

**CITY OF KALAMAZOO
DEPARTMENT OF
PUBLIC SERVICES**

WATER RESOURCES DIVISION



PUBLIC SERVICES DEPARTMENT

WATER RESOURCES DIVISION
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**Standard Specifications for
Water Main and Service Installation
2021**



WATER MAIN AND WATER SERVICES

PART 1 GENERAL

1.01 SCOPE

- A. This Section includes furnishing and installing water main systems.
- B. Reconnection of proposed water main and/or water service connections to existing water main and/or water service constructions shall be in conformance with requirements of this Section.
- C. This Section shall include furnishing, excavating, installing, testing, disinfecting, and backfilling all required water main pipe, water service pipes, water main appurtenances, water service, and other work incidental to the water main and/or water service installation unless specifically included under other Items.
- D. This work shall also consist of providing as-constructed plans of the completed work.

1.02 SUBMITTALS

- A. Submittals shall be the responsibility of the Contractor:
 - 1. Shop Drawings for Review:
 - a. Manufacturer's Shop Drawings indicating physical dimensions, and joint details for each size, type, and class of pipe, fittings and specials furnished for the project.
 - 2. Information for the Record:
 - a. Manufacturer's certification indicating that the pipe and joints meet specifications for each production run for each size, type, and class of pipe furnished. The Engineer may request test results to verify certification. Certification documents shall be according to the Source Quality Control of this Section.
 - b. Manufacturer's installation instructions.
 - c. The laboratory shall submit test certifications of pipe ordered tested under "Field Quality Control," of this Section.
 - 3. Engineer may request additional Shop Drawings or Information for the Record as required.
 - 4. **Requests for approved equals must be submitted to the Engineer for review a minimum of two (2) weeks prior to bid.**

1.03 AS CONSTRUCTED RECORD

- A. During construction the contractor shall be required to keep current a set of "as constructed" drawings. Before final payment shall be made, the contractor shall submit for approval to the City of Kalamazoo the complete set of as constructed drawings. Each set of "as constructed" drawings shall be labeled "As Constructed", dated, and contain at a minimum the following information (additional information may be required by the City of Kalamazoo):
 - 1. Note distance between all fittings (Center to Center of Fittings).
 - 2. Note Hydrant to valve, valve to main distances (Center to Center of Fittings).
 - 3. Note the type of bend used, (# of degrees), and the Direction of Bend: (Up or down), (N-S-E-W).

4. Note lengths and locations of restrained joints.
5. Details and profiles of special field situations that relate to the water distribution system shall be included.
6. Dimensional information locating each water distribution system component to real world features, such as property lines, right-of-way lines, and centerlines of roads.
7. On all cul-de-sacs with no center island, measure bends and hydrants to center of cul-de-sac. On all cul-de-sacs with a center island, measure bends and hydrants to center of the roadway.
8. When fittings/hydrants are installed as proposed, please circle the proposed listing.
9. All hydrants shall be noted as to whether or not drip valve plugs were installed.
10. When installing 12 inch or larger valves, (Butterfly Valves), indicate which side of the main the operating nut was placed, as well as gear box style with number of turns to close.
11. The contractor shall complete the service card information including a sketch of the water service installation with dimensions and location of the curb box.
12. Contractor shall GPS all valves, hydrants, fittings, as well a minimum every 3 lengths of pipe for straight runs. DWG files shall be provided to the Engineer upon completion of the project. GPS accuracy shall be subfoot.
13. **All as-built record drawings shall be completed and turned in to the Engineer within 2 weeks from completion of the installation.**

