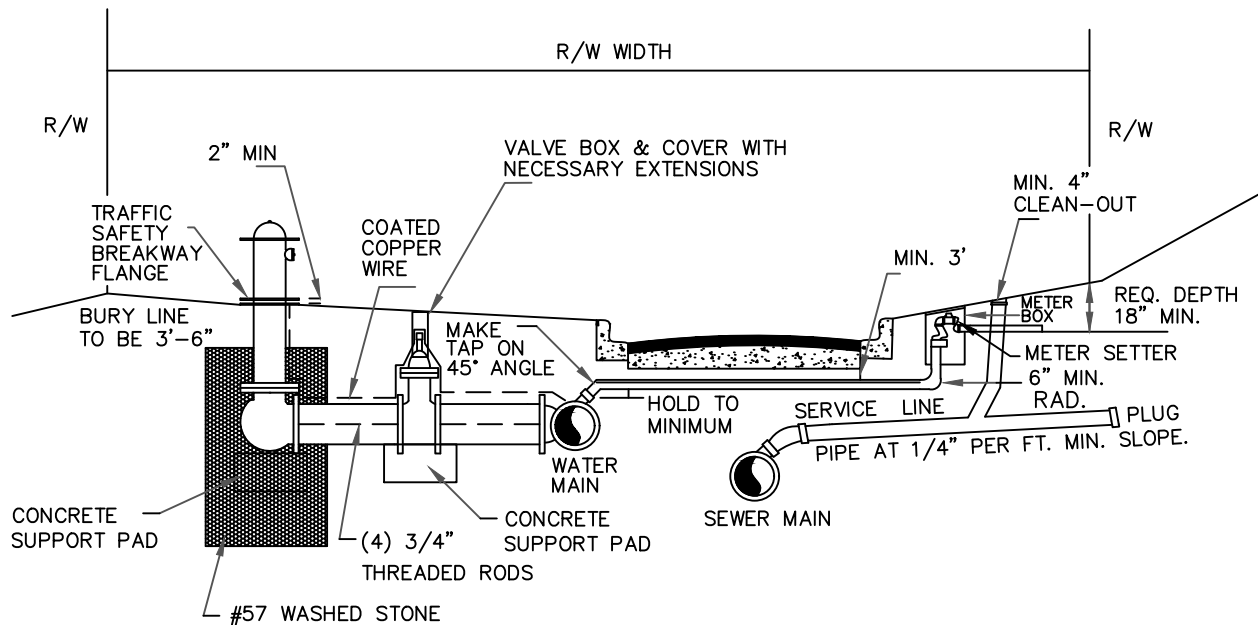


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NOTE:

1. ADD 14GA COATED COPPER WIRE CONTINUOUS ALONG MAIN WITH 24\"

NOT TO SCALE



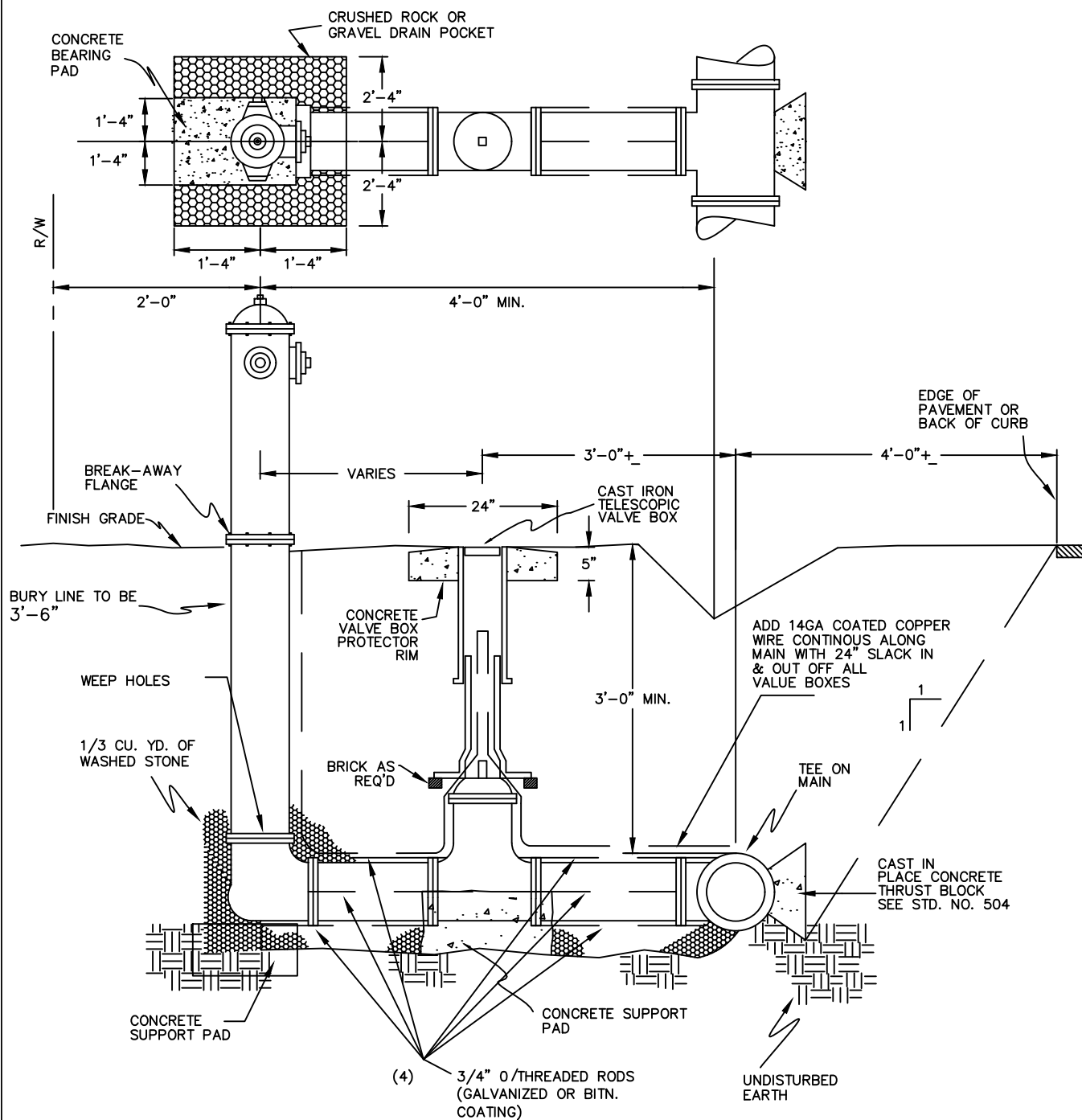
CITY OF HICKORY

TYPICAL RESIDENTIAL CONNECTION  
AND HYDRANT SETTING DETAIL

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2-1-07

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502



## SECTION

NOTES: FIRE HYDRANTS SHALL BE ONE OF THE FOLLOWING THREE TYPES WITH THE 4 1/2" PUMPER NOZZLES BEING NATIONAL STANDARD PIPE THREADS AND 2 (TWO) 2 1/2" HOSE NOZZLES BEING NATIONAL STANDARD THREADS.

- A) CENTURION, MANUFACTURED BY MUELLER COMPANY
- B) SUPER CENTURION, MANUFACTURED BY MULLER COMPANY
- C) MARK-73 TRAFFIC MODEL, MANUFACTURED BY AMERICAN CAST IRON PIPE COMPANY

NOT TO SCALE



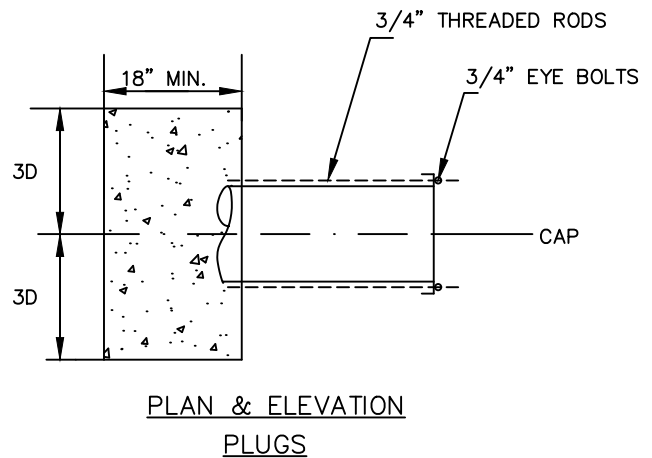
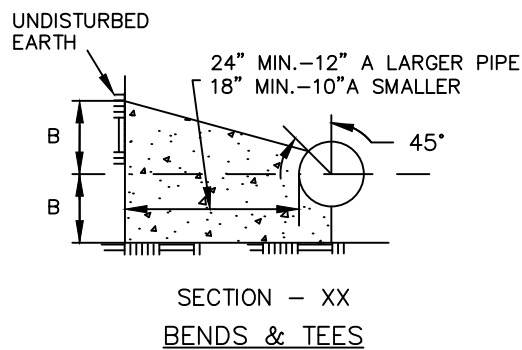
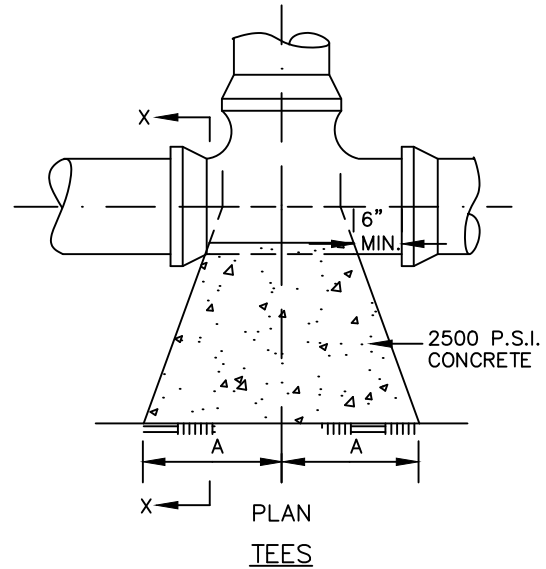
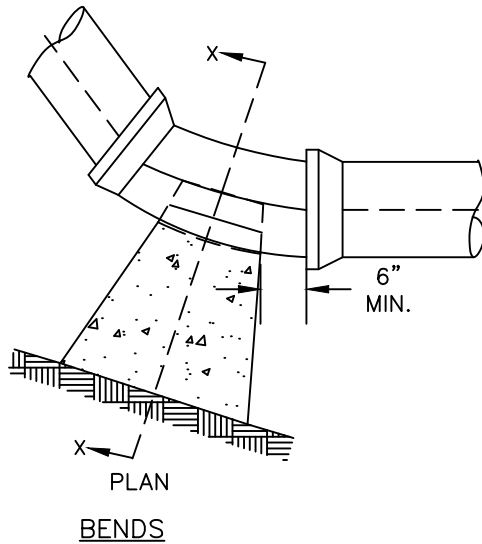
CITY OF HICKORY

FIRE HYDRANT INSTALLATION DETAIL

DATE:  
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- NOTES:
1. DEAD MAN RESTRAINED  
W/ 2-3/4" ALL THREAD  
RODS 3" TO 8" AND 4-3/4"  
ALL THREAD RODS 12" TO 16"

PIPE SIZE	11 1/4° BEND		22 1/2° BEND		45° BEND		90° BEND		TEE	
	A	B	C	D	A	B	A	B	A	B
6	9	10	12	10	16	10	20	10	10	12
8	12	13	16	13	22	13	26	13	13	16
12	16	21	22	21	28	21	32	21	18	24
16	21	27	30	27	36	27	44	27	24	32

ALL DIMENSIONS IN TABLE ARE IN INCHES.  
NOTE: WHERE WORKING PRESSURES EXCEED 150 PSI.  
AWWA STANDARDS SHALL APPLY.

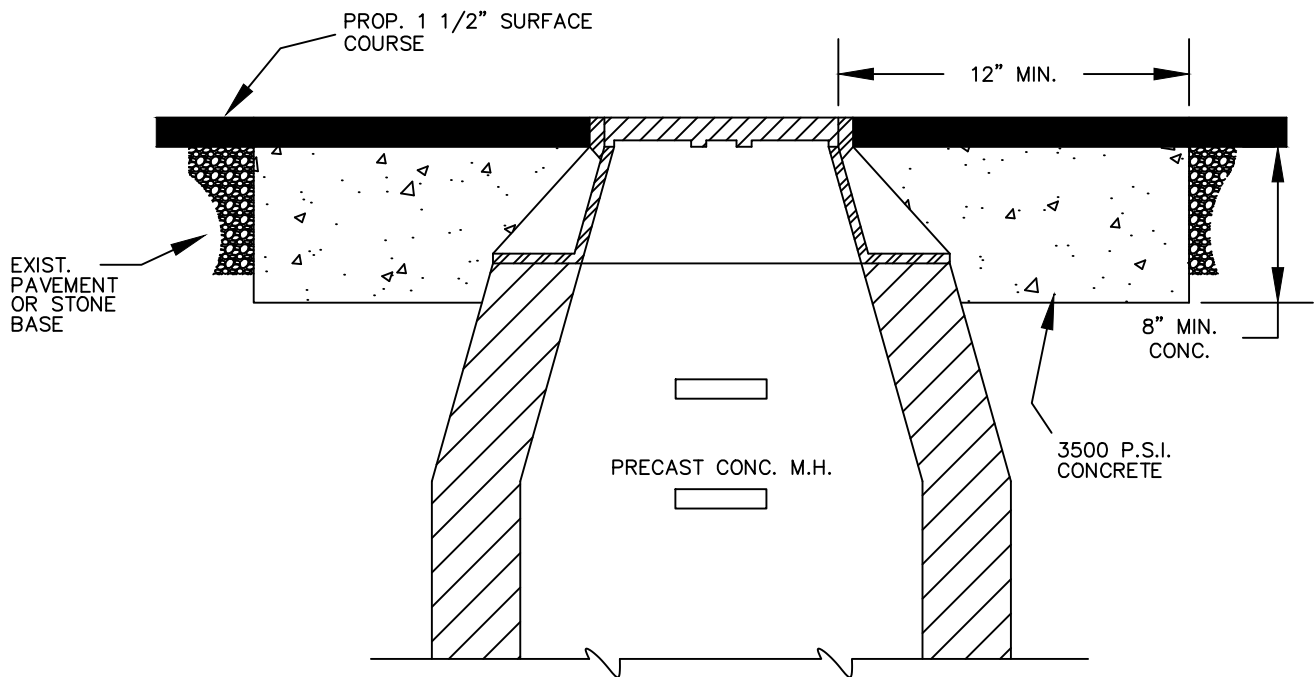
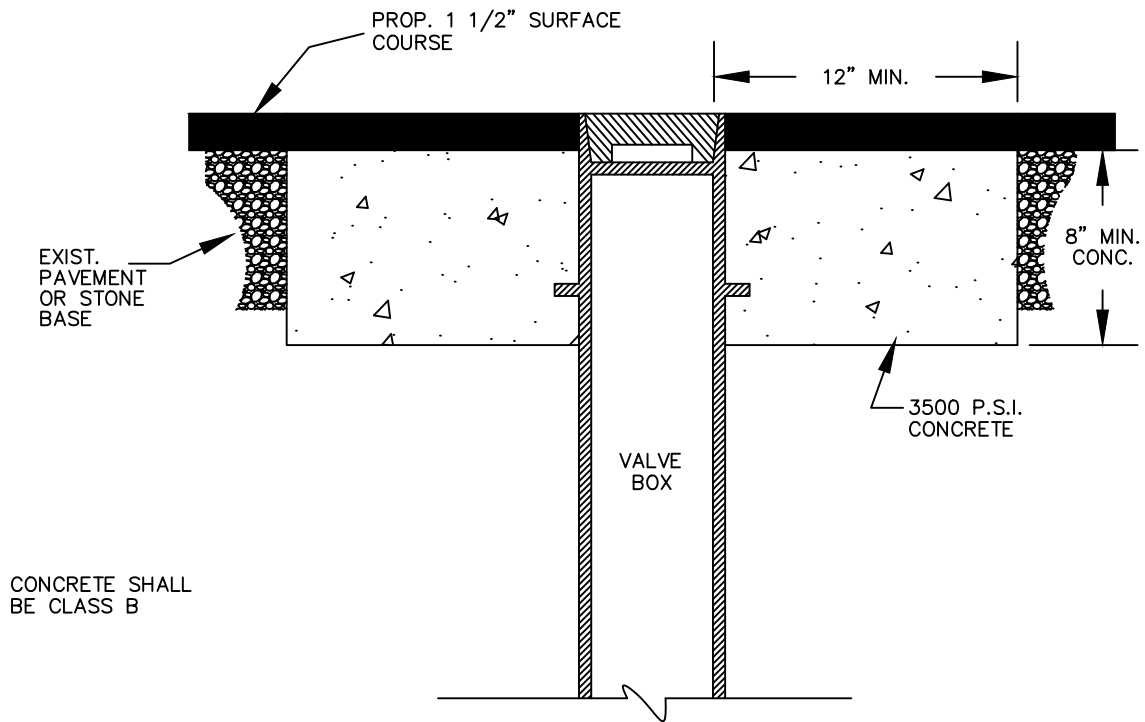
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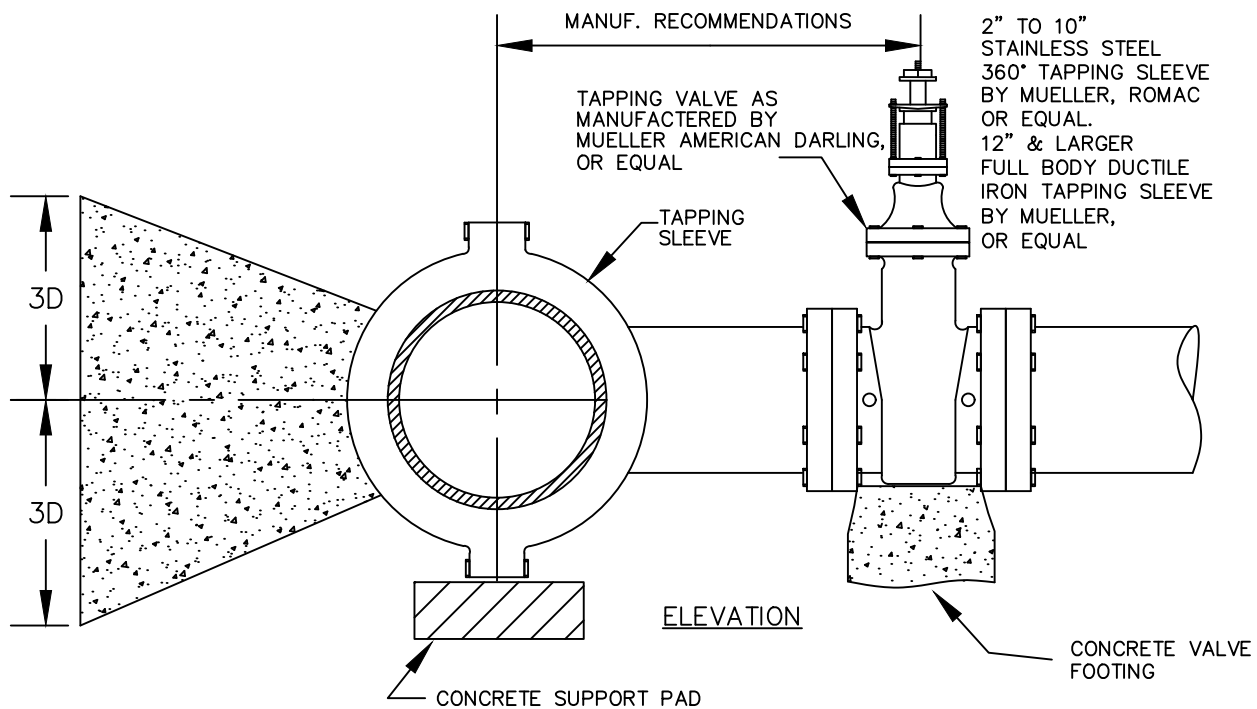
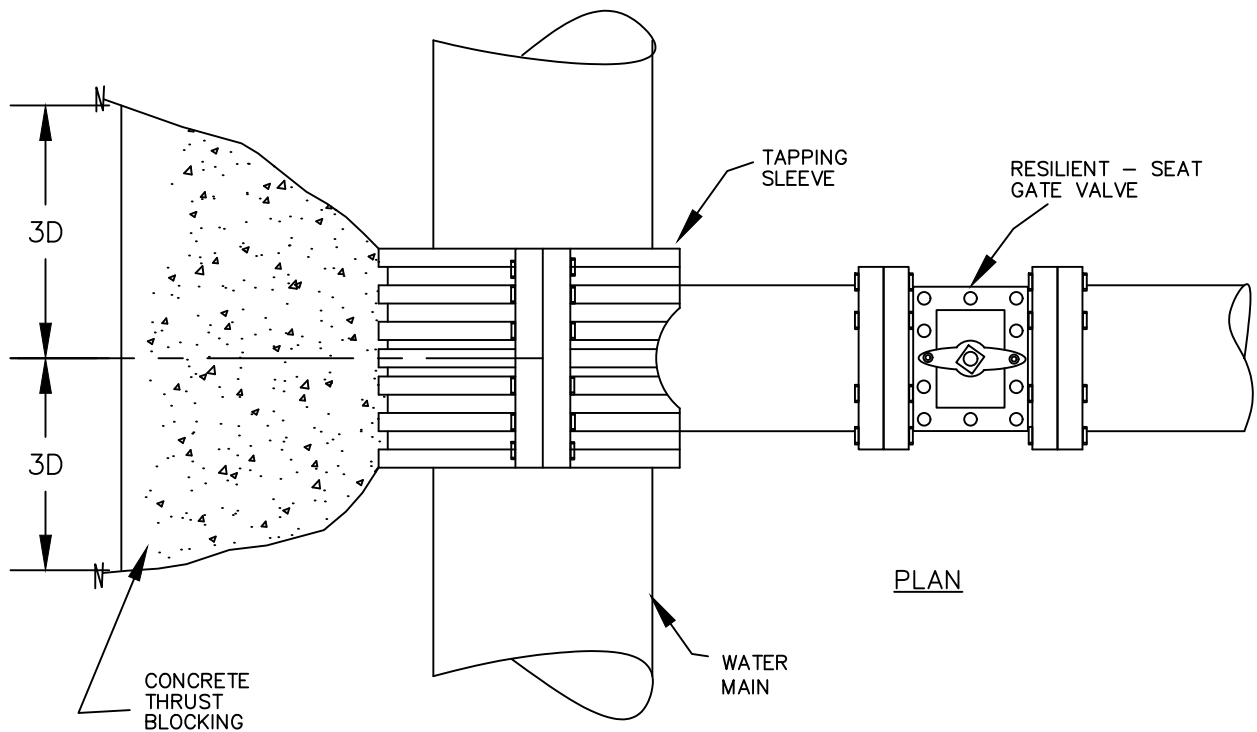
CITY OF HICKORY  
THRUST BLOCK FOR WATER MAINS  
(150 PSI WORKING PRESSURE)

DATE:  
2-1-07

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NOT TO SCALE



#### NOTES

1. CONCRETE SHALL NOT CONTACT BOLTS OR ENDS OF MECHANICAL JOINT FITTING.
2. SEE STANDARD THRUST BLOCK TABLES, SEE STD. NO. 870 #504 FOR AREA OF CONCRETE REQUIRED.

