

STANDARD WATER SPECIFICATIONS WATER LINES AND APPURTENANCES

PULASKI, TENNESSEE

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APPROVED WATER SPECIFICATIONS

THE DOCUMENT BEARING THIS STAMP HAS BEEN RECEIVED AND REVIEWED BY THE

TENNESSEE DEPT. OF ENVIRONMENT & CONSERVATION

DIVISION OF WATER RESOURCES

AND IS HEREBY APPROVED FOR USE IN CONSTRUCTION BY THE COMMISSIONER



09/18/2023

THIS APPROVAL SHALL NOT BE CONSTRUED AS CREATING A
PRESUMPTION OF CORRECT OPERATION OR AS WARRANTING BY THE
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DESIGNED GOALS.

APPROVAL EXPIRES FIVE YEARS FROM ABOVE DATE



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WATER LINES AND APPURTENANCES

1. Scope of Work

The water line work to be accomplished under this Detailed Specification consists of the furnishing of all labor, materials, equipment, and services necessary for the construction of water lines and appurtenances for the City of Pulaski, Tennessee (Owner).

2. Location of Water Lines

The approximate location of the water line in relation to the Limits of Rights-of-Way, pavement, *etc.*, shall be shown on Plans submitted and approved by the Owner and the Tennessee Department of Environment and Conservation. The final location of the water line shall be constructed by the Contractor as close to that shown on the Plans. The final location may be varied by the Contractor with the approval of the Owner provided (1) the proposed location is within the construction easement shown on the approved Plans, and (2) the proposed location is approved by the City of Pulaski and the Giles County Highway Department, or other agency or legal entity having jurisdiction. The final location in any event may be varied by necessity due to construction conditions at the direction of the Owner due to the requirements of the Tennessee Department of Transportation (TDOT), the City of Pulaski and the Giles County Highway Department, or other agency or legal entity having jurisdiction.

3. Pipeline Materials for Water Lines

a. General

The minimum size of any new water line to be connected to the City of Pulaski water system shall be 6 inches, except where otherwise authorized by written permission of the City of Pulaski.

Generally, the water lines shall be DR 18 C900 polyvinyl chloride (PVC) plastic pipe meeting the requirements of the latest AWWA/ANSI Standards.

All water lines above 12-inches shall be Ductile Iron Pressure Class 350.

Water lines extending under proposed roadways or at locations stipulated by the Owner shall be Ductile Iron Pressure Class 350.

b. Polyvinyl Chloride (PVC) Pipe

Polyvinyl chloride (PVC) pipe for water lines shall be made from Class 12454-B polyvinyl chloride plastic (PVC 1120) as defined in the latest revision of ASTM Specification D1784.

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Additives and fillers, including but not limited to stabilizers, antioxidants, lubricants, colorants, etc. shall not exceed ten (10) parts by weight per 100 parts of PVC resin in the compound.

The pipe shall meet all the requirements of the latest revision of AWWA C900 Specification for standard thermoplastic pipe dimension ratio DR 18 rated for 235 psi water pressure at 73°F. The pipe shall have push-on elastomeric gasket bell end joints designed so that the pipe and fittings may be connected on the job without the use of solvent cement or any special equipment. Push-on joints and lubricants shall conform to the latest revision of AWWA C900 Specification.

The pipe shall be furnished in nominal lengths of 20 feet. The pipe shall be supported at least every 10 feet of its length during storage. If the pipe is to be stored for more than 30 days, it shall be shielded from direct sun- light.

All PVC pipe for water lines shall bear identification markings that will remain legible during normal handling, storage, and installation. Marking on pipe shall include the following and shall be applied at intervals of not more than five feet:

- (1) Nominal size (for example, 6 in.).
- (2) Type of plastic pipe material in accordance with the designation code (for example, C900).
- (3) Dimension ratio (for example, DR 18).
- (4) ASTM designation D 2241.
- (5) Manufacturer's name or trademark and production-record code.
- (6) Seal (mark) of the testing agency verifying the suitability of the pipe material for potable-water service.

c. Ductile Iron Pipe

(1) Pipe and Push-on Type Joints

Ductile iron pipe (DIP) shall be centrifugally cast meeting the requirements of the latest revision of ANSI/AWWA Standard C151/A21.51 as modified in this Paragraph. Except where specifically designated otherwise by the Owner, the pipe shall be push-on type joint, AWWA Pressure Class 350 as described in Table 5 of the latest revision of ANSI/AWWA Standard C150/A21.50, with 20 feet laying length. Where special joints are required by the Owner, they shall comply with the specifications for special joints provided hereinafter.

The inside of all pipe shall be cement-mortar lined in accordance with the latest revision of ANSI/AWWA Standard C104-A21.4. In addition, the cement-mortar lining shall be coated with asphaltic material at least one mil thick that conforms to all appropriate requirements of the latest revision of ANSI/AWWA Standard C104/A21.4.

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The weight, class, or nominal thickness, and casting period for each length of ductile iron pipe shall be shown on each length of DIP. The manufacturer's mark, country where cast, year in which the pipe was produced, and the letters "DI" or "DUCTILE" shall be cast or metal stamped on the pipe. All required markings shall be clear and legible, and all cast or metal-stamped marks shall be on or near the bell.

(2) Restrained Type Joints

Where stipulated by the Owner, ductile iron pipe shall have restrained-type joints and shall meet all requirements of Paragraph 3.c.(1) except for joint type. The restrained joints shall be suitable for a maximum working pressure of 100 psi plus a 100 psi surge allowance. The restrained joints shall be Flex-Ring Joint® Pipe or Fastite Joint Pipe with Fast-Grip® gaskets manufactured by American Cast Iron Pipe Company; TR Flex® Restrained Joint Pipe or Ductile Iron Tyton Joint Pipe with Field Lok™ gaskets manufactured by United States Pipe and Foundry Company; or an approved equal.

d. Fittings (Ductile Iron Pipe and PVC Pipe)

Fittings for ductile iron pipe and PVC pipe shall be ductile iron meeting the requirements of the latest revision of ANSI/AWWA Standard C110/A21.10 or ANSI/AWWA C153/A21.53 as modified in this Paragraph. Except where specifically designated otherwise by the Owner, fittings shall be push-on joint, suitable for a working pressure of 100 psi plus a surge allowance of 100 psi. The push-on joints shall conform to the dimensions and weights set out in the latest revision of ANSI/AWWA Standard C110/A21.10 or ANSI/AWWA C153/A21.53 and shall also conform to the latest revision of ANSI/AWWA C111/A21.11 or ANSI/AWWA C153/A21.53.

All water line fittings shall be restrained by megalug retainers and concrete thrusting blocking.

The inside of all fittings shall be cement mortar lined in accordance with the latest revision of ANSI/AWWA Standard C104/A21.4. In addition, the cement mortar lining shall be coated with asphaltic material at least one mil thick that conforms to all appropriate requirements of the latest revision of ANSI/AWWA Standard C104/A21.4.

Ductile iron fittings shall have distinctly cast on them the pressure rating, nominal diameters of openings, manufacturer's identification, the country where cast, and the number of degrees or fraction of the circle on all bends. Ductile-iron fittings shall have the letters "DI" or "DUCTILE" cast on them. Cast letters and figures shall be on the outside body of the fitting and shall have dimensions no smaller than the following:

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Size in.	Height of Letters in.	Relief in.
Less than 8	As large as practical	As large as practical
8 – 10	$\frac{3}{4}$	$\frac{3}{32}$
12	1 $\frac{1}{4}$	$\frac{3}{32}$

4. Lines and Grades

Unless otherwise directed by the Owner, lines and grades shall be set to conform to those shown on the approved Plans where required to ensure that air release valves have sufficient depth and function properly. PLAN AND PROFILE INFORMATION SHALL BE PROVIDED FOR ALL WATER LINES OVER 8 INCHES IN SIZE.

The Contractor shall lay the new finished water transmission lines to maintain a minimum vertical separation of 18 inches between the finished water transmission lines and the existing sanitary sewer line where they cross and a minimum horizontal separation of 10 feet between the finished water transmission lines and the existing sanitary sewer line where they parallel.

When local conditions prevent a horizontal separation of 10 feet, a water main maybe laid closer to a storm or sanitary sewer provided that the bottom of the water main is at least 18 inches above the top of the sewer; or the sewer shall be constructed of material and with joints that are equivalent to water main standards of construction and shall be pressure tested to assure water tightness prior to backfilling.

5. Excavation of Pipeline Trenches (Water Lines)

a. General

The excavation shall be carried to the depths indicated on the approved Plans and/or directed by the Owner to permit proper bedding of the pipe. Trenches shall be opened to a depth where the top of the pipe shall not be less than thirty-six (36) inches below the surface of the ground when laid through wooded areas, fields, and other such areas outside the pavement or traveled surface of highways and roadways. Where a greater depth of cover is not indicated on the approved Plans, the minimum depth of cover shall not be less than forty-two (42) inches for pipelines laid in the shoulder or traveled surface of any highway and/or roadway. Any line laid within the right-of-way of a State Highway shall have a minimum depth of cover of four (4) feet. ALL DEPTHS OF COVER ARE MEASURED TO THE TOP OF THE PIPE.

Trenches shall be of sufficient width to provide free working space on each side of the pipe and permit proper backfilling around the pipe, but unless specifically authorized by the Owner, trenches shall in no case be excavated or permitted to

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become **narrower** than 1 foot 6 inches plus the nominal diameter of the pipe. The trench width shall be a minimum of the width of the pipe with 9 inches clear space on either side which is required for working space.

Unless specifically directed otherwise by the Owner or where required to uncover or determine the presence of underground obstructions, not more than three hundred feet of trench shall be opened ahead of the pipe laying, and not more than two hundred feet of open ditch shall be left behind the pipe laying. Before laying the pipe, the Contractor shall open the trench far enough ahead to reveal obstructions that may necessitate changing the line or grade of the pipeline. It will be the responsibility of the Contractor to contact and coordinate the location of all existing utilities. **NO WORK SHALL BEGIN UNTIL ALL EXISTING UNDERGROUND UTILITIES HAVE BEEN LOCATED AND MARKED (and depth verified).**

All barricades, watchmen, and other such signs and signals as may be necessary to warn the public of the dangers in connection with open trenches, excavations and other obstructions shall be provided by and at the expense of the Contractor.

The trench shall be straight and uniform to permit laying pipe to the proper lines and grades.

When so required by the City of Pulaski, one-half of the street crossings and road crossings shall be excavated, then temporary bridges consisting of ½-inch steel plate shall be placed over the side excavated for the convenience of the traveling public; then the remainder of the excavation shall be carried out. All backfilled ditches shall be maintained in such a manner that they offer minimal hazard to the passage of traffic. The convenience of the traveling public and the property owners abutting the improvements shall be taken into consideration. All public or private drives shall be promptly backfilled or bridged. **ALL PERMIT FEES AND DEPOSITS ARE THE SOLE RESPONSIBILITY OF THE CONTRACTOR AND SHALL HAVE BEEN APPROVED BY THE CITY OF PULASKI PRIOR TO ANY CONSTRUCTION.**

All excavated material not needed for backfilling purposes shall be disposed of in a manner satisfactory to the Owner.

