

SECTION 4

SPECIFICATIONS FOR WATER MAINS

4.01 DESCRIPTION OF WORK

The work must consist of furnishing and installing water main of the specified size or sizes at the depths shown on the drawings or specified herein, and furnishing all fittings and joint material, labor, materials, tools, and equipment for receiving, unloading, transporting, laying, testing, and disinfecting of water pipe and fittings. Contractor must furnish all hydrants, valves, valve boxes and other necessary accessories to complete the pipe work as shown on the drawings and specified herein. Excavating, trenching, and backfilling must be as specified in Section 2.

The work must be performed in accordance with the specifications and drawings, the MDOT 2020 Standard Specifications for Construction and the following specifications.

Submittals must be completed per Section 1 General Requirements.

4.02 MATERIALS

All materials furnished by the Contractor must conform to the specifications which follow. Where reference specifications are mentioned the current edition or latest issue must be used. All water main material must meet NSF Standard 61.

All materials must be American or Canadian made unless otherwise allowed in the Project Technical Specifications or approved by the Township.

4.02.01 Ductile Iron Pipe

4.02.01.01 Pipe

Ductile iron pipe must conform to the requirements of AWWA C151 (ANSI A21.51) and C150 (ANSI A21.50). Ductile iron pipe must be Class 52 unless otherwise specified. All pipe must have a cement mortar lining with seal coat conforming to the requirements of AWWA C104 (ANSI A21.4). Seal coat must have NSF61 approval for use with potable water. All ductile iron pipe must be encased in a seamless polyethylene tube.

4.02.01.02 Fittings

All fittings must be ductile iron in accordance with AWWA C110 (ANSI A21.10) or AWWA C153 (ANSI A21.53). Fittings twenty-four (24) inch diameter and smaller must have a minimum pressure rating of 350 psi.; fittings larger than twenty-four (24) inch diameter must have a minimum pressure rating of 250 psi.

Fittings must have either cement mortar lined with seal coat in accordance with AWWA C104 (ANSI A21.4) or fusion bonded epoxy coating in accordance with AWWA C116 (ANSI A21.16). Lining must have NSF61 approval for use with potable water. All ductile iron fittings must be encased in a seamless polyethylene tube.

Mechanical Joint T Bolts must be corrosion – resistant, high strength low alloy steel that conforms to ANSI/AWWA C111/A21.11. The bolts must have a baked-on Teflon, Xyland, PTFE or Fluorocarbon with a blue coating.

4.02.01.03 Joints

Unless otherwise specified, all pipe joints must be rubber gasket joints conforming to the requirements of AWWA C111 (ANSI A21.11) for bolted mechanical joints or push-on joints. Joints on fittings must be bolted mechanical joints.

Push-on restrained joint pipe must be first approved by the Township. If approved, all ductile iron restrained joint pipe must be Clow Corporation “Super-Lock”, American Ductile Iron Pipe “Lok-Ring Joint” or Flex-Ring Joint, Griffen Pipe Products Co. “Snap-Lok”, or approved equal. The Township will first encourage the use of EBAA Iron Sales Megalug or approved equal to restrain pipe.

When in known or suspected contaminated soils, consult the Engineer and Township to verify gasket material.

4.02.02 Polyvinyl Chloride (PVC) and Molecularly Oriented PVC (PVCO) Pipe

4.02.02.01 Pipe

All polyvinyl chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) pipe for use in public water supply distribution systems must meet ANSI/NSF Standard 14 regardless of the method of installation. The pipe must be stamped either “NSF-pw” or otherwise marked to state that the pipe has been certified to Standard 14 requirements by a certified third party.

Polyvinyl chloride (PVC) pipe, six (6) inch through twelve(12) inch diameter, shall conform to ANSI/AWWA C900. The pipe shall have a pressure rating of 235 psi. The PVC pressure pipe shall have an outside diameter equivalent to cast iron and ductile iron pipe.

Molecularly Oriented Polyvinyl Chloride (PVCO) pipe six (6) inch through twelve (12) inch diameter shall conform to ANSI/AWWA C909. The pipe shall have a pressure rating of 235 psi for six (6) inch to twelve (12) inch. The PVCO pressure pipe shall have an outside diameter equivalent to cast iron and ductile iron pipe.

Pipe color must be blue or as required by the Township.

4.02.02.02 Fittings

Fittings must be ductile iron as specified in Section 4.02.01.02. All ductile iron fittings must be encased in a seamless polyethylene tube.

Anchorage (restraint) of bends, tees, plugs and all other fittings must be per Section 4.12.05 of this specification.

4.02.02.03 Joints

Joints must be bell and spigot with elastomeric rubber gasket conforming to Section 4 of AWWA C900 or C909, as applicable.

When in known or suspected contaminated soils, consult the Engineer and Township to verify gasket material.

4.02.02.04 Tracer Wire

Two (2) tracer wires must be placed with all PVC and HDPE pipe installation. The tracer wires must be #12 AWG high strength locator wire with a minimum break load of 1150 pounds. Protective coating must be minimum of 45 mil. High Molecular Weight, High Density Polyethylene (HMW-HDPE).

Test stations must be Copperhead Lite Duty LD14*TP-ADJ Test Station colored blue or approved equal.

Wire connectors must be watertight and provide for electrical continuity. Connectors must be dielectric silicone filled to seal out moisture and corrosion. Non-Locking, friction fit, or taped connectors are prohibited.

4.02.03 Tapping Sleeves

Asbestos Cement Pipe (AC Pipe) requires a Romac SST Stainless Steel Tapping Sleeve or approved equal.

Ductile Iron Pipe requires a Ford Stainless Steel Tapping Sleeve style FTSC or approved equal.

PVC pipe requires a Ford Stainless Steel Tapping Sleeve or approved equal.

4.02.04 Valves

4.02.04.01 Resilient Seated Gate Valves

All resilient seated gate valves must conform to AWWA C509 or AWWA C515, Standards for Resilient-Seated Gate Valves for Water Supply Service. The valves must be fully bronze mounted and must be furnished with O-ring packing. The direction of the opening must be to the RIGHT (clockwise) and the operating nut

must be the standard 2-inch square nut. All resilient seated valves must be encased in a seamless polyethylene tube.

Valves must be EJ Iron Works "Flowmaster", Clow Valve Co. R/W Resilient Wedge, American Resilient Wedge, or equal.

4.02.04.02 Butterfly Valves

When approved for use by the Township for water mains sixteen (16) inch and higher, all butterfly valves must conform to AWWA C504, Standard for Rubber Seated Butterfly Valves. Valves must be Class 150B and must have a "short body" form. Valves suitable for buried service will be Pratt Ground-Hog or approved equal. Shaft seals must be replaceable without removing the valve shaft. Valves must be equipped with totally enclosed worm gear actuators conforming to AWWA C504. All butterfly valves must be encased in a seamless polyethylene tube.

4.02.04.03 Valve Boxes

Valve boxes must be screw type, three sectionals, adjustable with round bases with an overall length sufficient to permit the tops to be set flush with the established pavement or ground surface. The box must be provided with a cast iron lid or cover and marked with the word "WATER". The valve boxes must be designed to withstand heavy traffic and must be a Tyler Pipe 6860 Series, Item D or approved equal. Polyethylene tubing and fabric are required for installation per detail 4-34.

If valve box is greater than 6' below grade, the Township will provide an extended valve operator.

4.02.04.04 Geotextile Filter Fabric

Geotextile filter fabric for valve box wrapping (see detail) must be nonwoven.

4.02.05 Valve Chambers and Access Structures

The Township may require valve chambers or access structures in lieu of just valve boxes for a project. Please refer to the project specifications for more information.

4.02.05.01 Adjusting Rings

Precast grade adjusting rings must conform to the requirements of ASTM Designation C478.

4.02.05.02 Precast Units (Valve Chambers)

Precast reinforced concrete manhole risers and precast reinforced concrete manhole conical top sections must conform to the requirements for reinforced concrete manhole risers and tops, ASTM Designation C478. Joints for precast

sections must be a rubber O-ring in accordance with ASTM C443, butyl rubber composition seals, RAM-NEK or approved equal.

4.02.05.03 Castings

Castings must meet the requirements specified in the MDOT 2020 Standard Specifications for Construction Section 908. Manhole covers and rings and similar combinations of castings must be machined to provide an even bearing.

Unless otherwise specified, manhole castings must be EJIW 1045 Type C Cover or approved equal. Cover must be imprinted with the word “WATER”.

4.02.05.04 Steel Reinforcement (Valve Chambers)

Steel reinforcement must conform to the requirements for steel reinforcement of Section 905 of the MDOT 2020 Standard Specifications for Construction.

4.02.05.05 Manhole Steps (Valve Chambers)

Unless otherwise specified, manhole steps must be plastic coated steel steps conforming to the requirements of ASTM Designation C478, or approved equal, spaced at 16” on center. Steps must be aligned perpendicular to the existing water main on the side of the butterfly valve operator.

4.02.05.06 Mortar

Mortar must conform to ASTM C270 Type S.

Mortar must consist of one part of Air Entraining Portland Cement, and two parts masonry sand. These proportions must be measured by volume.

Masonry Sand must conform to the requirements of “Natural Sand, 2MS” of the MDOT 2020 Standard Specifications for Construction.

Air Entraining Portland Cement must conform to the requirements for Type 1A of the MDOT 2020 Standard Specifications for Construction for Air Entraining Portland Cement, ASTM Designation C150.

Water for mixing mortar must be obtained from the public water supply unless otherwise approved by the Township.

4.02.05.07 Expansion Joint Material (Valve Chambers)

Expansion Joint Material must be fiber or cellular, asphalt sealed with bituminous mastic.

4.02.06 Hydrants and Hydrant Leads

Fire hydrants must conform to AWWA C502, Standard for Dry Barrel Fire Hydrants. The hydrants must be furnished by EJ Model 5BR250, product code 55425D. Hydrants must have the following features:

- Two 2.5-inch NST pumper nozzles
- One 4-inch Grand Rapids pumper nozzle
- 1.75-inch square operating nut, open RIGHT
- 5-inch valve opening
- Yellow color
- 6-foot bury length
- Nuts and bolts must be stainless steel.

Hydrant Leads must consist of anchoring pipe and couplings. Pipe must be six (6) inch diameter ductile iron per specification 4.02.01. The 90-degree elbow must be a swivel elbow similar to the Tyler 90° swivel x swivel hydrant Ell or approved equal.

4.02.07 Plastic Wrap for Pipe

Seamless polyethylene tube (“polywrap”) must be in accordance with AWWA C105 (ANSI A21.5) of eight (8) mills minimum thickness. The ends of adjacent sections of polyethylene tubing must be overlapped a minimum of one (1) foot, and the joint taped or otherwise secured to prevent displacement during backfill operations.

The seamless polyethylene tube must be extended beyond the exposed portion of existing mains being connected to and secured to the pipe.

When tapping proposed/existing water main that is encased in seamless polyethylene tube, the Contractor must first wrap the pipe with tape and complete water service tap through the taped section.