NOT TO SCALE

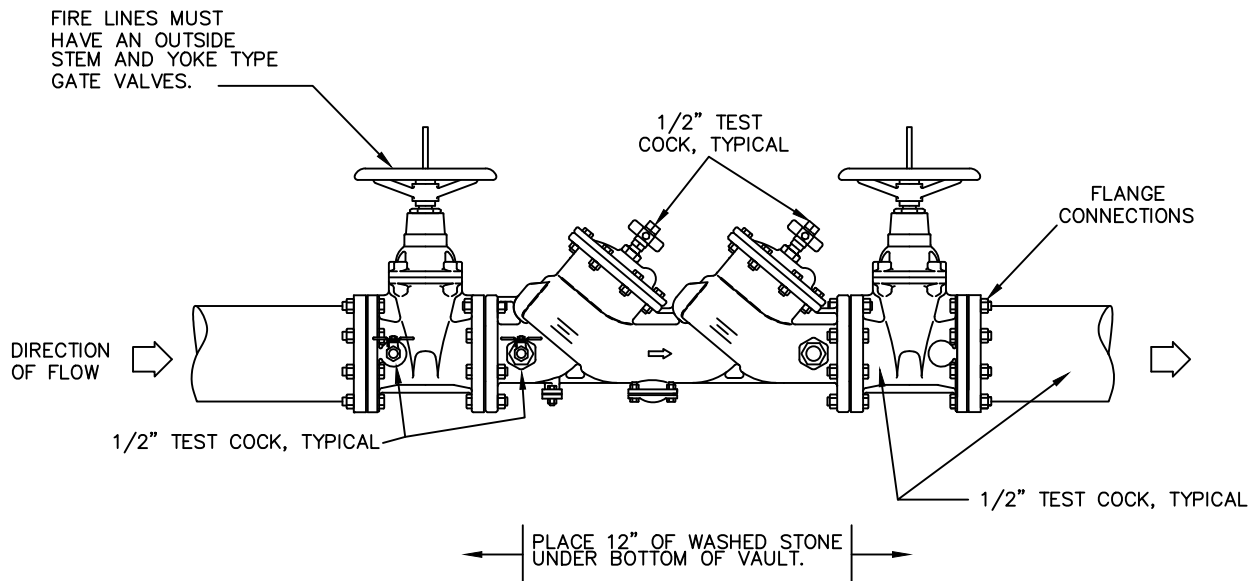


## CITY OF HICKORY

### TAPPING SLEEVE & VALVE ASSEMBLY

DATE:  
2-1-07

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NOTES:

1. 4" AND LARGER PVC PIPE APPLICATIONS SHALL REQUIRE GATE AND CHECK VALVE ASSEMBLY TO BE SUPPORTED BY A CRADLE.
2. 6" AND LARGER DUCTILE IRON PIPE APPLICATIONS SHALL REQUIRE GATE AND CHECK VALVE ASSEMBLY TO BE SUPPORTED BY A CRADLE.
3. VAULTS FOR GATE AND CHECK VALVE ASSEMBLY SHALL PROVIDE ADEQUATE INSIDE CLEARANCE TO FACILITATE INSTALLATION, REMOVAL, AND MAINTANCE W/ MINIMUM OF 18" CLEAR IN ALL DIRECTIONS. SUBMITTALS TO CITY OF HICKORY ARE REQUIRED.
4. TYPICALLY VAULTS SHALL BE CONSTRUCTED IN NON-TRAFFIC AREAS, ADJACENT TO RIGHT OF WAY LINE.
5. RPZ SHALL BE SUBSTITUTED W/ IDENTICAL LAYOUT WHERE REQUIRED. VAULT DRAIN SHALL BE PLUMBED TO STORM DRAIN WHERE AVAILABLE.

NOT TO SCALE



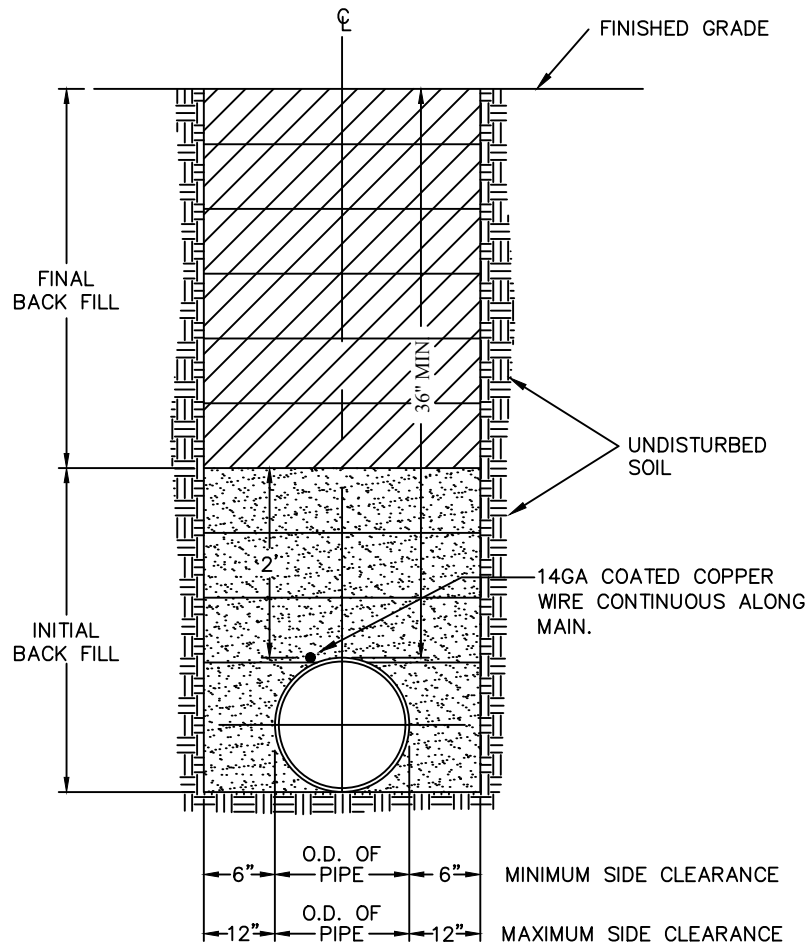
CITY OF HICKORY

DOUBLE DETECTOR CHECK  
VALVE ASSEMBLY W/ METER

DATE:  
2-1-07

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TYPICAL TRENCH BOTTOM DIMENSIONS FOR:  
DUCTILE IRON, C-900 PVC, AND CONCRETE PIPE

TRENCH DETAIL  
CLASS D FLAT SUBGRADE

NOTES:

1. TRENCHES REQUIRING SHORING AND BRACING, DIMENSIONS SHALL BE TAKEN FROM THE INSIDE FACE OF THE SHORING AND BRACING.
2. NO ROCKS OR BOULDERS 2" OR LARGER TO BE USED IN INITIAL BACKFILL.
3. ALL BACKFILLED MATERIAL SHALL BE SUITABLE MATERIAL.
4. BACK FILL SHALL BE COMPACTED IN 6" LAYERS IN TRAFFIC AREAS, 12" LAYERS IN NON-TRAFFIC AREAS USING VIBRATORY EQUIPMENT.

DEPTH OF BEDDING  
MATERIAL BELOW PIPE

D	d (MIN.)
27" & SMALLER	6"
30" - 60"	12"
66" & LARGER	18"

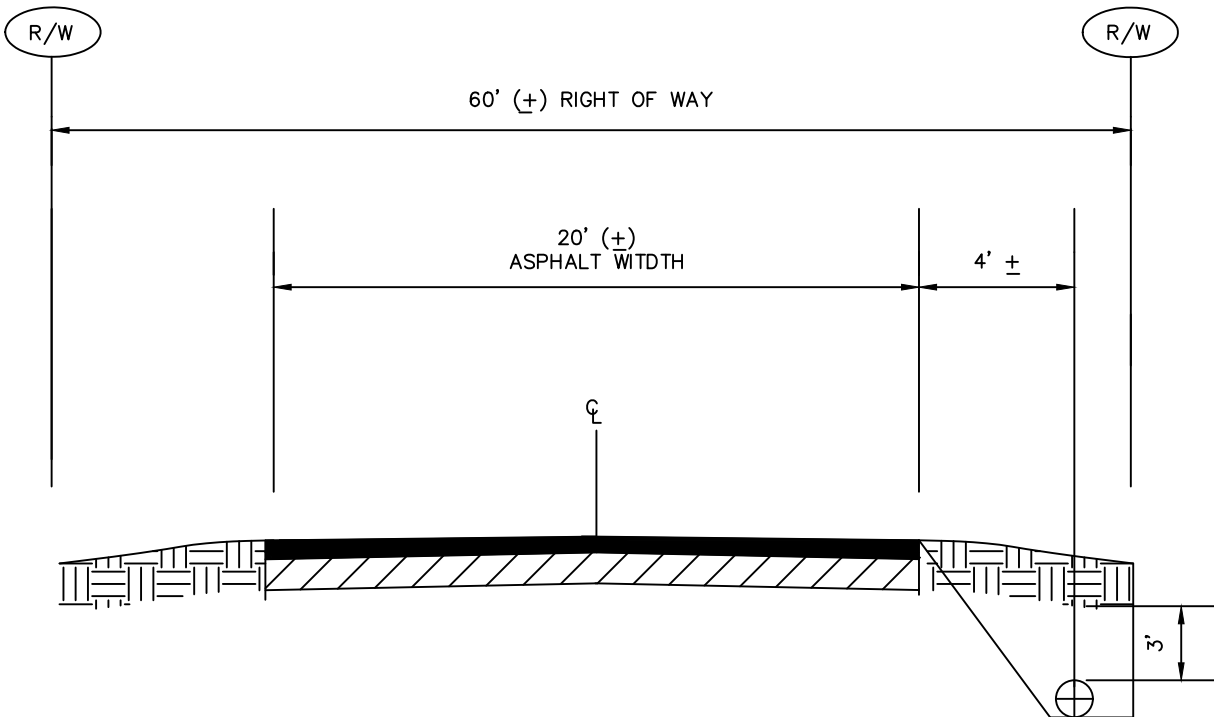
NOT TO SCALE



CITY OF HICKORY  
WATER LINE TRENCH BOTTOM DIMENSIONS  
AND BACKFILLING REQUIREMENTS

DATE:  
2-1-07

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TYPICAL PAVED SECTION  
NTS

NOTES

- BACKFILL TO BE PLACED IN 4" TO 6" LAYERS WITH PNEUMATIC TAMP AND THE SHOULDERS TO BE PLACED BACK IN ORIGINAL CONDITIONS.
- SEED AND STRAW TO BE PLACED
- CONCRETE DRIVEWAYS ARE TO BE SMOOTH CUT AND PLACED BACK IN ORIGINAL CONDITION AT COMPLETION OF PROJECT.
- POUR CONCRETE FOR ALL WATER LINE FITTINGS, INCLUDING PLUGS, FIRE HYDRANTS, BENDS, ETC. UNLESS OTHERWISE NOTED IN PLANS.

NOT TO SCALE



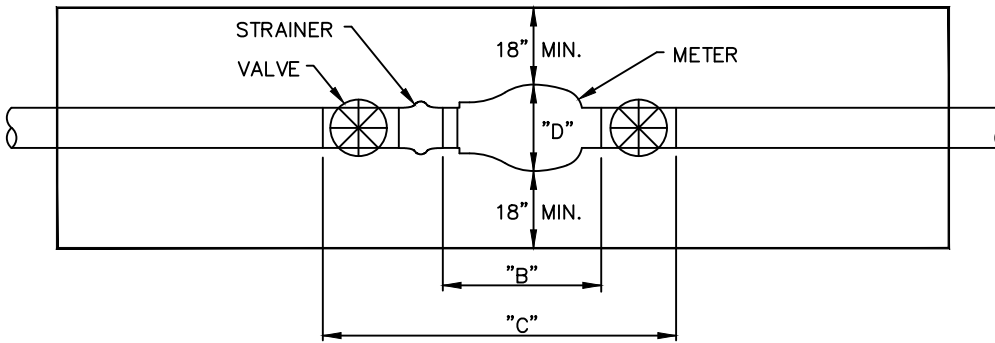
CITY OF HICKORY

WATER LINE INSTALLATION IN  
ROADWAY SHOULDER

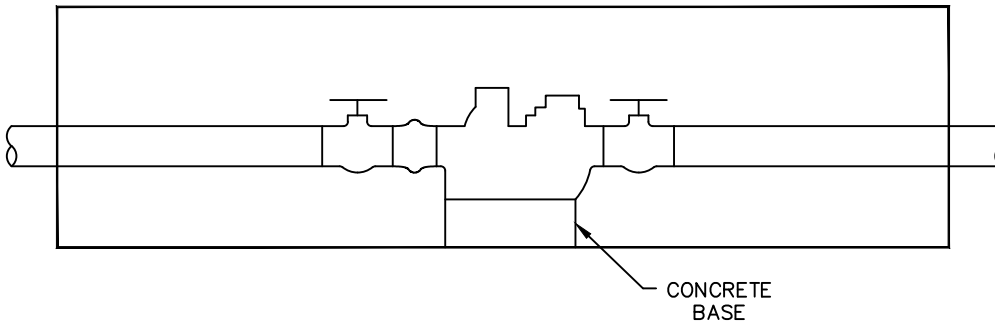
DATE:  
2-1-07

SHEET 1 OF 1  
STD. NO.  
509





PLAN VIEW



ELEVATION

DIMENSIONS

METER SIZE	"B"	"C"	"D"
3"	17"	42"	8 1/2"
4"	20"	48"	9 1/8"
6"	24"	56"	12 3/4"
8"	20"	52"	13 1/2"

\* NEPTUNE METERS

HATCH ACCESS

METER SIZE	BILCO TYPE
3"	K-4 (3'x3')
4"	K-4 (3'x3')
6"	K-4 (3'x3')
8"	KD-2 (4'x4')

INTERIOR VAULT DIMENSIONS

METER SIZE	W (ft)	L (ft)	H (ft)	* PIPE OPENING
3"	4	5	3	12"x12"
4"	4	6	4	14"x14"
6"	4	6	4	14"x14"
8"	5	6	4	14"x16"

\* OPENING DIMENSIONS ARE WIDTH x HEIGHT WITH OPENING CENTERED ON WIDTH OF VAULT.

NOTES:

1. CONCRETE TO BE 4000 PSI @ 28 DAY STRENGTH.
2. REINFORCING TO BE #4 BARS @ 6" CTS EACH WAY.
3. A BACKFLOW PREVENTION DEVICE IS REQUIRED AND SHALL BE THE RESPONSIBILITY OF THE OWNER/DEVELOPER. THIS SHALL BE IN A SEPERATE STRUCTURE FROM THE METER.

NOT TO SCALE



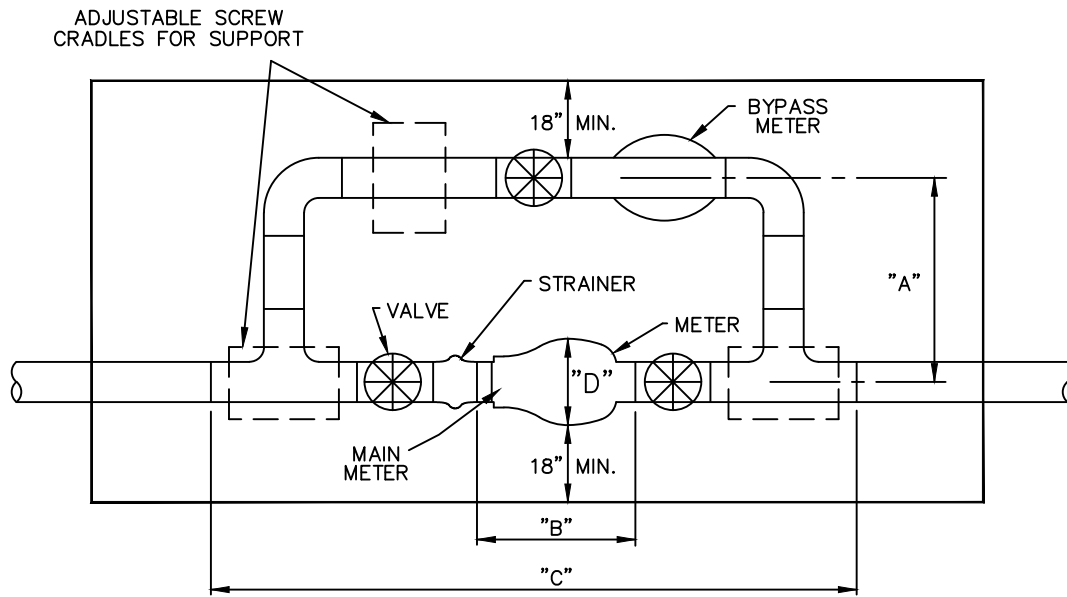
CITY OF HICKORY

METER VAULT  
WITHOUT BYPASS (3"-8")

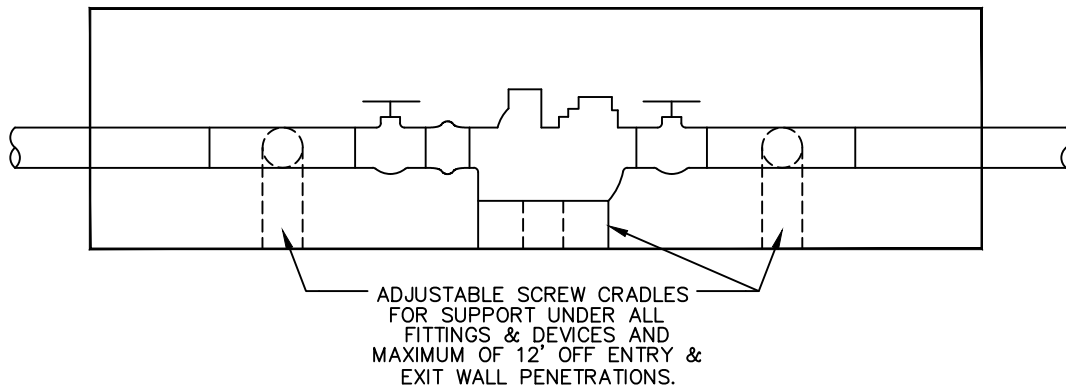
DATE:  
2-1-07

SHEET 1 OF 1  
STD. NO.  
511





PLAN VIEW



ELEVATION

NOT TO SCALE

#### HATCH ACCESS

METER SIZE	BILCO TYPE
3"	K-4 (3'x3')
4"	K-4 (3'x3')
6"	KD-3 (4'x6')
8"	KD-3 (4'x6')

#### DIMENSIONS

METER SIZE	"A"	"B"	"C"	"D"
3"	23"	17"	53"	8 1/2"
4"	25"	20"	63 1/2"	9 1/8"
6"	28"	24"	81"	12 3/4"
8"	29"	20"	82"	13 1/2"

\* NEPTUNE METERS

#### INTERIOR VAULT DIMENSIONS

METER SIZE	W (ft)	L (ft)	H (ft)	* PIPE OPENING
3"	5	6	3	12" x 12"
4"	5	7	4	14" x 14"
6"	6	9	4	14" x 14"
8"	6	9	4	14" x 16"

\* OPENING DIMENSIONS ARE WIDTH x HEIGHT WITH  
OPENING CENTERED ON WIDTH OF VAULT.

#### NOTES:

1. CONCRETE TO BE 4000 PSI @ 28 DAY STRENGTH.
2. REINFORCING TO BE #4 BARS @ 6" CTS EACH WAY.
3. A BACKFLOW PREVENTION DEVICE IS REQUIRED AND SHALL BE THE RESPONSIBILITY OF THE OWNER/DEVELOPER.  
THIS SHALL BE IN A SEPERATE STRUCTURE FROM THE METER.