WHERE UNDERCUTTING OF THE TRENCH IS REQUIRED, the quantity of same will be determined by an inspection by the Owner. The quantity of undercutting of trench will be determined by the area of unsuitable native material encountered. The Contractor will be required to remove all unsuitable material and fill the ditch with crushed stone to 6-inches below the elevation of the invert of the pipe. If native materials obtained from prior trench excavation are determined by the Owner to be suitable for replacing the materials excavated by undercutting, no imported materials will be required.

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All excavation shall be accomplished in accordance with applicable OSHA safety laws and regulations; the City of Pulaski does not assume responsibility of any degree or sort for acts of the Contractor.

In all areas along State Highways where the pipeline is being laid in the pavement or in the right-of-way of the road, TDOT requires that excavation during each day be limited to the footage of pipe that can be laid and the trench be backfilled so that not ditch is left open overnight in such areas. No gravel trenches shall be open to traffic at any time along State Highways. The rules and regulations of TDOT shall apply to State Highways; the requirements of the City of Pulaski and the Giles County Highway Department shall apply to all other roads.

b. Excavation on Easements

Excavation of pipeline trenches on easements shall be performed in such a manner that the private property owner's facilities and grounds shall be restored to as near their original condition as possible considering the work performed. The grass cover of the ditches or excavations shall be the same type as the original undisturbed cover. Work to be performed shall be done in the area of the construction limits shown on the approved Plans. The Contractor shall denote the limits of construction in any area if this is not a part of the proposed development.

Before any excavation is begun or before drilling and blasting, a minimum of nine (9) inches of the topsoil or original cover shall be removed and stockpiled in a manner not to contaminate the topsoil with other fill or excavated material. Should the depth of excavation require a trench wider than specified in Subparagraph a. above, a minimum of nine (9) inches of topsoil or original cover shall be removed from the additional area and stockpiled as described hereinbefore.

Excavated materials suitable for backfill shall be placed at a distance far enough from the ditch to allow excavated rock to be placed next to the open trench; however, stockpiling OUTSIDE THE EASEMENT SHALL BE DONE ONLY WITH THE PROPERTY OWNER'S WRITTEN PERMISSION. A COPY OF THE PROPERTY OWNER'S WRITTEN PERMISSION SHALL BE FORWARDED TO THE OWNER.

c. Excavation Near Sanitary Sewer Lines

The Contractor shall protect the water line that crosses sewer lines by providing an 18-inch minimum separation between the top of the sewer line and the bottom of the water line. When this vertical separation cannot be achieved, the water line shall be centered over the sewer line so that both joints will be as far from the sewer line as possible.

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When water lines are laid parallel to sewer lines, there should be a minimum of 10 feet horizontal separation or a minimum of 18 inches vertical separation as specified above and laid in separate trenches.

When the above conditions cannot be obtained, both the water and sewer lines shall be constructed of Pressure Class 350 ductile iron pipe and be pressure tested to assure water tightness.

6. Water Line Laying, Bedding and Initial Backfilling

a. General

The trench shall be excavated to the depth and width shown on the Standard Details and the bedding prepared as specified and shown on the Standard Details, in advance of pipe laying.

Before each piece of pipe is lowered into the trench, it shall be thoroughly swabbed out to ensure its being clean. Each piece of pipe shall be lowered separately unless special permission is given otherwise by the Owner.

Care shall be taken to prevent injury to the pipe both inside and out. No piece of pipe or fitting which is known to be defective shall be laid or placed in the lines. If any defective pipe or fitting shall be discovered after the pipeline is laid, they shall be removed and replaced with a satisfactory pipe or fitting without cost to the Owner.

All bend-type and "tee" fittings in the pipelines, either vertical or horizontal, shall be satisfactorily braced or anchored against the tendency of movement with joint harness, and concrete or equal anchors as shown on the Standard Details to the satisfaction of the Owner.

Open ends of unfinished pipelines shall be securely plugged or closed at the end of each day's work or when the line is left temporarily at any other time.

CRUSHED STONE BEDDING AND INITIAL BACKFILL MEETING THE QUALITY REQUIREMENTS OF ASTM D692 AND THE GRADATION REQUIREMENTS FOR SIZE NO. 67, TDOT SPECIFICATION SHALL BE USED FOR ALL PIPE INSTALLED IN TRENCHES UNDER EXISTING OR PROPOSED PAVED AREAS.

b. Ductile Iron Pipe

Ductile iron pipe shall be installed in accordance with the requirements of the latest revision of ANSI/AWWA Standard C600 as modified in this Paragraph.

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In case a length of DIP is cut in the field, it shall be so cut as to leave a smooth end at right angle to the longitudinal axis of the pipe in accordance with Section 3.4.4 of the latest revision of ANSI/AWWA Standard C600.

The maximum horizontal or vertical deflection allowed at a push-on type joint for DIP shall not exceed the deflection shown on the Standard Details.

Ductile iron pipe shall be laid on a loose soil foundation by placing "select material" on the excavated trench bottom to a depth of not less than four- inches. "Select material" shall be native soil excavated from the trench, free of rocks, foreign materials and frozen earth. The loose soil foundation shall be prepared to ensure that the pipe is uniformly supported over its entire length. Any unyielding material such as rock within the pipe foundation shall be removed and the foundation shall be brought up to grade as specified in Subparagraph a. of this Paragraph. Initial backfill materials up to a plane even with the top of the pipe shall be compacted to 80 percent of their Standard Proctor Density (ASTM D698-Method A). The initial backfill materials shall be manually worked under the sides of the pipe with a shovel to provide satisfactory haunch support.

c. PVC Pipe

PVC pipe shall be installed in accordance with the requirements of the latest revision of ANSI/AWWA Standard C605 as modified in this paragraph.

In case a length of PVC pipe is cut in the field, it shall be so cut as to leave a smooth end at right angle to the longitudinal axis of the pipe in accordance with Section 5.5.1 of the latest revision of ANSI/AWWA Standard C605.

The maximum horizontal or vertical bending allowed in a length of PVC pipe shall not exceed the bending shown on the Standard Details.

PVC pipe shall be laid on a loose soil foundation by placing select material on the excavated trench bottom to a depth of not less than four inches. "Select material" shall be native soil excavated from the trench, free of rocks, foreign materials and frozen earth. The loose soil foundation shall be prepared to ensure that the pipe is uniformly supported over its entire length. Any unyielding material such as rock within the pipe foundation shall be removed and the foundation shall be brought up to grade as specified in Subparagraph a. of this Paragraph. Initial backfill materials up to a plane even with the top of the pipe shall be compacted to 80 percent of their Standard Proctor Density (ASTM D698-Method A). The initial backfill materials shall be manually worked under the sides of the pipe with a shovel to provide satisfactory haunch support.

NO. 10 THHN GREEN COATED TRACER WIRE SHALL BE LAID IN THE TRENCH ABOVE THE PIPE APPROXIMATELY ALONG THE LONGITUDINAL AXIS OF THE PIPE. THE WIRE SHALL BE LAID

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CONTINUOUSLY. THE TRACER WIRE SHALL BE ACCESSED AT ALL VALVES OR INTERMEDIATE ACCESS POINTS SO THAT ACCESS POINTS ARE NO MORE THAN 1,000 FEET APART.

7. Crushed Stone for Pipe Bedding

When rock is encountered, the trench shall be excavated to a depth at least 6 inches below the bottom of the pipe and refilled with the bedding material to a sufficient depth to provide a firm bed for the bottom quadrant of the pipe. Crushed stone shall be utilized to a depth of 12 inches above the top of the pipe **in rock**.

Bedding shall be crushed stone meeting the requirements of the TDOT Size No. 67 gradation.

8. Undercutting of Pipeline Trench

If unsuitable material is encountered in a trench bottom, the Owner may require additional excavation to ensure a firm foundation for the pipe. In such cases, the trench bottom shall be brought back up to proper grade with bedding material as provided herein. Crushed stone or chert refill will be required below a plane 6 inches beneath the bottom of the pipe.

9. Class "C" Concrete for Thrust Blocks, Anchors and Encasement

Thrust blocks shall be placed on the water line at all bends, "wyes," "tees," "dead- ends," or as otherwise required by the Engineer. All thrust blocks, anchors and pipe encasements shall be Class "C" concrete of size shown on the Standard Details. Class "C" concrete shall possess the following characteristics and/or proportions of materials:

<u>Minimum Cement Content:</u>	5.0 bags (470 pounds) per cubic yard.
<u>Minimum 28-day compressive strength:</u>	2500 psi – average of any three cylinders.
<u>Slump:</u>	Five (5) to eight (8) inches.
<u>Admixtures:</u>	None required.

All thrust blocks shall be designed to resist surges and transient pressures normally encountered in lines operating at a working pressure of 100 psi unless otherwise directed by the Engineer.

10. Backfilling Pipeline Trenches

a. General

In the backfilling of the trench above the pipe or pipe envelope, material shall be crushed stone to a depth of 12 inches above the top of pipe in a rock trench

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and select native material 6 inches above the top of pipe in a dirt trench. Material above the initial backfill material shall be reasonably free from rock and be acceptable to the Owner. The backfill material shall be carefully and solidly tamped around the pipe up to the point where the pipe is thoroughly covered with at least one foot material. Walking or working on the completed pipeline, except as may be necessary in tamping or backfilling, shall not be permitted until the trench has been backfilled to a height of at least one foot above the top of the pipe. The filling of the trench shall be carried on simultaneously on both sides of the pipe in such a manner that the completed pipeline will not be disturbed and injurious side pressures do not occur.

In filling the remainder of the trench, the backfill material may be shoveled into the trench without compacting, and heaped over whenever, in the opinion of the Owner, this method of backfilling may be used without inconvenience to the public. Where street paving or shoulders are to be replaced, the Contractor will be required to tamp or puddle all backfill as described hereinafter.

In areas where the line is laid in the right-of-way of a State Highway or when required by the Owner backfill shall be of select material of the same type as the existing natural material or fill in which the trench is dug.

When so required by the Owner, the backfilling shall all be placed in layers not exceeding six (6) inches and firmly tamped into place by tampers or rammers.

Mechanical tamping will be required on lines where street pavement is to be replaced immediately. BACKFILL MATERIAL WILL BE FLOWABLE FILL OR CRUSHED STONE IN PAVED STREETS OR ROADWAYS AS SPECIFIED HEREINAFTER.

Whenever, in the opinion of the Owner, it is necessary, he may require the Contractor to use a combination of any or all of the above outlined methods for proper compaction of the backfill in the trenches.