1.04 CONTRACT WORK

- A. Prior to the start of construction, the City of Kalamazoo shall be given the opportunity to provide construction services for any and all portions of the water main construction. The City of Kalamazoo shall submit an estimated cost to perform the work or will issue a bill based on time and material costs. A separate contract with the City of Kalamazoo will be needed for work to be performed by the City of Kalamazoo.
 1. City of Kalamazoo shall perform all water main taps in the water system, unless otherwise directed by the Engineer.
- B. The City of Kalamazoo Department of Public Services must approve the Contractor who will perform water main installation. A reference list of at least five (5) Type 1 supply water main projects completed by the Contractor shall be submitted in support of the Contractor's qualifications. The Department of Public Services maintains a list of Contractors approved for water main installation and can be contacted to receive a current copy of that list.
- C. The Contractor (when hired by the City) or Developer (when the Contractor is hired to perform work by the Developer), shall provide a written statement of warranty (Warranty Bond) for a period of 2 years from the date of **final acceptance** for water main work or **after meter is installed** for water service work. Warranty work shall cover any necessary cost to repair water main or appurtenance leaks and water main or appurtenance leak damage at no cost to the City of Kalamazoo. Final acceptance on all water main and appurtenance work shall not occur until all items have been inspected by the Engineer, passed all required testing, as well as receipt and approval of all as built documents. Additionally, final acceptance on a water service will only be given **once the water meter is installed**.
 1. Water service or water main warranty work shall be completed either a prequalified contractor under the inspection of the City of Kalamazoo, or by City of Kalamazoo field service crews. All warranty work shall be paid for by the Developer or the Contractor.
- D. The Contractor is responsible for field locating all work which has not yet received final acceptance by the City of Kalamazoo. All damage to work that has not received final acceptance is the responsibility of the Contractor.

PART 2 PRODUCTS

All Products shall be supplied new from the manufacturer and certified new from the supplier. No second hand or salvaged material shall be allowed. All products shall be **“Buy American”** unless otherwise specified in this section.

2.01 DUCTILE IRON

A. Ductile Iron (DI) Pipe Specifications:

1. Ductile Iron Pipe shall be manufactured in accordance with American National Standards Institute (ANSI) and American Water Works Association (AWWA) ANSI/AWWA C150/A21.50 and C151/A21.51. Pipe shall be minimum thickness Class 52 pipe. Flanged pipe shall be manufactured in accordance with ANSI/AWWA C 115/A21.15. Pipe through concrete floors or foundations shall be minimum thickness Class 53 pipe.
 - a. Water pipe must be lined with a standard thickness cement mortar lining sealed with a bituminous seal coat in accordance with ANSI/AWWA C104/A21.4, unless otherwise required. The outside of the pipe must be coated with the standard bituminous seal and each length of pipe must be marked with the following information
 - 1) Metal thickness class.
 - 2) Net weight of the pipe without lining.
 - 3) The nominal size.
 - 4) The manufacturer's identifying symbol.
 - b. Underground pipe shall be push on or mechanical joints and above ground pipe shall be flanged joints with gaskets meeting the requirements of ANSI/AWWA C111/A21.11. Nitrile or fluoroelastomer gaskets shall must be used as indicated on the plans and in locations of known or suspected soil or groundwater contamination as necessary. Gaskets provided will be specified based on the type of contamination that is encountered. Each joint shall contain serrated silicon bronze electrical continuity wedges as directed by the Engineer or authorized representative. 4 to 6 inch pipe shall use 2 wedges, 8 to 12 inch pipe shall use 3 wedges, and 16 inch and above shall use 4 wedges.
 - c. Pipe used in conjunction with Horizontal Directional Drilling operations shall be Flex-Ring or TR FLEX joints.

B. Restrained Joints

1. Restrained joints shall meet the requirements of ANSI/AWWA C111/A21.11, and AWWA/ANSI C110/A21.10 or ANSI/AWWA C153/A21.53.
2. Mechanical restrained joints shall be EBAA Iron Megalug series 1100, Romac Romagrip, Ford Series 1400, or approved equal.
 - a. Restraint devices for nominal pipe sizes 4 inch through 54 inch shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10.
 - b. The devices shall have a working pressure rating of 350 psi for 4 to 16 inch, 250 psi for 18 to 48 inch and 200 psi for the 54 inch size. Ratings are for water pressure and must include a minimum safety factor of 2 to 1 in all sizes.