4.02.07 Water Service Materials

4.02.07.01 Copper Water Service Pipe

Copper water service pipe must be in accordance with ASTM Specification B88 for Type K annealed, seamless copper. Diameter must be 1-inch minimum and all fittings must be flared end. Unless otherwise approved, water services must have no unions/couplings between the corporation stop and curb stop.

4.02.07.02 Corporation Stops

Corporation stops must be threaded per AWWA C800.

1-inch Corporation stops must be flared Ford Meter Box Company, Inc. F600 or equal.

1 ½ inch and 2-inch Corporation Stops must be compression or flared. Compression fittings must be Ford Meter Box Company Inc, FB1000 compression fitting with CTS pack joint.

4.02.07.03 Curb Stops

Curb stops must be flared per ASTM B-88.

1-inch Curb stops must be 1-inch flared Ford Box Meter Company, Inc., FB600 or Equal.

1 ½ inch and 2-inch Curb stops must be compression or flared. Compression fittings must be Ford Meter Box Company Inc., B44-666-NL, B44-777-NL, or equal.

4.02.07.04 Curb Boxes

Curb boxes must be standard cast iron, screw type such as Tyler Pipe 6500 Series, Item 95-E, or equal.

Curb Box Locks are required for 1-inch services and must be the Vadle Curb Box Lock or equal.

4.02.07.05 Service Saddles

Service saddles must be single or double strap with AWWA C800 threads.

For six inch through eight inch (6" – 8") ductile iron, cast iron, and asbestos-cement water main, service saddles must be Ford Meter Box Company, Inc Styles 101B or 202B or equal. For twelve inch (12" and larger) ductile iron, cast iron, and asbestos-cement water main, service saddles must be Ford Meter Box Company, Inc. Style 202B or equal.

For six through eight inch (6" – 8") plastic pipe, service saddles must be Ford Meter Box Company, Inc. Styles 101BS or 202BS or equal. For twelve inch (12") and larger plastic pipe, service saddles must be Ford Meter Box Company, Inc. Style 202BS or equal.

4.03 INSPECTION

4.03.01 Shop Inspection

All materials furnished by the Contractor are subject, at the discretion of the Township, to inspection and approval at the Manufacturer's plant. The inspection in the plant of the manufacturer of materials furnished by the Contractor will be made at the expense of the Township.

4.03.02 Field Inspection

All pipe and accessories must be laid, joined, and tested under pressure for defects and leakage in the manner specified herein and as approved by the Township.

4.03.03 Disposition of Defective Material

All material found during the progress of the work to have cracks, flaws, or other defects will be rejected by the Township. All defective materials furnished by the Contractor must be promptly removed from the site. Any material furnished by the Owner and found defective will be set aside and removed from the site of the work by the Owner.

4.04 RESPONSIBILITY FOR MATERIAL

4.04.01 Responsibility for Material Furnished by Contractor

The Contractor must be responsible for all material furnished by it and must replace at its own expense all such material found defective in manufacturing or damaged in handling after delivery by the manufacturer. This must include the furnishing of all material and labor required for the replacement of defective or damaged installed material discovered prior to the final acceptance of the work.

4.04.02 Responsibility for Material Furnished by Owner

The Contractor's responsibility for material furnished by the Owner must begin at the point of its delivery to the Contractor. Materials already on the site must become the Contractor's responsibility on the day of the award of the contract. The Contractor must examine all material furnished by the Owner at the time and place of delivery the Contractor and must reject all defective material. Any material furnished by the Owner and installed by the Contractor without discovery of such defects will, if found defective prior to final acceptance of the work, be exchanged for sound material by the Owner. The Contractor, however, must at its own expense, furnish all supplies, labor, and facilities necessary to remove said defective material and install the sound material in a manner satisfactory to the Owner.

4.04.03 Responsibility for Safe Storage

The Contractor must be responsible for the safe storage of material furnished by or to it, and accepted by it, and intended for the work, until the material has been incorporated in the completed project. The interior of all pipe, fittings, and other accessories must be always kept free from dirt and foreign matter. Valves and hydrants must be drained and stored in a manner that will protect them from damage by freezing.

4.04.04 Replacement of Damaged Material

Any material furnished by the Owner that becomes damaged after acceptance by the Contractor must be replaced by the Contractor at its own expense.

4.05 HANDLING OF MATERIAL

The Contractor must use care and proper equipment during the unloading and distribution of water main materials on the job site to ensure the materials are not damaged.

Pipe and/or fittings must not be rolled or skidded off the truck beds against previously unloaded materials.

4.06 ALIGNMENT AND GRADE

4.06.01 General

The water main must be laid and maintained to the required lines and grades with fittings, valves, and hydrants at the required locations and all valve and hydrant stems plumb. The water main must have a ten (10) feet horizontal separation and an eighteen (18) inch vertical separation from all sewer piping and structures.

High points must be located at hydrants.

4.06.02 Deviations Occasioned by Other Structures

Whenever obstructions not shown on the drawings are encountered during the progress of the work and interfere to such an extent that an alteration in the drawings is required, the Township has the authority to order a deviation from the line and grade or arrange with the owners of the structures for the removal, relocation, or reconstruction of the obstructions. If the change in drawings results in a change in the amount of work by the Contractor, such altered work must be done by written order only on the basis of payment to the Contractor for extra work or credit to the Owner for less work.

4.06.03 Depth of Pipe

All pipes must be laid so that the top of the pipe has a minimum cover of five (5) feet below existing grade at the water main and six (6) feet when underneath section roads, unless specified otherwise. When elevations and grades are provided on the drawings, the Contractor must install in accordance with those elevations and grades.

4.07 LAYING

4.07.01 Lowering of Water Main Material Into Trench

Proper implements, tools, and facilities must be provided and used by the Contractor for the safe and expedient completion of the work. All pipe fittings, valves, and hydrants must be carefully lowered into the trench by means of suitable tools or equipment, in such a manner as to prevent damage to water main material and protective coatings and linings. Under no circumstances may water main materials be dropped or dumped into the trench.

If damage occurs to any pipe, fittings, valves, hydrants, or water main accessories in handling, the damage must be immediately brought to the Township's attention. The Township will prescribe corrective repairs or rejection of the damaged items.

4.07.02 Inspection Before Installation

All pipe and fittings must be carefully examined for cracks and other defects while suspended above the trench immediately before installation in final position. Spigot ends must be examined with particular care as this area is the most vulnerable to damage from handling. Defective pipe or fittings must be laid aside for inspection by the Township, who will prescribe corrective repairs or rejection.

4.07.03 Cleaning of Pipe and Fittings

All lumps, blisters, and excess coating must be removed from the bell and spigot end of each pipe, and the outside of the spigot and the inside of the bell must be wire brushed and wiped clean and dry and free from oil and grease before the pipe is laid.

4.07.04 Laying of Pipe

All dirt or other foreign material must be removed from the inside of the pipe before it is lowered into its position in the trench, and it must be kept clean by approved means during and after laying. No tools or other articles must be stored in the pipe at any time.

As each length of pipe is placed in the trench, the spigot end must be centered in the bell and the pipe forced home and brought to correct line and grade. The pipe must be secured in place with approved backfill material tamped under it except at the bells. Precautions must be taken to prevent dirt from entering the joint space.

At times when pipe laying is not in progress, the open ends of the pipe must be closed by a watertight plug or other means approved by the Township. This provision must apply during the noon hour as well as overnight. If water is in the trench, the seal must remain in place until the trench is pumped completely dry.

4.07.05 Cutting of Pipe and Connections to Existing Water Mains

The Contractor must cut the pipe in a straight and uniform manner, at right angles to the axis of the pipe, wherever necessary for placing valves, fittings, or closure pieces without damage to the pipe, and without extra cost to the Owner. The cut ends of the pipe must be beveled before assembly of the joint.

The Contractor must be required to determine the requirements for safely cutting and disposing of Asbestos-Cement pipe by reviewing local, state, and federal regulations and requirements.

Connection to existing mains must be done at a time when it will least interfere with normal use of the main. The Contractor must be responsible for draining water from the closed off section of the existing main so that the connection can be made.

The Contractor must uncover existing mains at points of connection sufficiently in advance of making the connection to allow verification of the dimensions and elevation of the existing main and must make any revisions required to the fitting, or obtain special adaptors required for the connection. Existing pipelines must be adequately supported during the connection operation and prior to placement of backfill.

The Contractor must be responsible for preventing contamination of existing water mains while the connection is made. The Contractor must be responsible for any damage caused by its operations to existing mains to which the connections are being made.

4.07.06 Bell Ends to Face Direction of Laying

Pipe must be laid with bell ends facing in the direction of laying, unless directed otherwise by the Township. Where pipe is laid on a grade of ten (10) percent or greater, the laying must start at the bottom and proceed upward with the bell ends of the pipe upgrade.

4.07.07 Ductile/Cast Iron Sleeves

In connecting ductile/cast iron pipe together with a ductile/cast iron sleeve, the space between adjoining ductile/cast iron pipes must not exceed two (2) inches. Where the space between adjoining ductile/cast iron pipes exceeds two (2) inches,

a spacer must be placed to fill the space. The spacer must be a piece of ductile iron pipe of the same diameter and class as the adjoining pipe and must be cut straight and uniform and be free of defects and damage. In lieu of a spacer, the Contractor may elect to use joint restraining glands on both sides of the sleeve. If restraining glands are used, the pipe must extend into each end of the sleeve a minimum of one-third (1/3) the length of the sleeve, unless approved otherwise by the Township.

4.07.08 Tracer Wire

PVC and PVCO water main must be installed with two (2) tracer wires attached to the pipe at approximately five (5) foot intervals using tape or other suitable methods to assure that the wire is not dislocated during pipe installation and backfilling.

Wire connectors must be used for connecting strands of tracer wire and must be installed in a manner as to prevent any uninsulated wire exposure. Test stations must be supplied at ground level near the hydrant. Tracer wires must terminate at a test station at every hydrant or as directed by the Township. Tracer wires must be installed with two (2) feet of slack on either side of all connection points to the test station.

Prior to acceptance of the water main the Contractor must verify the continuity and conductivity of the tracer wire in the presence of the Township. At any areas in which conductivity and/or continuity are compromised, the contractor must excavate, repair, and retest the tracer wire at no cost to the Township. Continuity testing will involve using typical low frequency (512 HZ or similar) line locating equipment.

4.08 JOINING OF MECHANICAL – JOINT PIPE

4.08.01 General Requirements

The general requirements in Section 4.03 – 4.07 inclusive must apply except that, where the terms “bell” and “spigot” are there used, they must be considered to refer to the bell and spigot ends of the lengths of mechanical-joint pipe.

4.08.02 Cleaning and Assembly of Joint

The last eight (8) inches outside of the spigot and inside of the bell of mechanical joint pipe must be thoroughly cleaned to remove oil, grit, excess coating, and other foreign matter from the joint and then coated with a lubricant. The gasket lubricant must be NSF 61 approved, nontoxic, tasteless, and odorless, and must be as supplied or recommended by the pipe manufacturer and approved by the Township. The retaining gland must then be slipped on the spigot end of the pipe with the lip extension of the gland toward the socket, or bell, end. The rubber gasket must be coated with lubricant and placed on the spigot end with the thick edge toward the gland.