Before final acceptance, the Contractor will be required to level off all trenches where backfill material has been piled up, or to bring the trench up to the level of the surrounding street, roadway, or terrain. The Contractor will be required to remove from the streets, roadways, and private property all excess earth or other materials.

b. Backfill in Paved Areas

(1) State Highways

Where water lines are to be installed within the paved surface of the shoulders of State Highways, the backfill shall be flowable fill meeting

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the requirements of Section 204.06 above the initial crushed stone backfill as shown on the Standard Details.

A 10-inch layer of TDOT Class "A", Grading "D" compacted in 5-inch lifts shall be installed prior to any pavement preparation.

WORK IN THIS AREA SHALL ONLY BE DONE WITH PRIOR WRITTEN APPROVAL OF THE TENNESSEE DEPARTMENT OF TRANSPORTATION.

(2) City Streets

Where water lines are to be installed within the paved surface or shoulders of City of Pulaski streets, the backfill material shall be TDOT Size No. 67 crushed stone above the pipe envelope as shown on the Standard Details.

c. Backfilling Operations Conducted on Easements

Backfilling of trenches or excavations on easements shall be performed in such a manner that the private property owner's facilities and grounds shall be restored to as near as possible their original condition immediately after pipe laying.

After the pipe bedding, pipe, and backfill along the sides of the pipe and over the pipe (if required) as specified hereinbefore has been placed, the excavated rock next to the ditch shall be placed in the ditch. Excavated rock shall not be placed any closer than eighteen (18) inches from the finished grade and any excess rock shall be removed by the Contractor and disposed of as directed.

The residue of the stockpiled bedding material shall be cleaned up and placed into the trench, leaving no bedding stone scattered over the area. The previously excavated materials suitable for backfill shall be placed into the ditch only upon clean-up and backfill of the bedding material. The top portion of the trench or excavation shall be filled using the stockpiled topsoil. The ditch shall be left high to allow for settling unless in the opinion of the Owner this method of backfilling will cause inconvenience to the private property owner. SEEDING OR SODDING SHALL PROCEED IMMEDIATELY FOLLOWING BACKFILL.

If the backfilling operation is performed during extremely dry weather the contractor should leave some stockpiled topsoil to use later as additional fill after settlement has occurred.

THE CONTRACTOR WILL BE HELD RESPONSIBLE FOR THE CONDITION OF GRASS COVER AND THE CONDITION OF THE GROUND SURFACE AT THE TIME OF FINAL INSPECTION UNLESS THE PRIVATE OWNER HAS PLOWED OR EXCAVATED THE GROUND.

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d. Disposal of Excess Material

The Contractor shall be responsible for the off-site disposal of any and all excess or unsuitable material excavated in the construction of the project. The Contractor shall be responsible for obtaining any and all permits, license fee, *etc.*, associated with the disposal of excess material.

11. Inspection of Lines – During Construction

The Contractor shall notify the Owner when pipe will be received on the job where proper arrangements may be made for inspecting the unloading and stringing, as well as inspecting the pipe proper and examining for the stamp for the independent laboratory.

BEFORE THE CONTRACTOR BACKFILLS ANY OF THE LINES, THEY SHALL BE FIRST INSPECTED BY THE OWNER; AND THE OWNER SHALL GIVE THE CONTRACTOR PERMISSION TO PROCEED WITH THE BACKFILLING. If any joints, pipes, or other workmanship or materials are found to be defective, they shall be removed and replaced by the Contractor.

12. Hydrostatic Testing of Water Lines

Water lines shall be subjected to hydrostatic testing in accordance with the requirements of the latest revision of ANSI/AWWA Standard C600 for ductile iron pipe and ANSI/AWWA Standard C605 for PVC pipe, as modified in this paragraph, as a condition of acceptance. For the purposes of this paragraph, normal working pressure in the water line is 75 psi. Transient or "surge" pressures of up to 75 psi are expected. Therefore, water lines shall be tested under a pressure of 150 psi measured at the highest point of each pipeline and shall not show leakage exceeding the following values:

Allowable Leakage/1,000 Feet of Pipeline

Pipe Size (PVC)	150 psi Test Pressure (at Highest Point along Test Section)
6-inch	0.5 Gal/Hour/50 Joints
8-inch	0.66 Gal/Hour/50 Joints
10-inch	0.83 Gal/Hour/50 Joints
12-inch	0.99 Gal/Hour/50 Joints

The Contractor shall furnish all gauges, meters, pumps, and other equipment required and shall maintain said equipment in condition for accurate testing as determined by the Engineer.

Each section of pipe shall be slowly filled with water to the specified test pressure, based on the elevation of the highest point on the section under test.

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Pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Owner.

Before applying the specified test pressure, air shall be expelled completely from the pipe. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed, and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged or left in place at the discretion of the Owner.

Any exposed pipe, fittings and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings or joints that are discovered following the pressure test shall be repaired or replaced with sound material, and the test shall be repeated until it is satisfactory to the Owner. Where leaks are visible at exposed joints and/or evident on the surface when joints are covered, the pipe shall be rejoined, and leakage minimized regardless of total leakage as shown by test.

LEAKAGE SHALL BE DEFINED AS THE QUANTITY OF WATER THAT MUST BE SUPPLIED INTO THE NEWLY LAID PIPE OR ANY VALVED SECTION THEREOF TO MAINTAIN PRESSURE WITHIN 5 PSI OF THE SPECIFIED TEST PRESSURE AFTER THE PIPE HAS BEEN FILLED WITH WATER AND THE AIR HAS BEEN EXPELLED. LEAKAGE SHALL NOT BE MEASURED BY A DROP IN PRESSURE IN A TEST SECTION OVER A PERIOD OF TIME.

Duration of the pressure test shall be not less than 2 hours where joints are exposed and not less than 8 hours where joints are covered.

Lines which fail to meet the leakage requirements shall be repaired and retested until test requirements are met. All pipe, fittings and other materials found to be defective under test shall be removed and replaced at the Contractor's expense.

Leaks due to faulty joining of pipe sections shall be repaired using mechanical joint cast or ductile iron sleeves. Steel repair clamps will not be allowed.

13. Disinfection of Lines

The new water lines shall not be placed in service – either temporarily or permanently – until they have been thoroughly disinfected in accordance with the following requirements and to the satisfaction of the Owner.

Disinfection of New Facilities - Bacteriological samples will be collected and analyzed to verify the effectiveness of the disinfection practices prior to placing new facilities in service. Bacteriological samples shall be collected to determine the effectiveness of the installation process including protecting the pipe material during storage, installation, and disinfection. This can be demonstrated by collecting two sets of microbiological samples 24 hours apart or collecting a single set of

Detailed Specifications

microbiological samples 48 hours or longer after flushing the highly chlorinated water from the lines. In either case microbiological samples in each set will be collected at approximately 2,500-foot intervals with samples near the beginning point and at the end point unless alternate sampling frequency and distance between sampling point approval has been obtained from the state. Where sanitary conditions were not maintained before, during or after construction, an additional bacteriological sample shall be collected from a location representing the water from the contaminated area. Unsanitary conditions include failure to document the sanitary handling of materials, to conduct construction inspections and to maintain records, and to document sanitary practices during construction and other hazards such trench flooding during construction. If the constructed facility yields positive bacterial samples, additional flushing, disinfection and bacteriological sampling shall be repeated until the water is coliform free. Disinfection of water lines shall comply with AWWA Standard C651.

The interiors of pipes, fittings, and valves shall be protected from contamination. Pipe delivered for construction shall be stung to minimize the entrance of foreign material. All openings in the pipeline shall be closed with water tight plugs when pipe laying is stopped at the close of the day's work or for other reasons, such as rest breaks or meal periods. Rodent-proof plugs may be used when watertight plugs are not practicable and when thorough cleaning will be performed by flushing or other means.

The tablet method consists of placing calcium hypochlorite granules or tablets in the water main as it is being installed and then filling the main with potable water when installation is completed. This method may be used if the pipes and appurtenances are kept clean and dry during construction. During construction, calcium hypochlorite granules shall be placed at the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500-ft intervals. The quantity of granules shall be shown in the table below.

Ounces of calcium hypochlorite granules to be placed at beginning of main and at each 500-foot interval.

Pipe Diameter (d)		Calcium Hypochlorite Granules	
Inches	(mm)	Oz.	(g)
4	100	1.7	57
6	150	3.8	113
8	200	6.7	200
10	250	10.5	300
12	300	15.1	430
14 and larger	(350 and larger)	$D^2 \times 15.1$	$D^2 \times 427.9$

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

Filling and contact - When installation has been completed, the main shall be filled with water at a rate to ensure that the water within the main will flow at a velocity

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no greater than 1 ft/s (0.3 m/s). Precautions shall be taken to ensure that air pockets are eliminated. This water shall remain in the pipe for at least 24 hours. If the water temperature is less than 41 degrees Fahrenheit (5 degrees Celsius), the water shall remain in the pipe for at least 48 hours. As an optional procedure (if specified by the purchaser), water used to fill the new main shall be supplied through a temporary connection that shall include an appropriate cross-connection control device, consistent with the degree of hazard, for backflow protection of the active distribution system. A detectable chlorine residual should be found at each sampling point after the 24 hour period. The results must be reported.

14. Highways Crossings

a. Bored State Highway Crossings

All bored crossings of U.S. and State of Tennessee Highways, shall be made by boring with a steel casing pipe as specified in Paragraph 16 hereinafter and as shown on the Standard Details. The pipe shall be jacked through a bored hole. Where boring is required, the holes shall be bored under the highway at least four (4) feet below the surface with no disturbance to the surface. THE CONTRACTOR SHALL OBTAIN ALL APPROVALS AND POST ALL BONDS AS REQUIRED BY THE GOVERNMENT ENTITIES AFFECTED.

b. Open-Cut State Highway Crossings

If approval of TDOT can be obtained by the Contractor, special open-cut highway crossings of U.S. and State of Tennessee Highways can be made as shown on the Standard Details. The Contractor shall be responsible for following all permit conditions required by TDOT. The Contractor shall keep the pipeline trench to a minimum to prevent excessive disturbance of the existing pavement. The proposed water line shall be at least four (4) feet below the highway. The Contractor shall be fully responsible for the successful operation, without interruption, of traffic and shall be held responsible for returning the highway to its original condition. The Contractor shall be responsible for any settlement which occurs as a result of his work. The Contractor shall also post signs warning approaching motorists of the work underway. During construction, flagmen will be required. Any open trenches shall be bridged with temporary bridges consisting of 1-inch steel plate for the convenience of the traveling public.

c. Open-Cut County and City Highway Crossings

Whenever possible, crossings under highways will be open-cut. There the following TDOT requirements apply: "Where open-cutting is allowed, the following conditions shall be met: (a) All backfill material shall be compacted crushed stone, and (b) One-half of the traveled portion of the paving must be open at all times." Crossings of city streets and county roads will be open-cut with the permission of the City of Pulaski and the Giles County Highway Department.