NOT TO SCALE



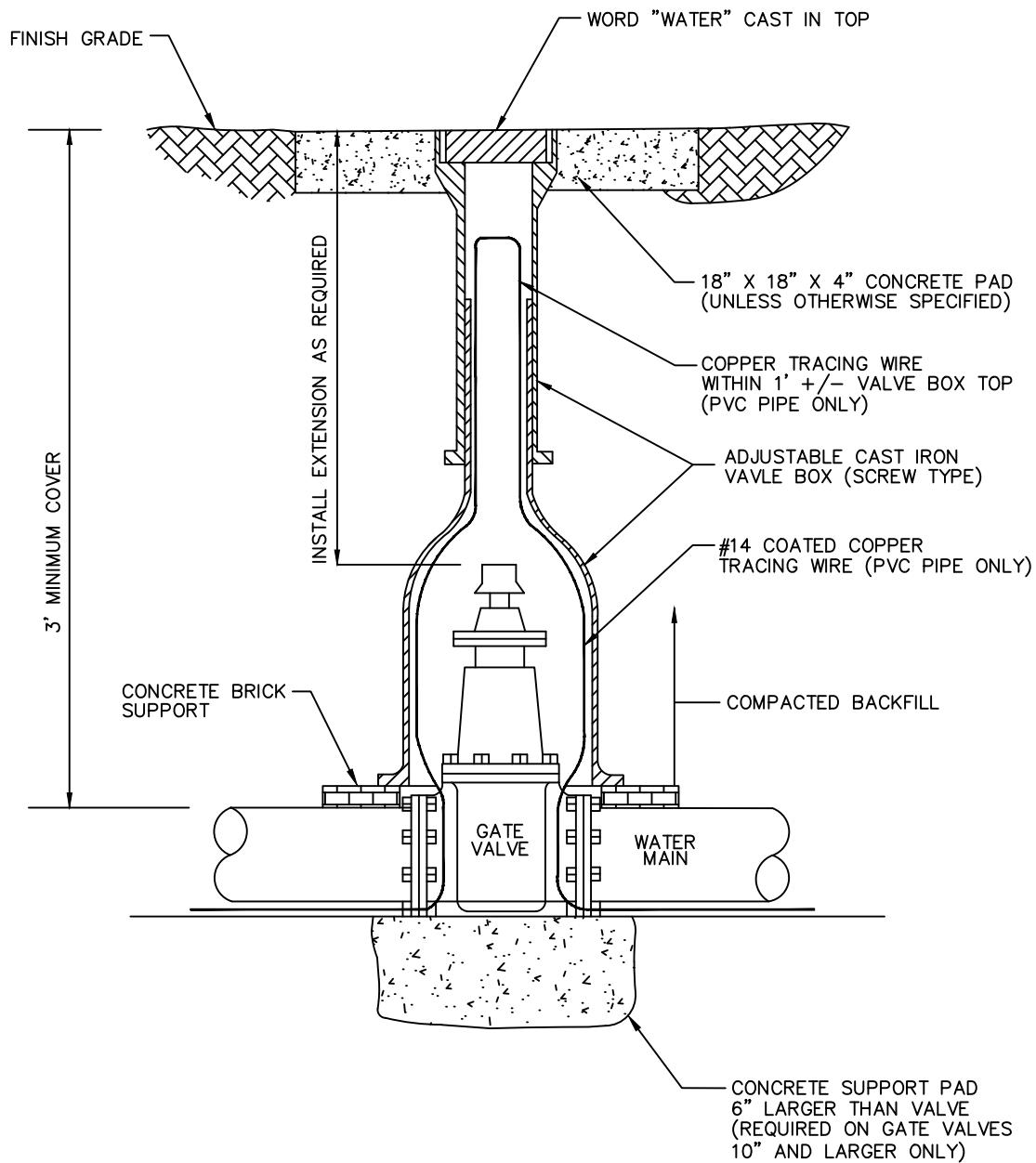
CITY OF HICKORY

METER VAULT  
WITH BYPASS (3"-8")

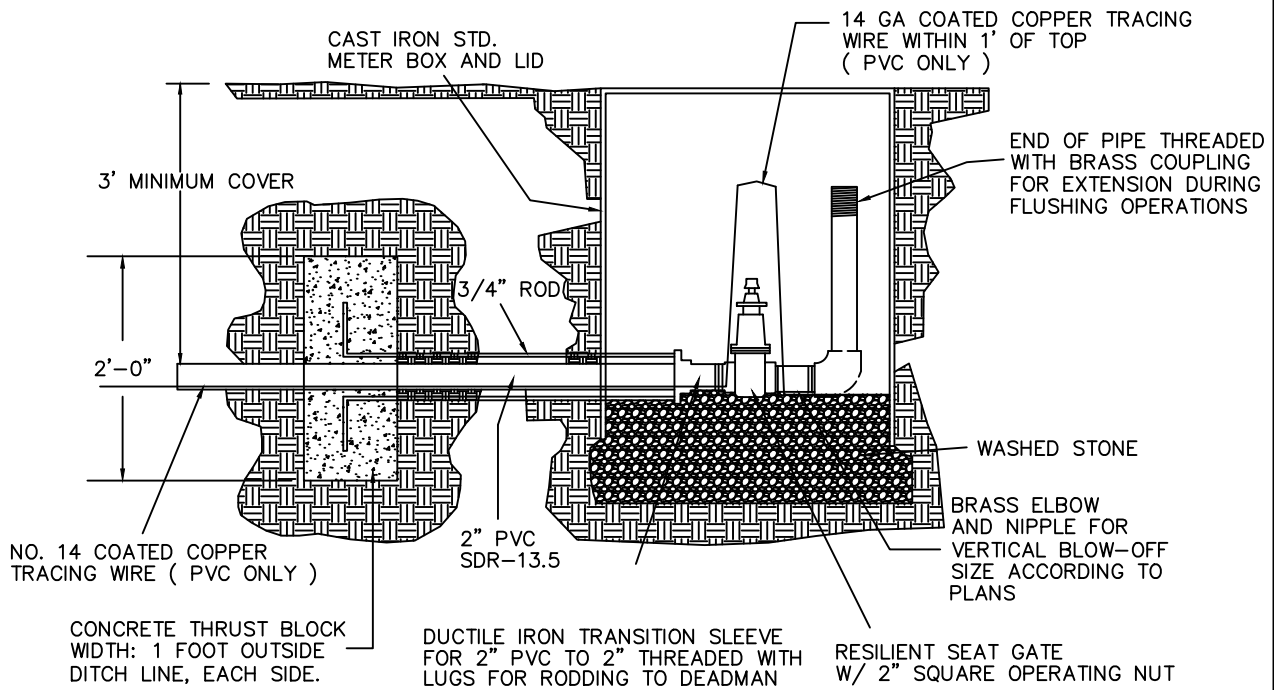
DATE:  
2-1-07

SHEET 2 OF 2

STD. NO.  
512



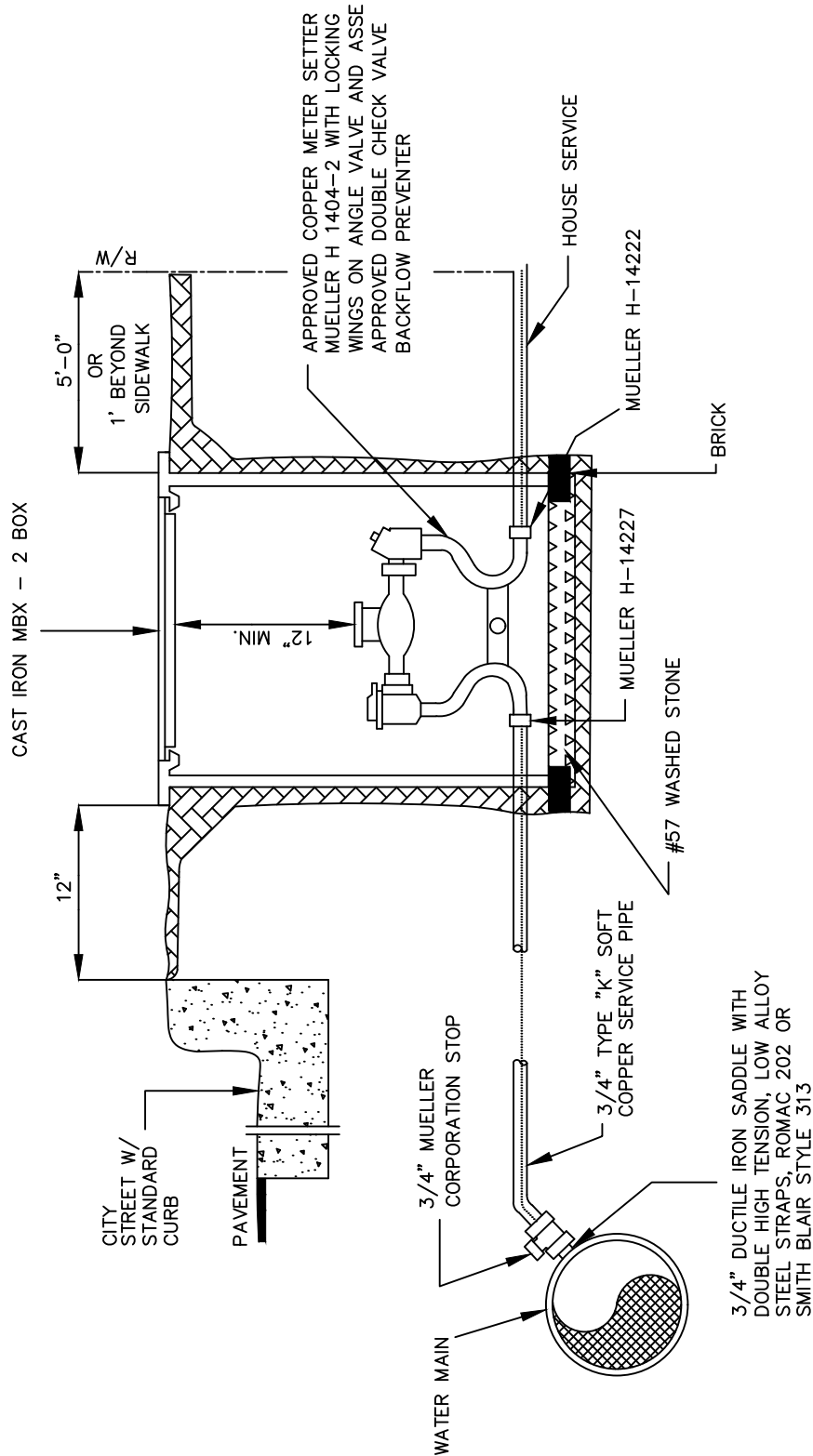
NOT TO SCALE



BLOW-OFF DETAIL

NOTE:  
1. GLUED JOINTS WILL NOT BE PERMITTED.

NOT TO SCALE



FOR PRESSURES  $\geq$  100 PSI

MUELLER SETTERS B-2404-2AN  
MUELLER CORPORATIONS B-2500-8N

3/4" CONN. SHOWN

FOR 1" CONNECTION

- 1) 1" CORPORATION COCK
- 2) 1" TYPE "K" SOFT COPPER
- 3) 1" STANDARD METER

NOT TO SCALE

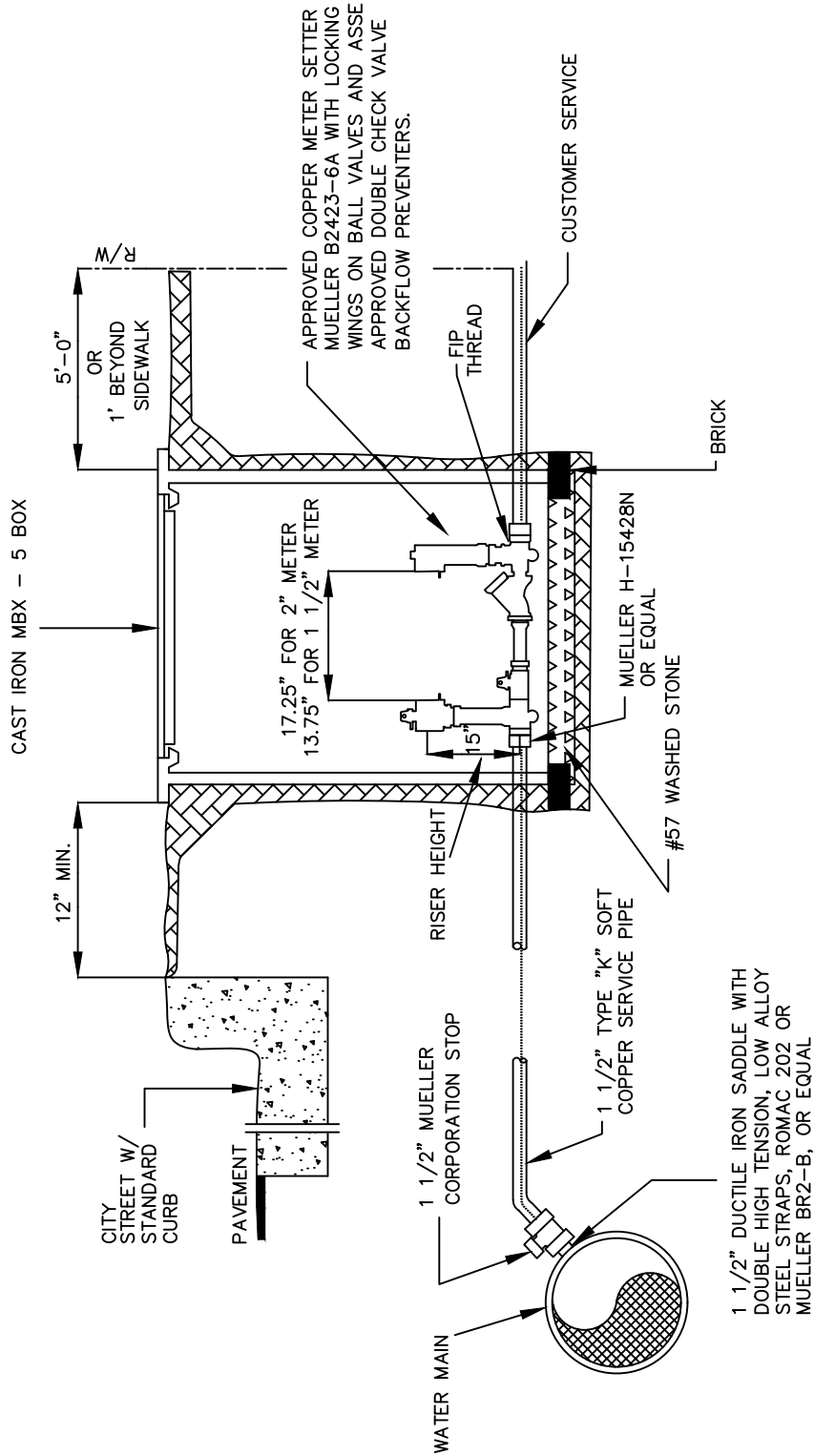


CITY OF HICKORY

TYPICAL WATER SERVICE  
CONNECTION (3/4" & 1")

DATE:  
2-1-07

SHEET 1 OF 2  
STD. NO.  
515



1 1/2" CONN. SHOWN

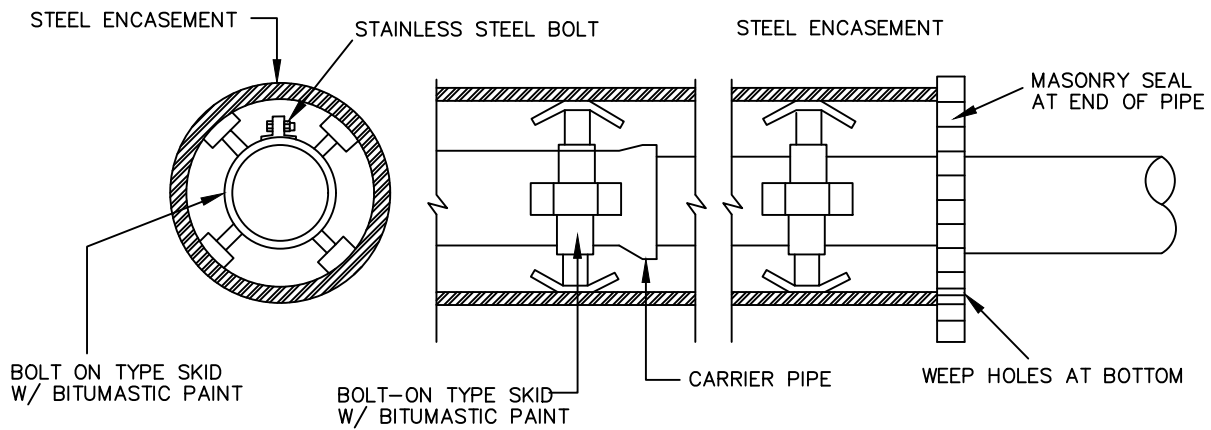
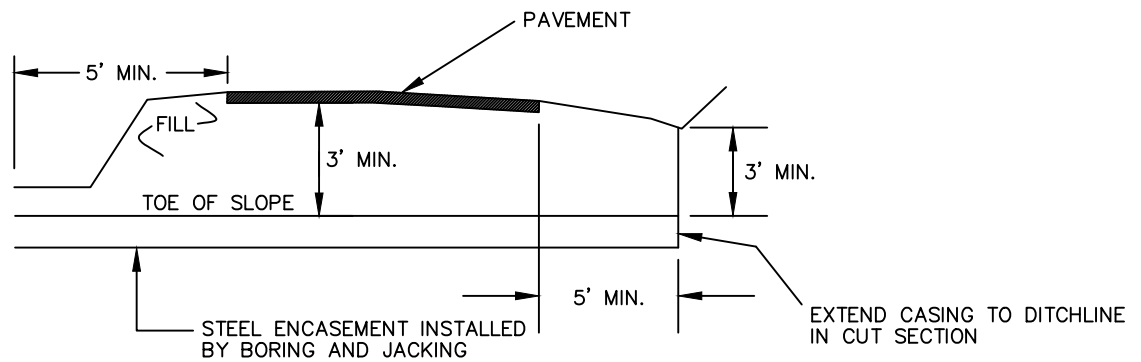
FOR 2" CONNECTION

- 1) 2" CORPORATION COCK
- 2) 2" TYPE "K" SOFT COPPER
- 3) 2" STANDARD METER
- 4) 2" METER SETTER

FOR PRESSURES  $\geq 100$  PSI

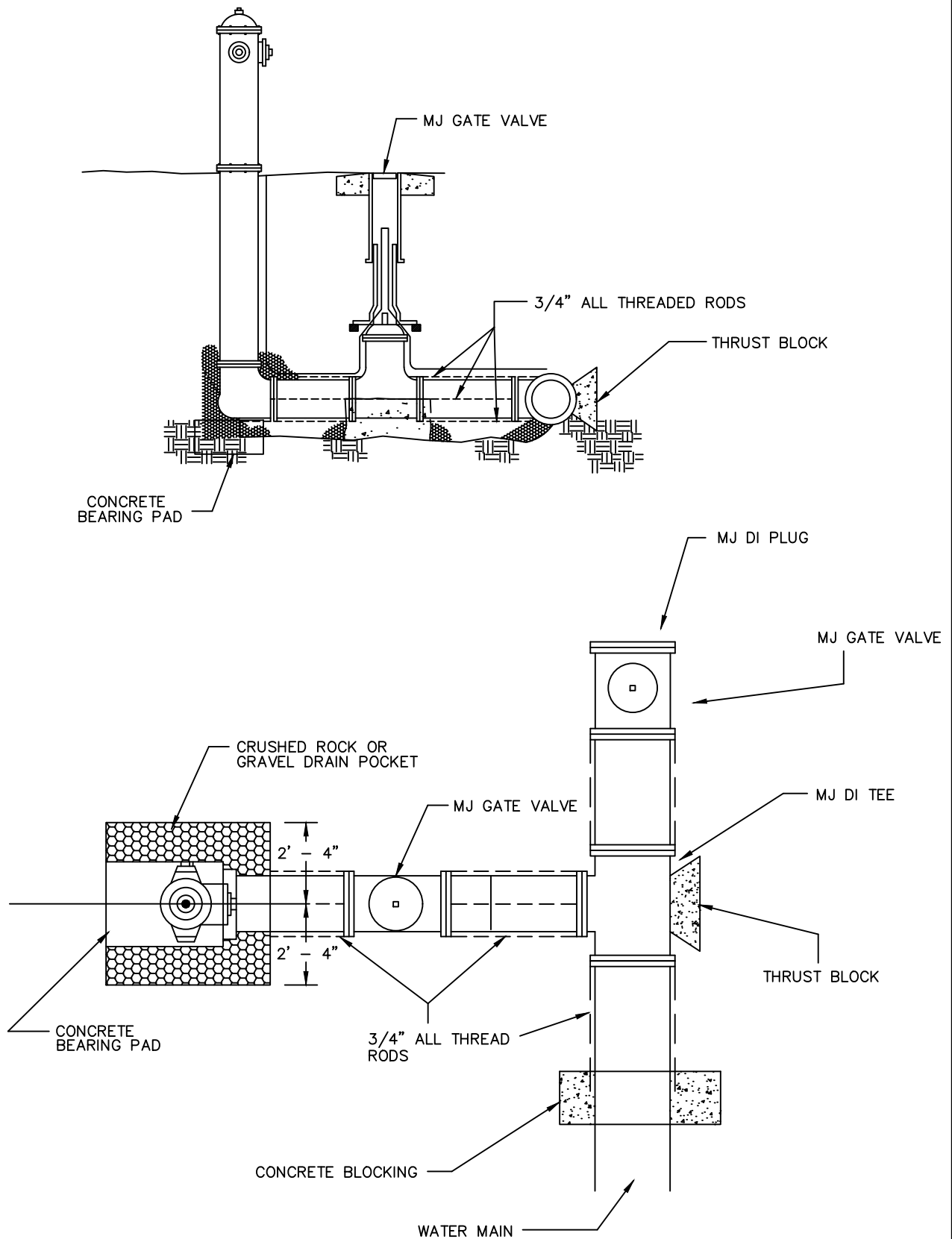
MUELLER SETTERS B-2423-6AN  
MUELLER CORPORATIONS B-2500-8N

NOT TO SCALE



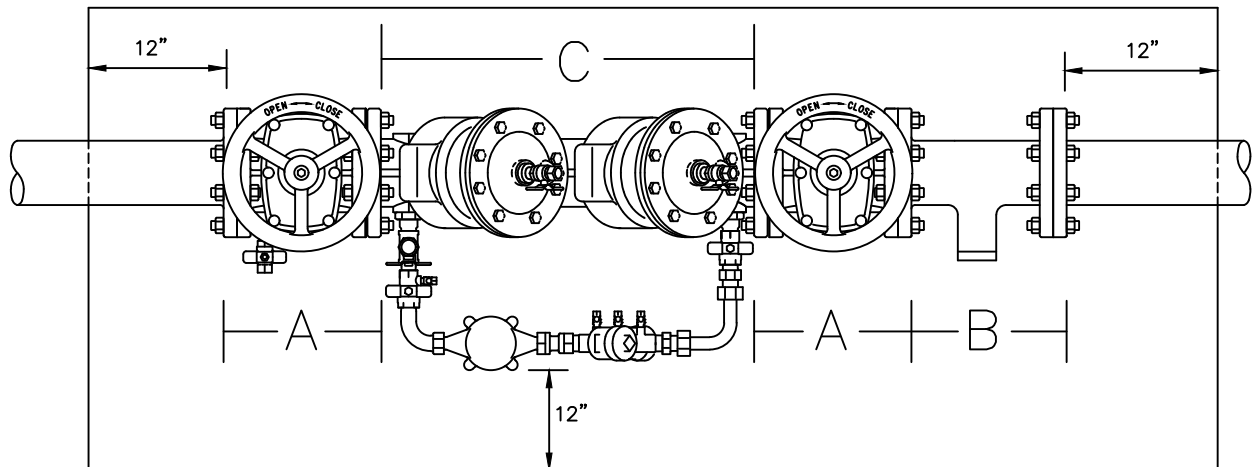
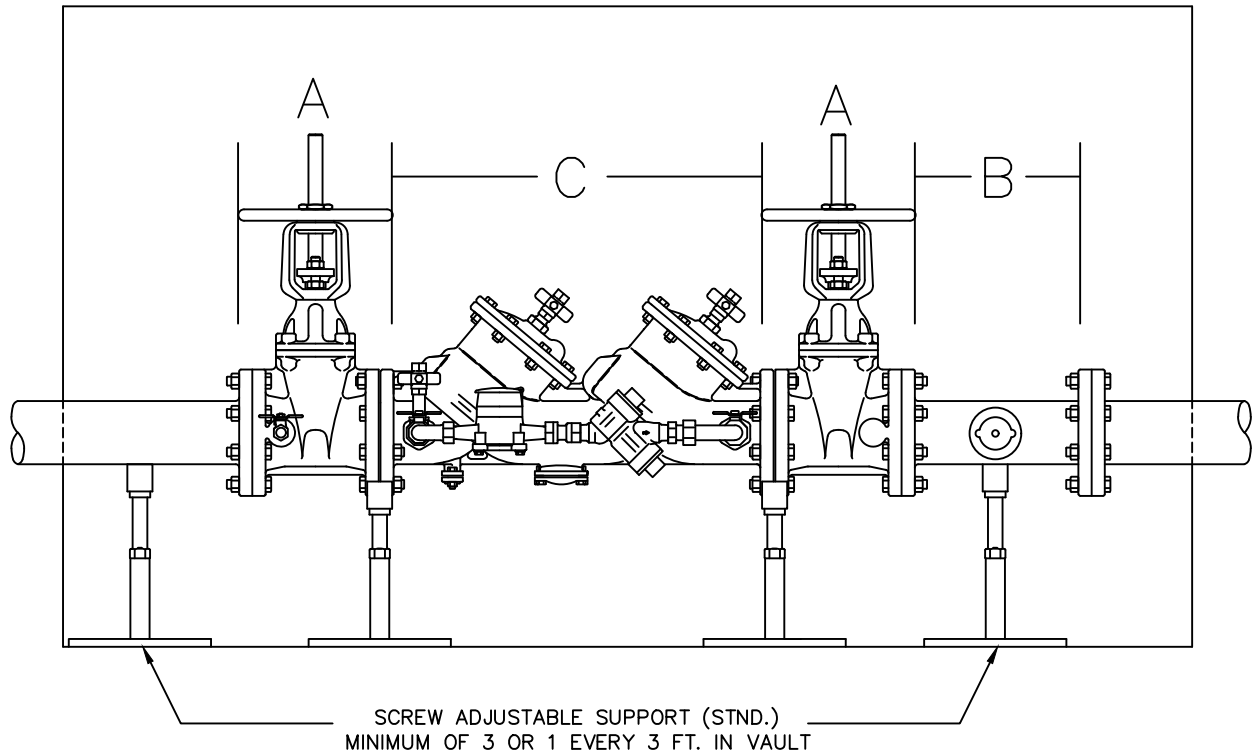
BORE ENCASEMENT DETAIL