4.08.03 Bolting of Joint

The entire section of the pipe must be pushed forward to seat the spigot end in the bell. The gasket must then be pressed into place within the bell; care must be taken to locate the gasket evenly around the entire joint. The retaining gland must be moved along the pipe into position for bolting, all of the bolts inserted, and the nuts screwed up tightly with the fingers. All nuts must be tightened with a suitable (preferably torque-limiting) wrench. The torque for various sizes of bolts must conform to ANSI/AWWA C600, Standard for Installation of Ductile-Iron Mains and Their Appurtenances, as follows:

<u>Nominal Joint Size</u> Inches	<u>Bolt Size</u> Inches	<u>Range of Torque</u> Foot – Pounds
3”	5/8	45 – 60
4”-24”	¾	75 – 90
30”-36”	1	100 – 120
42”-48”	1-1/4	120 – 150

Nuts spaced 180 degrees apart must be tightened alternately to produce an equal pressure on all parts of the gland. When tightening bolts, it is essential that the gland be brought up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. This may be done by partially tightening the bottom bolt first, then the top bolt, next the bolts at either side, and last, the remaining bolts. Repeat this cycle until all bolts are within the above range of torques. If effective sealing is not attained at the maximum torque indicated above, the joint should be disassembled and reassembled after thorough cleaning. Over stressing of bolts to compensate for poor installation practice is not allowed.

4.08.04 Permissible Deflection in Mechanical-Joint Pipe

Whenever it is desirable to deflect mechanical-joint pipe to form a long radius curve, the amount of deflection must not exceed the maximum limits shown in Table 1.

TABLE 1

PERMISSIBLE DEFLECTIONS IN MECHANICAL - JOINT PIPE

Size of Pipe Inches	Max. Permissible Deflection Per Length - Inches		Approx. Radius of Curve Produced By Succession of Joints - Feet	
	18'	20'	18'	20'
3	31	35	125	140
4	31	35	125	140
6	27	30	145	160
8	20	22	195	220
10	20	22	195	220
12	20	22	195	220
14	13.5	15	285	320
16	13.5	15	285	320
18	11	12	340	380
20	11	12	340	380

4.09 JOINING OF PUSH-ON JOINT PIPE

4.09.01 General Requirements

The general requirements in Section 4.03 - 4.07 inclusive must apply except that, where the terms "bell" and "spigot" are there used, they must be considered to refer to the bell and spigot of the lengths of push-on joint pipe.

4.09.02 Cleaning and Assembly of Joint

The inside of the bell and the outside of the spigot end must be thoroughly cleaned to remove oil, grit, excess coating, and other foreign matter. The circular rubber gasket must be flexed inward and inserted in the gasket recess of the bell socket.

The thin film of gasket lubricant ,must be applied to either the inside surface of the gasket or the spigot end of the pipe or both. For plastic pipe, lubricating of the spigot end only must occur and be per manufacturer’s recommendations.

Gasket lubricant must be NSF 61 approved, nontoxic, tasteless, and odorless and must be as supplied or recommended by the pipe manufacturer and approved by the Township.

The spigot end of the pipe must be centered in the bell and forced or pushed home. Smaller sizes of pipe can be pushed or forced into place by hand; larger sizes will require the use of mechanical assistance.

The condition of the trench bottom must be such that location and position of the pipe to be joined is in a straight line assuring a joint of maximum tightness and permanent seal.

4.09.03 Permissible Deflection in Push-On Joint Pipe

Whenever it is desirable to deflect push-on joint pipe to form a long radius curve, the amount of deflection must not exceed the maximum limits shown in Table 2, unless recommended by the pipe manufacturer and approved by the Township.

TABLE 2

PERMISSIBLE DEFLECTIONS IN PUSH-ON JOINT PIPE

Size of Pipe Inches	Max. Permissible Deflection Per Length - Inches		Approx. Radius of Curve Produced By Succession of Joints - Feet	
	18'	20'	18'	20'
3	19	21	205	230
4	19	21	205	230
6	19	21	205	230
8	19	21	205	230
10	19	21	205	230
12	19	21	205	230
14	11	12	340	380
16	11	12	340	380
18	11	12	340	380
20	11	12	340	380

4.09.04 Brass Wedges

Unless otherwise specified, brass wedges will be required for all ductile iron push on joint pipe. A minimum of two wedges must be used at each joint.

4.10 SETTING OF VALVES, VALVE CHAMBERS. AND FITTINGS

4.10.01 General Requirements

Valves, fittings, plugs, and caps must be set and joined to pipe in the manner specified above for cleaning, laying, and joining pipe.

4.10.02 Location of Valves

Valves in water mains must, where possible, be located on the street property lines extended unless shown otherwise on the drawings.

4.10.03 Valve Boxes and Valve Chambers

A valve box or a precast concrete valve chamber must be provided for every valve.

A valve box must be provided for every valve that has no gearing or operating mechanism or in which the gearing or operating mechanism is fully protected with a cast-iron grease case. The valve box must not transmit shock or stress to the valve and must be centered and plumb over the wrench nut of the valve, with the box cover flush with the surface of the finished pavement or such other level as may be directed.

To provide sand infiltration protection, the Contractor must wrap four (4) ounce per square yard geotextile fabric around and under the valve and box. Joints of the fabric must be taped.

Valve chambers must have a concrete base placed on a minimum of four (4) inches of pea gravel with full and even bearing. Grade rings must be mortared and tooled. At wall sections, joints must be completely mortared and troweled. The valve nut must be readily accessible for operation through the opening in the manhole.

The valve box lid and valve chamber lids must be at finished grade for permanent pavement and lawn areas and for non-pavement and non-lawn areas. Aggregate areas must have the valve box four (4) to six (6) inches below finished grade.

4.10.04 Dead Ends

All dead ends on new mains must be equipped with fire hydrants. Dead ends must incorporate at minimum twenty (20) feet of restrained Class 52 ductile iron pipe.

4.11 SETTING OF HYDRANTS

4.11.01 Location

Hydrants must be located as shown or as directed to provide complete accessibility and minimize the possibility of damage from vehicles or injury to pedestrians.

When placed behind the curb, unless otherwise directed, the hydrant barrel must be set so that no portion of the pumper or hose nozzle cap will be less than two (2) feet from the face of the curb.

When set in the lawn space between the curb and the sidewalk, or between the sidewalk and the property line, no portion of the hydrant or nozzle cap must be within six (6) inches of the sidewalk.

On permanent dead-end roads, hydrants need at least twenty (20) feet of restrained Class 52 ductile iron pipe and to be the same size as the main line.

Hydrants must be spaced with a minimum of two feet six inches (2'6") spacing from the center of the hydrant valve to the center of the hydrant.

4.11.02 Position

All hydrants must stand plumb and must have their nozzles parallel with, or at right angles to, the curb, with the pumper nozzle facing the curb. Hydrants must be set to the established grade, with nozzles a minimum of twenty-seven (27) inches above the street centerline grade and a minimum of twenty-one (21) inches above the ground at the hydrant, unless otherwise directed by the Township.

The Township requires crushed stone (5/8") bedding around the hydrant per the details.

4.11.03 Connection to Main

Each hydrant must be connected to the main with a six (6) inch ductile iron branch controlled by an independent six (6) inch gate valve, unless otherwise specified.

4.11.04 Hydrant Drainage

All hydrant weep holes must be unplugged unless otherwise directed by the Township and must be constructed per the detail in these specifications. Crushed stone (5/8") must be used for hydrant bedding and for drainage.

4.12 ANCHORAGE

4.12.01 Restrained Joint Pipe – Ductile Iron

All ductile iron restrained joint pipe must be McWane Ductile TR Flex; American Ductile Iron Pipe "Lok-Ring Joint" or "Flex-Ring Joint"; or approved equal. All components of the restrained joint must be as manufactured, supplied, or recommended by the manufacturer of the restrained joint pipe system installed.

4.12.02 Joint Restraint Devices – Ductile Iron and PVC

Joint restraining glands must be EBAA Iron Sales “Megalug”, Ford “Uniflange Series 1400”, Tyler Union “Tuf-Grip Series 1000” or approved equal. Joint restraining glands must not be used to provide restraint to plain end fittings.

For ANSI/AWWA C900 pipe, the EBAA Iron Inc. Series 2000PV Mechanical Joint Restraint. For ANSI/AWWA C909 PVC pipe, the EBAA Iron Inc. Series 19MJG00 Mechanical Joint Restraint must be used.

For ANSI/AWWA C900 and C909 in line pipe restraint, restraint must be the EBAA Iron Inc. Series 1900 Restraint Harness or approved equal. The in line pipe restraint must be encased in a seamless polyethylene tube.

4.12.03 Mechanical Joint Anchoring Fittings

Mechanical joint anchoring fittings must be as manufactured by Tyler Corporation or approved equal.

4.12.04 Anchorage for Hydrants

All hydrants must be restrained to the hydrant lateral valve, and the hydrant lateral valve must be restrained to the main using an approved joint restraint system consisting of restrained joint pipe, joint restraining glands, mechanical joint anchoring fittings, or approved equal.

4.12.05 Anchorage for Plugs, Caps, Tees, Bends and Valves

Unless otherwise specified or approved by the Township, movement of all plugs, caps, tees, bends, and valves must be prevented by use of restrained joint pipe or joint restraining glands. When joints are to be restrained with mechanical devices as noted above, all joints must be restrained for a minimum distance from the fitting as required in the following table (pipes larger than twenty (20) inch must have restraint as shown on the drawings).

Thrust blocks and tie rods will only be allowed if no other method is possible according to the Township

The use of joint restraining glands to provide restraint to plain end fittings is not an acceptable means of restraint and will not be allowed.

PIPE RESTRAINT LENGTH REQUIRED, FEET*

Pipe Diameter	Tees, 90° Bends	45° Bends	22-1/2° Bends	11-1/4° Bends	Dead Ends	Reducers (one size)	**
4"	33	13	7	3	82		
6"	46	19	9	4	117	61	90
8"	59	24	11	6	149	61	79
12"	83	34	17	9	213	114	172
16"	106	44	21	10	275	117	157
20"	127	53	26	13	333	117	149

**If straight run of pipe on small side of reducer exceeds this value, then no restrained joints are necessary.

NOTE: The length of restrained joint pipe required as shown in the table above is based on trench backfill being compacted to 95% of maximum unit weight in accordance with MDOT procedures.

All joints lying within the above minimum distances from the fitting must be restrained as noted herein.

Tees: Tees must be restrained in the branch direction as required in the table above. Also, to augment the above, in the straight through direction, the minimum length of the first pipe on either side of the tee must be ten (10) feet. In those cases where a valve is placed at the tee, the valve must be restrained to the tee as noted below, and the next pipe must be a minimum length of ten (10) feet.

Plugs/Caps: All dead ends on water mains must be plugged or capped with standard plugs or caps. The water main, including the plug or cap must be restrained back from the plug or cap as required in the table above for dead ends.

Bends: Bends must be restrained in both directions as required in the table above.