Detailed Specifications

15. Railroad Crossings

a. Jacked or Bored

The Contractor should familiarize himself with the requirements of the railroad within whose rights-of-way the Contractor is working. THE CONTRACTOR WILL OBTAIN AND PAY FOR ANY PERMIT THAT IS REQUIRED IN ORDER TO WORK WITHIN THAT RIGHT-OF-WAY AND SHALL PAY FOR ANY SPECIAL INSURANCE TO THE AMOUNT AND EXTENT REQUIRED BY THE RAILROAD INVOLVED.

Generally, pipeline crossings of railroads shall be made by boring or jacking a smooth wall steel casing pipe under the roadbed and inserting the carrier therein as shown on the Standard Details. Casing pipe shall be so constructed as to prevent leakage of any substance from the casing through its length except at ends. Casing shall be so installed to prevent the formation of a waterway under the roadway, with an even bearing through its length, and shall slope to one end (except for longitudinal occupancy).

Bored or jacked installations shall have a bored hole diameter essentially the same as the outside diameter of the pipe. If voids should develop or if the bored hole diameter is greater than the outside diameter of the pipe by more than approximately 1 inch, remedial measures as approved by the Railway Company shall be taken. Boring operations shall not be stopped if such stoppage would be detrimental to the railroad.

16. Steel Casing Pipe for Highway and Railroad Crossings

a. General

Where required, highway and/or railroad crossings shall be bored or tunneled so as to prevent interruption to traffic and to prevent later settlement of the roadway or roadbed. The Contractor must be fully equipped and experienced in the installation of large diameter structures by boring or tunneling methods. The Contractor shall be fully responsible for the successful operation without interruption of traffic and shall be held responsible for any settlement which occurs as a result of his work.

b. Steel Casing Pipe

Black steel casing pipe shall be manufactured and tested in accordance with ASTM Specification A 139 or A-53, Grade B, 35,000 psi yield strength, meeting the American Railway Engineering Association (AREA) Specification for Coated Corrugated Metal Pipe and Arches, Chapter 1, Part 5. Steel casing pipe where shown shall be as follows:

Detailed Specifications

<u>Diameter Carrier in Inches</u>	<u>Diameter Casing in Inches</u>	<u>Minimum Wall Thickness Of Casing in Inches</u>
4	12	0.250
6	14	0.250
8	16	0.281
10	20	0.344
12	24	0.407
14	24	0.407
16	36	0.532
18	36	0.532
20	40	0.563
24	40	0.563

17. Stream or River Crossings

Where required by the Owner, the Contractor shall install Pressure Class 350 restrained joint ductile iron pipe as specified in Paragraph 3, Subparagraph c. of this Detailed Specification.

If a crossing of Richland Creek is required, the Contractor shall contact the Owner for the required pipeline specifications to be utilized.

THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS FOR STREAM OR RIVER CROSSINGS. THE CONTRACTOR SHALL BE REQUIRED TO MEET ALL APPLICABLE TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION WATER POLLUTION CONTROL REQUIREMENTS AS IT RELATES TO SOIL EROSION.

18. Gate Valves

Gate valves shall conform to AWWA Standards C509, latest revision, as modified herein. All gate valves shall be of the resilient seat type iron body, non-rising stem, suitable for water working pressure of the 200 psi. Valves shall be of a standard manufacture and of the highest quality both as to materials and workmanship. An affidavit of compliance is required. Bolting materials shall be cadmium plated. The stem sealing shall be by an O-ring.

All gate valves shall be furnished with mechanical joint end-connections, unless otherwise shown. The end-connections furnished shall be suitable for connection to the pipe furnished.

All gate valves shall have the name or monogram of the manufacturer, the year the valve casting was made, the size of the valve, and the working water pressure cast on the body of the valve. They shall be coated with black asphalt varnish and touched up in the field as required.

Detailed Specifications

All gate valves shall be provided with a 2-inch square operating nut and shall open by turning to the left (counter-clockwise). All gate valves shall be M & H, Clow, Mueller or an approved equal.

19. Butterfly Valves

Butterfly valves for pipeline service shall be suitable for 150 psi working pressure, shall be designed for underground service and shall meet the requirements of AWWA Standard C504, latest revision, as modified hereinafter. Butterfly valves shall be Dresser Style 450, Model 655 BIF a Division of Leeds and Northrup, American Flow Control or other manufacturer approved by the Owner in writing. Valves may be either of the "short" or "long" laying length type where this meets service conditions.

Butterfly valves shall be furnished with mechanical joint end connections unless flanged connections are requested by the Contractor. The end connections shall be suitable for the connections to cast or ductile iron pipe, or concrete pressure pipe. "Slip-on" joints will not be allowed.

Valve operators shall consist of a geared 2-inch square nut and shall conform to the latest revision of AWWA Standard C504, latest revision, and shall be designed to hold the valve in any intermediate position between fully open and fully closed without creeping or fluttering. The gear box shall be fully sealed and grease packed. Stops shall be provided to stop the valve in the fully open or fully closed positions. Valve operators shall take at least 32 turns to open and shall be capable of resisting without damage an input of at least 300 foot pounds. Valves shall open by turning counter-clockwise.

20. Valve Boxes

Valve boxes shall be cast iron, THREE (3) PIECE, screw type with drop cover marked "Water". They shall be set vertically and properly adjusted so that the cover shall be in the same plane as the finished surface of the ground or street. For ease of location and identification a 2'-0" square by 6-inch thick concrete pad with a cast aluminum plaque imbedded therein shall be furnished as shown on the Standard Details.

21. Tapping Sleeves and Valves

Tapping sleeves with mechanical joint ends and flanged connection for valve together with a gate valve conforming to the specifications for Gate Valves in Paragraph 18 of this Detailed Specification shall be provided where required. Tapping sleeves and valves shall have a pressure rating corresponding to the pressure zone in which they are located. The Contractor shall verify in the field the type of existing pipe that the tapping sleeve will be used in connection with. The valve shall be supplied with a three-piece valve box and operating nut. Tapping sleeves and valves shall be as manufactured by M & H Valve and Fitting Company, Eddy Valve Company, or approved equal.

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22. Air Release Valves and Boxes

Air release valves and boxes shall be installed on the mains at all high points in the lines as shown on the approved Plans. The exact location of air release valves will be determined in the field by the Owner.

The air release valves for pipelines 12-inch and smaller shall be provided as shown on the Standard Details. For pipelines larger than 12-inch, the Contractor shall contact the Owner for the required air release valve specifications to be utilized. The valves shall be 2-inch inlet diameter for 6-inch through 12-inch pipe and shall be fitted with the proper size orifice. The body and cover shall be of cast iron, the trim shall be brass and the float shall be of stainless steel. The valves shall be suitable for use in lines having a maximum water pressure of 150 psi.

23. Blow-Offs

Blow-offs shall be installed as shown on the Standard Details as directed by the Owner.

24. Fire Hydrants

Fire hydrants shall be the Style 129 manufactured by Mueller or M & H Valve Company. Installation of hydrants shall be in accordance with Section 3.7 of the latest revision of ANSI/AWWA Standard C600. Seals shall be O-ring type. The hydrant inlet shall be suitable for mechanical joint connection. The hydrant main valve shall be 5 1/4-inch compression type. Installation of fire hydrants shall be completed as shown on the Standard Details.

After installation, each fire hydrant shall be tested for flow and residual pressure. All fire hydrants shall be color coded according to the standard color scheme of the National Fire Prevention Association.

The top bonnet and nozzle caps of each hydrant shall be painted with the appropriate standard color designation to indicate the flow capability of each hydrant. The color schemes of the hydrant top bonnet and nozzle caps, along with the corresponding flow rates and hydrant classes, shall be as follows:

<u>Hydrant Class</u>	<u>Flow Rate @ 20 psi</u>	<u>Color</u>
Class AA	1,500 GPM and Above	Light Blue
Class A	1,000 GPM – 1,499 GPM	Green
Class B	500 GPM – 999 GPM	Orange
Class C	0 GPM – 499 GPM	Red

Detailed Specifications

25. Service Connection Piping for Water Meter Reconnection

a. Water Meters

Water meters will be furnished by the City of Pulaski.

b. Meter Fittings

The necessary corporation stops, curb cocks, and all other fittings and accessories shall be furnished as indicated on the Standard Details.

c. Meter Boxes

All meter boxes shall be constructed as shown on the Standard Details. Shop drawings of the meter boxes and covers shall be subject to the approval of the Owner prior to installation.

d. Service Connection Piping

Service connection piping shall be ¾-inch Type K copper meeting ASTM Designation B 8-83a. Copper fittings shall meet all applicable ANSI requirements. Special care shall be taken to protect the service piping with earthen material, from sharp and hard objects. Cover is to be at least 30 inches at all points. The Contractor will be responsible for providing and installing all service connections to the meter box and shall provide the corporation cock at the water line (which shall be left in the open position) and where the meter box is to be placed (this cock shall be left in the closed position). The location of the meter box curb cock shall be marked by means of a wire attached at one end to the curb cock and at the other end to stake where so directed by the Owner.

e. Casing Pipe for Highway Crossing

Service lines which cross highways shall be installed as specified in Paragraph 16 of this Detailed Specification using the materials and methods specified in this Paragraph for the carrier pipe.

26. Removing and Replacing Concrete Driveways, Sidewalks and Paved Ditches

Whenever driveways are removed or disturbed in connection with the construction work, they shall be replaced to the original lines and grades in fully as good or better condition than which existed prior to the Contractor's operation.

After the sub-base has been brought to a satisfactory grade, a 3-inch layer of cinders or crushed stone shall be spread over it and thoroughly tamped. Immediately prior to pouring the concrete, the cinders or stone shall be thoroughly wetted, or the concrete shall be poured on a layer of heavy building paper.

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The driveways shall consist of 6 inches of Class "A" concrete, struck off to accurately placed screeds and worked with a wooded float until the mortar appears on top. After the surface has been thoroughly floated, it shall be brushed to leave marking of a uniform type similar to the existing driveway. All joints and edges shall be finished with an edging tool. The allowable joint variation shall be 1/8 inch to 10 feet transversely and longitudinally.

Other type of driveways, such as brick, stone asphaltic concrete, *etc.*, shall be replaced with material removed during the progress of the work, in equally as good condition as that found before the work began.

27. Removing and Replacing Concrete Curb and Gutter

Where a concrete curb and gutter are damaged or disturbed during the construction work, it shall be replaced, using Class "A" concrete, in fully good or better condition than which existed prior to the Contractor's operation.

28. Replacing Existing Streets and Roadways

a. General

The Contractor shall replace all existing streets, alleys, and roadways which may be removed, disturbed, or damaged in connection with his operation. The Contractor shall reconstruct same to the original lines and grades in such manner as to leave all such surfaces in fully as good or better condition than that which existed prior to his operations. The reuse of materials removed in making excavations will be permitted in the manner described, provided said materials are in good condition.

Grave, crushed limestone, bituminous materials, or other materials used in the resurfacing of streets, shall meet the current requirements of the Standard Specifications of TDOT.