NOT TO SCALE



NOT TO SCALE





- A. GATE VALVE ( NRS WHEEL OPERATED)
- B. TEE FOR FIRE DEPARTMENT CONNECTION
- C. DDCV WATER METER (FT3) ; USC APPROVED

NOT TO SCALE

DOUBLE DETECTOR CHECK VALVE WITH METER VAULT DIMENSIONS

SIZE	LENGTH (FT)	WIDTH (FT)	HEIGHT (FT)	HATCH
2"	6	4	4	2 x 2
2 1/2"	8	4	4	2 x 2
3"	8	4	4	2 x 2
4"	10	4	4	2.5 x 4
6"	12	4	4	2.5 x 4
8"	12	4	4	2.5 x 4
10"	12	4	4	2.5 x 4

REDUCED PRESSURE ZONE ASSEMBLY VAULT DIMENSIONS

SIZE	LENGTH (FT)	WIDTH (FT)	HEIGHT (FT)	HATCH
2"	8	4	4	2 x 2
2 1/2"	8	4	4	2 x 2
3"	8	4	4	2 x 2
4"	10	4	4	2.5 x 4
6"	10	4	4	2.5 x 4
8"	12	4	4	2.5 x 4
10"	13	4	4	2.5 x 4

NOTES:

1. DOUBLE DETECTOR CHECK VALVE TO BE USC APPROVED FEBCO MODEL 856, AMES MODEL 3000 SS WITH DETECTOR OR EQUAL.
2. REDUCED PRESSURE ZONE APPLICATION TO COMPLY WITH NCDENER GREEN BOOK.
3. REDUCED PRESSURE ZONES USC APPROVED FEBCO MODEL 826 YD OR APPROVED EQUAL. VAULT AS PRODUCED BY PRECAST OR EQUAL.

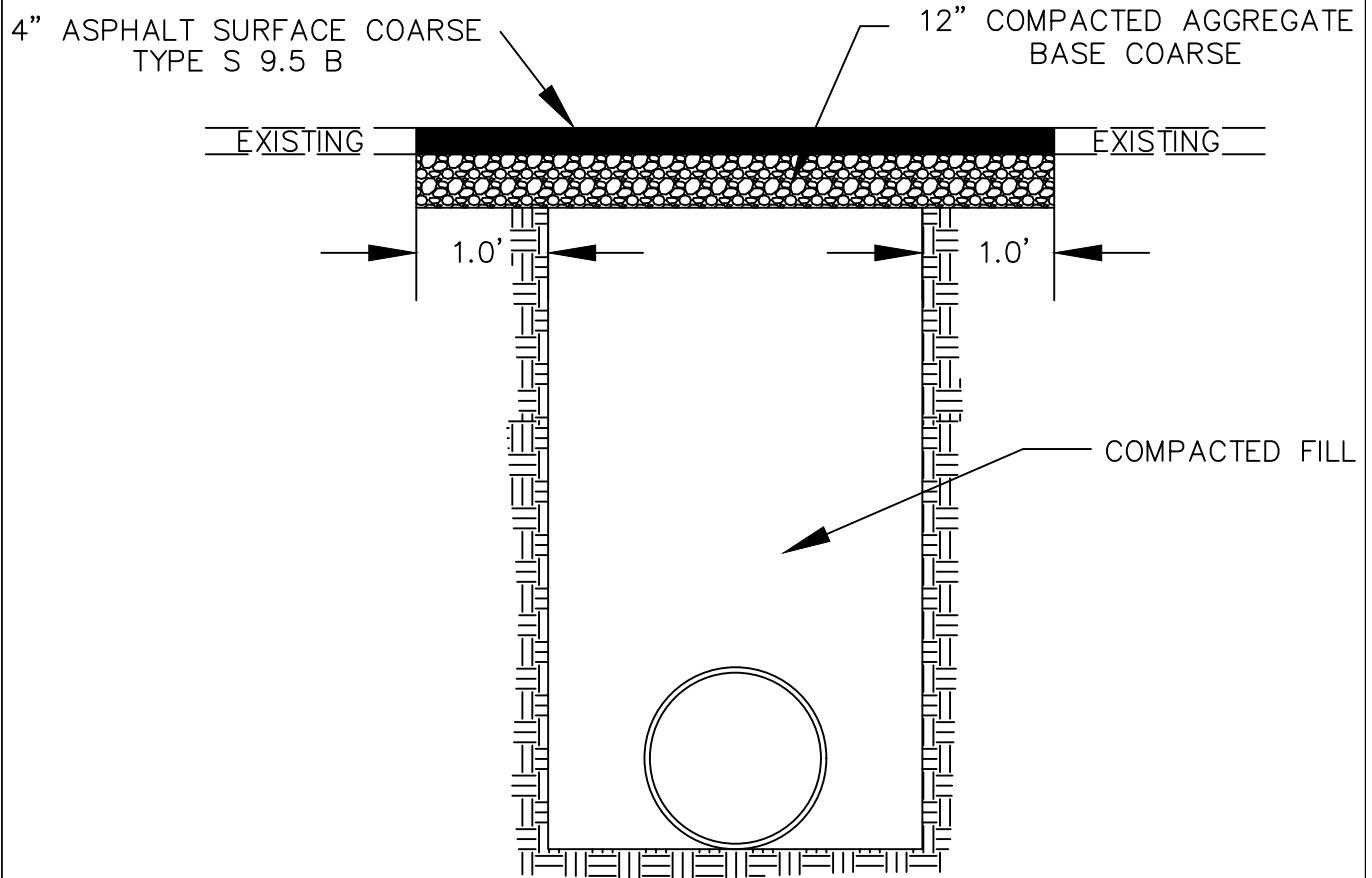
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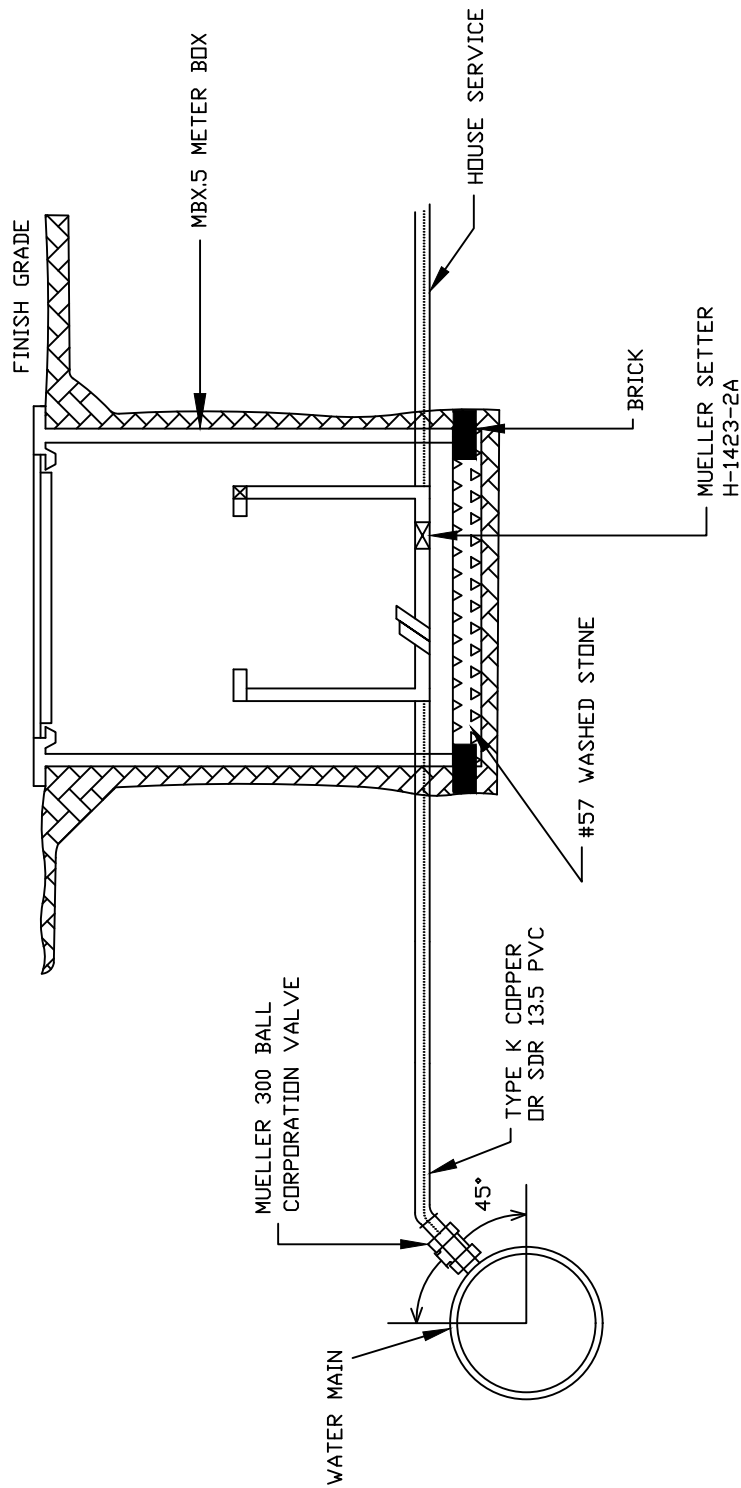
CITY OF HICKORY  
FIRE SPRINKLER  
BACKFLOW PREVENTION

DATE:  
2-1-07

SHEET 2 OF 2  
STD. NO.  
518



NOT TO SCALE



TAPPING SADDLE TO BE SMITH BLAIR  
 DOUBLE STRAP TYPE OR MUELLER  
 DOUBLE STRAP TYPE

NOT TO SCALE



CITY OF HICKORY

1 1/2" - 2" STANDARD WATER  
 SERVICE CONNECTION

DATE:  
 2-1-07

SHEET 1 OF 1  
 STD. NO.  
 520

Engineering Department  
Manual Of  
Practice



Life. Well Crafted.

Water Specifications

## SECTION 022000 - EARTHWORK

### PART 1 – GENERAL

#### 1.01 SECTION INCLUDES

- A. Installation, protection and/or modification of utilities during site work construction, including any necessary staging of work.
- B. Scarifying, compaction and testing of previously graded sites to ensure proper preparation and acceptability.
- C. Excavation and embankment placement to required lines, dimensions, and subgrade elevations.
- D. Preparation of existing low areas for placing of fill, including disposal of muck, topsoil, silt and wet or unsuitable materials.
- E. SUB-SURFACE DATA:
  - 1. Investigation: Sub-surface investigations titled Geotechnical Investigation proposed Hickory Center, Hickory, NC Project No. 90G-010100.6, dated September 18, 1990 have been made. A copy of this report can be found at the back of this specification. The report is furnished as a matter of convenience and courtesy and there is no implied or expressed warranty as to the correctness of the report as to the existing condition. However, where a treatment is not covered in the specification, the recommendations made in the report shall be considered binding.
  - 2. Site Visit: Data shown is for general information for bidders. Contractors are expected to examine the site, make investigations and decide for themselves the character of the materials to be encountered.
  - 3. Responsibility: The owner will not assume responsibility for variations of sub-soil quality or condition.

#### 1.02 REFERENCE STANDARDS

The following most current publications form part of this specification to the extent indicated by references thereto and shall be followed for all construction testing.

Section 02200-1

American Society for Testing and Materials (ASTM):

D 422	Method for Partial Size Analysis of Soils
D 698	Test for Moisture-Density Relations of Soils using 5.5 lb. (2.5 kg) Rammer and 12-inch (304.8mm) Drop (Standard Proctor)
D 1556	Test for Density of Soil in Place by Sand Cone Method
D 1557	Test for Moisture-Density Relations Using 10-lb (4.5 kg) Rammer and 18-inch (457mm) Drop (Modified Proctor)
D 1559	Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
D 2167	Test for Density of Soil in Place by the Rubber Balloon Method
D 2216	Laboratory Determination of Moisture Content of Soil
D 2487	Classification of Soils for Engineering Purposes
D 2922	Tests for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
D 3017	Test for Moisture Content of Soil and Soil-Aggregates by Nuclear Methods (Shallow Depth)
D 4318	Test for Plastic Limit, Liquid Limit & Plasticity Index of Soils
C 25	Chemical Analysis of Limestone, Quicklime and Hydrated Lime
C 110	Physical Testing of Quicklime and Hydrated Lime, Wet Sieve Method
C 618	Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland cement Concrete
C 977	Quicklime and Hydrated Lime for Soil Stabilization

American Association of State Highway and Transportation Officials (AASHTO)

T 88	Mechanical Analysis of Soils
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PART 2 PRODUCTS

2.01 MATERIALS

- A. Acceptable Stabilization Fabrics and Geogride:
  - 1. Mirafi 500X or 600X
  - 2. Phillips 66 Supac 6WS
  - 3. Dupont Typar 3401 and 3601
  - 4. Trevira S1114 and S1120
  - 5. Tensar SS-1 and SS-2
  - 6. Exxon GTF-200 or 350
- B. Filter/Drainage Fabrics:
  - 1. Mirafi 140NS
  - 2. Phillips 66 Supac 4NP
  - 3. Dupont Typar 3341

Section 02200-2

- C. Silt Fencing Fabrics:
  - 1. Phillips 66 Supac 5 NP (UV)
  - 2. Mirafi 100X
- D. Material for filling and backfilling shall be clean subsoil free from debris, roots, topsoil, frozen material and rock larger than ½ cu. ft. Fill materials shall be tested and approved by the laboratory for the degree of compaction required by its intended use.
- E. Unsuitable fill material shall be defined as that which fails to conform to requirements of paragraph 2.01 above.

PART 3 EXECUTION

3.01 PREPATATION

- A. Remove excess or unsuitable materials from the site at no additional cost to Owner. All excess and/or unsuitable material shall be wasted off site at allocation approved by the North Carolina Department of Natural Resources and Community Development (Erosion Control). Backfill areas with layers of material and compact as specified.
- B. Prior to placing fill in low areas, such as previously existing creeks, ponds or lakes perform following procedures:
  - 1. Drain water out by gravity with ditch having flow line lower than lowest elevation in low area. If drainage cannot be performed by gravity ditch, use adequate pump to obtain same results.
  - 2. After drainage of low area is complete, remove muck, mud, debris, and other unsuitable material by using acceptable equipment and methods that will keep natural underlying low areas dry and undisturbed.
  - 3. If proposed for fill, all muck, mud and other materials removed from above in low areas shall be dried on-site by spreading in thin layers for observation by Owner's representative. Material shall be inspected and, if found to be suitable for use as fill material shall be incorporated into lowest elevation of site filling operation, but not under or within 10'-0" of perimeter of building pad or paving subgrade. If, after observation by Owner's representative, material is found to be unsuitable material shall be removed from site at no additional cost to Owner.

Section 02200-3



4. Provide additional materials at no additional cost to Owner where existing materials are insufficient or unsuitable for their intended use. Borrow pits shall be approved by Owner's representative and the North Carolina Department of Natural Resources and Community Development (Erosion Control).

### 3.02 EXCAVATION FOR FILLING AND GRADING

- A. Classification of Excavation: Contractor by submitting bid acknowledges that he has investigated site to determine type, quality, quantity and character of excavation work to be performed. All excavation shall be considered unclassified excavation.
- B. Perform excavation using capable, well-maintained equipment and methods acceptable to Owner and governing agencies.
- C. When performing grading operations during periods of wet weather, provide adequate drainage and ground water management to control moisture of soils. Site dewatering is Earthwork Contractors responsibility at no additional cost to Owner.
- D. Shore, base and drain excavations as necessary to maintain safe, secure and free of water at all times.
- E. Perform rock excavation in a manner that will produce material of such size as to permit it being placed in embankments. Remove loose or shattered rock, overhanging ledges and boulders, which might dislodge.
- F. Use suitable material to replace rock overblast in building area and in expansion area to facilitate placement of utilities and future footings.
- G. Break or crush rock obtained from blasting to allow use for fill in parking area as follows:
  1. Rock 6" or greater in largest dimension is unacceptable as fill within proposed building and paving area.
  2. Rock less than 6" in largest dimension is acceptable as fill to within 24" of surface of proposed subgrade when mixed with suitable material.
  3. Rock fragments less than 2" in largest dimension and mixed with suitable material is acceptable as fill within the upper two feet (2') of proposed subgrade.

### 3.03 USE OF EXPLOSIVES

- A. Comply with all laws, rules and regulations of federal, state and local authorities and insure which govern storage, use, manufacture, sale, handling, transportation, licensing, or other disposition of explosives. Take special precautions for proper use of explosives to prevent harm to human life and damage to surface structures, all utility lines or other subsurface structures. Do not conduct blasting operations until persons in vicinity have had ample notice and have reached positions of safety.
- B. Contractor shall save harmless Owner, Architect and Owner's representative from any claim growing out of use of such explosives. Removal of materials of any nature by blasting shall be done in such manner and such time as to avoid damage affecting integrity of design and to avoid damage to any new or existing structure included in or adjacent to work. It shall be Contractors' responsibility to determine method of operation to ensure desired results and integrity of completed work.

### 3.04 FILLING AND SUBGRADE PREPARATION

- A. BUILDING SUBGRADE AREAS:
  - 1. Building subgrade pad shall be that portion of site directly beneath and ten feet (10') beyond the building and appurtenance limits.
  - 2. The building subgrade pad shall be prepared in strict accordance with the "foundation subsurface preparation", to be provided by Owner.
  - 3. Unless specifically indicated otherwise on the drawings, areas exposed by excavation or stripping and on which building subgrade preparations are to be performed shall be scarified to a minimum depth of 12" and compacted to a minimum of 98% of the optimum density, in accordance with ASTM D 698, at a moisture content of not less than 1% below and not more than 3% above the optimum moisture content.

These areas shall then be proof rolled to detect any areas of insufficient compaction. Proof rolling shall be accomplished by making a minimum of two (2) complete passes with a fully-loaded tandem-axle dump truck or approved equivalent, in each of the two perpendicular directions under the supervision and direction of a field geotechnical engineer. Areas of failure shall be excavated and replaced with suitable fill material per these specifications.

4. Unless specifically indicated otherwise on the drawing, fill materials used in preparation of building subgrade shall be placed in lifts or layers not to exceed 8" loose measure and compacted to a minimum density of 98% of optimum density, in accordance with ASTM D 698, at a moisture content of not less than 1% below and not more than 3% above the optimum moisture content. Unless specifically stated otherwise in the "foundation subsurface preparation" on the drawing.
5. The top 18" of building and parking subgrade shall be compacted to 100% Standard Proctor.

The following table stipulated maximum allowable values for Plasticity Index (PI) and Liquid Limit (LL) of suitable materials to be used as fill in the specified areas.

<u>Location:</u>	<u>PI</u>	<u>LL</u>
Building area, below upper four feet	20	50
Building area, upper four feet	12	40

B. SETTLEMENT MONITORING OF BUILDING SUBGRADE AREAS:

1. Settlement hubs are to be installed in the building areas in locations shown on the plans by the site grading contractor.
2. Settlement hubs shall be 8" in diameter and embedded a minimum of 30" into the subgrade at the building pad "blue top" elevation as detailed on the plans.
3. Settlement hub monitoring shall begin as soon as the building subgrade is reached. Monitoring shall be performed daily the first week of installation and weekly thereafter. Accuracy of monitoring is to be to 1/100 of a foot.
4. The on-site soils engineer shall monitor the settlement hubs. The site contractor shall insure that a stable bench mark is maintained at all times during monitoring and site work.
5. Reports of settlement monitoring and progress shall be submitted to the architect, and the general contractor.
6. Refer to soils report for further information.