- c. Gland body, wedges and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536.
 - d. Ductile iron gripping wedges shall be heat treated within a range of 370 to 470 BHN.
 - e. Three (3) test bars shall be incrementally poured per production shift as per Underwriter's Laboratory (U.L.) specifications and ASTM A536. Testing for tensile, yield and elongation shall be done in accordance with ASTM E8.
 - f. Chemical and nodularity tests shall be performed as recommended by the Ductile Iron Society, on a per ladle basis.
 - g. All components shall be manufacture and assembled in the United States.
 - h. Coating for restraint devices shall consist of the following:
 - 1) All wedge assemblies and related parts shall be processed through a phosphate wash, rinse and drying operation prior to coating application. The coating shall consist of a minimum of two coats of liquid thermoset epoxy coating with heat cure to follow each coat.
 - 2) All casting bodies shall be surface pretreated with a phosphate wash, rinse and sealer before drying. The coating shall be electrostatically applied and heat cured. The coating shall be a polyester based powder to provide corrosion, impact and UV resistance.
 - 3) The coating system shall be MEGA-BOND by EBAA Iron, Inc. or approved equal.
3. Push on restrained joint shall be field locking gasket or Flex Ring style as manufactured by US Pipe, McWane, American USA, or approved equal. Field locking or Flex Ring gasket shall match appropriately to the manufacturer of the pipe used.
 4. Use of threaded rods or thrust blocks as a restrained joint shall not be permitted, unless approved by the Engineer.
 5. Restrained flange adapters shall be EBAA Iron Megaflange series 2100 or approved equal.
 - a. Restrained flange adapters shall be made of ductile iron conforming to ASTM A536 and have flange bolt circles that are compatible with ANSI/AWWA C110/A21.10 (125#/Class 150 Bolt Pattern).
 - b. Restraint for flange adapter shall consist of plurality of individual actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of gripping wedges.
 - c. The flange adapters shall be capable of deflection during assembly or permit lengths of pipe to be field cut to allow a minimum of 0.6 inch gap between the end of the pipe and the mating flange without affecting the integrity of the seal.
 - d. All internal surfaces of the gasket ring (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. The coating shall meet ANSI/NSF-61. Exterior surfaces of the gasket ring shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.
 - e. Restraint Ring coated with MEGA-Bond Restraint Coating System.

C. Ductile Iron Pipe Fittings

1. Fittings, plugs, and gaskets must meet the requirements of ANSI/AWWA C111/A21.11, and AWWA/ANSI C110/A21.10 or ANSI/AWWA C153/A21.53. Cement mortar linings for fittings must meet the requirements of ANSI/AWWA C104/A21.4.
2. Mechanical joints shall be EBAA Iron Megalug series 1100, Romac Romagrip, or approved equal.
3. Restrained flange adapters shall be EBAA Iron Megaflange series 2100 or approved equal.

2.02 Ductile Iron Valves

- A. All underground valves in sizes from 4 inches to 10 inches shall be reduced wall, resilient-seated gate valves for water supply service meeting the requirements of AWWA C 515. Valves shall be American Flow Control Series 2500, Clow model 2638, or EJ Flowmaster Series resilient seated gate valve, Mechanical joint with rubber gaskets (per AWWA/ANSI C 111/A21.11), ductile iron body, stainless steel stem, mechanical joint restraint, and ¾ inch tee head bolts. Valves shall open right (clockwise) and be equipped with standard AWWA operating nut. Nut shall be color coded red. Valves shall have a working pressure rating of 250 psi or greater.
1. In lieu of a mechanical joint restraint, American Flow Control Series 2500 valves may be equipped with ALPHA joints.
- B. All underground valves 12 inches and larger shall be rubber-seated butterfly valves meeting the requirements of AWWA C 504. Valves shall be Pratt Groundhog Butterfly Valves, by Henry Pratt Company, Clow, M&H, or Kennedy model 4500, mechanical joint with rubber gaskets (per AWWA/ANSI C 111/A21.11), ductile iron body, mechanical joint restraint, and ¾ inch tee head bolts. Valves shall open right (clockwise) and be equipped with standard AWWA operating nut. Nut shall be color coded red. Valves shall have a working pressure rating of 250 psi or greater.
- C. All above ground or in pits/vaults valves between 3 inches and 10 inches shall be rubber seated gate valves meeting the requirements of AWWA C515. Valves shall be American Flow Control Series 2500 Resilient Wedge Gate Valve, Clow model 2638, EJ Flowmaster Series, or approved equal with flanged joint with rubber gaskets (per AWWA/ANSI C 111/A21.11), ductile iron body, stainless steel bolts, nuts and washers, stainless steel stem, and be equipped with a hand wheel to operate. Valves shall have a working pressure rating of 150 psi or greater.
- D. All above ground or in pits/vaults valves 12 inches and larger shall be rubber seated butterfly valves meeting the requirements of AWWA C504. Valves shall be by Henry Pratt Company, Clow, M&H, or Kennedy, flanged joint with rubber gaskets (per AWWA/ANSI C 111/A21.11), ductile iron body, and ¾ inch stainless steel bolts, washers and nuts. Valves shall open right (clockwise) and be equipped with standard wheel to operate. Valves shall have a working pressure rating of 150 psi or greater.
- E. All underground valves in sizes from 4 inches to 16 inches used in combination with a tapping saddle shall be reduced wall, resilient-seated gate valves for water supply service meeting the requirements of AWWA C 515. Valves shall be American Flow Control Series 2500, Clow model 2638, EJ Flowmaster Series with one flanged and one mechanical joint ends with rubber gaskets (per AWWA/ANSI C 111/A21.11), ductile iron body, stainless steel stem, mechanical joint restraint, and ¾ inch tee head bolts or approved equal. Valves shall open right (clockwise) and be equipped with standard AWWA operating nut. Nut shall be color coded red. Valves shall have a working pressure rating of 250 psi or greater.