The maximum allowable width will be 5.0 feet. Any disturbance beyond said 5.0 feet will be considered as due to the Contractor's negligence **without permission from the Owner**. Where State Highways are crossed the typical sections shown on the Standard Details shall be utilized to repair the highway.

b. Backfill of Trenches Under Roadways (Must be approved by Public Works)

Replacement of streets and roadways after trenching shall be handled in the following manner:

When crushed stone or flowable fill is used to backfill the trench, it shall be brought to subgrade.

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The Contractor shall maintain the trench by adding crushed stone to finished grade to keep the trench in a safe and passable condition until such time that sufficient settlement has taken place and the trenches are ready for final resurfacing.

Backfill material under pavement on the right-of-way of City streets shall be TDOT Size No. 67 gradation crushed stone with a 6 inch cap of Class "A", Grading "D" crushed stone.

c. Traffic-Bound Base Course

After the backfill has been compacted to within about 6 inches of finish grade as specified hereinbefore, the Contractor shall then place approximately 6 inches of crushed stone as a traffic-bound base course, at the proper elevation to allow for settlement, but not in such a way as to prevent traffic from using the street or roadway. Crushed stone shall be TDOT Class "A", Grading "D".

The Contractor shall maintain the traffic-bound base course by adding crushed stone—as specified above—in a safe and passable condition for a period of sixty (60) days, or until such time as in the opinion of the Owner sufficient settlement has taken place; and trenches are ready for final resurfacing. Crushed stone will be paid for at the unit price specified in the Contract.

d. Subgrade for Final Resurfacing

The traffic-bound course described above shall comprise the base course for all types of resurfacing.

When in the opinion of the Owner, the trench has reached a condition of settlement satisfactory for final resurfacing, the Contractor shall first strip the base course or backfill with crushed stone—size as specified above—to obtain the proper subgrade elevation. The subgrade shall then be rolled with an approved type roller, or tamped until thoroughly compact and 6 inches thick.

Any depressions shall be filled with crushed stone – as specified – and the process of rolling or tamping continued until the subgrade has a smooth and uniform surface.

e. Removing and Replacing Concrete Street Pavement

Where Portland cement concrete pavement must be removed and/or replaced, it shall be replaced to a thickness equivalent to the existing pavement but in no case less than six inches. It shall be accomplished with Class "A" concrete.

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f. Portland Cement Concrete Subslab

Where Portland cement concrete pavement subslab is required under bituminous pavement replacement, it shall conform to the existing pavement and/or the Standard Details and shall be accomplished with Class "A" concrete. The subgrade shall be prepared as above specified.

g. Asphaltic Concrete Pavement

Where asphaltic concrete pavement is to be replaced, the subgrade shall be prepared as above specified, and this subgrade shall comprise the base course upon which the bituminous pavement shall be laid. The existing pavement shall be neatly cut back approximately one (1) foot outside the trench and the new pavement tied into the existing. The subgrade or base shall be thoroughly cleaned and broomed and a prime coat of medium tar shall be uniformly applied at a rate of 0.20 to 0.25 gallons per square yard.

Where Portland cement concrete subslab is required, the prime shall be applied to the concrete at a rate of 0.05 gallons per square yard. The prime shall be applied by a pressure distributor or other approved pressure spray method.

When the prime coat has become tacky but not dry and hard, a bituminous surfacing consisting of asphaltic concrete shall be placed, spread, finished and compacted in accordance with the current standard specifications of TDOT, Section 411, Grading D, with 85-100 penetration grade asphalt. Compacted thickness of asphaltic concrete pavement replacement shall be as directed.

h. Bituminous Surfacing (Surface Treatment)

Where bituminous surfacing is to be replaced, as shown on the Standard Details, or as directed by the Owner, the traffic-bound base shall comprise the subgrade upon which the bituminous surfacing shall be constructed.

After the subgrade or base has been prepared, thoroughly cleaned and broomed, a prime coat of medium tar shall be applied at the rate of 0.30 to 0.35 gallon per square yard.

When the prime coat has become tacky but not hard, bituminous material (asphalt of the grade directed by the Owner) shall be applied in two applications at the rate of 0.35 to 0.45 gallon per square yard for each application. The Contractor shall apply approximately 50 pounds per square yard of crushed stone chips between the two applications of bituminous material and 35-40 pounds of chips after the final application of bituminous material.

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i. Untreated Surface

Where the existing surface is untreated crushed stone, the Contractor shall replace the surfacing that is disturbed or removed with crushed stone as above specified to at least the thickness of the existing surface.

29. Seeding of Disturbed Areas

The areas disturbed by construction which are not a part of pavements shall be seeded in accordance with the requirement below. Roadway shoulders which were crushed stone or receive crushed stone are considered as pavements. Special attention shall be directed to the work performed on private easements.

All disturbed areas other than lawns, which shall be reseeded in approximately their preconstruction condition, shall be left smooth and thickly sown with a mixture of Blue Grass, Italian Rye Grass, Kentucky Fescue #31 and/or such other grasses as are specified by the Owner (in pastures, *etc.*, the property owner's preference of grasses shall be used). When the final grading has been completed, the entire area to be seeded shall be hand raked and fertilized with ammonium nitrate at the rate of 5 pounds per 1,000 square feet and an approved commercial fertilizer at the rate of 10 pounds per 1,000 square feet. The analysis of the commercial fertilizer shall be determined by soil tests.

After the fertilizer has been distributed, the Contractor shall rake or harrow the ground to thoroughly work the fertilizer into the soil. The seed shall then be sowed in two (2) operations, broadcast either by hand or by approved sowing equipment. The application shall be 30 pounds per acre for each operation. If the Owner determines to use "hulled" or "unhulled" Bermuda, the application rate shall be 7 pounds per acre. After the seed has been distributed, the Contractor shall then lightly cover the seed by use of a drag or their approved device. All seed shall be certified not more than three percent weed. The seeded area shall then be covered with straw at the rate of 1 ½ tons per acre.

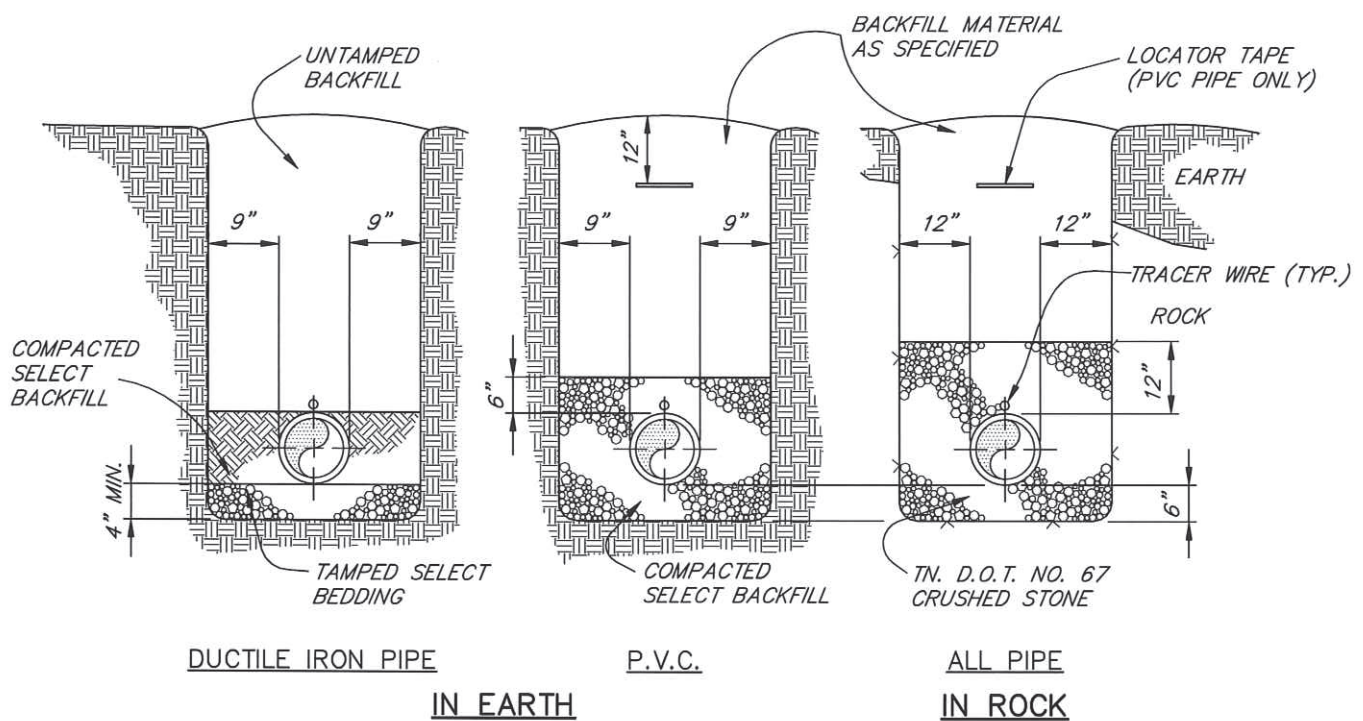
Any necessary reseeding or repairing shall be accomplished by the Contractor prior to final acceptance. If the construction work is brought to completion when, in the opinion of the Owner, the season is not favorable for the seeding of the grounds, then the Contractor shall delay this item of work until the proper season for such seeding as directed by the Owner.

All planting and seeding shall be watered thoroughly as soon as completed and shall be watered twice daily or more often, if necessary until all growth is thoroughly established.

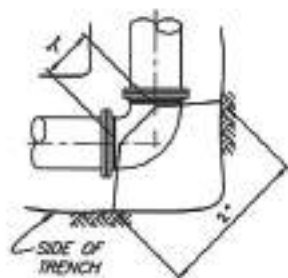
30. Rip-Rap

Rip-rap where directed by the Owner shall be of the "rubble stone" type complying with the requirements set forth by TDOT Standard Specifications for Road and Bridge Construction Section 709, Subsections: 09.01, 709.02(a), 709.04, 709.08, and 709.09.