Valves: Valves used in conjunction with restrained joint pipe must be restrained in accordance with the recommendations of the manufacturer of the restrained joint pipe. All valves at crosses or tees must be restrained to the tee by use of restrained joint pipe or joint restraining glands as specified above. Hydrant valves may be restrained using mechanical joint anchoring fittings.

Unstable Soils: Secure all fittings with restrained joint pipe or joint restraining glands throughout entire area of muck plus an additional length beyond the muck area in suitable soils for a distance in accordance with this section.

4.12.06 Reaction Backing (Thrust Blocks)

Reaction backing (thrust blocks) must be used only at locations indicated on the Drawings or approved by the Township.

Reaction backing must be poured-in-place concrete having a compressive strength of not less than 2,000 psi after twenty-eight (28) days. Backing must be placed between solid, undisturbed ground and the fitting to be anchored. The area of bearing on the pipe and on the ground in each instance must be that shown in the table below or directed by the Township. The backing must, unless otherwise shown or directed, be so placed that the pipe and fitting joints will be accessible for repair. Concrete must not be allowed to be placed around joint restraint devices. If concrete will be placed around fittings, the fittings and joints must be wrapped in polyethylene encasement per section 4.02.07.

REACTION BACKING

Minimum Bearing Area against undisturbed trench wall, in square feet, for sand is indicated in the table below. Details of placement are shown in Standard Details.

Pipe Size	Tees, Plugs, Wyes, 45 Elbows	Hydrants, 90 Elbows	Wyes, 22-1/2 Elbows or Less
6"	3	3	1
8"	4	6	2
10"	7	9	3
12"	9	11	3
16"	13	20	6
20"	20	28	8

Other Soil Conditions

Cement Sand or Hardpan	-	multiply above by 0.5
Gravel	-	multiply above by 0.7
Hard Dry Clay	-	multiply above by 0.7
Soft Clay	-	multiply above by 2.0

4.13 WATER MAIN CONNECTIONS

4.13.01 General

Connections to existing water mains may require special fittings, and it is the responsibility of the Contractor and Owner to ensure a proper connection occurs. Temporary support must be provided, and all pipe and fittings being connected must be disinfected by swabbing pipe, valves, and/or fittings with a 4 percent chlorine solution. Salvaged materials during the connection operation must be delivered to the Township's storage yard.

4.13.02 Watermain Shutdown

If connection can occur while the water main is shutdown, the Contractor must install a solid or cutting-in sleeve with the necessary required fittings. Approval from the Township must be granted for a connection to occur during a water main shutdown.

4.13.03 Watermain Live Tap

The live tapping procedure must occur in accordance with Section 823.03G of the 2020 MDOT Standard Specifications for Construction. The Contractor must utilize the Township's approved subcontractor for live-tapping. The Contractor will be responsible for payment of the live tap. Field verification of the existing water main configuration will be required ahead of the tap. Tapping location new water main must have 36 inches of spacing or greater from the nearest joint.

4.14 HYDROSTATIC TEST

4.14.01 Procedure

All tests must be made by the Contractor using its own equipment, operators, and supervision, in the presence of the Township or its duly authorized representative. The length of the section to be tested must be as approved by the Township, or as shown on the drawings. The test must not be against an existing valve unless written permission is obtained from the water system operator. In no case must a test be made against an existing valve that is found to be leaking or otherwise defective. Testing must be in accordance with AWWA C600.

Contractor may coordinate with the Township to use water. The Township may have a meter fee and other fees for water usage that will be billed to the Contractor. Contractor will be billed for the difference after total water use has been determined.

The Contractor must provide their own Reduced Pressure Zone (RPZ) Backflow Preventer as approved by the Township.

Temporary fittings needed for testing, the meter supply fee, and the water usage fee must be included in the major items of work and will not be paid for separately.

4.14.02 Air Removal Before Test

Before applying the specified test pressure, all air must be expelled from the pipe. If permanent air vents are not located at all high points, the Contractor must install corporation cocks at such points so the air can be expelled as the line is filled with potable water. After all the air has been expelled, the corporation cocks must be closed, and the test pressure applied.

4.14.03 Leakage Test

A leakage test must be conducted during the hydrostatic pressure test in the presence of the Township. The Contractor must furnish the pump, pipe, connections, gages, and all other necessary apparatus, and must furnish the necessary assistance to conduct the test. The duration of the test must be a minimum of 2 hours, and during the test the main must be subjected to a pressure of 150 psi. When several valved sections are tested as one test, the maximum allowable leakage will be equivalent to the calculated allowable leakage for the smallest valved section therein.

Leakage must be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain the specified leakage test pressure after the air in the pipeline has been expelled, and the pipe has been filled with water. No pipe installation will be accepted if the leakage is greater than that determined by the formula:

$$L = \frac{SD\sqrt{P}}{148,000}$$

Where:

L = Allowable leakage, in gallons per hour

S = Length of pipe tested, in feet

D = Nominal diameter of the pipe, in inches

P = Average test pressure during the leakage test, in pounds per square inch (gage).

This formula is based on allowable leakage of 10.49 gallons per day, per mile of pipe, per inch of nominal diameter at 150 psi.

The Township will furnish a written report of the results of the leakage test that identifies the specific length of pipe tested, the pressure, the duration of the test, and the amount of leakage.

4.14.04 Variation from Permissible Leakage

If any test of pipe laid discloses leakage greater than that specified above, the Contractor must at its own expense locate and repair the leaks until the leakage is within the specified allowance. All visible leaks are to be repaired regardless of the allowance used for testing.

4.14.05 Time for Making Test

The pipe may be subjected to hydrostatic pressure and inspected and tested for leakage at any convenient time after the trench has been partially backfilled. Where any section of the main is provided with concrete reaction backing, the hydrostatic pressure test must not be made until at least seven (7) days have elapsed after the concrete was installed. If high-early-strength cement is used in the concrete reaction backing, the hydrostatic pressure test will not be made until at least two (2) days have elapsed.

4.15 CLEANING AND DISINFECTING

4.15.01 Flushing Water Main

The water main and services three (3) inch diameter and larger must be flushed by providing taps in sufficient size or number to provide a velocity of three (3) feet per second in the line being flushed. Hydrants may be used providing the requirements listed below are met.

4.15.01.01 Procedure

The Contractor must submit to the Township a procedure schedule outlining the method he proposes to use for flushing water mains. Mains must be flushed at a maximum of 1/4-mile intervals.

4.15.01.02 Time for Flushing

Flushing may be done prior to hydrostatic pressure testing or following hydrostatic pressure testing, but, in any case, prior to chlorination of the water main.

4.15.02 Chlorination

All newly laid lines must be chlorinated. The Contractor must furnish all necessary equipment and materials and must furnish all necessary assistance for effective disinfection of the water mains. Chlorination must be accomplished by using the following general procedure.

4.15.02.01 Procedure

Disinfection must be in accordance with AWWA C651. After the water main has been pressure tested and flushed, the Contractor must employ one of the following methods to disinfect the new water main:

Continuous Feed Method: the potable water must be chlorinated so that after a 24-hour holding period in the main, a free chlorine residual of not less than 10 ppm (mg/L) exists in the main.

Slug Method: the water entering the new main must receive a dose of chlorine fed at a constant rate such that the water will have not less than 100 ppm (mg/L) free chlorine. The chlorine must be applied continuously and for a sufficient period to develop a solid column, or slug, of chlorinated water that will, as it moves through the main, expose all interior surfaces (including fittings, valves, hydrants, and other appurtenances) to a concentration of approximately 100 ppm for at least three (3) hours.

The free chlorine residual must be measured in the slug as it moves through the main. If at any time it drops below 50 ppm, the flow must be stopped; chlorination equipment must be relocated at the head of the slug; and, as flow resumes, chlorine must be applied to restore the free chlorine in the slug to not less than 100 ppm.

The amount of chlorine required for each 100 feet of pipe of various diameters to produce 50 ppm chlorine solution is as follows:

Pipe Sizes (Inches)	100 Percent Chlorine (lb.)	16% Bleach (gal.)
6	0.062	0.046
8	0.110	0.081
10	0.171	0.128
12	0.247	0.18
16	0.439	0.313
24	0.987	0.737
30	1.542	1.100

4.15.02.02 High Test Calcium Hypochlorite

("HTH", "Perchlora", "Pittchlor"). Prepare a ten-thousand-parts-per-million solution in water and pump at a constant rate into the water main while bleeding off the water at the extreme end. The bleed rate will determine the feed rate of the chlorine to arrive at a 50 to 100 ppm solution in the water main.

4.15.02.03 Liquid Chlorine

Liquid chlorine may be applied to the water main much the same way as the hypochlorite solution listed above. The rate of application will have to be adjusted for the degree of concentration of the liquid chlorine.

4.15.02.04 Point of Application

The chlorinating agent must be applied at the supply end of the line through a corporation cock. The water for injecting the chlorine into the new main may be taken from the pressure side of the isolation valve or by utilizing a pressure pump. Care must be exercised to prevent any of the strong chlorine solution from entering existing water mains.

4.15.02.05 Retention Period

The chlorinated water must be retained in the new water main according to the requirements of AWWA C651 described in Section 4.14.02.01 of this Specification. The chlorinated water in the new main must be retained for a period not to exceed 24 hours. In cases where a shorter retention period is necessary, a stronger solution may be used and the retention period reduced accordingly. For these stronger solutions, the approval of the Township must be secured in writing as to the length of retention time in relationship to chlorine strength.

While the chlorine solution is in the line, the Contractor must operate valves and hydrants in the chlorinated section to ensure the complete disinfection thereof.

4.15.02.06 Flushing and Testing

The chlorinated water must be flushed from the main, fittings, valves, branches, and hydrants at the end of the retention time so that the entire line is clear of any residual chlorine. The environment to which the chlorinated water is to be discharged must be inspected. If the chlorinated discharge could cause damage to the environment, a neutralizing chemical must be applied to the water to thoroughly neutralize the residual chlorine.

A sample must then be taken from the line in the presence of the Township. Samples must be taken for every 1,200 feet of water main installed, and the end of the line, and from each branch. The Township will deliver the sample(s) to a laboratory for bacteriological analysis. If the water sample(s) does not pass this bacteriological test, the chlorination procedure outlined above must be repeated until the quality of water is substantially the same as that being delivered from the existing distribution system. The test procedure must be repeated until two consecutive safe results are obtained at each location as required by the Michigan Department of Environmental Quality. The two samples must be taken 24 hours apart. The main must be re-chlorinated after two (2) failed consecutive tests, whether the test fails at a different sample point or not.

Testing must be coordinated with laboratory schedules for holidays and weekends.

4.16 WATER MAIN SERVICES

4.16.01 Line and Grade

Alignment must be at right angles to the street centerline. All services must be installed with a minimum earth cover of five (5) feet, without exception. In no case must the maximum earth cover exceed seven (7) feet.

4.16.02 Installation

Tapping must occur at 45 degrees above center and provide horizontal loop to corporation stop. Tapping location for services must have 24 inches of spacing or greater from the nearest joint. Tapping of the mains must be made under pressure with a tapping machine similar to Hays No. B-1, or Mueller B-100. Drilling through service clamps, saddles or welded couplings must be performed with a machine similar to Mueller D-5. All taps must be made in a dry trench. The cost of dewatering will be considered incidental.