7. After on-site soils engineer has determined when settlement has reached the acceptance limit, the site grading contractor is responsible for providing building pad elevations as shown on the grading plans.

C. AREAS OF CONSTRUCTION EXCLUSIVE OF THE BUILDING SUBGRADE:

1. Unless specifically stated otherwise on the drawing, areas exposed by excavation or stripping and on which subgrade preparations are to be performed shall be scarified to minimum depth of 8" and compacted to minimum of 98% of optimum density, in accordance with ASTM D 698, at a moisture content of not less than 1% below and not more than 3% above the optimum moisture content. These areas shall then be proof rolled to detect any areas of insufficient compaction. Proof rolling shall be accomplished by making a minimum of two (2) complete passes with a fully-loaded tandem-axle dump truck or approved equivalent, in each of the two perpendicular directions under the supervision and direction of a field geotechnical engineer. Areas of failure shall be excavated and replaced with suitable material per these specifications.
2. Unless specifically stated otherwise on the drawings, fill materials used in preparation of subgrade shall be placed in lifts or layers not to exceed 8" loose measure and compacted to a minimum density of 98% of optimum density, in accordance with ASTM D 698, at a moisture content of not less than 1% below and not more than 3% above the optimum moisture content.
3. The following table stipulates maximum allowable values for Plasticity Index (PI) and Liquid Limit (LL) of suitable fill materials to be used in the specified areas, unless specifically stated otherwise on the drawings.

<u>Location*</u>	<u>PI</u>	<u>LL</u>
Area below upper tow feet, exclusive of building area	20	50
Upper two feet, exclusive of building area	15	40

\*References to depth are to proposed subgrade elevations.

4. Material imported from off-site shall be CBR (California Bearing Ratio) value equal to or above the pavement design subgrade CBR value indicated on the drawings.

5. The site grading contractor shall provide and install all topsoil as indicated on the drawings and in conformance with landscaping plans and specifications.

### 3.05 MAINTENANCE OF SUBGRADE

- A. Finish subgrades shall be verified to ensure proper elevation and conditions for construction above subgrade.
- B. Protect subgrade from excessive wheel loading during construction, including concrete trucks and dump trucks.
- C. Remove areas of finished subgrade found to be insufficient for any reason to depth necessary and replace in a manner that will comply with compaction requirements per these specifications. Surface of subgrade after compaction shall be hard, uniform, smooth, stable and true to grade and cross-section.
- D. Grading of paving areas shall be within a tolerance of up to 0.10 feet as so long as it does not adversely affect drainage and other conditions. Contractor to provide engineering and field staking necessary for verification of lines, grades and elevations.
- E. Maintain subgrade for area to be paved. Make adjustments that may be required in accordance with specifications at no additional expense to Owner.

### 3.06 RIP-RAP

- A. Rip-rap shall be constructed as shown on the drawings.

### 3.07 FINISH GRADING

- A. Grade all areas where finish grade elevations or contours are indicated on drawings, other than paved areas, including excavated areas, filling transition areas and landscaped areas. Grading areas shall be uniform and smooth, free from rock, debris or irregular surface changes. Finished subgrade surface shall not be more than 0.10 feet above or below established finished subgrade elevation and all ground surfaces shall vary uniformly below indicated elevations. Finish ditches shall be graded to allow for proper drainage without ponding and in a manner than will minimize erosion potential. For topsoil application, refer to Section 02900 (LANDSCAPING, SEEDING AND SODDING).

- B. Correct all settlement and eroded areas within one year after date of substantial completion of all work at no additional expense to Owner. Bring grades to proper elevation.

### 3.08 FIELD QUALITY CONTROL

- A. Independent Testing Laboratory selected and paid by Owner, shall be retained to perform construction testing and act as the Owner's representative on site based on the following:
  - 1. Building Subgrade Areas, including 10'-0" Outside Exterior Building Lines: In cut areas, not less than one compaction test for every 2,500 square feet. In fill areas, same rate of testing for each lift (measured loose).
  - 2. Areas of construction exclusive of Building Subgrade: In cut areas, not less than one compaction test for every 10,000 square feet. In fill areas, same rate of testing for each lift (measured loose).
- B. In compaction requirements are not complied with at any time during construction process, remove and recompact deficient areas until proper compaction is obtained at no additional expense to Owner.
- C. In all areas to receive pavement, a CBR (or LBR) test shall be performed for each type of material imported from off-site.
- D. The following test shall be performed on each type of on-site or imported soil materials used as compacted fill as part of construction testing requirements.
  - 1. Moisture and Density Relationship: ASTM D 698 or ASTM D 1557.
  - 2. Mechanical Analysis: AASHTO T-88
  - 3. Plasticity Index: ASTM D 4318
- E. Field density tests for in-place materials shall be performed according to one of the following standards as part of construction testing requirements:
  - 1. Sand-Cone Method: ASTM D 1556
  - 2. Balloon Method: ASTM D 2167
  - 3. Nuclear Method: ASTM D 2922  
(Method B-Direct Transmission)

- F. Independent Testing Laboratory shall prepare test reports that indicate test location, elevation data and test results. The architect and Contractor shall be provided with copies of reports within 96 hours of time test was performed. In event that any test performed fails to meet these specifications, Independent Testing Laboratory shall notify the General Contractor immediately.

The Contractor at no additional expense shall pay for all costs related to retesting due to failures to Owner. We reserve the right to employ an Independent Testing Laboratory and to direct any testing that is deemed necessary. Contractor shall provide free access to site for testing activities.

END OF SECTION

Section 02200-10

## SECTION 02222 - EXCAVATION, BACKFILLING AND COMPACTING FOR UTILITIES

### PART 1 – GENERAL

#### 1.01 SUMMARY

This section includes the excavation, bedding and backfilling of utilities necessary to perform work indicated on drawings and contract documents.

#### 1.02 RELATED REQUIREMENTS

Construction drawings  
Specs. Section 02110 SITE PREPARATION  
Specs. Section 02200 EARTHWORK

#### 1.03 SUBMITTALS

- A. Shop drawings or details pertaining to site utilities are not required unless use of materials, methods, equipment or procedures contrary to drawings or these specifications are proposed. Do not perform work until required shop drawings have been accepted by Owner.
- B. The Contractor shall contact all utility companies and determine if additional easements will be required to complete the project. Contractor shall provide written confirmation of the status of ALL easements to the owner's Construction Manager at the time of the preconstruction conference or no later than 90 days prior to the project possession date.

### PART 2 – PRODUCTS

- A. Bedding Material: Processed sand and gravel free from clay lumps, organic or other deleterious material and complying with following gradation requirements:

U.S. Sieve Size	Percent Passing (by weight)
1 inch	100
$\frac{3}{4}$ inch	90-100
$\frac{3}{8}$ inch	20-55
No. 4	0-10
No.8	0-5

- B. Steel Casing Pipe: Comply with AWWA C-201 or C-202, minimum grade B, size and wall thickness as indicated on drawings.



## PART 3 – EXECUTION

### 3.01 SUMMARY

- A. Set all lines, elevations and grades for utility and drainage system work and control system for duration of work, including careful maintenance of bench marks, property corners, monuments or other reference points.
- B. Maintain in operating condition existing utilities, active utilities and drainage systems encountered in utility installation. Repair any surface or subsurface improvement shown on drawings.
- C. Verify location, size, elevation and other pertinent data required to make connections to existing utilities and drainage systems as indicated on drawings. Contractor shall comply with local codes and regulations.

### 3.02 EXCAVATION, TRENCHING AND BACKFILLING

- A. Perform excavation as indicated for specified depths. During excavation, stockpile materials suitable for backfilling in orderly manner far enough from bank of trench to avoid overloading, slides or cave-ins.
- B. Remove excavated materials not required or not suitable for backfilling or embankments and waste off-site. Any structures discovered during excavation(s) shall be disposed of as specified.
- C. Prevent surface water from flowing into trenches or other excavations by temporary grading or other methods, as required. Remove accumulated water in trenches or other excavations by pumping or other acceptable methods.
- D. Open cut excavation with trenching machine or backhoe. Where machines other than ladder or wheel-type trenching machines are used, do not use clods for backfill. Dispose of unsuitable material and provide other suitable material at no additional cost to owner.
- E. All excavation shall be unclassified.

### 3.03 TRENCH EXCAVATION

- A. The local utility companies shall be contacted before excavation shall begin. Dig trench at proper width and depth for laying pipe, conduit or cable. Cut trench banks as nearly vertical as practical and remove stones as necessary to avoid point-bearing. Overexcavate rock, wet or unstable soil, if encountered, from trench bottom as necessary to provide suitable base for continuous and uniform bedding as directed by soils engineer.
- B. All trench excavation side walls greater than 5 feet in depth shall be sloped, shoring, sheeted, braced or other wise supported by means of the sufficient strength to protect the workmen within them in accordance with the applicable rules and regulations established for construction by the Department of Labor, Occupational Safety and Health Administration (OSHA), and by local ordinances. Lateral travel distance to an exit ladder or steps shall not be greater than 25 feet in trenches 4 feet or deeper.
- C. Accurately grade trench bottom to provide uniform bearing and support for each section of pipe on bedding material at every point along entire length, except where necessary to excavate for bell holes, proper sealing of pipe joint, or other required connections. Dig bell holes and depressions for joints after trench bottom has been graded. Dig no deeper, longer or wider than needed to make joint connection properly.
- D. Trench width requirements below the top of the pipe shall not be less than 12" not more than 18" wider than outside surface of any pipe or conduit that is to be installed to designated elevations and grades. All other trench width requirements for pipe, conduit or cable shall be at least practical width that will allow for proper compaction of trench backfill.
- E. Trench depth requirements measured from finished grade or paved surface shall meet the following requirements or applicable codes and ordinances.
  - 1. WATER MAINS: 36" to top of pipe barrel
  - 2. SANITARY SEWER: Elevations and grades as indicated on drawings.
  - 3. STORM SEWER: Depths, elevations and grades as shown on drawings.
  - 4. ELECTRICAL CONDUITS: 24" minimum to top of conduit or as required by NEC 300-5, NEC 710-36 codes or the local utility company requirements, whichever is deeper.
  - 5. TV CONDUITS: 18" minimum to top of conduit or as required by the local utility company, whichever is deeper.
  - 6. TELEPHONE CONDUITS: 18" minimum to top of conduit, or as required by the local utility company, whichever is deeper.
  - 7. GAS MAINS AND SERVICE: 30" minimum to top of pipe, or as required by the local utility company, whichever is deeper.

### 3.04 SHEETING AND BRACING

Provide sheeting and bracing, when necessary, in trenches and other excavations where protection of workmen required. Sheeting may be removed after sufficient backfilling to protect against damaging or injurious caving.

### 3.05 PIPE BEDDING

Accurately cut trenches for pipe or conduit that is installed to designed elevations and grades to line and grade from 4" below bottom of pipe and to width as specified. Place 4" of bedding material, compact in bottom of trench, and accurately shape to conform to lower portion of pipe barrel. After pipe installation, place select backfill as determined in Section 02200, and compact in maximum 8" layers measured loose to the top of the trench.

### 3.06 TRENCH BACKFILLING

- A. Criteria: Trenches shall not be backfilled until required test are performed and the utility systems comply with and are accepted by applicable governing authorities. Backfilling trenches as specified. If improperly backfilled, reopen to depth required to obtain proper compaction. Backfill and compact, as specified, to properly correct condition in an acceptable manner.
- B. Backfilling: After pipe or conduit has been installed, bedded and tested as specified, backfill trench or structure excavation with specified material placed in 8" maximum loose lifts. Compact to minimum density of 98% of optimum density in accordance with ASTM D 698.
- C. Compaction: Exercise proper caution when compacting immediately over top of pipes or conduits. Water jetting or flooding is not permitted as method of compaction.
- D. Compaction Testing: If determined by the owner and at the owner's expense an independent testing laboratory shall perform test at intervals not exceeding 200'-0" or trench for the first and every other eight-inch (8") lift of compacted trench backfill and furnish copies of test results as specified.

END OF SECTION

## SECTION 02227 - BORING AND ENCASEMENT

### PART 1 – GENERAL

1.1 GENERAL DESCRIPTION: This section covers the furnishing of all supervision, labor, equipment and materials required for the complete installation of encasement pipe and carrier pipes under highways and railroads by boring and jacking as shown on the drawings and specified herein.

1.2 GENERAL INTENTION: This section shall include construction methods for pipe lines installed by boring and jacking in the locations as shown on the contract drawings. The contractor shall inspect the locations at the proposed crossings and shall familiarize himself with the conditions under which the work will be performed, and with all necessary details and the suitability of his equipment and methods for the work required. All work in railroads shall comply with all current requirements of governing highways and railroad agencies. The Contractor shall be familiar with these requirements.

### PART 2 – MATERIALS

2.1 The encasement pipe shall be of the size as shown on the contract drawings. All encasement pipe shall be smooth wall welded steel conforming to ASTM Designation A139, Grade B. The outside of the pipe shall be coated in accordance with AWWA Standard C203. Minimum pipe wall thickness shall be as follows:

Pipe-Nominal Diameter Inches	Wall Thickness Inches
16	.250
20	.250
24	.250
30	.312
36	.500

2.2 Steel spiders shall be galvanized.

### PART 3 – EXECUTION

3.1 Encasements shall be installed by boring and jacking unless field conditions require otherwise. It shall be the Contractor's responsibility to notify the Engineer immediately if conditions do not permit a jack and bore installation.

- 3.2 Installation of encasement pipe shall include all related work and services such as mobilization of equipment, construction and maintaining working pits, right-of-way maintenance and restoration, traffic maintenance, mining, excavations, dewatering, sheeting, shoring and bracing for embankments, operating pits, and as elsewhere required shall be placed and maintained in order that work may proceed safely and expeditiously.
- 3.3 The encasement pipe shall be of the diameter indicated for the carrier pipe as shown on the drawings.
- 3.4 Boring Machine Alignment: The boring machine shall be accurately aligned before the boring is commenced and the Contractor shall take such necessary steps as are required to accurately place the encasement with respect to line and grade. Payment will not be made for a bore and encasement that is not accurate as to line and grade as determined by the Engineer.
- 3.5 Extension of Encasement Pipe: As the boring operation progresses, each new section of the encasement pipe shall be butt welded to the section previously jacked into place. The boring auger shall not be of a greater diameter than the outside diameter of encasement. The leading edge of the steel casing shall be kept as close to the auger head as possible and shall be advanced at the same rate of speed as the earth auger in order to minimize any unsupported holes in the earth. Any voids that occur are to be filled with 3:1 ratio sand to cement grout at 50 psi pressure, sand or pea gravel, as directed by the Engineer to insure that there will be no settlement. The Engineer will direct that this space be filled if the space is large enough to cause any earth settling. There will be no payment for grout work.
- 3.6 Before the pipe is installed in the casing, bolt-on meter skids painted with bitumastic paint shall be rigidly fastened to the barrel of the pipe. After completion of the casing, the Contractor shall insert the pipeline in the pre-jointed segments. No contact will be permitted between the casing and the carrier pipeline.
- 3.7 Obstructions: In the event that an obstruction is encountered during the boring operation which cannot be penetrated as determined by the Engineer, the auger is to be withdrawn and the steel pipe encasement is to be cut off, capped and completely filled with 3:1 ratio sand to cement grout at 50 psi pressure before moving to a new site. Payment will be made by the Owner on completed before the boring operation was stopped plus the additional linear footage at the new site. There will be no payment for the grout work.

- 3.8 Pipeline Installation: After completion of the boring and encasement, the Contractor shall insert the pipeline in pre-jointed segments. A galvanized steel spider shall be installed behind each carrier pipe bell in the encasement pipe, as shown on the Contract Drawings. After placing and jointed the pipeline, the ends of casing pipes and tunnels shall be closed with brick masonry bulkheads.
- 3.9 Method of Measurement: Measurement will be in feet along the flow line of the encasement pipe which is installed.
- 3.10 Basis of Payment: The quantity of encasement pipe measured as provided in paragraph entitled "Method of Measurement" will be paid for at the contract unit price per linear feet.
- 3.11 Payment shall be for the total number of lineal feet of encasement pipe installed at the respective unit price bid for the item.
- 3.12 Price and payment shall constitute full compensation for furnishing all equipment, labor, tools, and materials to complete all of the work required under this section including excavation of working pits, encasement pipe, carrier pipe, dewatering, shoring, etc.

End Section

## SECTION 2400 – THRUST BLOCKING

### 1.1 INTRODUCTION

Thrust Blocks are to be installed at all fittings which change a direction of the pipeline centerline, either in part or whole including but not solely, bends and tees, at dead end situations of the pipeline or as directed by the Engineer/Owner.

### 1.2 MATERIALS

Concrete used for construction of Thrust Blocking shall be a minimum of 3000-psi compressive strength determined in accordance with ASTM C39 or C42 with a maximum of 5" slump delivered from the factory. The only water to be added in the field is that which the factory held back from achieving the 5" slump at the point of mixing. Reinforcing steel shall be of grade and installed as shown on the plan details in such cases, as it is required. Sakrete or any like material shall not be permitted under any circumstance.

### 1.3 THRUST BLOCKING CONSTRUCTION

Thrust Blocking shall be constructed to the minimum dimensions shown on the drawings or as field directed by the Engineer. All faces shall rest against undisturbed earth with the exception of the face to which the load is to be applied. Care must be exercised so that concrete is not allowed to drop more than 4' free undisturbed fall so that separation of aggregates is avoided and maximum benefit is achieved. All joints and faces of the appurtenances to be restrained shall be wrapped continuous with a 4 mil plastic such that the concrete does not come into direct contact with bolts, joints, flanges, gaskets etc. Diligence must be exercised so that pipe joints are not encased with concrete intended to provide thrust blocking except as specified or directed by the Engineer.

END OF SECTION

Section 2400-1

SECTION 2401 – WATER VALVES, VALVE BOXES,  
AIR RELIEF VALVES AND TAPPING SLEEVE & VALVES

1.1 INTRODUCTION

This section covers the requirements for furnishing and installing the above-mentioned items and their respective appurtenances as detailed on the plans. This shall include all labor, equipment, materials and incidentals that are necessary to complete installation of subject items in accordance with the plans and specifications. All supplied materials shall be of a type and class as specified herein

This section will specify storage and handling, excavation, bedding, laying and coupling of joints and backfilling. All construction shall be as specified as herein, unless written deviation is received from the Engineer.

Work under this section shall be measured by the actual number of components and paid for at unit prices established in the Contract.

1.2 CATALOG CUT SUBMITTALS

Contractor shall submit 4 copies of catalog cuts to Engineer for review for all materials that are required to complete the work as described in the associated plans. Engineer will retain two sets of original submittals and return two sets to the Contractor with the appropriate response annotated.

1.3 STORAGE AND HANDLING

The Contractor shall inspect the materials upon receipt for visible defects prior to off loading. The Contractor shall unload all valves and appurtenances as so to avoid any deformation or other injury. The Contractor shall implement appropriate measures during storage such that no storm water may pass through or encumber the materials. All materials shall be stored in such a manner that they will drain and so protect them from contamination or freezing.

If any material is found to be defective during installation, then same material shall be removed and replaced with appropriate quality and type at the Contractors expense.

1.4 MATERIALS

A. Gate Valves:

All Gate Valves shall as a minimum reflect a rating of 200 psi, contain clearway equal to the full nominal diameter of the adjoining pipe, be open left operation (counterclockwise), reflect the name and date of manufacture, be of non-rising stem type, contain a directional arrow for operation cast into the body, have a 2” operating nut for control and contain Mechanical Joint connections. All requirements shall be met unless specified on the plans or directed by the Engineer in writing.



All materials shall withstand a hydraulic test pressure of equal to twice the rated pressure and Contractor shall provide written proof of test from manufacturer upon request.

A.1 Resilient Seated Wedge Valve:

Gate Valves 2" through 36" diameter shall be of cast iron or ductile iron body, resilient seated wedge type valves conforming to the requirements of AWWA Standard C 509 and/or AWWA Standard C 500. Unless specifically approved in writing by the Engineer all valves shall be from one manufacturer and all parts interchangeable.

Gate valves shall conform to ASTM A-536 as it relates to cast iron or ductile iron manufacturer of the body, bonnet and gate. Shell thickness of components shall conform to the thickness in Table 2, Sect. 4.4 of AWWA Standard C 509 or AWWA Standard C 500 as appropriate. Valve body and bonnet coating shall conform to AWWA Standard C 550 and include fusion bonded epoxy coating for the interior and exterior surfaces of the valve.

The gate shall be completely covered with a rubber coating securely fixed to all ferrous surfaces. The gate and rubber coating shall conform to ASTM D429.

Valve stems shall be of cast bronze construction. Valves shall contain a stuffing box, which located above the thrust collar, which will contain O-rings for sealing. The valve shall be of type construction that allows replacement of the ring seals while the valve is fully open and under pressure.

Valves 16" and larger in diameter shall be designed and constructed in such a manner as to include beveled reduction gears to reduce the number of turns and torque required to operate valves.

A.2 Double Disc Valves:

Gate valves larger than 36" diameter shall be ductile iron body, double disc parallel seat conforming to AWWA Standard C 500. All valves shall be from one manufacturer with interchangeable parts.

Gate valves shall conform with ASTM A536 as it relates to manufacturer of body, bonnet and gate constructed of ductile iron. Entire valve body and bonnet shall be coated on interior and exterior surfaces.

Gates shall be constructed of cast iron smooth and continuous without pockets on either face. Cam surfaces shall be open to the bottom. Gate ring seals shall be inserted into a dovetail groove under pressure and make up a single insertable finish.

Gate valves shall operate as a bottom wedging design with a two-part wedge contact. Wedge and Hook shall be separate castings.

Valve stems shall be of cast bronze construction. Valves shall contain a stuffing box, which located above the thrust collar, which will contain O-rings for sealing. The valve shall be of type construction that allows replacement of the ring seals while the valve is fully open and under pressure.

Valves 16" and larger in diameter shall be designed and constructed in such a manner as to include beveled reduction gears to reduce the number of turns and torque required to operate valves. All rollers, tracks and scrapers shall be of bronze casting.