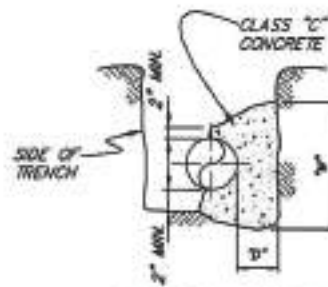
APPENDIX 'A'
STANDARD DETAILS



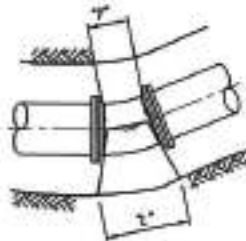
STANDARD WATER LINE LAYING, BEDDING AND INITIAL BACKFILLING



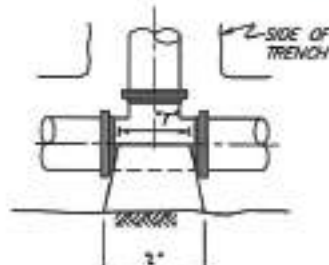
90° BEND



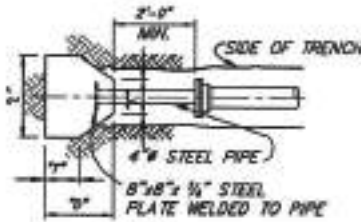
TYPICAL SECTION



45° 22 1/2° & 11 1/4° BENDS



TEE



PLUG

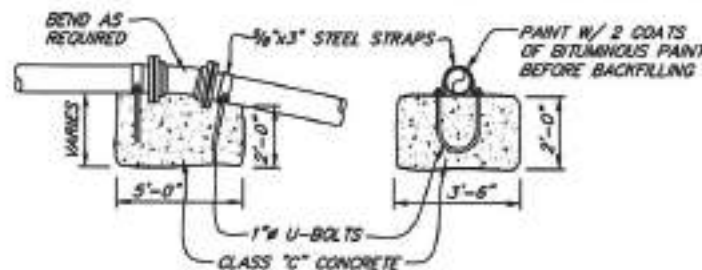
NOTES

1. FOR TEE WITH BRANCH UNEQUAL TO RUN, USE TEE TYPE KICKER WITH D, L & W DIMENSIONS THE SAME AS THOSE FOR PLUG WITH SAME DIMENSIONS AS BRANCH OF TEE, SELECT T DIMENSION FROM TEE TABLE UNDER COLUMN HEADED BY THE SIZE OF THE BRANCH.
2. IF EXACT SIZE OF PIPE BLOCKING IS NOT SHOWN, USE NEXT LARGER SIZE.
3. DIMENSION D MAY BE GREATER THAN SPECIFIED TO ALLOW WORKING SPACE, CONCRETE BLOCKING MUST BE POURED AGAINST UNDISTURBED EARTH.
4. ALL IRON SURFACES SHALL BE PROTECTED WITH 8 MIL POLYETHYLENE PRIOR TO PLACING CONCRETE.

BEARING PRESSURE 3000 PSF					
PSI = 150					
90° BEND					
SIZE	6"	8"	10"	12"	
D	12	16	20	23	
L	24	32	39	46	
W	24	32	39	46	
T	12	12	16	18	
45° BEND					
SIZE	6"	8"	10"	12"	
D	12	12	15	17	
L	18	23	29	34	
W	18	23	29	34	
T	10	10	12	14	
22 1/2° & 11 1/4° BENDS					
SIZE	6"	8"	10"	12"	
D	12	12	12	12	
L	13	17	20	24	
W	13	17	20	24	
T	10	10	12	14	
TEE					
SIZE	6"	8"	10"	12"	
D	12	12	16	18	
L	20	27	33	39	
W	20	27	33	39	
T	18	18	22	24	
PLUG					
SIZE	6"	8"	10"	12"	
D	12	14	16	20	
L	20	27	33	39	
W	20	27	33	39	
T	12	14	12	12	

DIMENSIONS ARE IN INCHES

CLASS "C" CONCRETE FOR THRUST BLOCKS AND ANCHORS



VERTICAL ANCHORING DETAIL
FOR VERTICAL BENDS 5° OR MORE

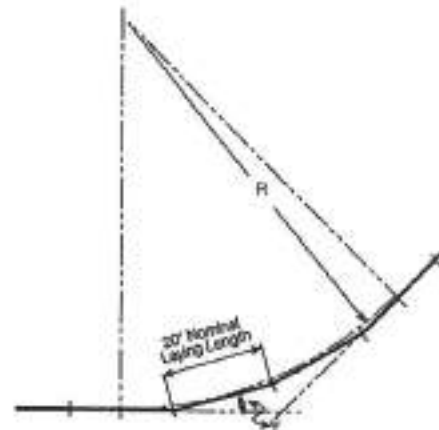


Table No. 2-3

Size in.	Nominal Laying Length ft.	Maximum Recommended Deflection†					
		Standard Ball			Special Deflection Ball		
		X Offset per Nominal Length in.	Y Deflection Angle	Radius of Curve* ft.	X Offset per Nominal Length in.	Y Deflection Angle	Radius of Curve* ft.
4	18	19	5°	208	-	-	-
6	20	21	5°	230	-	-	-
8	20	21	5°	230	-	-	-
10	20	21	5°	230	-	-	-
12	20	21	5°	230	-	-	-
14	20	21	5°	230	-	-	-
16	20	21	5°	230	-	-	-
18	20	21	5°	230	-	-	-
20	20	21	5°	230	-	-	-
24	20	21	5°	230	-	-	-
30	20	21	5°	230	-	-	-
36	20	17	4°	285	21	5°	230
42	20	12	3°	380	21	5°	230
48	20	12	3°	380	17	4°	285
54	20	12	3°	380	17	4°	285
60	20	12	3°	380	17	4°	285
64	20	12	3°	380	17	4°	285

*Approximate radius of curve produced by a succession of nominal lengths of pipe fully deflected.

†Special Deflection Balls must be specifically ordered and will be marked with white bell face for easy identification. For easiest assembly, the joints should be assembled with the pipe in reasonably straight alignment. After joint assembly, the pipe may be deflected up to the maximum shown above. Offset distances are based on 20' lengths.

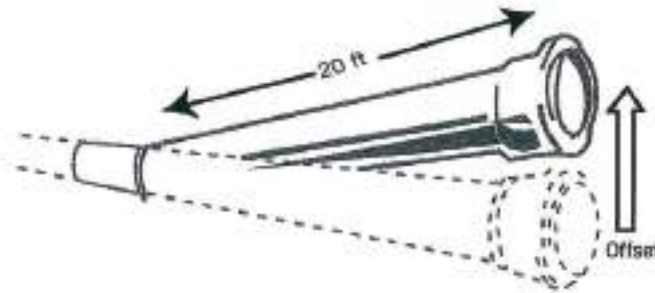


R = Radius of Curve (ft.)

Y = Deflection Angle (degrees)

Radius of Curve = $\frac{\text{Nominal Laying Length}}{2 \times \tan(Y/2)}$

DUCTILE IRON PIPE JOINT DEFLECTION



**MAXIMUM RECOMMENDED OFFSETS, TO ACHIEVE
MINIMUM CURVE RADIUS BY DEFLECTING A
STRAIGHT LENGTH OF 20 FT. PIPE AT A FITTING
JOINT (FOR ALL DIMENSION RATIOS)**

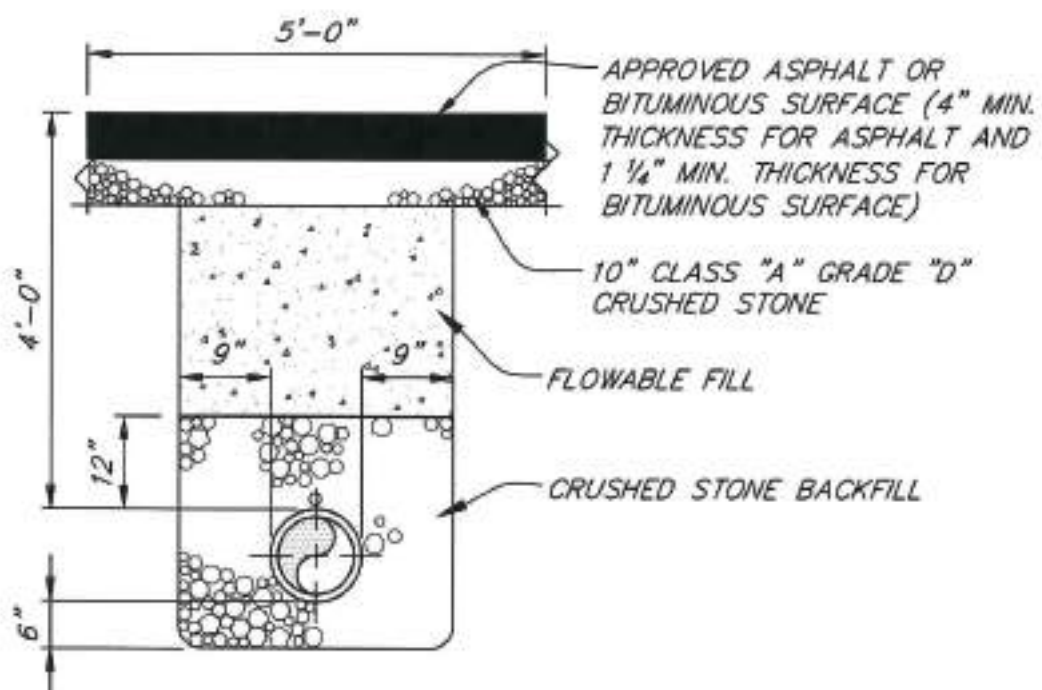
PIPE SIZE inches	MAX OFFSET inches	ANGLE AT ONE BELL	RESULTING RADIUS OF CURVATURE USING 20 FOOT LENGTHS
Molded PVC Fittings (all sizes)	4	1°**	1146 ft**

*** At each fitting bell. Bell by bell configurations such as Tee's and Couplings offer a total of 2° deflection per fitting.*

Note: If shorter lengths of pipe are used, the above offset values must be multiplied by:

$$4" \times \frac{\text{length of pipe (in feet)}}{20}$$

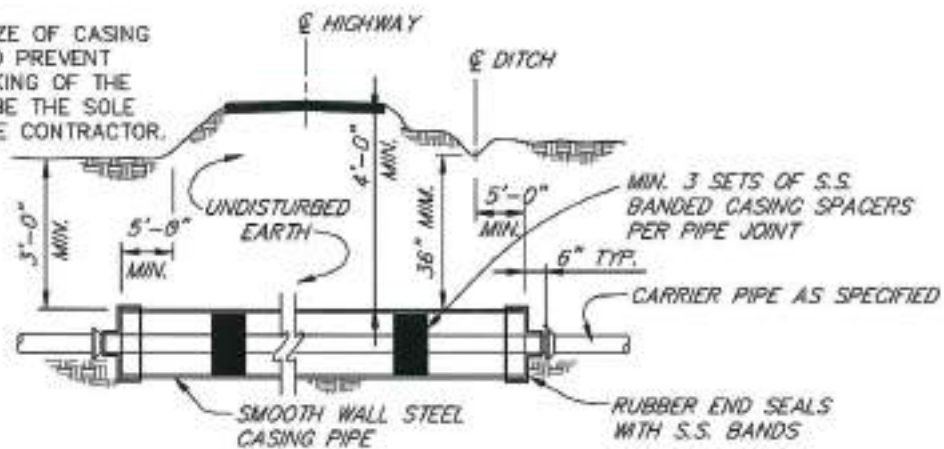
PVC PIPE JOINT DEFLECTION



OPEN CUT STATE HIGHWAY CROSSING

NOTE

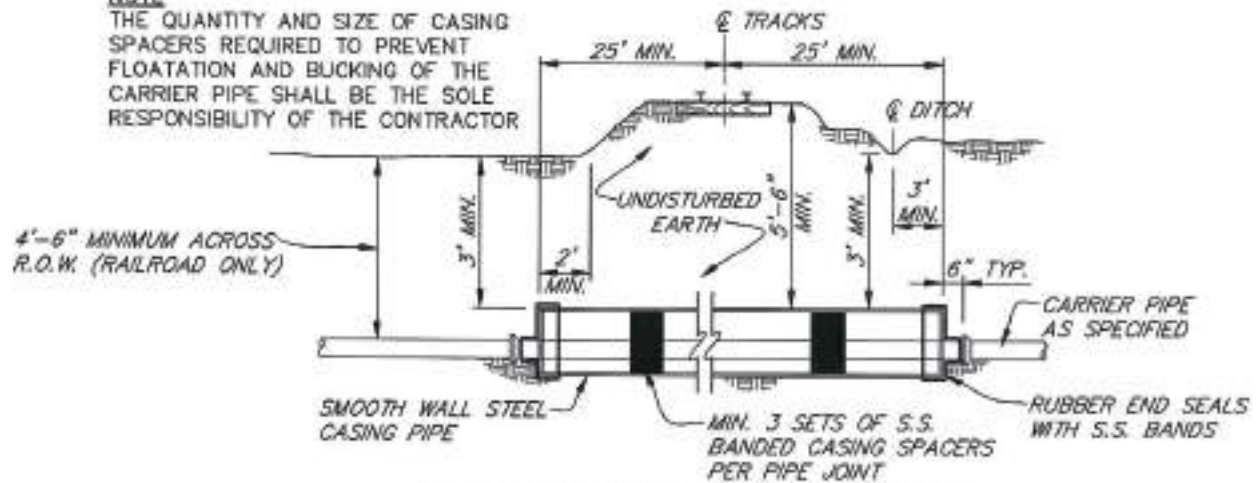
THE QUANTITY AND SIZE OF CASING SPACERS REQUIRED TO PREVENT FLOATATION AND BUCKING OF THE CARRIER PIPE SHALL BE THE SOLE RESPONSIBILITY OF THE CONTRACTOR.



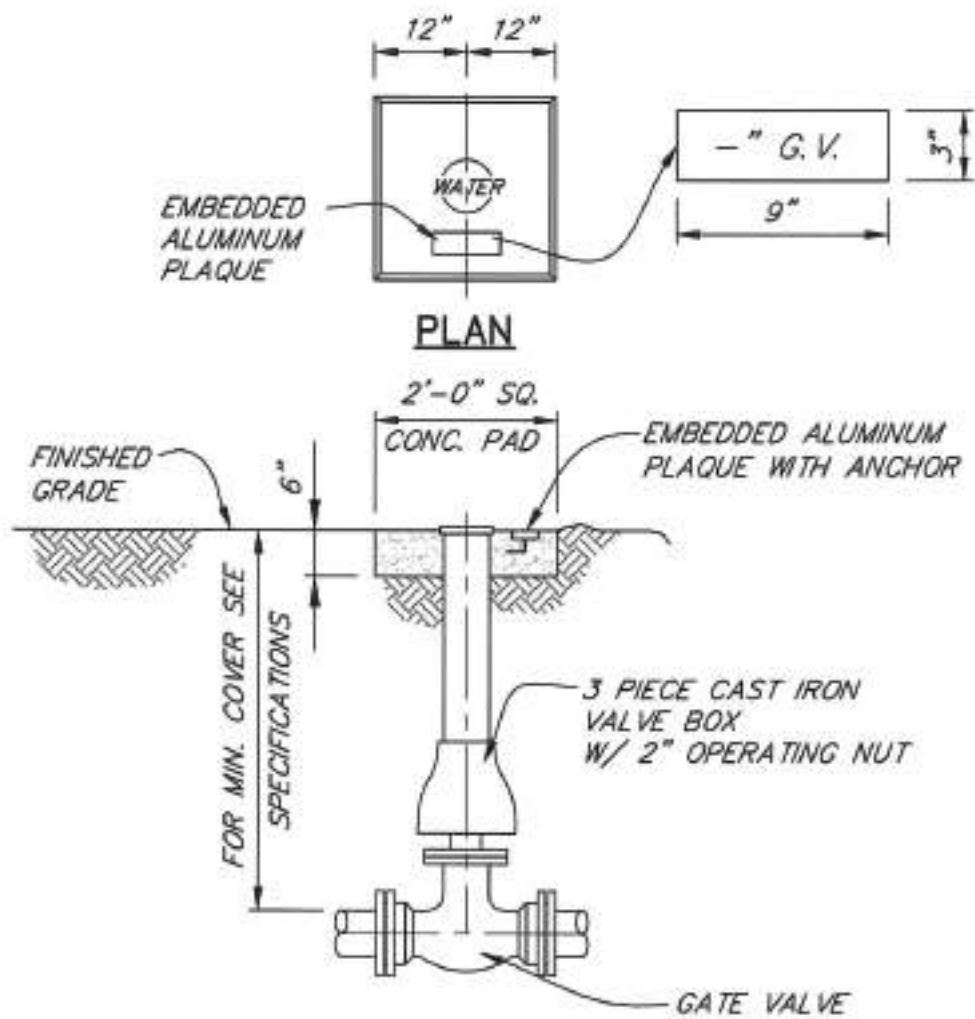
BORED HIGHWAY CROSSING

NOTE

THE QUANTITY AND SIZE OF CASING SPACERS REQUIRED TO PREVENT FLOATATION AND BUCKING OF THE CARRIER PIPE SHALL BE THE SOLE RESPONSIBILITY OF THE CONTRACTOR