All disturbed polywrap/coatings must be repaired/replaced to provide the required protection to the mainline watermain.

Unions/couplings are not allowed to be used unless previously approved by the Township.

Service lines must be jacked or bored across pavements. No pavement must be cut or removed without permission by the Township and the Road Commission in which the service is located. Water services must be installed in the same trench as the sanitary lateral and must be installed five (5) feet minimum away from the lateral.

MAXIMUM TAP SIZE (IN INCHES) BASED ON PIPE DIAMETER (IN INCHES)

TYPE OF PIPE TAP	PIPE DIAMETER								
	6	8	10	12	14	16	18	20	24
Cast Iron Cl 22 (Direct)	0.75	1	1.25	2	2	2	2	2	2
Ductile Iron Cl 52 (Direct)	1	1	1.25	2	2	2	2	2	2
Asbestos-Cement Cl 150 (Direct)	Not Allowed			1	1	1	1	1	1
PVC (Direct)	Not Allowed								
All Pipe (w/ dbl strap service saddle)	1.5	2	2	2	2	2	2	2	2

4.16.03 Curb Stop and Curb Box

Curb stop and curb boxes must be plumb with the curb box lock. Location must be within the right-of-way at 32.5 feet off of centerline. The curb box and stop must be wrapped with 30 inch x 30 inch geotextile fabric and must have a brick installed underneath the curb stop for support.

Within easements the curb box must be set within six inches (6) of the edge of easement or as designated by the Township.

When water services are replaced to the curb box as part of the project or when damaged by the Contractor, the Contractor must make sure that the curb boxes are cleaned and properly adjusted in accordance with Township standards. If the curb box is damaged by the Contractor, the Contractor must replace the curb box at the Contractor's expense.

4.17 FIRE SERVICE

A fire service live tap must be performed by the township's approved contractor. Should the fire service be used for domestic supply, there must be an isolation valve after the domestic connection. The main must be constructed from the water main materials as described in section 4.02 with the exception that within twenty (20) feet of the building, the pipe must be Class 52 ductile iron pipe as detailed in section 4.02.01.

4.18 RECORD DRAWING AND WITNESSING

4.18.01 Witnessing

A 2x2 hardwood or 2x4 treated witness markers must be used to mark the following locations in the field: end of service line and water line extended, valve box, valve chamber, curb box, and bends. The witness marker must be extended three (3) feet below to three (3) feet above finished grade.

4.18.02 Record Drawing Submittals

See Sections 1.06, 1.08, and 1.12.07 for more information on record drawing submittal requirements. Below are the individual requirements for record drawings for all water main construction. Records from the Contractor will be provided every Friday to the Township.

4.18.02.01 Valve, Fittings, and Hydrant Drawings

Dimensioned drawings detailing valves, hydrants, and fittings locations must be included on the record drawings.

4.18.02.02 Connection to Existing Water Main

Details will be required for connecting into the existing water main.

4.18.02.03 Water Main and Service Line Witnesses

Witnesses are defined as horizontal measurements to 3 permanent surface features. For water services, curb stop box and chamber witnesses must be reported on the record drawing. One of the witnesses must be to each lot's property corner. For water mains, the end of water main and fittings for future extension must be witnessed and reported on record drawings. Mainline and hydrant valve boxes must be witnessed and reported on the record drawings. Location of 45-degree bends must be witnessed and reported on the record drawings. Tap locations must be witnessed and reported on the record drawings.

4.18.02.04 Field Information Required

Type of pipe and a list of materials must be reported on the record drawings. Clearances between utilities must also be reported on the record drawings.

4.19 MEASUREMENT AND PAYMENT

4.19.01 General

All proposed construction will be measured for payment by the Engineer in accordance with the items listed in the proposal. If work is not indicated in the proposal, it must be considered included in the major items of work for water main installation.

The unit price bid for each proposal item will be payment in full for completing the work, ready for use as specified.

Removal of existing water main and appurtenances must be considered incidental to other major items of work unless otherwise noted and provided for by specific proposal items.

All labor, materials, and costs associated with excavation, bedding, and backfill for water main items must be included in the price of those items unless otherwise noted and provided for by specific proposal items.

All labor, materials, and costs associated with flushing, chlorination, and testing must be considered incidental to other major items of work unless noted otherwise.

4.19.02 Water Main

Measurement of the length of the main will be in feet along the centerline of the main through any fittings along the length being measured and must include any joint restraint or polyethylene encasement required.

Tracer wire/test stations must be considered incidental to water main.

4.19.03 Hydrants

Hydrants will be measured as single units including all connective piping, and joint restraint required to bring the hydrant to proper grade. Cost of the branch pipe must be incidental to the cost of installing the hydrant.

Hydrant extensions will be measured by the vertical foot. Valve box extension will be considered incidental to hydrant extension.

Salvage and reset hydrant will be counted as a unit and paid for by the unit.

4.19.04 Fittings

Fittings such as bends, tees, crosses, plugs, reducers, and sleeves will be measured as single units and must include any joint restraint required.

Salvage fitting will be counted as a unit and paid for by the unit.

Salvage fitting and reuse will be counted as a unit and paid for by the unit unless indicated otherwise in the proposal.

When no proposal item is provided, the work must be incidental to the major items of work.

4.19.05 Valves

Valves will be measured as single units and must include valve box, joint restraint, and other materials as required for installation of the valve and valve box.

Valve chambers will be counted as the unit and must include the joint restraint, the valve chamber, the casting, and other materials required for installation of the valve and the valve chamber.

Salvage and reset valve and box will be counted as a unit and paid for by the unit.

4.19.06 Taps

Tapping sleeve, tapping valve, and box will be counted as a unit and paid for by the unit.

4.19.07 Thrust Block

Thrust blocks will be measured as single units and must include removal of existing thrust blocks.

When no proposal item is provided, the work must be considered part of the major items of work.

4.19.08 Water Services

Measurement of the length of the service will be in feet along the centerline of the service through any fittings along the length being measured.

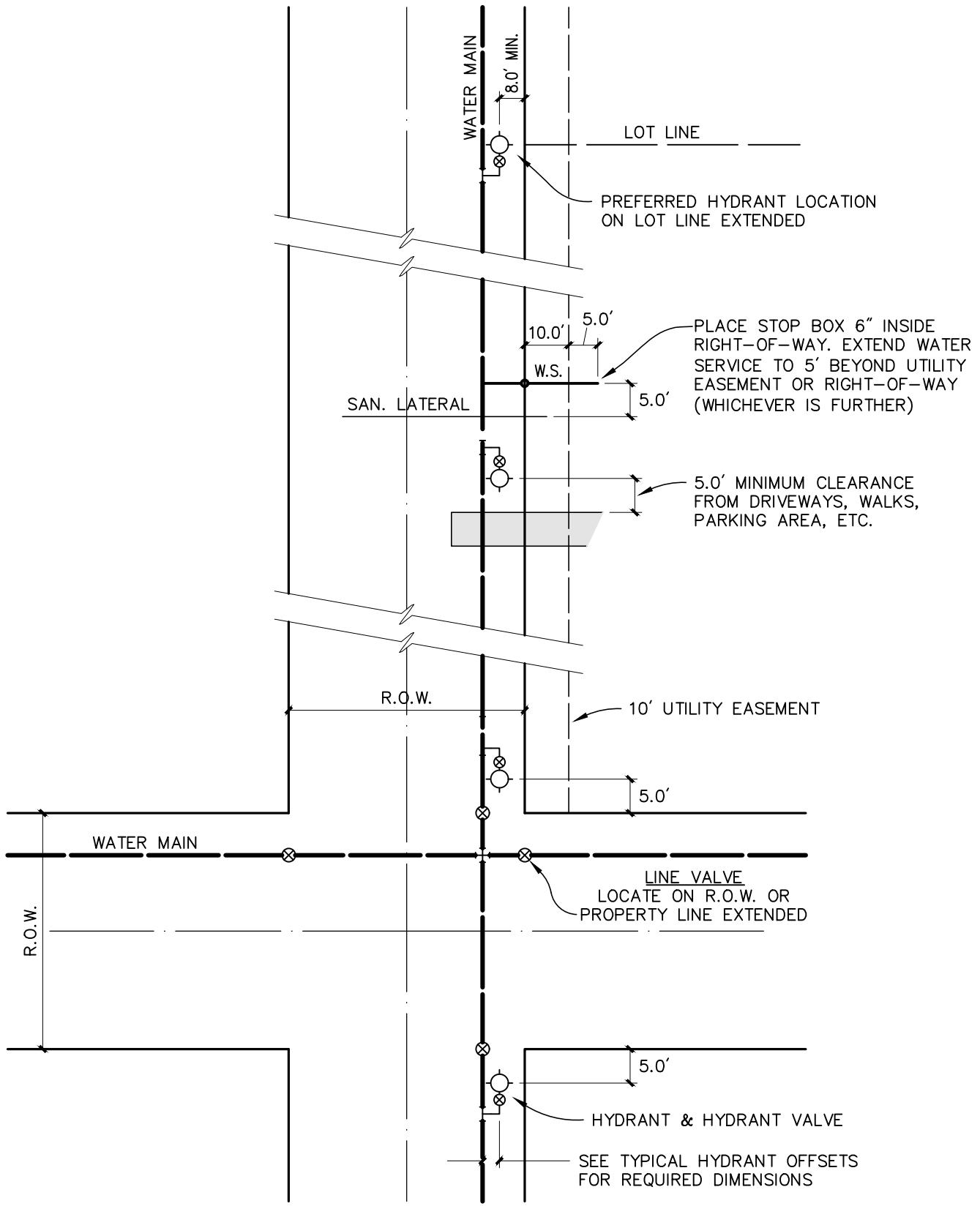
Corporation Stops will be measured in single units and include the tap of the water main and the double strap service saddle.

Curb Stops will be measured in single units and include the stop box.

4.19.09 Other

Salvage plug and connect to existing water line will be counted as a unit and paid for by the unit.

Access structures will be counted as a unit and paid for by the unit.