Bypasses shall be supplied and installed as a part of all valves. Bypass shall be a minimum of 3" diameter and operating mechanism shall be of resilient seated wedge type.

B. Valve Boxes:

All valve boxes shall be adjustable screw type with a base sized to fit over the valve yoke and a lid with "water" cast integral. All valve boxes shall be constructed of domestic or foreign cast iron that complies with the requirements of ASTM A48. Valve boxes shall be the appropriate range of adjustment for the site and Contractor should minimize the use of extensions.

C. Air Valve:

All air valves shall operate as both an air/vacuum valve and air release valve simultaneously in one unit. The air/vacuum portion of the appurtenance shall operate such that during the filling operation, or when necessary, it will allow large amounts of air to be expelled from the line to avoid substantially compressing air in the line and also operate to effectively allow air to reenter the line in the case that internal pressures would approach negative values, such as happens with line breaks or separations. The air release portion of the valve shall operate such that it automatically releases minute amounts of air as necessary while in service. All air valves must conform to AWWA Standard C512.

All air valves shall contain a rating of 150 psi with a test rating of 300 psi.

Body and cover shall be manufactured of cast iron conforming to ASTM A126, Class B. The float shall be stainless steel with stainless steel guide and rated to withstand ultimate system surge pressure successfully. Valves 4" and larger shall have floats of stainless steel with dual stainless steel guides and rated to withstand ultimate system surge pressure successfully. The body and cover shall be constructed of cast iron and be concentrically located. All internal parts shall be stainless steel or Buna-N rubber.

D. Tapping Sleeve and Valve:

All sleeves shall have flanged outlet of appropriate size and strength to accommodate the tapping valve. Tapping valve shall be resilient seat wedge gate valve design with each flange capable of accepting the sleeve, tap machine face, or mechanical joint connection to adjacent pipe.

Tapping sleeves up to 12" shall be Stainless Steel Wrap Around type. Tapping sleeves 12" and larger shall be Ductile Iron Full Body type. All tapping sleeve and valves shall be of the size and type detailed on the plans.

Stainless steel tapping sleeves shall be constructed of two-piece stainless steel jointed by grade 18-8 stainless steel bolts. The gasket shall be girded virgin SBR compound rated for water service per ASTM D2000 and the gasket shall provide full range pipe coverage. Outlet pipe shall be constructed of grade 18-8 stainless steel and be schedule 5. All sleeves shall contain a 3/4" test outlet with brass plug for the purpose of air testing the sleeve.

All connections to the existing system shall be coordinated with the Water Purveyor having jurisdiction.

## 1.5 INSTALLATION

A. Excavation:

This section shall cover the excavation and proper disposal of any and all materials disturbed during the construction of trenches which is further defined as all excavation necessary for the proper installation storm or sanitary sewers and any appurtenances and waterlines and any appurtenances. This section shall further cover any work deemed appropriate by the Engineer.

Excavation shall be done to the lines and grades as depicted or detailed on the plans or as directed by the Engineer. All work involving this section shall be coordinated with any Grading, Site Utility work or other construction on the project site and shall be maintained satisfactorily so that adequate drainage is provided at all times. Any roots that protrude into the trench lines shall be trimmed flush with the trench walls.

All excavation shall be open cut unless otherwise depicted on the plans or specifically authorized by the Engineer. If after excavation the bottom of the proposed trench is found to contain rock, materials which can not be removed with standard and prudent construction equipment or is unsuitable for providing a uniform bearing surface then same material shall be removed to a depth not less than 8" below proposed depth, backfilled with approved material and compacted. Excavation widths shall be such that not less than one full diameter of the pipe is clear between the outside face of the pipe and each closest trench wall or inside face sheeting, shoring, or trench box as necessary.

Excavated materials to be used during backfill operation shall be suitable material, significantly free from debris and/or rocks and approved by the Engineer. Acceptable material which is excavated shall be neatly and compactly deposited at the sides of the trench where space provides but at no time closer than 2'0" from the closest side of the trench. When stockpiling of material is required, the Contractor at his expense shall do so at an approved site and this site shall be kept and neat to avoid unsightly appearance. Stockpiling shall be arranged to allow for natural drainage without pollution of water by erosion.

B. Sheeting, Bracing and Trench Boxes:

As appropriate reference to OSHA Regulation 1926.652(b), the Contractor will be required to keep the sides of excavation vertical by sheet, bracing or the use of trench boxes to prevent movement by slides or settling of the side, to prevent injury or displacement of pipe or appurtenance or diminished the required working space adjacent to pipe. Furthermore, the Contractor may be required, for the purpose of preventing injury to persons, property or adjacent structures, to leave sheeting or bracing in place.

All measures employed, when required, shall extend a minimum of 18" above existing grade and a maximum of 48" above grade. In no case shall timbers, beams or other sheeting/bracing materials be left in the trench, which may form or promote voids that cannot easily be corrected during the backfilling operation or compaction of backfill. It is agreed upon by these specifications that where it is necessary to leave sheeting or bracing intact and backfilled that the Owner is under no obligation to pay Contractor for time or materials involved in constructing such measures. Contractor shall assume and accept any and all risk associated with or encumbered by failure to implement proper and necessary sheeting, bracing or trench box use on any excavation and will be held responsible for caving, settlement and all other damages resulting there from.

C. Valves:

Prior to each installation, the Contractor shall make sure the interior is wiped clean and the valve is test operated by opening and closing. All valves shall be set with the operating mechanism plumb and at the location depicted on the plans.

Initial backfill shall be thoroughly compacted by hand around the valve body to a distance of 12" in all directions and compaction by mechanical means such as vibratory trench roller or striking compactor shall be thoroughly achieved to a distance of 3' 0" each side.

D. Valve Boxes:

A valve box shall be installed over every underground valve. All valve boxes shall be set plumb with the valve; the operating mechanism of the valve shall be centered in the top opening and their lid flush with finished grade.

E. Air Valves:

All air valves shall be installed in a cast iron meter box with a minimum of 18" by 24" clear inside dimension and at the exact location as depicted on the plans.

F. Tapping Sleeve and Valve:

All tapping sleeves shall be installed at the exact location as depicted on the plans. All tapping sleeves shall be installed per strict conformance with manufactures specification, flange perfectly horizontal with existing pipe and bolts tightened with a torque wrench to the proper specification. All tapping valves shall follow valve installation requirements. The tapping sleeve shall be air tested prior to performing the tap into the existing line.

## 1.6 BACKFILLING AND COMPACTION

A. Trenches shall be backfilled immediately upon approval of pipeline construction.

B. Roadways and Crossing:

Full depth and width of trench shall be backfilled by placing material in uniform layers not to exceed 12" thick and shall be thoroughly compacted by approved mechanical compactors under optimum moisture conditions. Compaction of the trench shall be to 95% as determined by Standard Proctor Test for all areas outside the paved area and any depth exceeding 18" below finished surface of asphalt. The top 18" of any trench directly under pavement or within 36" of the edge of pavement shall be compacted to 100% as determined by Standard Proctor Test. If existing material is not suitable for obtaining compaction then select backfill shall be used when requested by the Engineer.

All paving and base course affected shall be removed and replaced with new material of equal or better quality with like texture and color as the adjacent pavement.

All backfill methods shall be in strict compliance with manufactures recommendations and all methods shall be instituted such that no damage, misalignment, or unjointing of the pipe or appurtenances is experienced.

Backfill shall be kept free of organics (grasses, sticks, stumps, roots etc.), stones (all stones over 1" diameter within first 12" of backfill and all stones over 2.5" diameter for the remainder of the backfill), any frozen soil or other soil which is not suitable for backfill (highly plastic clay) or any other objectionable items. All backfill shall be installed and graded in a manner that erosion or saturation will not negatively affect the backfilled area.

Heavy equipment shall not be operated over any pipe or appurtenance until it has been properly backfilled and has minimum cover as required by the plans. Where any part of the required cover is above proposed finished grade, the Contractor shall place, maintain and lastly remove such material at no additional cost to the Owner. Any pipe or appurtenance, which becomes misaligned, shows excessive settlement or has been damaged by the Contractor shall be corrected or replaced as deemed necessary by the Engineer/Owner at no additional cost to the Owner.

Prior to acceptance, the Contractor shall properly maintain all installations in such a manner that they will operate without failure.

C. Finish Grading:

All areas disturbed shall be graded to a continuous finish without irregularities or abrupt changes and shall not consist of areas, which will retain water or cause foreseeable future maintenance. Prior to acceptance, all debris, excess material, trash or any unsightly occurrence shall be removed and the project site shall be in a neat and satisfactory condition.

END OF SECTION

Section 2401-7

## SECTION 2402 – FIRE HYDRANTS AND APPURTENANCES

### 1.1 INTRODUCTION

The scope of work covered under this section shall be to furnish all labor, equipment, materials and any other items that are necessary for the proper installation of fire hydrants. Fire Hydrants shall conform to the applicable requirements of AWWA Standard C502 (Latest Edition) for dry barrel, traffic model type.

### 1.2 CATALOG CUT SUBMITTALS

Contractor shall submit 4 copies of catalog cuts to Engineer for review that are required to complete the work as described in the associated plans. Engineer will retain two sets of original submittals and return two sets to the Contractor with the appropriate response annotated.

### 1.3 STORAGE AND HANDLING

The Contractor shall inspect the materials upon receipt for visible defects prior to off loading. The Contractor shall unload all fire hydrants and valves so as to avoid any deformation or other injury. The Contractor shall implement appropriate measures during storage such that no storm water may pass through or encumber the materials. All materials shall be stored in such manner that they will drain and so protect them from contamination or freezing.

If any material is found to be defective during installation, then same material shall be removed and replaced with appropriate quality and type at the Contractors expense.

### 1.4 MATERIALS

#### A. Fire Hydrants:

All fire hydrants shall comply with all applicable standards of AWWA Standard C502 (Latest Edition) for dry barrel, traffic model type. The traffic model shall consist of a break away flange and stem which will allow the upper section of the hydrant barrel and operating stem to separate from the lower components upon impact and not cause damage to the lower section. All hydrants shall contain O-ring seal for the operating stem which prevents contact between the stem and water at all times. All hydrants shall have an automatic oiler system which introduces lubricant every time the stem is operated.

Fire hydrants shall consist of two 2½ inch hose nozzles and one 4½ inch pumper nozzle all nozzles shall be reverse thread into the barrel and the thread pattern shall be National Standard Threads as per Appendix A of AWWA Standard C502. Furthermore the operating nut shall be pentagonal shaped with 1½ inch between the point and flat. Hydrants shall be operated open left (counterclockwise) with a 4½ inch compression base seat opening against pressure. All hydrants shall be capable of operating against 250 psi working pressure and shall withstand 500 psi hydrostatic test pressures.

All hydrants shall have standard 6 inch mechanical joint connections and shall be no less than 3 foot 6 inch bury unless otherwise noted on the plans. All hydrants shall be painted the appropriate color as indicated on the plans and shall have reflective bead bonnets. Following installation and testing and before final acceptance all fire hydrants shall be painted with epoxy paint to an acceptable appearance resulting in uniform color and no oxidation or rusting.

All fire hydrant iron parts shall be fabricated of ductile iron.

The fire hydrant main valve shall be 4½ inch minimum and shall be of the full compression design, opening against and closing with pressure. The valve seat ring shall thread into a bronze sub-seat and all gaskets sealing the seat ring shall be bronze to bronze surface.

Drain valves shall be bronze and allow complete draining of all residual water in the hydrant barrel. Draining shall be automatic and not dependent on separate operation.

All bolting and fasteners shall be stainless steel.

The operating mechanism shall utilize two O-ring seals between the revolving nut and bronze sheathed upper section of the valve rod. The top of the rod shall also be fitted with a travel stop nut to limit downward travel of the rod. A thermoplastic thrust washer shall be used to reduce friction in the thrust collar while opening the hydrant. All weather grease shall be used to provide permanent lubrication.

#### 1.5 INSTALLATION

All fire hydrants shall be connected to the main waterline with a 6 inch leg consisting of the same material as the main waterline and having at least the same depth of bury. All fire hydrants shall be installed plumb with the pumper nozzle facing parallel to the roadway and with the center of the lowest outlet not less than 18 inches or more than 24 inches above finished grade. Hydrants shall be rodded to the 6 inch gate valve and the valve rodded to the branch tee or mounted directly to a hydrant tee. Backfill around fire hydrants shall be thoroughly compacted to finished grade and not less than seven cubic feet of clean stone meeting gradation #67 shall be placed 6 inches under, around the base, and up the barrel to insure proper residual drainage from the barrel. A solid and sound cap block shall be set under the fire hydrant shoe for a solid base.

Fire hydrants shall be located, painted and buried to the depth shown on the plans.

END OF SECTION



## SECTION 2500 – LEAKAGE TESTING

### 1.1 INTRODUCTION

All structures are required to be watertight and all pressure and gravity piping and pipelines shall be tested by the Contractor as directed by this section and/or the Engineer/Owner. All tests shall be organized by the Contractor at the Engineers convenience.

All labor, equipment, water, materials, gauges, meters and any other items shall be furnished by the Contractor at his expense. In the case of a failed test, minor defects will be corrected and retested immediately. Any failure due to a major defect will constitute stopping the test and rescheduling with Engineer/Owner.

### 1.2 STRUCTURES

All fluid containing structures shall be subject to a gravity pressure test by filling the structure with water to overflow, or as directed by the Engineer, and observing the water level for a period not less than 24 hours. Leakage will be considered to be within the allowable limits for structures when there is no visible sign of leakage evident by either moisture on exposed surfaces or water level drop in excess of 1 inch within the 24 hour period. All wall castings or penetrations shall be plugged temporarily during the test period.

If leakage exceeds the allowable limit, the work shall be repaired by removing and replacing the defective portions, waterproofing the inside and outside or by other methods as approved by the Engineer.

### 1.3 PRESSURE PIPING

All pressure piping shall be subject to a hydrostatic pressure/leakage test in accordance with AWWA C600 (Ductile) or AWWA C605 (PVC).

Upon satisfactorily constructing the pipeline, including all appurtenances called for on the associated plans, and effectively backfilling the trench the hydrostatic test shall be conducted.

The Contractor shall prepare a testing plan/schedule to be approved by the Engineer, which will effectively test the entire section to be constructed, and at no time test more than 4,000 linear feet of pipeline at one time.

As the pipeline is being filled with water in preparation of the test, all air shall be expelled from the pipe. If sufficient exit points are not available, the Contractor at his expense shall install air reliefs of a type and location as approved by the Engineer.

The pipeline shall be subjected to a hydrostatic pressure of 150 psi or 50 psi above existing line static pressures, whichever is greater, for a period of 2 hours or as specified by the Engineer. Pressure shall be applied to the line by means of hand pump for lines 2" and smaller or by approved mechanical means for larger lines

Allowable leakage shall not exceed that determined by the following formula:

$$L = \frac{SD(P)^{1/2}}{148,000}$$

L = Allowable leakage in gallons per hour.  
S = Length of line under test in feet.  
D = Nominal diameter of pipe in inches.  
P = Average test pressure in psi.

Any visible leak shall be corrected to minimize water leakage no matter of the allowable leakage calculation.

All pipe and appurtenances found to be defective during the hydrostatic test shall be removed and/or corrected at the Contractors expense and Engineers approval.

All materials shall be subject to manufacturer's recommendations for storage, pre-testing, etc.

After a successful test has been obtained the Contractor shall notify the Engineer in writing and request written recognition from Engineer of acceptable test results.

END OF SECTION

Section 2500 - 2

## SECTION 2501 – STERILIZATION

### 1.1 INTRODUCTION

Before being placed into service and after successful hydrostatic pressure test, all newly constructed or repaired pipelines or structures, which will hold or carry potable water, shall be chlorinated and flushed or cleaned as directed by this specification and the Engineer. The Contractor shall chlorinate all pipelines and/or structures by use of liquid chlorine gas/water mixture or the use by use of calcium hypochlorite granules. All sterilization procedures shall be according to AWWA Standard C651-14.

Prior to chlorination all dirt and foreign matter shall be removed by thoroughly Preliminary Flushing or cleaning of the pipelines and/or structures.

### 1.2 PRELIMINARY FLUSHING

Prior to chlorination, pipelines shall be filled with water to eliminate air pockets and shall be flushed to remove all dirt and particulate matter. Contractor shall be responsible for providing means of measuring water such that a velocity sufficient to remove any and all debris is reached.

### 1.3 CHLORINE APPLICATION

All sterilization procedures shall be as specified below or as prescribed by AWWA Standard C651-14. The chlorine gas/water mixture shall be introduced into the pipelines or structure by means of an approved method by the Engineer and at such rate that all lines or structures contain a chlorine dosage of not less than 100 ppm. The retention time shall be not less than 24 hours and shall produce not less than 10 ppm at any point in the pipeline or structure at the end of the retention period. All valves, fire hydrants and appurtenances shall be opened and closed numerous times during the contact period.

Pipelines and structures may, at Contractors option, be chlorinated in sections isolated by means of gate valves or as approved by Engineer.

Chlorine gas/water mixture shall be dosed into the pipeline or structure to be sterilized by means of a tap and corporation stop placed onto the line as convenient to Contractor and approved by Engineer.

As a substitute to chlorine gas/water mixture, the Contractor may add calcium hypochlorite to the pipe as it is being installed. Such sterilization shall be achieved by placing the granules at the upstream end of the section to be tested and at 500' intervals at a dosage correlating to the sizes shown below:

Calcium Hypochlorite dosage per 500' of line	
Pipe Dia.	Calcium Hypo chlorite (oz.)
2"	0.42
4"	1.7
6"	3.8
8"	6.7
10"	10.5
12"	15.1
16"	26.8
18"	33.97
20"+	$D^2 \times 15.1$

\*Where D is the inside pipe diameter in feet,  $D = d/12$

After chlorination period is complete, all water shall be flushed from the pipeline or structure until it is equal quality to the existing supply and proved to the Engineer/Owner to be acceptable through Chemical and Bacteriological testing.

During the flushing period each valve and fire hydrant shall be operated numerous times to provide through flushing of the system and removal of all highly chlorinated water. The line shall set for a minimum of 48 hours following flushing at which time samples shall be pulled and stored in properly sterilized containers for bacteriological testing in a number to be determined by the Engineer and at the Contractors expense. The number of samples will be based on one sample per 4,000 linear feet of main and all dead ends. All bacteriological testing must be completed by a state-approved, certified laboratory. Per rule .1001. Upon receipt of successfully passing results, in duplicate, the line shall at the Engineers/Owners discretion be deemed acceptable.

Highly chlorinated water shall not be released into the existing distribution main or the surrounding environment. All water retained in the line shall be flushed until such time as the representative sample is identical to the existing water quality. All water shall be expelled from the lines and sprayed vertically so remaining chlorine is significantly dissipated through aerosolizing the chlorine or approved chemical dechlorination method as approved by the Engineer.

END OF SECTION



## SECTION 2570 – BITUMINOUS PAVEMENT REPAIR

### 1.1 INTRODUCTION

The scope of this section is to furnish all labor, equipment, materials and any other items necessary to replace or repair all asphalt surfaces. All work shall be performed in conformance with the applicable sections of the North Carolina Department of Transportation, Division of Highways, “Standard Specification for Roads and Structures”(Latest Edition).

### 1.2 PERFORMANCE

Asphalt mixtures shall not be prepared or placed when the average ambient temperature is less than 40 degrees farenheight, during rainy weather, when sub grade or base course is frozen, when sub grade or base course is showing evidence of excess moisture or when the surface to be adjoined to is excessively moist and would prevent proper bonding with the new surface.

Preparation and construction of sub grade, base course and surface course shall be completed immediately after completion of all underground piping or structures, installation of curb and gutters, all yard piping, conduits and other facilities passing under paved areas and all structural slabs and foundations required within or adjacent to the paved areas.

### 1.3 INSTALLATION

#### A. Sub grade Preparation:

Sub grade preparation activities shall be in strict conformance with Section 500 or Section 505, where applicable, of the “Standard Specifications for Road and Structures” (Latest Edition) issued by NCDOT- Div. of Highways.

#### B. Aggregate base Course Installation:

Application of aggregate base course shall be in strict conformance with Section 520 of the “Standard Specification for Roads and Structures” (Latest Edition) issued by NCDOT- Div. of Highways.

#### C. Bituminous Plant Mix – General:

The work covered under this section of this specification shall be performed in strict conformance with Section 610 and Section 620 of the “Standard Specifications for Road and Structures” (Latest Edition) issued by NCDOT- Div. of Highways.

#### D. Prime Coat:

The work covered under this section of this specification shall be performed in strict conformance with Section 600 of the “Standard Specifications for Road and Structures” (Latest Edition) issued by NCDOT- Div. of Highways.

E. Tack Coat:

The work covered under this section of this specification shall be performed in strict conformance with Section 605 of the “Standard Specifications for Road and Structures” (Latest Edition) issued by NCDOT- Div. of Highways.

F. Bituminous Surface Course (S 9.5B):

The work covered under this section of this specification shall be performed in strict conformance with NCDOT Superpave specifications (Latest Edition) issued by NCDOT- Div. of Highways.

G. Traffic Markings:

The Contractor shall repair and restore any traffic markings that were damaged, destroyed or covered during the construction operation. All work shall be done in accordance with the requirements and specifications of NCDOT and in conformance with the MUTCD Manual (Latest Edition). The payment for work under this section shall be included in the unit bid price for bituminous surface coat and no additional payment will be made.

H. Existing Structures:

All existing structures which fall under or near repaired or restored bituminous areas shall be adjusted to final grade prior to application. All work under this section shall be included in the unit bid price for bituminous surface coat and no additional payment will be made if depicted on the plans. All encountered structures, which were not depicted on the plans or visible, will be paid at agreed upon price by Contractor and Engineer/Owner.

I. Testing and Acceptance:

All work in this section shall be subject to thickness and compaction tests as deemed necessary by the Engineer/Owner. All tests shall be included in the unit bid price for bituminous paving and paid by the Contractor. All tests found to be in nonconformance require the removal, replacement and restoration of areas in question. For additional tests requested by the Engineer/Owner, the Owner will pay for all successful tests and the Contractor shall pay for tests resulting in nonconformance and repair area as previously discussed. Compaction test shall be required as follows:

1. One test per intersection.
2. One test per road crossing less than 100 feet.
3. One test per 500 feet for excavations in a bituminous area.