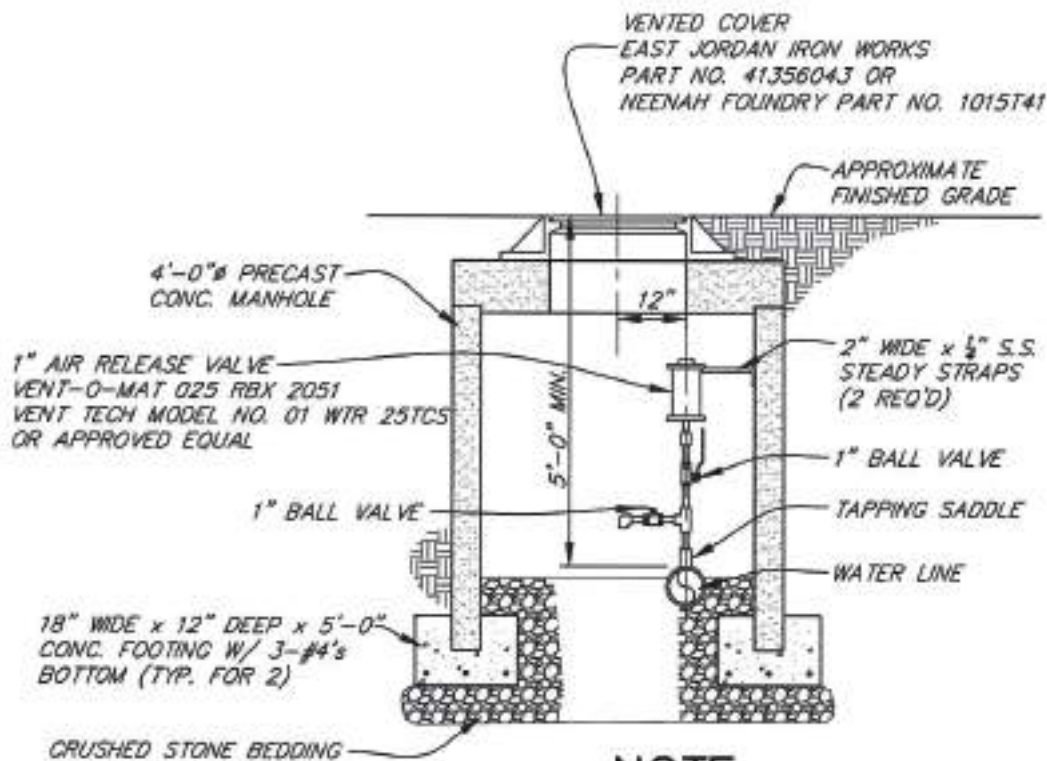


BORED RAILROAD CROSSING



SECTION

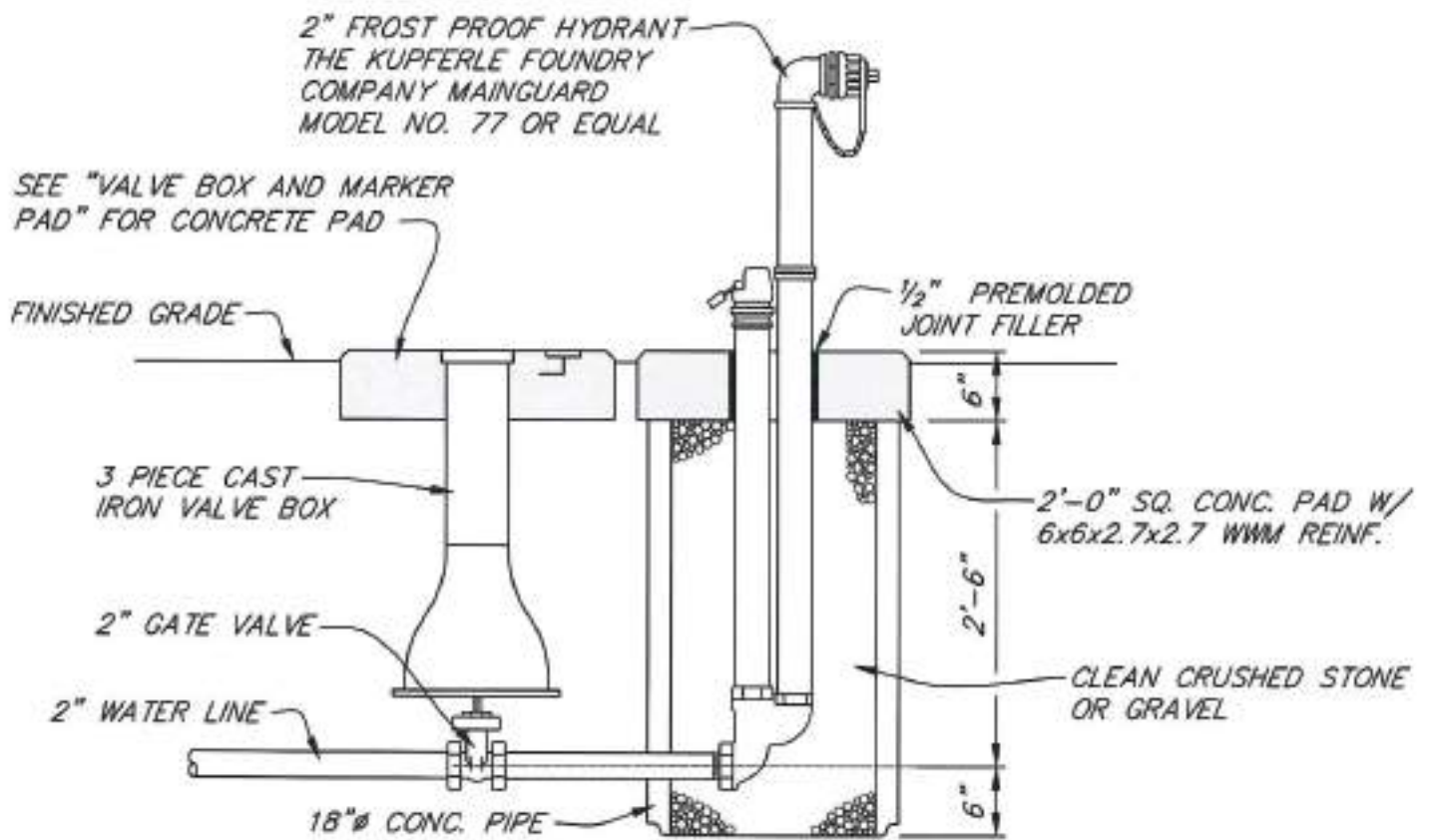
VALVE BOX AND MARKER PAD



NOTE

ALL PIPING AND VALVES
SHALL BE 304 STAINLESS STEEL

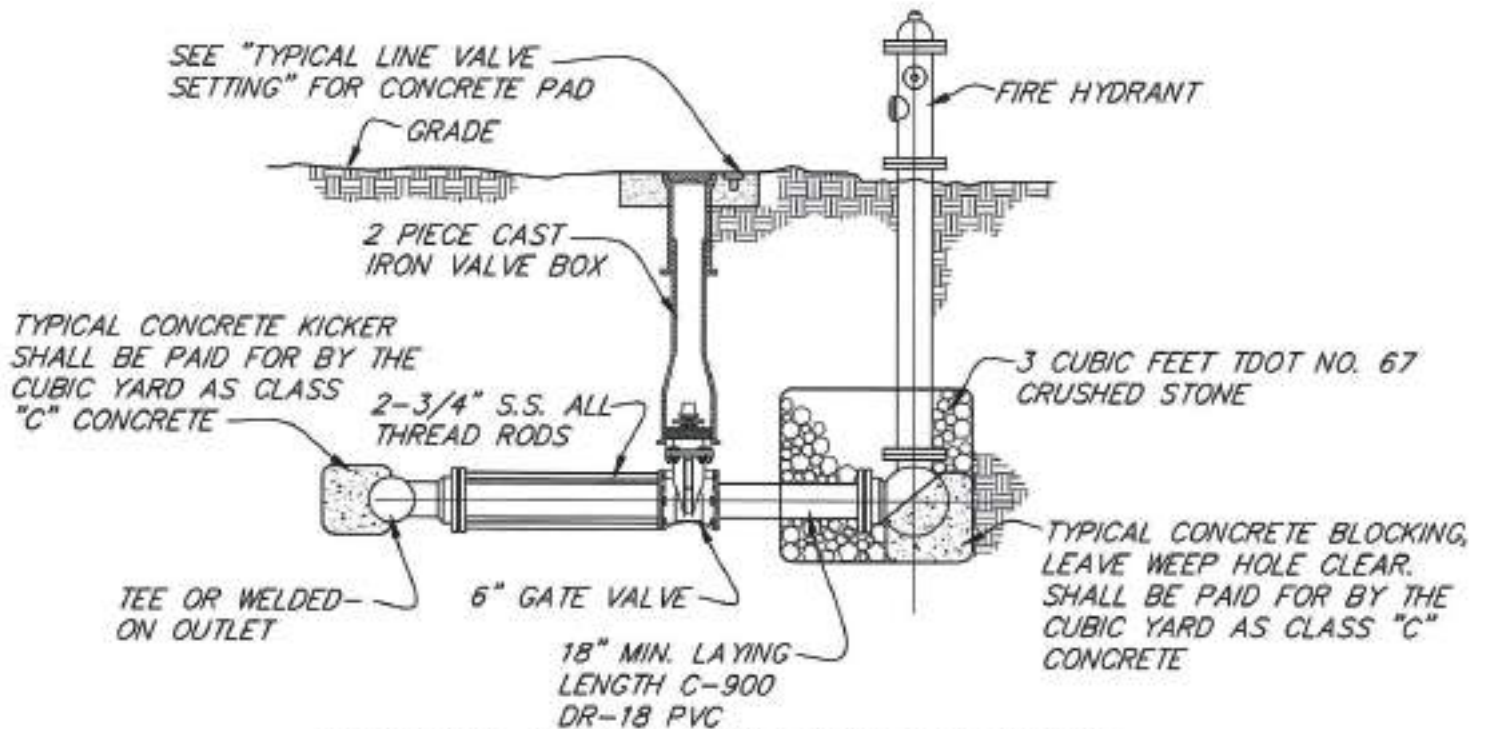
AIR RELEASE VALVES AND BOXES



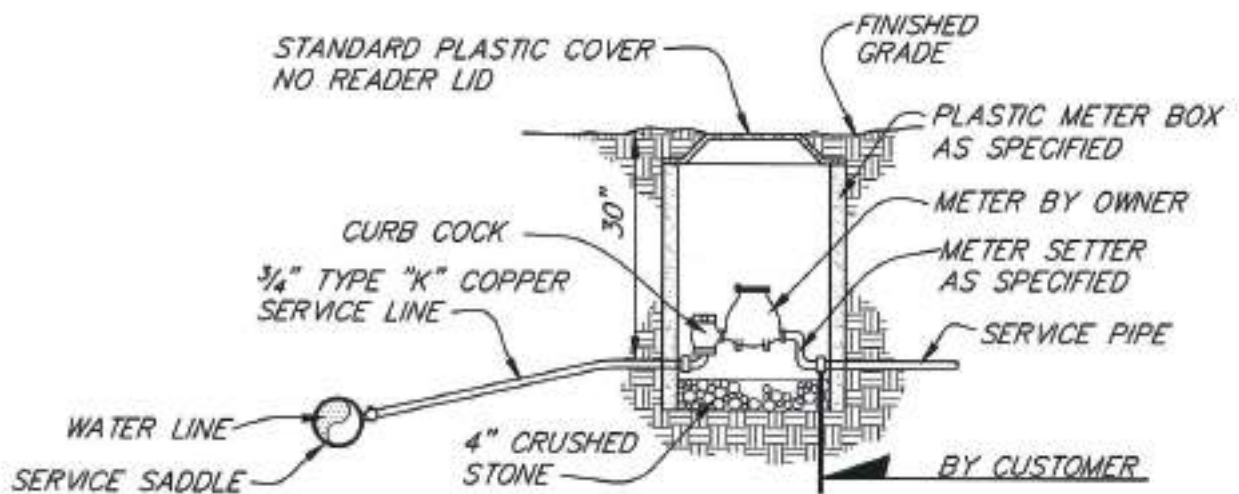
BLOW-OFF VALVE ASSEMBLY

NOTE:

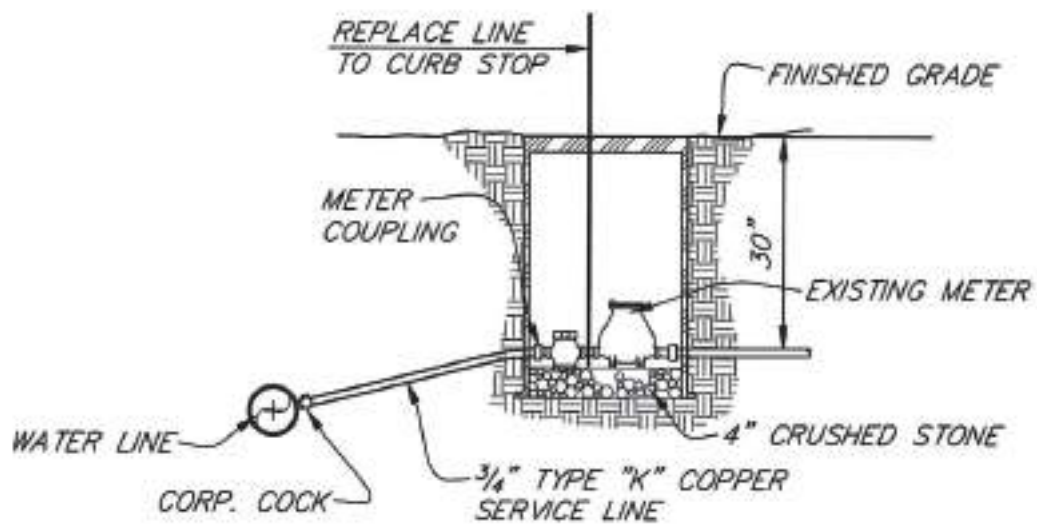
FOR THE PURPOSE OF PAYMENT, FIRE HYDRANTS SHALL CONSIST OF THE FIRE HYDRANT PROPER, 6" GATE VALVE AND BOX WITH CONCRETE PAD, MAIN LINE TEE, AND CRUSHED STONE. THE 6" CONNECTION LINE SHALL BE PAID UNDER UNIT COST ITEMS.



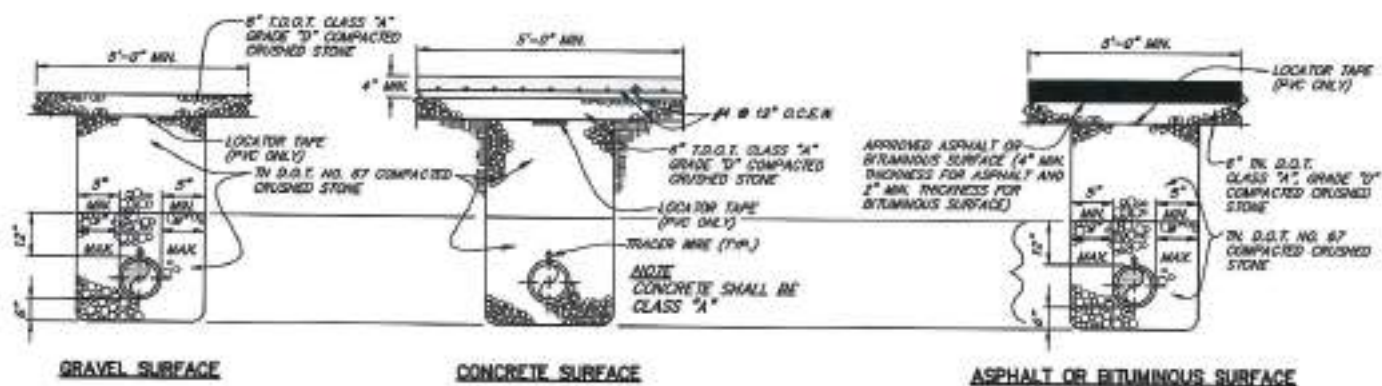
TYPICAL FIRE HYDRANT SETTING



SERVICE CONNECTION FOR NEW WATER METER



SERVICE CONNECTION PIPING FOR
WATER METER RECONNECTION



REPLACING EXISTING STREETS AND ROADWAYS