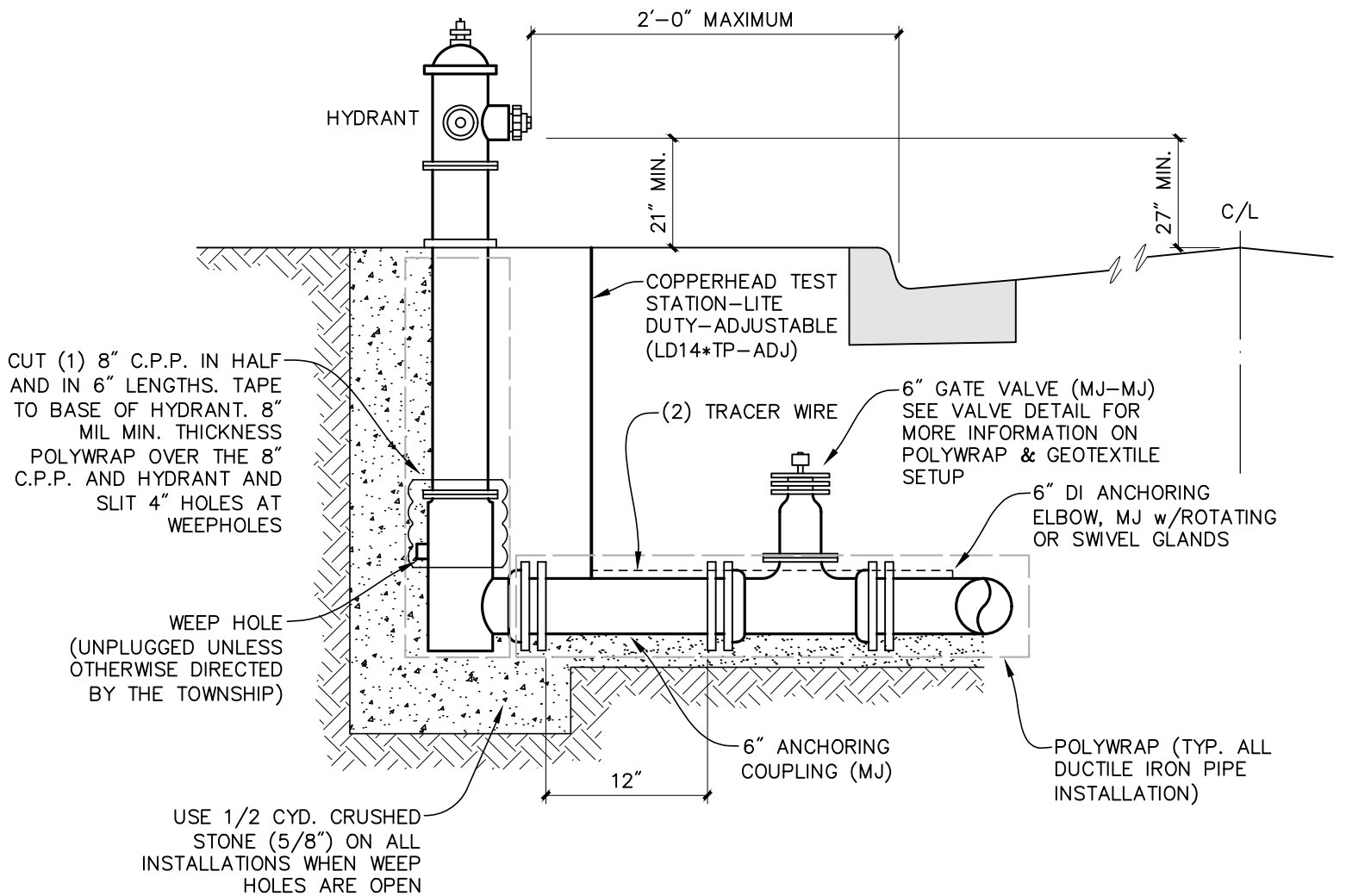


VALVE & HYDRANT LOCATIONS

SCALE : NONE

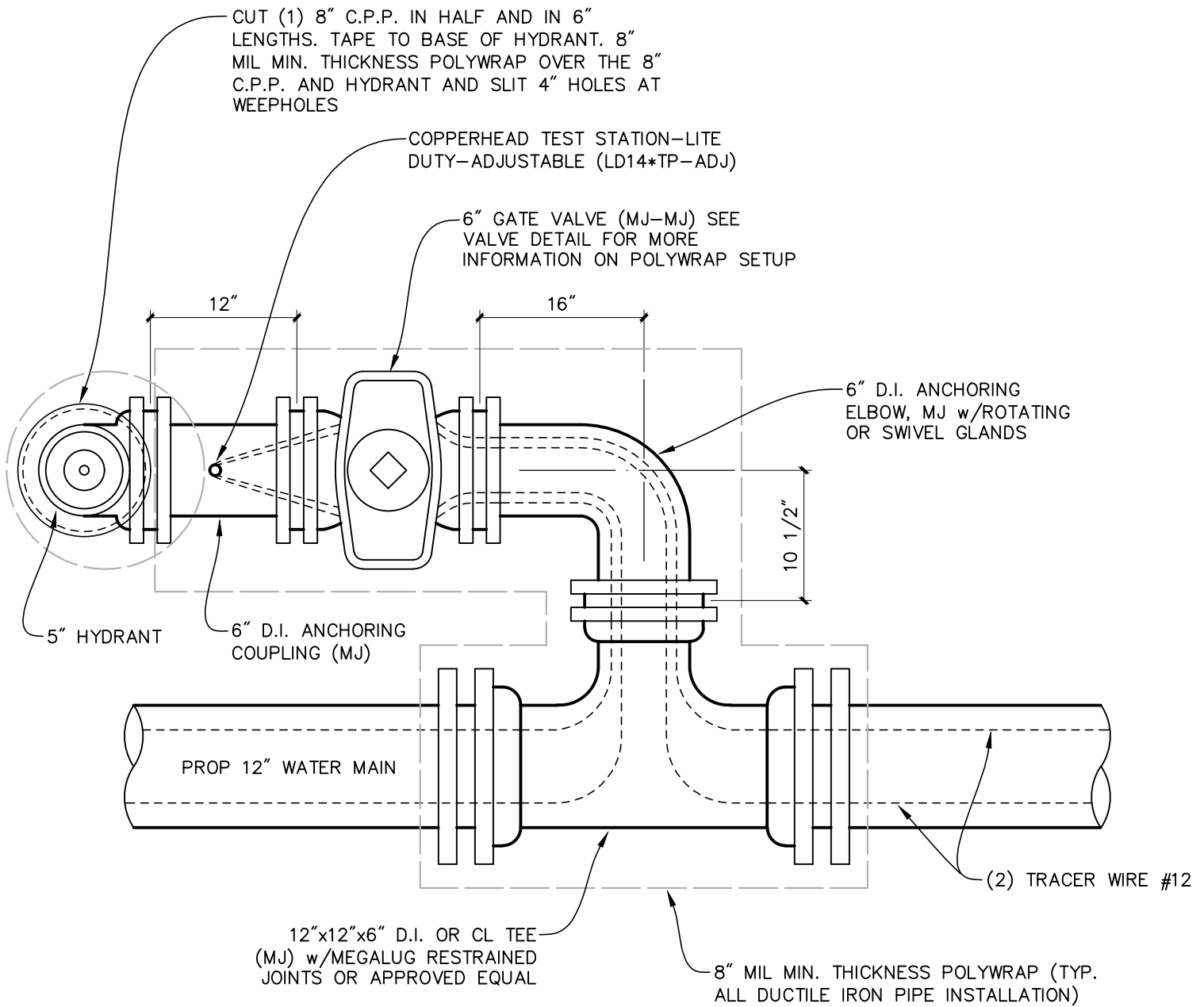
NOTE

WATER MAIN SIZE AND LOCATION SHALL BE INDICATED ON CONSTRUCTION DRAWINGS



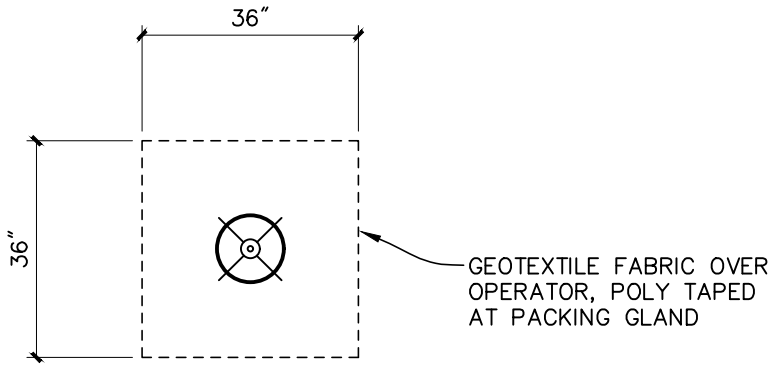
HYDRANT DETAIL

SCALE : NONE

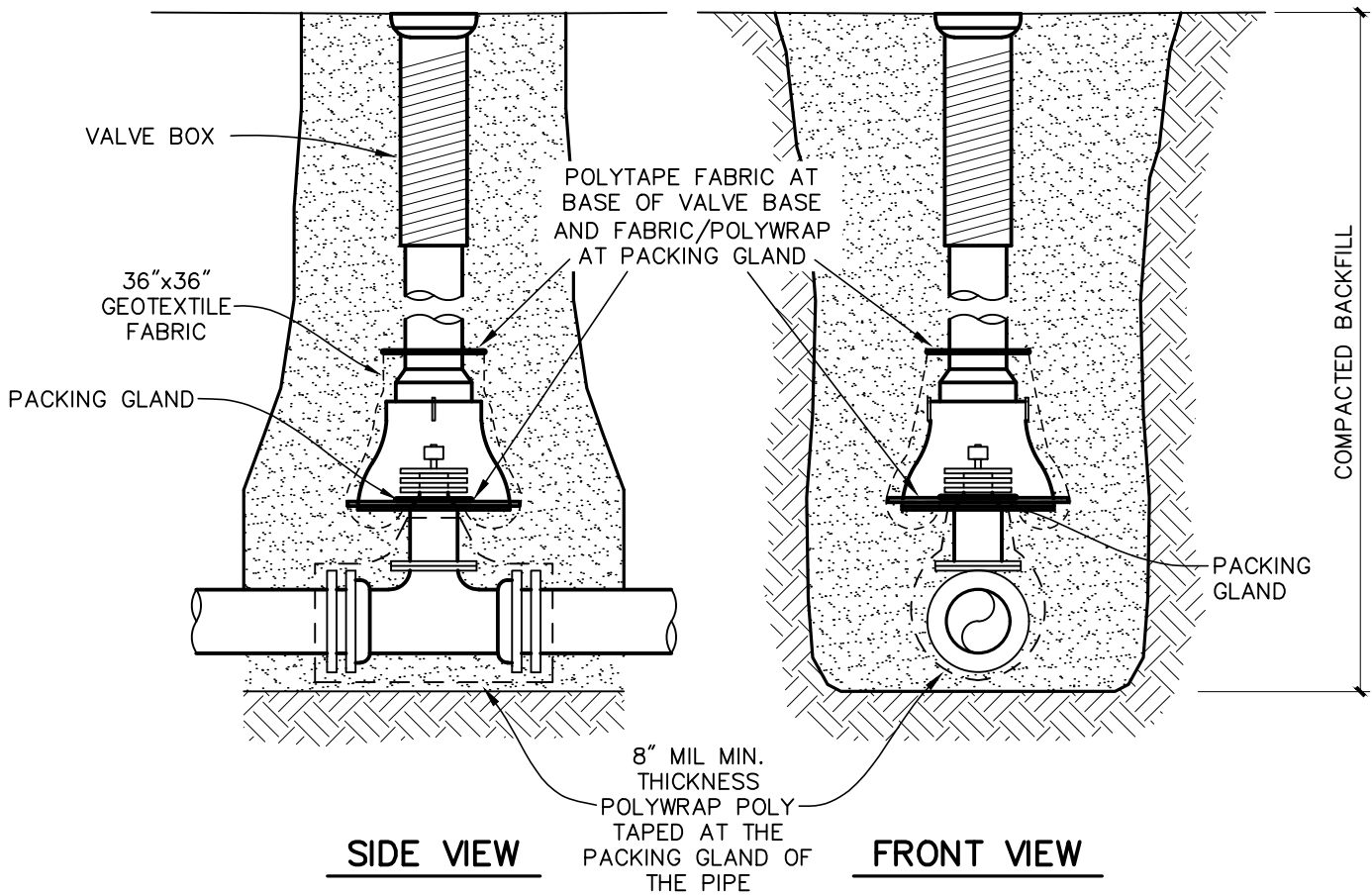


HYDRANT ASSEMBLY