- F. All valves used in conjunction with a fire service line shall be Mueller R-2361-6 Outside Screw and Yoke (O.S.&Y.) with sample tap or approved equal. The stem shall be type 304 stainless steel. Sample tap shall have a 4 ½ inch brass nipple, brass ball valve, and brass plug meeting NSF/ANSI Standard 61 requirements. Sample tap shall be ½ inch for 4 inch and smaller valves and ¾ inch for valves larger than 4 inch.
- G. All valves installed using the insertion style method shall be an all stainless steel body Resilient Wedge Gate Valve designed for permanent use in potable water systems. The design will allow the valve to be installed into an existing pressurized pipeline while maintaining constant pressure and service without system shutdown. No restraining devices, restraining fasteners, or transition gaskets shall be required for the installation or operation of the valve. Valves in sizes 4 inches to 12 inches shall be Hydra-Stop Insta-Valve 250 or approved equal. 16 inch valves shall be Hydra-stop Insta-Valve Plus 250 or approved equal.

2.03 HYDRANTS

- A. All fire hydrants shall be American Flow Control or EJ and shall meet the requirements of AWWA C502. Hydrants shall be provided as complete units including hydrant, hydrant marker, pipe, pipe fittings and valve meeting section 2.01, 2.03 and 2.04 requirements. Hydrants shall be supplied for a bury depth of 5.5 feet. The hydrant barrel shall be painted safety yellow by the manufacturer. Hydrant caps and operating nut shall be painted John Deere green by the manufacturer.
 - 1. American Flow Control hydrants shall be 5 ¼ inch Waterous Pacer Traffic Model WB67-250. Hydrants shall be supplied with a 16 inch upper standpipe length. The Hydrant will come equipped with a bronze upper valve washer. In lieu of a mechanical joint restraint, hydrants may be equipped with ALPHA joints.
 - 2. EJ hydrants shall be WaterMaster Model 5BR250 with snow barrel.
- B. Hydrants shall come equipped with a Carrol Drain. Drain piping shall be made of type 304 stainless steel. External port shall have removable cap for flushing hydrant. Carrol Drain assembly shall be constructed so that it is removable when replacement of assembly is necessary.
- C. Hydrants shall have two 2 ½ inch national standard hose connections, 7.5 threads per inch, OD of threads 3 1/16 inch and one 5 inch integral "STORZ" type nozzle connection. Hose nozzle cap nut, weather shield hydrant operating nut, Storz nozzle cap nut, and Carrol Drain cap nut shall be square 15/16 inch at bottom of nut tapered to 13/16 inch at top (Waterous reference #19). The hydrant mechanism shall be on a non-rising stem opening clockwise. Chains shall not be supplied with the hydrant caps.
- D. Hydrants shall be equipped drip valve, tapped for plug. The drip valve system shall be bronze. Draining system shall be positively activated by the main operating rod, meaning the drip valve will open when the hydrant is closed. Hydrant shall be provided with plug removed.
- E. Hydrants shall have a 6 inch shoe with mechanical joint connections in conformance to ANSI/AWWA C115/21.11.

2.04 FIRE HYDRANT MARKER

- A. The fire hydrant sign shall be installed on a galvanized 2 pound sign post.
- B. The fire hydrant sign shall be aluminum 8 inch x 18 inch (MDOT type III-A) with hydrant symbol and down arrow of a reflective material.
- C. Fire hydrant mounted marker whips shall be 4 feet x 3/8 inch solid pultrusion fiberglass shaft, with seven (7) 6 inch bands of E.G. reflective sheeting of alternating lime green and red color.

Marker shall have a single solid stainless steel spring with aluminum threaded insert, and use Zinc coated bolt & mounting hardware.