Upon submittal of successful test reports and aesthetic acceptance, the Contractor shall be given an acceptance of the work in writing. The Contractor shall remain responsible for all improvements until final acceptance of the project.

END OF SECTION

## SECTION 2660 – WATER SYSTEM

### 1.1 INTRODUCTION

The scope of this section is to furnish all labor, equipment, materials and all other items that are customary and normally required to install and complete installation of ductile iron, polyvinyl chloride (PVC) and copper water lines in accordance with the plans. All pipe and incidental material shall be of the type specified in the plans and these specifications unless written variance is granted by the Engineer. All pipe storage/handling, excavation, bedding, laying, jointing and backfilling shall be accomplished as specified herein. Payment shall be made as depicted in the unit prices and measured as the actual laying length with no deduction for valves or fittings.

### 1.2 CATALOG CUTS SUBMITTALS

Contractor shall submit 4 copies of catalog cuts to Engineer for review for all materials that are required to complete the work as described in the associated plans. Engineer will retain two sets of original submittals and return two sets to the Contractor with the appropriate response annotated.

### 1.3 STORAGE AND HANDLING

The Contractor shall inspect the materials upon receipt for visible defects prior to off loading. The Contractor shall unload pipe so any deformation or other injury to the pipe is avoided. The Contractor shall implement appropriate measures during storage such that no storm water may pass through or encumber the materials. Pipe shall not be rolled or dragged over gravel, rock, asphalt or concrete during handling or staging. In the event of damaged material, the damaged section may be cut away from the undamaged section and disposed of with the undamaged portion being used. The Engineer may reject material that is severely damaged or injured in whole or part. In no event shall any pipe or material be placed along the project site by rolling off a truck or trailer and allowed to strike the ground. Striking pipe or material in this manner will damage the pipe, material, lining or casting of same and will be deemed defective and rejected by the Engineer.

If defective material is discovered after installation, it shall be removed and replaced or repaired with acceptable materials by the Contractor at their sole expense.

### 1.4 MATERIALS

A. Pipe size less than 3" diameter that is installed below grade and outside building shall comply with one or more of the following:

1. Seamless Copper Tubing: Type "K" roll form to comply with ASTM B 88-62 and installed with wrought copper (95-5 Tin Antimony solder joints) fittings in accordance with ANSI B16.22.
2. Polyvinyl Chloride Water Pipe: Pipe shall conform to ASTM D 2241 with SDR 21 rating or SCH 13.5 and shall be continually marked with manufacturer's name, pipe size, cell classification, SDR rating and



ASTM D 1748 classification. Pipe joints shall be integrally molded bell ends in accordance with ASTM D 3139 with factory supplied elastomeric gaskets and lubricant.

- B. Pipe size larger than 3" that is installed below grade and outside building shall comply with one of the following as depicted on the plans:

1. Ductile Iron Pipe:

All materials shall be true to theoretical form throughout, first quality with smooth interior and exterior and free from imperfections. All materials shall be available for inspection by the Engineer/Owner at any point from production to installation for the purpose of rejecting defective materials or altering to meet intended specification. All rejected material shall be immediately removed from the project site upon written notice from the Engineer.

All cited or referenced specifications or standards shall be the latest revisions under that identification or in the case of abandoned standards any such superseding standard. This shall be true for all specifications or standards except such requirements that clearly are not applicable.

Ductile iron pipe shall be manufactured in accordance with AWWA Standard C151. All Ductile iron pipe shall be class 350 psi unless specified differently on the plans and shall contain a cement mortar lining, unless specified differently on the plans, not less than 1/16" thick as specified in AWWA Standard C104. Wall thickness for all ductile iron pipes shall be in conformance with AWWA Standard C150. Standard laying conditions shall be assumed to be type 2 unless specified differently on the plans. The exterior of pipe shall be coated to a thickness of not less than 5 mils, as specified in AWWA Standards C110 & C115, with an asphaltic material.

1. a. Flanged Joints:

Flanged pipe shall have flanges with long hubs, shop fitted on the threaded end of pipe, shall be 125 lb. rated and accurately faced at right angles to the pipe axis so a complete fit is readily obtained. When required, flanges shall be tapped for stud bolts. The face of all flanges shall be drilled smooth and true and completely coated with coal tar finish, varnish or other approved anti-corrosion agent. Immediately prior to installation, flange faces shall be cleaned with a wire brush until the face is significantly consistent of bare metal.

Ductile iron flanged joint pipe shall conform to AWWA Standards C110 & C115 and shall have a minimum thickness of Class 53. Flanged end pipe shall be accurately measured and ordered so that no field cutting of pipe is necessary unless specifically approved by the Engineer. Unless approved no field alteration of flanged pipe will be allowed. Attempts to field cut pipe shall result in immediate rejection of all material affected. All flanged joints shall be properly aligned with no external force applied to the pipe or flange to achieve alignment. All bolts and gaskets shall be furnished by the Contractor installing the pipe for all joints, including such joints as the Contractor may be connecting to equipment or appurtenances which they did not supply or install.

Flanged joints shall be jointed with properly sized and type bolts as recommended by the manufacturer. Stud or tap bolts shall be used only as indicated on the plans. Steel or tap bolts shall be cadmium plated with true and sound fitting threads. Cadmium plating shall be by an approved process with a thickness of 3 to 5/10,000 of an inch. The Contractor, upon request, shall supply written confirmation of plating to the Engineer.

1. b. Mechanical Joints:

All mechanical joint pipe shall be manufactured in accordance with AWWA Standard C111, C151 and C150 as applicable with a rating of class 350 psi.

All bolts shall be finish tightened by means of a torque wrench to the specified torque as recommended by the manufacturer in such a manner as the pipe is sealed evenly around to the joint. If effective sealing is not obtained by following the above procedures then the joint shall be disassembled, cleaned and reassembled following the above procedures.

Bolts shall be high-grade steel, low alloy type with tee head and American Standard threads. Mechanical joint gland shall be cast iron and gasket shall be plain rubber.

1. c. Slip Joints:

Slip joint pipe shall be manufactured in accordance with AWWA Standards C 151 & C 150 as applicable with a rating of class 350 psi.

Bells of pipe shall be contoured to receive a bulb shaped circular rubber gasket and spigot end shall have sufficient taper to facilitate installation. Jointing shall be achieved by lubricating joint with approved lubricant, guiding spigot end of pipe into bell end of adjacent pipe until contact is made with gasket and exerting enough compressive force to drive the spigot forward into the bell until they achieve full contact. No joint shall exceed the maximum deflection allowed by the manufacturer, normally 8" in an 18' joint.

1. d. Restrained Joint:

Restrained joints shall consist of standard ductile iron slip bell with gaskets containing metal wedges. Wedges shall be manufactured of stainless steel and the gasket rubber shall be manufactured in accordance with ANSI/AWWA C111/A21.11. Bells shall be manufactured in accordance with ANSI/AWWA C153/A21.53. The joints shall be designed for a working pressure of 200 psi. Restrained joints shall be American "Fast Grip", U.S. Pipe "Field-Lok", or approved equal.

1. e. Ball and Socket Joints:

When specified ductile iron ball and socket joint pipe shall conform to AWWA Standards C150 & C151 as applicable and shall have a minimum thickness class of 55. The spherical socket shall be manufactured with applicable material requirements of ASTM A536 and threaded onto the ductile iron pipe barrel with threads conforming to ANSI B2.1 adapted to standard ductile iron pipe. The ball end of joint shall be integrally cast with the pipe barrel and accurately machined to fit into the adjoining pipe socket and provide constant compression of the gasket through deflection of up to 15 degrees of the assembled joint and shall maintain a watertight joint in all directions. The inside surface of the ball shall be shaped so that the waterway shall not be significantly impacted at any degree of deflection. A substantial external locking ductile iron gland shall prevent longitudinal separation.

Ball and Socket joints shall be American "Flex-Lok", U.S. Pipe "USIFLEX", or approved equal.

2. Fittings:

All ductile iron fittings shall be in conformance with AWWA Standards C110 & C111 for underground piping as applicable and shall be mechanical joint type unless otherwise specified on the plan. If flanged pipe is specified then it shall be in conformance with AWWA Standard C110 for exposed piping.

All fittings shall be manufactured in conformance with AWWA Standards C111 & C104 as applicable and shall be cement mortar lined unless otherwise specified on the plans. All fittings shall have rated working pressure of 250 psi unless otherwise specified on the plans.

3. Polyvinyl Chloride Pipe (PVC)

All materials shall be true to theoretical form throughout, first quality with smooth interior and exterior and free from imperfections. All materials shall be available for inspection by the Engineer/Owner at any point from production to installation for the purpose of rejecting defective materials or altering to meet intended specification. All rejected material shall be immediately removed from the project site upon written notice from the Engineer.

All cited or referenced specifications or standards shall be the latest revisions under that identification or in the case of abandoned standards any such superseding standard. This shall be true for all specifications or standards except such requirements that clearly are not applicable.

3. a. PVC Pipe 4" Diameter and Larger:

All PVC pipe 4" and larger shall be manufactured in conformance with AWWA Standard C900, ASTM 2241 and shall conform to the requirements of DR 18 class 235 psi or DR 14 class 305 psi. The exterior of all PVC shall bear a continuous stamp indicating the AWWA certification, DR ratio, size and manufacturer.

All PVC shall have a bell with integral rubber gasket and be slip joint manufactured in accordance with AWWA C151.

Bells of pipe shall be contoured to receive a bulb shaped circular rubber gasket and spigot end shall have sufficient taper to facilitate installation. Jointing shall be achieved by lubricating joint with approved lubricant, guiding spigot end of pipe into bell end of adjacent pipe until contact is made with gasket and exerting enough compressive force to drive the spigot forward into the bell until they achieve full contact. No joint shall exceed the maximum deflection allowed by the manufacturer, normally 11" in a 20' joint.

4. Fittings:

All ductile iron fittings shall be in conformance with AWWA Standards C110 & C111 for underground piping as applicable and shall be mechanical joint type unless otherwise specified on the plan. If flanged pipe is specified then it shall be in conformance with AWWA Standard C110 for exposed piping.

All fittings shall be manufactured in conformance with AWWA Standards C111 & C104 as applicable and shall be cement mortar lined unless otherwise specified on the plans. All fittings shall have rated working pressure of 250 psi unless otherwise specified on the plans.

## 1.5 INSTALLATION

### A. Excavation:

This section shall cover the excavation and proper disposal of any and all materials disturbed during the construction of trenches which is further defined as all excavation necessary for the proper installation of storm or sanitary sewers and any appurtenances and waterlines and any appurtenances. This section shall further cover any work deemed appropriate by the Engineer.

Excavation shall be done to the lines and grades as depicted or detailed on the plans or as directed by the Engineer. All work involving this section shall be coordinated with any Grading, Site Utility work or other construction on the project site and shall be maintained satisfactorily so that adequate drainage is provided at all times. Any roots that protrude into the trench lines shall be trimmed flush with the trench walls.

All excavation shall be open cut unless otherwise depicted on the plans or specifically authorized by the Engineer. If after excavation the bottom of the proposed trench is found to contain rock, materials which cannot be removed with standard and prudent construction equipment or is unsuitable for providing a uniform bearing surface then same material shall be removed to a depth not less than 8" below proposed depth, backfilled with approved material and compacted. Excavation widths shall be such that not less than one full diameter of the pipe is clear between the outside face of the pipe and each closest trench wall or inside face sheeting, shoring, or trench box as necessary.

Excavated materials to be used during backfill operation shall be suitable material, significantly free from debris and/or rocks and approved by the Engineer. Acceptable material which is excavated shall be neatly and compactly deposited at the sides of the trench where space provides but at no time closer than 2'0" from the closest side of the trench. When stockpiling of material is required, the Contractor, at his expense, shall do so at an approved site and this site shall be kept neat to avoid unsightly appearance. Stockpiling shall be arranged to allow for natural drainage without pollution of water by erosion.

Protection of existing pavement structures from damage due to staining from excavated material and to improve cleanup shall be obtained by placing a 1" layer of sand or rock dust over all asphalt or concrete surfaces which are planned or reasonably anticipated to have excavated material directly on during construction.

**B. Sheeting, Bracing and Trench Boxes:**

As appropriate reference to OSHA Regulation 1926.652(b), the Contractor will be required to keep the sides of excavation vertical by sheet, bracing or the use of trench boxes to prevent movement by slides or settling of the side, to prevent injury or displacement of pipe or appurtenance or diminished the required working space adjacent to pipe. Furthermore, the Contractor may be required, for the purpose of preventing injury to persons, property or adjacent structures, to leave sheeting or bracing in place.

All measures employed, when required, shall extend a minimum of 18" above existing grade and a maximum of 48" above grade. In no case shall timbers, beams or other sheeting/bracing materials be left in the trench, which may form or promote voids that cannot easily be corrected during the backfilling operation or compaction of backfill. It is agreed upon by these specifications that where it is necessary to leave sheeting or bracing intact and backfilled that the Owner is under no obligation to pay Contractor for time or materials involved in constructing such measures. Contractor shall assume and accept any and all risk associated with or encumbered by failure to implement proper and necessary sheeting, bracing or trench box use on any excavation and will be held responsible for caving, settlement and all other damages resulting there from.

**C. Foundations:**

Trench foundation shall be "Type 2" as defined in AWWA Standard C151 unless otherwise noted on the plans. Pipe bedding shall be as shown in the plans for the typical cross section for the type of pipe and location for which it is being installed. Pipe foundation shall be uniformly firm and compacted and shall be consistent with lines and grades as detailed on the plans.

Trench bottom shall be formed to follow the bottom third of the pipe, where soil conditions allow. All installations shall conform to a uniform bearing surface throughout the length of the pipe to fully and evenly support the barrel of the pipe. Bell holes shall be excavated under each bell of each joint such that no undue stress is borne by the bell of pipe thus leading to damage of the material. If undercut is required due to unsuitable soil, rock or through normal construction then suitable material shall be replaced and compacted with uniform support of the pipe provided for the entire length of the pipe. At no time shall undercut for rock be less than 8" from the proposed grade so to prevent future damage. Undercut limits for unsuitable material for supporting pipe loading shall be determined by and constructed according to the Engineer. Continued unsuitable soil may require replacing bottom of trench to grade with washed stone or, in extreme cases, concrete cradles. If washed stone or concrete cradles are specified then the Engineer, at unit price for materials, shall allow additional compensation to the Contractor.

The Contractor shall remove all water that may be encountered or which may accumulate in the trenches by pumping or bailing and no pipe shall be laid until the water has been successfully removed from the trench. Water so removed from the trench shall be disposed of in a manner as not to cause injury to completed work, work in progress or any adjoining area.

#### D. Installing Pipe:

All installation practices should be in strict conformance with the manufacturer's recommendations, AWWA Standards C600 and C605, and the construction specifications. Where any conflicts exist the Contractor shall inform the Engineer immediately and the applicable AWWA Standard shall take precedence. The Engineer shall be furnished installation manuals for any such product that a discrepancy arises or they deem appropriate.

Customary and reasonable tools, implements and facilities satisfactory to the Engineer shall be provided and used for the safe and progressive installation of pipe. All pipe, fittings, valves and other materials shall be hoisted into trench by means which are acceptable and are not conducive to injury of pipe, fittings, valves, and any other materials or their protective coatings or dangerous to any personnel who may be in the trench or vicinity. All pipe hoisted into the trench shall be clean and free from defects. Pipe shall be laid on the prepared foundation so as a straight, uniform flow line exists upon completion.

When cutting pipe lengths are necessary, the Contractor shall practice normal and prudent care so that all cuts are at right angles to the flow line of the pipe. If a skewed cut is specified then the Contractor shall perform the cut as required by the plans. All slip joint pipe which is cut shall be ground to a taper on the cut end to match the manufacturer's taper so pipe may be jointed as intended by the manufacturer.

All PVC pipe installed shall be chased continuously with a 14 gauge stranded, coated copper wire with the coating being royal or light blue. Wire shall be pulled taut so as to prevent damage from backfill and compaction operation or re-excavation in the future. Wire shall be taped no less than every 10 feet and at the taper of every bell end. Wire shall be pulled into every valve box with no less than 2x the depth of bury in length of wire left in the box for future connection to facilitate location. Wire shall be extended in an identical manner along fire hydrant legs and extended along the barrel to ground surface and looped around the base of the upper section at the flange.

Pipe joints shall be sound and in strict compliance with the manufacturer's recommendations. Maximum deflection allowed shall be as allowed by the manufacturer but at no time should be greater than 2 degrees or 8" per 18' joint without special expanded deflection bells being provided. All pipe which is damaged, broken or will not join shall be removed immediately and stockpiled for inspection by the Engineer. Pipe that is damaged during backfill or compaction operations shall be removed and replaced or repaired as directed by the Engineer.

All water lines shall have a minimum 12" vertical separation from storm sewer and shall have a minimum vertical separation of 18" from sanitary sewer when crossing. When crossing sanitary sewer lines the waterline shall cross above the sanitary sewer line. Horizontal separation of 10'0" shall be maintained from all sanitary sewers. If separations cannot be maintained then the Engineer shall be notified and both the waterline and sanitary sewer line shall be constructed of ferrous material such as ductile iron.

Pipe shall not be installed except in the presence of the Engineer or at his specific direction. In the event pipe is installed without the specific direction of the Engineer, then the Contractor may be required to clean, test, uncover for inspection or remove the sections as directed by the Engineer.

## 1.6 BACKFILL AND COMPACTION

A. Trenches shall be backfilled immediately upon approval of pipeline construction.

B. Roadways and Crossing:

Full depth and width of trench shall be backfilled by placing material in uniform layers not to exceed 12" thick and shall be thoroughly compacted by approved mechanical compactors under optimum moisture conditions. Compaction of the trench shall be to 95% as determined by Standard Proctor Test for all areas outside the paved area and any depth exceeding 18" below finished surface of asphalt. The top 18" of any trench directly under pavement or within 36" of the edge of pavement shall be compacted to 100% as determined by Standard Proctor Test. If existing material is not suitable for obtaining compaction then select backfill shall be used when requested by the Engineer.



All paving and base course affected shall be removed and replaced with new material of equal or better quality with like texture and color as the adjacent pavement.

All backfill methods shall be in strict compliance with manufacturer's recommendations and all methods shall be instituted such that no damage, misalignment, or unjointing of the pipe or appurtenances is experienced. Backfill shall be kept free of organics (grasses, sticks, stumps, roots etc.), stones (all stones over 1" diameter within first 12" of backfill and all stones over 2.5" diameter for the remainder of the backfill), any frozen soil or other soil which is not suitable for backfill (highly plastic clay) or any other objectionable items. All backfill shall be installed and graded in a manner that erosion or saturation will not negatively affect the backfilled area.

Heavy equipment shall not be operated over any pipe or appurtenance until it has been properly backfilled and has minimum cover as required by the plans. Where any part of the required cover is above proposed finished grade, the Contractor shall place, maintain and lastly remove such material at no additional cost to the Owner. Any pipe or appurtenance, which becomes misaligned, shows excessive settlement or has been damaged by the Contractor shall be corrected or replaced as deemed necessary by the Engineer/Owner at no additional cost to the Owner.

Prior to acceptance, the Contractor shall properly maintain all installations in such a manner that they will operate without failure.

C. Finish Grading:

All areas disturbed shall be graded to a continuous finish without irregularities or abrupt changes and shall not consist of areas, which will retain water or cause foreseeable future maintenance. Prior to acceptance, all debris, excess material, trash or any unsightly occurrence shall be removed and the project site shall be in a neat and satisfactory condition.

Cleanup and seeding is part of the pipeline installation. No more than 4,000 linear feet of waterline may be laid prior to completion of cleanup of the first section of pipeline laid. During construction no more than 4,000 linear feet or 2 weeks' time may pass before cleanup and seeding is performed.

END OF SECTION

## SECTION – 02661 WATER SYSTEM DESIGN

### Part I General

- 1.1 General Description: This section covers the acceptable design principles, system requirements and system specifications section references for water system design and layout.
- 1.2 General Intentions: The work covered under this section includes standards and general regulations for water system references, component sizing, professional involvement and layout.
- 1.3 All water system improvements shall be designed, significantly inspected, tested, and certified to NCDEQ and System by a North Carolina Licensed Professional Engineer.
- 1.4 Record Drawings, release of liens, consent of surety, Engineer's certification, approved/witnessed static pressure test and approved/certified Bacteria test are ALL required as minimum documents for system to be accepted for addition to Public Water System. Absence of any one document shall be grounds for non-approval.
- 1.5 All system improvements shall be installed in accordance with these and all referenced specifications and shall become the sole benefit and responsibility of the Public Water System upon completion and acceptance.
- 1.6 In the event of donated systems, the developer shall submit a written request to the Public Utilities Director requesting acceptance of the system by the Public Water System detailing the length, material and construction cost.
- 1.7 All donated systems shall have a one-year workmanship and materials warranty.

### Part II Referenced Specifications

- 2.1 North Carolina Department of Environmental Quality Public Water Supply Minimum Design Criteria.
- 2.2 City of Hickory Water System Construction Specification Sections: 02222, 02227, 02668, 02400, 02401, 02402, 02500, 02501 and 02660.

### Part III Plan and Specification Submittal

- 3.1 North Carolina Department of Environmental Quality Public Water Supply Minimum Design Criteria shall be followed.
- 3.2 The Public Utilities Director or Authorized Representative shall approve all plans and specifications for waterline extensions.
- 3.3 All waterline extensions connecting to the Public Water System or any Tributary system shall be permitted as required by NCDEQ under the signature of the Public Water Supply Authorized Representative.
- 3.4 No waterline extensions shall be allowed without prior written consent of the water availability and plans and specification approval by the Public Utilities Director.

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- 3.5 All plans and specifications submitted shall be reviewed and approved, approved with notes or disapproved, as appropriate, within 20 days of submittal and returned to the submitting Professional Engineer.
- 3.6 Upon receipt of returned plans, professional engineer will respond appropriately and resubmit to Public Utilities Director with completed NCDEQ-PWS Waterline Extension Application (Current Edition), Engineer's Report and corrected copy of plans.
- 3.7 Submitting Professional Engineer shall complete all necessary encroachments, permits, reports, submittals, revisions etc. as may be required to obtain project approval to begin construction.