SCALE : NONE



TOP VIEW



SIDE VIEW

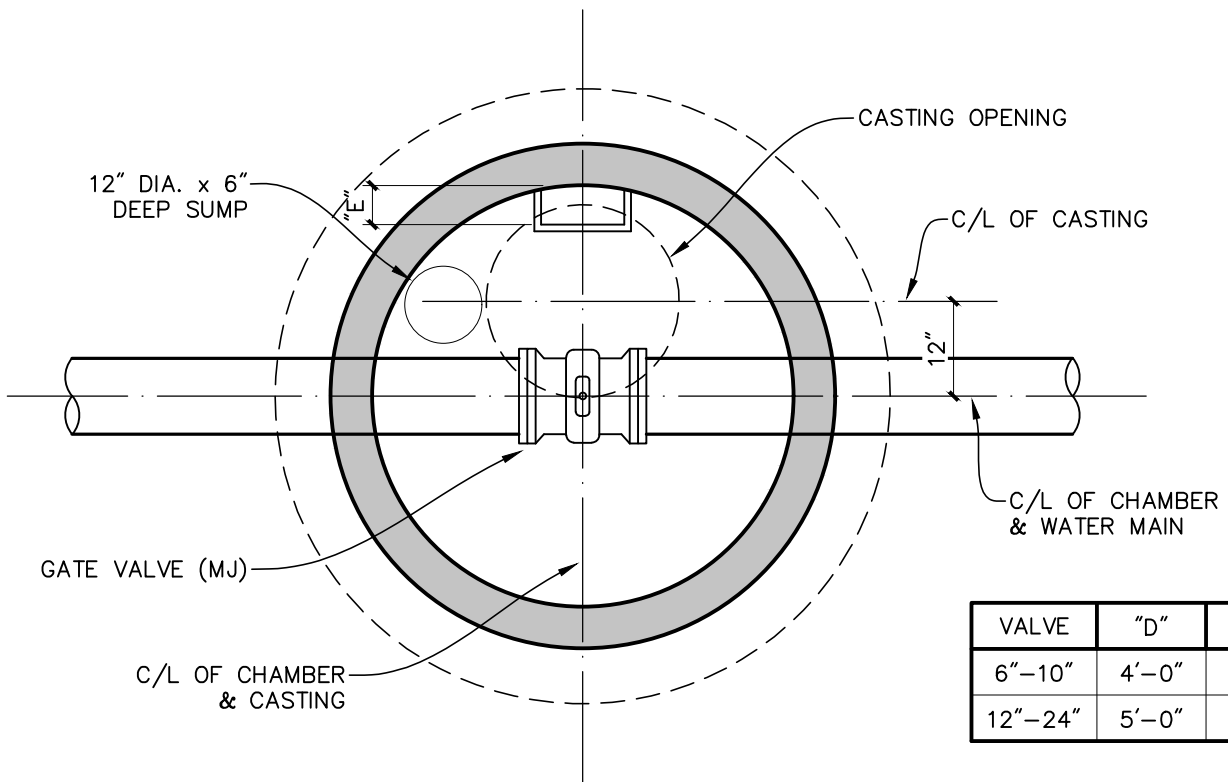
FRONT VIEW

VALVE & BOX FOUNDATION

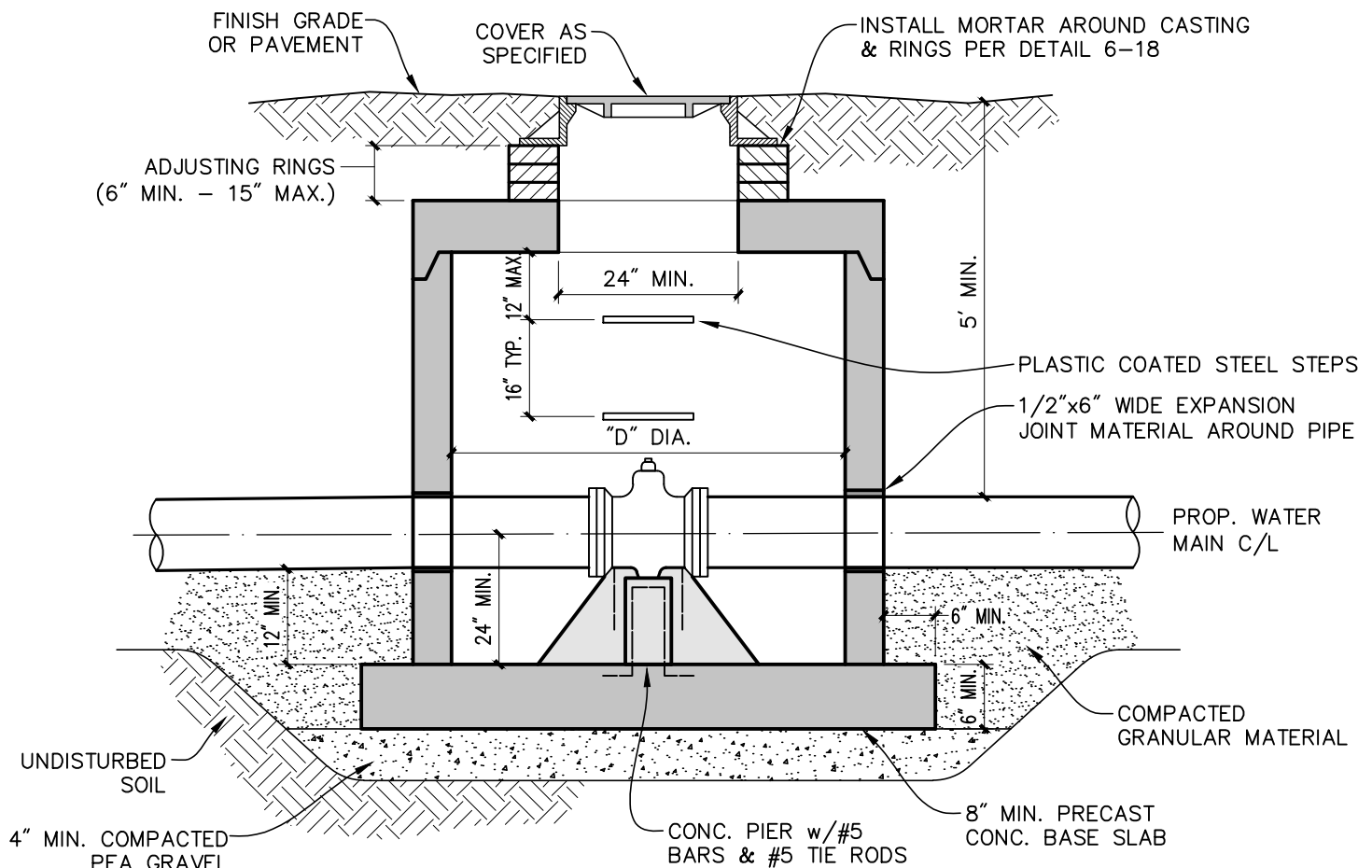
SCALE : NONE

NOTE

VALVE BOX AND SUPPORTS SHALL NOT BE IN CONTACT WITH VALVE OR PIPE. MAINTAIN MINIMUM 2" CLEARANCE.



VALVE	"D"	"E"
6"-10"	4'-0"	5"
12"-24"	5'-0"	3"

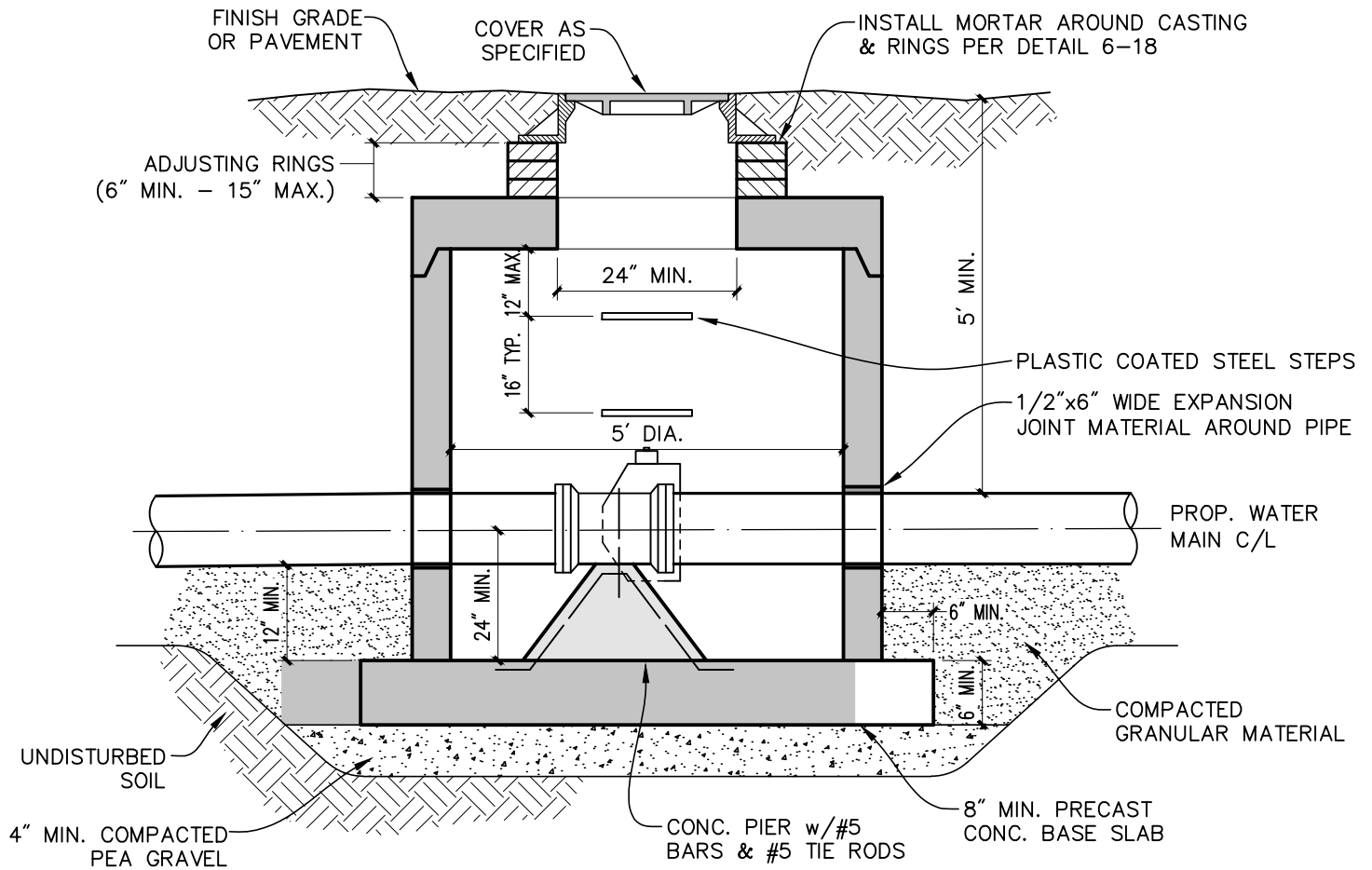
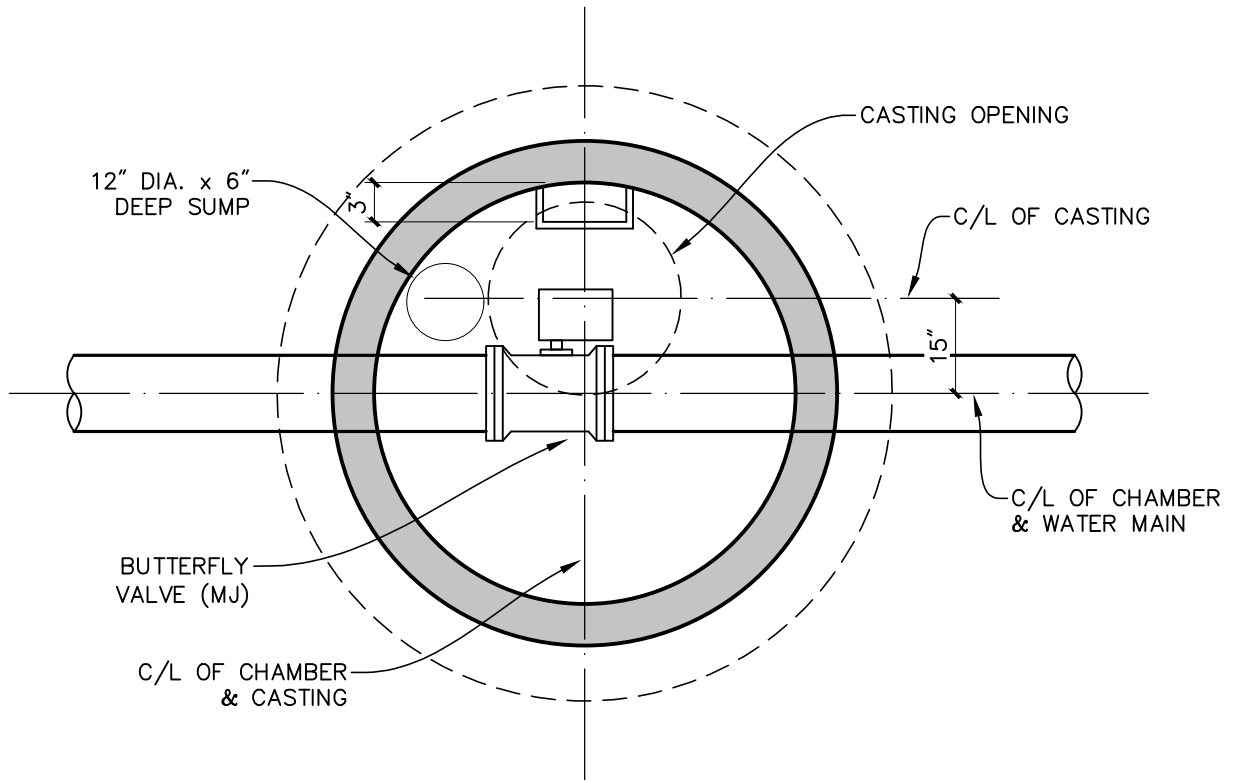


STANDARD GATE VALVE CHAMBER

SCALE : NONE

NOTE

SET ON MINIMUM 4" PEA GRAVEL (CIP) WRAPPED IN GEOTEXTILE FABRIC.

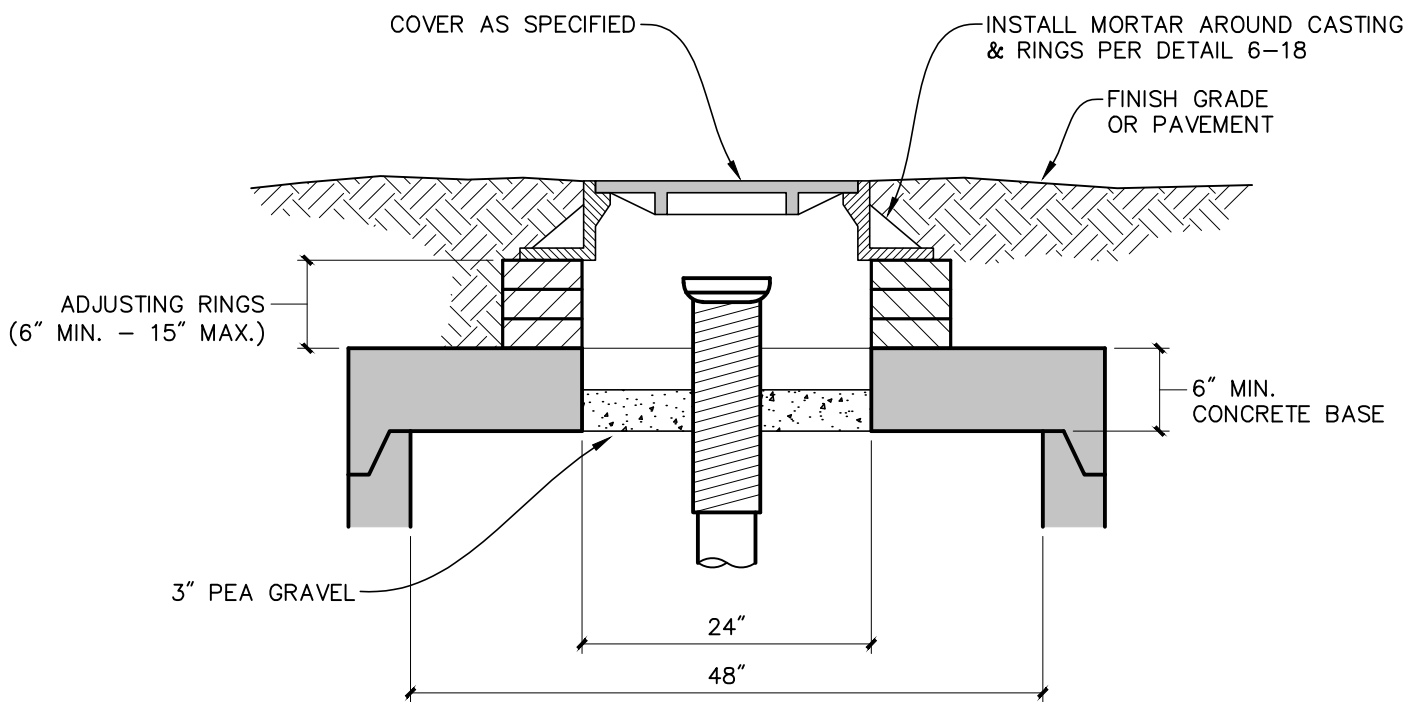


STANDARD 12"–24" BUTTERFLY VALVE CHAMBER

SCALE : NONE

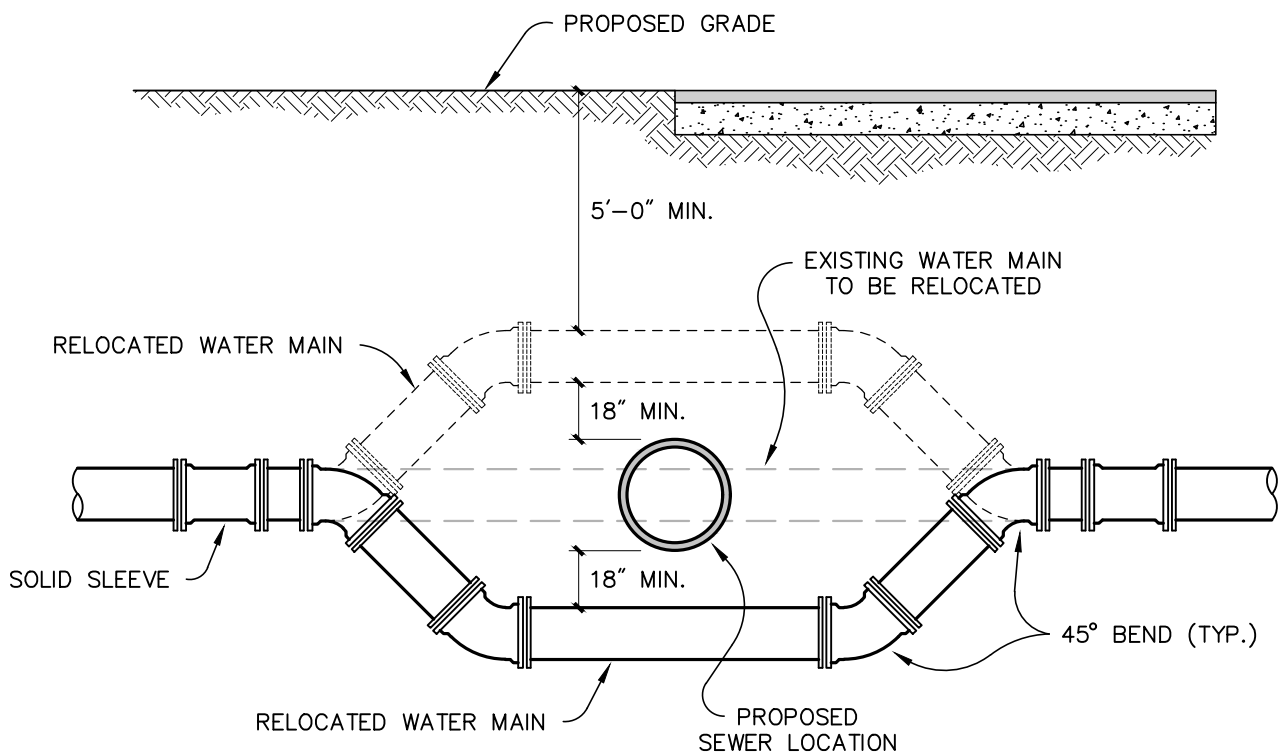
NOTE

SET ON MINIMUM 4" PEA GRAVEL (CIP)
WRAPPED IN GEOTEXTILE FABRIC.



ACCESS STRUCTURE

SCALE : NONE



WATERMAIN RELOCATION DETAIL

SCALE : NONE

NOTE

WHEN THE MINIMUM CLEARANCE AND COVER CAN BE OBTAINED, THE WATER MAIN IS TO BE RELOCATED ABOVE THE SEWER WITHOUT CREATING A NEW HIGH POINT