### Part IV Minimum Line Size

- 4.1 No line smaller than 8-inches in diameter shall be extended to dead-end.
- 4.2 Waterlines 6-inches in diameter or smaller are allowed only with approval of Public Utilities Director and only in the event of looped conditions between lines of larger size and feed from different sources.
- 4.3 Fire hydrants shall not be placed on lines smaller than 6-inches in diameter.
- 4.4 Waterlines 2-inches in diameter are allowed only with approval of the Public Utilities Director and in the following cases:
  - a. 1,000 linear feet or less in length.
  - b. Main line blow-off installed on end.
  - c. No possibility of future extension to serve other properties.
  - d. No more than 20 residential service connections on the line.
- 4.5 Two-inch waterlines may be looped to allow for up to 40 residential service connections as approved by Public Utilities Director.
- 4.6 Phased Construction of waterlines must be extended to the furthest side of the last property being served by that phase.
- 4.7 Waterline extensions proposed must be sized to serve property in basin.
- 4.8 Waterlines that may be extended to serve future properties shall be minimum of 8-inches in diameter.
- 4.9 Master Meters are allowed for Townhome, Condominium, Apartment or Multi-Tenant Office use as approved by the Director.
- 4.9.1 Service Connection Meters shall be sized to meet the current NC Building Code as a minimum, with the following sizes being required based on AWWA Manual M6, current edition, and NCAC 15A: 18C.0802 and .0902:
  - a. 2-inch meters shall not serve in excess of 16 residential units, or equivalent.
  - b. 3-inch meters shall not serve in excess of 28 residential units, or equivalent.
  - c. 4-inch meters shall not serve in excess of 50 residential units, or equivalent.

### Part V Approvals

- 5.1 All waterline extensions shall be designed by a NC licensed Professional Engineer, reviewed and approved by the Public Utilities Director of the Public Water System, permitted by the Authorized Representative of the Public Water System through NCDEQ and all other agencies.

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Part VI Ownership and Maintenance

- 6.1 The Public Water System will assume sole benefit and responsibility of the improvements once all sections of the specification have been satisfied.

END OF SECTION

Section 02661-2

## SECTION 02668 - WATER SERVICE CONNECTIONS

### 1.0 DESCRIPTION:

Water service connections shall include tapping the main line and providing all saddles, corporation stops, fittings, service lines, copper setters, meters, meter boxes and other incidentals required for proper installation.

#### 1.1 Related Work: See the following sections for related specifications.

Section 02933 – Seeding and Mulching

### 2.0 MATERIALS:

Shop drawings, catalog cuts and related data for service pipe and appurtenances shall be submitted to the Director of Public Utilities for approval.

2.1 Copper Setter (Meter Setter): shall be of copper and brass, domestic manufacture and of the proper size for the service on which they are installed. The setters shall be equipped with a double check valve outlet and padlock wings on the key valve.  $\frac{3}{4}$ " – 1" copper setters shall be Mueller H1404-2A or approved equal.  $1\frac{1}{2}$ " - 2" copper setters shall be Mueller H1423-2A or approved equal.

2.2 Corporation Stops: shall be of brass, domestic manufacture and of the proper size for the service on which they are installed. Where dictated by the tapping angle, eighth or quarter bend couplings shall be provided. Suitable brass adapters for coupling to service pipe shall be provided. Corporation stops shall be Mueller 300 B-25008 or approved equal.

2.3 Tapping Saddles: shall be of ductile iron saddles with double high tension, low alloy steel straps. Tapping saddles shall be Romac style 202, Mueller BR2-B, or approved equal.

#### 2.4 Service Pipe and Fittings:

##### 2.4.1 Polyethylene Tubing:

Tubing: AWWA C901, Polyethylene (PE3408), Pressure Pipe (Class 200),  
DR=9

Fittings: AWWA C901, fusion or compression connection

2.4.2 Copper Tubing:

Tubing: ASTM Specification B-88, Type K, Seamless, Annealed

Fittings: AWWA C800 flared or compression fittings

2.5 Pipe Connection Clamps: shall be of stainless steel.

2.6 Meters:

2.6.1 General: All meters shall be Neptune Compound meters or approved equal.

2.6.2 Certification: The meters are to be accepted on a certificate furnished by the Manufacturer that meters have met the requirements of the Standard Specifications for Water Meters, as adopted by the American Water Works Association (AWWA).

2.6.3 Delivery: Registers shall be direct reading with sweep hand and shall record in cubic-feet and totalized on five odometer wheels. The registers shall be of the hermetically sealed gear train and register type with magnet drive.

2.6.4 Guarantee: Each and every meter shall be guaranteed for a period of no less than one year from date of purchase against faulty material and workmanship. Hermetically Sealed Registers shall be guaranteed for a ten-year period.

2.7 Meter Boxes: shall be 18" deep Fastec MBX-1 cast iron, or approved equal, for  $\frac{3}{4}$ " and 1" meters. Meter Boxes for 1½" and 2" meters shall be Fastec MBX-5 cast iron, or approved equal. Lid of meter box shall clearly be marked "Water".

3.0 INSTALLATION: Service connections shall be installed at locations as designated by the Owner. Installation shall be made in a manner acceptable to the Director.

3.1 Taps: Proper size taps shall be made on the distribution line. A corporation stop, with the proper bend and service pipe adapter, shall be installed in the tap.

3.2 Backfill: Ditches and cleanup of the work area shall meet approval of the Director.

END OF SECTION

## SECTION 2900 – RESTORATION OF SURFACES

### 1.1 INTRODUCTION

The scope of this section is to furnish all labor, equipment and materials necessary for the proper restoration of existing surfaces disturbed or damaged as a result of any construction activity not specifically detailed for other landscaping or restoration in any other part of this specification. Any damage to existing surfaces or structures shall be restored to original condition or better using like materials and workmanship to the original.

### 1.2 INSTALLATION

All pervious surfaces shall be dressed smooth and seeded in strict accordance with the section of these specifications entitled Seeding and Landscaping. Shoulders of all roads shall be restored as specified for lawns. Wooded areas or fields shall be restored raked smooth and seeded as specified in the section entitled Seeding and Landscaping.

#### A. Ditches:

Ditches shall be regarded to the original grade or such grade that flow is maintained to prevent ponding or standing water. If the grade must be altered, the Engineer shall approve the final grade and all adjacent slope grades with the Contractor performing the work as directed by the Engineer. The surface of all ditches shall be returned to the same condition as found before commencing work. The unit price for this work shall be encumbered in pipeline installation prices.

#### B. Concrete Walks:

Concrete walks removed or damaged as a part of the construction operation shall be replaced with new Class B concrete formed and poured in place and installed to match the original line, grade and general appearance of the existing walk. Concrete shall be poured to match the original walk thickness, but not less than 4" thick, over a thoroughly compacted and leveled sub grade. Walks shall be float finished, edged with an edging tool and grooved at intervals to match the existing walk, or at intervals not exceeding the width, uniform throughout the length of the replacement measured in one direction. This work shall be paid at unit price.

#### C. Driveways

Concrete drives removed or damaged as a part of the construction operation shall be replaced with new Class B concrete formed and poured in place and installed to match the original line, grade and general appearance of the existing drive. Concrete drives shall be poured the same thickness of the original drive, but not less than 4" thick, and shall contain reinforcing steel, mating, etc. to match the original drive. Prior to placing the concrete a 4" aggregate base course shall be placed in the drive area and leveled. The Contractor shall be responsible for coordinating restoration with property owner and allowing for curing time.

Bitumous or Asphaltic concrete drives shall be restored to the original base and asphalt thickness. As a minimum, all bitumous or asphaltic concrete drives shall consist of 6" base course and 2" surface material. Base material shall be thoroughly compacted and leveled to provide the appropriate depth of support and surface material shall be compacted in 2" lifts and topped with the appropriate depth to match the existing surface grade. All work done under this provision shall be performed in accordance with the section entitled Bituminous pavement Repairs. The Contractor shall be responsible for coordinating restoration activities with the property owners.

All unpaved drives shall be surfaced with not less than 4" of Crusher-run gravel and topped with similar surface material as the existing drive. The final drive shall consist of the 4" base and not less than 3" of surface material to match the existing drive. All unpaved drives shall be restored to a condition better than the original when encountered.

All drives shall be temporarily replaced with 4" of Crusher-run installed level with the existing drive surface and maintained until such time as the permanent drive can be restored. Restoration should not take more than three weeks without approval from the Engineer/Owner.

#### D. Roadway Replacement

Bituminous or Asphaltic pavements shall include all areas paved with blacktop; built-up pavements, oil and stone, tar and stone or any similar pavements constructed with a bituminous or asphalt and stone material.

Immediately upon completion of installation of underground piping and structures, the trench shall be backfilled and compacted to specification and roadway shall be repaired. The excavated area shall be restored to match the original material. In the case of tar and stone, oil and stone or other unprocurable material the repair shall consist of asphalt repair. The repair shall consist of a 12" aggregate base course, and a 4" surface course as defined in the specification entitled Bituminous Pavement Repairs. If Engineer deems appropriate then the Contractor may be allowed to surface treat damaged pavements outside of the excavation without removal of existing surface and base courses by overlaying the area in question and matching back to the existing surface.

Portland cement concrete road surfaces shall be replaced with Class B concrete and shall have equal thickness and reinforcing steel as the original roadway. Prior to placing concrete an aggregate base course of 6" thickness shall be placed and compacted.



The Contractor shall repair or replace any and all traffic markings damaged, removed or covered during construction. All existing manholes or valve covers shall be raised to finished grade prior to paving to prevent covering of existing infrastructure. The Contractor shall include this work as a part of the project and shall not seek additional compensation outside of the original unit prices. All such inquiries shall be requested and approved by the Engineer.

All differential settlement shall be corrected immediately as directed by the Engineer and the Engineer shall approve corrections.

All work under this category shall be performed in accordance with NCDOT Standards and shall be subject to inspection by the local representative for conformance with the requirements and specifications.

E. Lawns and Landscaped Areas

All lawns and disturbed area shall be regarded to match the existing grade prior to construction. Lawns, as previously defined, shall be graded, seeded and fertilized in strict conformance with the section of this specification entitled Seeding and Landscaping. Top soiled areas shall be replaced with topsoil of equal or better quality and quantity.

All shrubs, hedges, ornamental trees, flower or other items constituting landscaping shall be replaced to the original condition with the same items as removed or similar materials at property owner's approval.

F. Curb and Gutter

Curb and gutter sections removed, damaged, destroyed or otherwise impacted by the construction operation, Contractor or his agents shall be replaced with new Class B concrete to a condition matching or similar to that existing before construction activities. If curb and gutter cannot be matched exactly to the original condition, the Engineer shall approve alteration.

G. Damage to any Structure

All damage to existing structures shall be repaired by materials and workmanship equal to the original construction. At the direction of the Engineer, sufficiently damaged structures may require total replacement to the extent deemed appropriate by the Engineer. The Engineer shall approve all such replacements and unless otherwise noted separate payment for the repair or replacement will not be allowed.

END SECTION

## SECTION 2930 – SEEDING AND LANDSCAPING

### 1.1 INTRODUCTION

This section covers the furnishing of all labor, equipment, material and any other items necessary for landscaping of all areas of the site disturbed by construction operations and all earth surfaces of embankments including rough and fine grading, topsoil if required, fertilizer, lime, seeding and mulching. The Contractor shall adapt his operations to variations in weather or soil conditions as necessary for successful establishment and growth of grasses or legumes.

### 1.2 CATALOG CUT SUBMITTALS

Contractor shall submit 4 copies of catalog cuts to Engineer for review for all materials that are required to complete the work as described in the associated plans. Engineer will retain two sets of original submittals and return two sets to the Contractor with the appropriate response annotated.

### 1.3 STORAGE AND HANDLING

Contractor shall take all prudent and customary measures to ensure that all materials stay moisture free and are not degraded by storage or handling. All lime and fertilizer shall be kept free from hardening or caking and if this occurs they shall be pulverized to their original state. All seed shall be further protected such that it is not subjected to heat or rodents. If degradation occurs and the materials no longer hold the mineral values advertised then they shall be removed from the site and new materials applied.

### 1.4 MATERIALS

#### A. Lime

The quality of lime and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Lime Law and regulations adopted by the NC- Board of Agriculture.

Lime shall be agriculture grade ground dolomite limestone. It shall contain not less than 85% of the calcium and magnesium carbonates and shall be of such fineness that at least 90% will pass a No. 10 sieve and at least 50% will pass a No. 100 sieve.

#### B. Fertilizer

The quality of fertilizer and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Fertilizer Law and regulations adopted by the NC- Board of Agriculture.

Fertilizer shall be 10-10-10 grades. Upon written approval of the Engineer a different grade of fertilizer may be used, provided the rate of application is adjusted to provide the same amounts of plant food.

C. Seed

The quality of seed and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Seed Law and regulations adopted by the NC- Board of Agriculture.

The NC-Dept. of Agriculture shall have approved seed or any agency approved by the Engineer before being sown, and no seed will be accepted with the date of test more than 9 months prior to the date of sowing. Such testing does not relieve the Contractor from responsibility for furnishing and sowing seed that meets these specifications at the time of sowing. When a low percentage of germination causes the quality of seed to fall below the minimum pure live seed specified, the Contractor may elect, subject to approval of the Engineer, to increase the rate of seeding sufficiently to obtain the minimum pure live seed contents specified, provided that such an increase in seeding does not cause the quantity of noxious weed seed per square yard to exceed the quantity that would be allowable at the regular rate of seed.

Seed shall be entirely free from bulbets or seed of Johnson Grass, Nutgrass, Sandbur, Wild Onion, Wild Garlic and Bermuda Grass. The specifications for restricted noxious weed seed refers to the number per pound, singly or collectively, of Blessed Thistle, Wild Radish, Canada Thistle, Corncockel, Field Bindweed, Quackgrass, Dodders, Dock, Horsenettle, Bracted Plantain, Buckhorn or Wild Mustard; but in no case shall the number of Blessed Thistle or Wild Radish exceed 27 seeds of each per pound.

D. Mulch

Straw shall be free of weed seed or any other species, which would be detrimental or deterring to specified grass maturation. Straw shall be from oat, rye or wheat species and threshed to limit seed content.

E. Tack

Emulsified asphalt or organic tack shall be applied uniformly over straw so as to ensure proper hold and give uniform appearance over the entire area. Tack shall be applied by spraying onto surface immediately after applying straw. Application rates will vary dependent upon conditions. Organic tack shall be used when the ambient temperature is below freezing

## 1.5 PREPERATION

### A. Protection of Existing Vegetation

The Contractor shall not remove or damage vegetation, which is outside the Clearing Limits established by the Owner/Engineer or as displayed on the plans. All trees that are damaged and scheduled to remain shall be repaired in an acceptable manner promptly to prevent progressive deterioration. Vegetation which is scheduled to be replaced or is damaged beyond repair during construction operations shall be replaced with a similar size and species. Where this is not feasible the property owner shall be compensated for the vegetation damaged. Damage incurred during construction operations and due to insufficient protection shall be paid at the Contractors expense.

Existing vegetation not indicated for removal shall be protected against unnecessary cutting, breaking or skinning of roots, skinning or bruising of bark or smothering of vegetation by placing stockpiles of excavated material against the trunk or excessively over roots within the drip line. Vegetation shall also be protected against excessive vehicle or foot traffic within the drip line.

Roots cut during excavation shall be properly protected by either asphalt sealing or in some cases wrapping exposed roots in wet burlap to prevent drying.

### B. Grading

Rough grading of the area shall be achieved as soon as the excavated area is backfilled and compacted. Rough grading shall be defined as all material restored which is required to bring the area to finish grade and acceptable surface drainage for storm water which provides for water to flow from the site in such a manner as that it does not place unusual risk to unsuspecting users of adjacent areas or inhabitants.

Fine grading of the area shall be achieved in a timely manner after completion of rough grading of the area. Fine grading shall consist of shaping final contours to ensure proper drainage and removing all debris or construction waste materials to provide an acceptable appearance. Construction area subject to finish grading shall have soil loosened to a depth of not less than 6 inches in a manner approved by the Engineer to promote seed growth. All finish landscaping shall be completed on a section-by-section basis where it is reasonable to expect completion of landscaping.

All grading, landscaping, and erosion control measures shall be properly pursued and maintained in order to maintain an acceptable appearance of the project. If such time occurs as this perception is degraded then the Engineer may suspend progress on the project until the issues are appropriately addressed.

C. Surface and Bed Preparation

The Contractor shall smooth or shape surface contours outside the project site when such contours are detrimental to the seedbed preparation or will pose foreseeable problems with future maintenance of the area. The Engineer shall direct the Contractor to what extent outside areas shall be affected or the Contractor may elect to work with individual property owners with written verification delivered to the Engineer/Owner of the agreement with the property owner's signature.

1.c Level Areas and Slopes Less than 2:1

The construction area shall have soil loosened to a depth not less than 6 inches and shall be free from all debris, clods and all other irregularities which would prohibit a smooth, shaped finish grade. Top 3 inches of soil shall be worked to a clod free finish suitable for planting seed.

2.c Slopes Greater Than 2:1

The construction area shall have soil loosened and acceptable for vegetation growth but the surface shall be free from all debris, clods and other irregularities. The surface may be track finished, scarified, grooved or punctured so as to provide a place for seed and other planting material to lodge. In the case of such slopes the Engineer may allow partial completion of the slope sections at different times to promote stabilization. If the vegetation growth is acceptable the Engineer may allow this to remain as the permanent ground cover.

The Contractor shall not pursue the finished preparation of surface areas to be landscaped if the soil is frozen, marginally wet or when the Engineer deems it unsuitable for working conditions.

D. Rate of Application

Seed shall be applied by means of Broadcast Spreader, Hydro-Seeder or other previously approved method. In no case shall seed, lime, or fertilizer be spread by hand. The rates of application for seed, lime and fertilizer shall be as follows, unless a variance is permitted by the Engineer in writing prior to performing work.

1.d Limestone

In the absence of a soil test performed at the Contractors expense and given to the Engineer on letterhead from the testing laboratory, Limestone shall be applied at the rate of 2000 lb/ acre.

2.d Fertilizer

In the absence of a soil test performed at the Contractors expense and given to the Engineer on letterhead from the testing laboratory, Fertilizer shall be applied at the rate of 1000 lb/ acre. Fertilizer shall be 10-10-10 grade, unless a variance is permitted by the Engineer in writing prior to performing work. A second application at 500-lb/ acre shall be applied to the area when the grass has reached a blade height of 3 inches or 45 days which ever comes first.

3.d Seed

The type and rate of application shall vary at different times of the year and shall be applied at the rate and type appropriate for the time of year. All rates of application are measured in pounds per acre.

- a. Fall and Winter (Sept. 1 to May 1)  
85 pounds of Ky-31 tall fescue mixed with 15 pounds of rye grain.
- b. Spring and Summer (May 1 to September 1)  
100 pounds of Ky-31 tall fescue mixed with 10 pounds of rye grain.
- c. Cut of Fill slopes greater than 2:1  
The application rate on cut or fill slopes greater than 2:1 shall include the appropriate mix above for the time of year along with; 40 lb/acre of sericea lespedeza (hulled in spring or summer and unhulled in fall and winter) and either 15 pounds of Sudan grass in spring and summer or 25 pounds of rye cereal per acre in fall and winter.

4.d Mulch

Mulch shall be straw mulch applied at a rate of approximately 3000 pounds per acre. Straw shall be applied at such rate necessary to thoroughly cover and protect all finish grading, seed, lime and fertilizer but not smoother the maturation of seed.

E. Application

Application of all limestone, fertilizer, seed and mulch shall be completed immediately following final preparation of the seed bed and shall not be pursued during a time when the Engineer deems weather to be non-conducive for seed growth, i.e. ground wet, frozen, etc. Lime, fertilizer and seed shall be distributed uniformly over the prepared seedbed at the specific rate of application and then harrowed, raked, or otherwise thoroughly worked or mixed into the seedbed. Immediately following the covering operation, the seedbed shall be properly compacted as directed in the manner and degree approved by the Engineer.

When a hydraulic seeder is used for application of seed and fertilizer, the seed shall not remain in water containing fertilizer for more than 1 hour prior to application unless otherwise permitted by the Engineer.

The Engineer may permit modifications to the requirements for covering or compacting lime, fertilizer and seed in the prepared seedbed if the Contractor requests modification due to height, steepness of slope or non-conductive soil conditions. Modifications may be considered in the case of: Slopes greater than 2:1 and Slopes where surface is too rocky to successfully permit compaction or covering of the seedbed. Modifications may be permitted to include reduction of application rates and reduction or elimination of compaction requirements.

All equipment normal and prudent for the preparation of seedbed and uniform distribution of lime, fertilizer and seed shall be approved by the Engineer prior to use on the project. In the event of malfunctioning or improperly maintained equipment, the Engineer reserves the right to suspend work on the project until such time as the equipment is restored to good repair and properly operational.

F. Mulching

Mulch shall be spread uniformly over all seeded areas at a rate of 1 ½ to 2 tons per acre in a continuous, uniform blanket. Mulch shall be spread by hand or by approved mechanical shredder or blower which will provide a uniform blanket. An acceptable application shall be one that completely covers the ground but still allows some sunlight to penetrate and air to circulate while providing effective soil moisture conservation and reduced erosion. Mulching operation shall be pursued immediately following final seedbed preparation.

Tack or other approved binding material shall be applied over top of mulch in all necessary areas to ensure mulch will be held in place during adverse conditions. The rate and method of application shall be completed as directed by the Engineer.

The Contractor shall implement sufficient precautions to prevent mulch from entering drainage structures through displacement by wind, water or other causes. The Contractor shall remove completely any blockage to drainage structures, which may occur.

G. Maintenance

Grassed areas shall be accepted when a 95% cover of permanent grasses is achieved and weeds are not the dominant foliage. The Contractor shall keep all grassed areas in good condition, reseeding and mowing if and when necessary as directed by the Engineer. A good lawn shall be established over the entire project area and shall be maintained by the Contractor in an approved manner and kept in an approved condition until final acceptance.

The Contractor shall protect against washouts on slopes and ditch sections by a manner approved by the Engineer. Any damage or failure due to any cause shall be corrected by being either repaired or completely redone as may be directed by the Engineer. Areas of damage or failure resulting either from negligence on the part of the Contractor in performing construction operations or from not taking sufficient precautions to control erosion and silt as required throughout the various sections of the specifications, shall be repaired by the Contractor as directed by the Engineer at no cost to the Owner.

End of Section