2.05 TAPPING SLEEVES

- A. Tapping sleeves for size on size taps or 12 inch and larger sleeves:
1. Model shall be American Flow Control series 2800-C, Tyler Union, Smith-Blair series 665, Romac style SST III, Ford style FTSS, Ford MJTS, or approved equal.
 2. Ductile Iron Tapping Sleeves.
 - a. Sleeves shall be of construction meeting ASTM A536. Side flange seals shall be O-ring type of round cross-sectional shape.
 - b. All sleeves to include the end joint accessories and split glands necessary to assemble sleeve to pipe.
 - c. Sleeve shall be coated with asphaltic varnish in compliance with NSF-61.
 3. Stainless Steel Tapping Sleeves.
 - a. Sleeves shall be 18-8 type 304 Stainless Steel in accordance with AWWA C223.
 - b. Bolts, nuts, and washers shall be 18-8 Type 304 Stainless Steel. Nuts shall be heavy hex, and coated to prevent galling.
- B. Tapping sleeves smaller than 12 inch which are not size on size:
1. Model shall be Smith-Blair series 665, Romac style SST III, Ford style FTSS, or approved equal.
 2. Sleeves shall be 18-8 type 304 Stainless Steel in accordance with AWWA C223.
 3. Bolts, nuts, and washers shall be 18-8 Type 304 Stainless Steel. Nuts shall be heavy hex, and coated to prevent galling.
- C. Line Stop Tapping Sleeves and appurtenances:
1. Model shall be Hydra-Stop HSF 250 Patriot or approved equal
 2. Body shall be type 304 Stainless Steel in accordance with AWWA C223.
 3. Blind Flange shall be Epoxy Coated Carbon Steel or type 304 Stainless Steel.
 4. Bolts, Nuts and Washers shall be type 304 Stainless Steel.
 5. Completion Plug shall be HSF 250 Push and Pin Style, made of reinforced composite polymer.
 6. Completion Plug O-ring shall be BUNA-N Rubber
 7. Completion Plug Pins shall be SAE Grade 8, Zinc coated to prevent corrosion
 8. Completion Pin Plug shall be type 304 Stainless Steel, coated to prevent galling.
 9. Flange O-Ring shall be BUNA-N Rubber.
- D. All gaskets shall be Nitrile in compliance with NSF-61.
- E. No special tools shall be required other than standard socket wrench.
- F. Flange end pilot dimensions to be in compliance with MSS-Sp-60.

2.06 AIR RELEASE VALVES

- A. Air Release Valves – All air release valves shall be manufactured per ANSI/AWWA C512-04. Cla-Val Series 36 Combination Air Valves, or approved equal. The valves shall be of the size listed in the plans.
1. The combination air valve shall combine the operating features of both an air and vacuum valve and an air release valve in one housing. The air and vacuum valve portion shall automatically exhaust large quantities of air during the filling of the pipeline and automatically allow air to reenter the pipeline when the internal pressure of the pipeline approaches a negative value due to column separation, draining of the pipeline, or other emergency. The air release valve portion shall automatically release small amounts of air from the pipeline while it is under pressure.
 2. The inlet and outlet of the valve shall have the same cross section area. The float shall be guided by a stainless steel guide shaft and seat drip tight against a synthetic rubber seal. 4 inch and larger valves shall have dual guided shafts of hexagonal cross section and a protective discharge hood.
 3. The float shall be of all stainless steel construction and capable of withstanding maximum system surge pressure without failure. The body and cover shall be concentrically located and of ductile iron and the valve internal parts shall be stainless steel or Buna-N rubber.
 4. All 1 inch and 2 inch valves shall be NPT. All valves 4 inch and larger shall be flanged.
- B. Vent piping shall be 2 inch diameter, with copper piping below grade and galvanized piping above grade.
- C. Air vent screens shall be black PVC, with NPT threaded to match the size of the connection pipe. Screen shall be one-piece 304 Stainless, mesh size 100. Silver reflective tape shall be placed on the vent pipe.
- D. An air release valve sign shall be installed on a galvanized 2 pound sign post.
- E. The valve sign shall be aluminum 8 inch x 18 inch (MDOT type III-A) with valve symbol and down arrow of a reflective material.

2.07 REPAIR SLEEVES

- A. All repair sleeves shall be certified NSF/ANSI 61-G and 372, and be in accordance with AWWA C230. Sleeves without service tap shall be Smith – Blair model 226, PowerSeal model 3121, or approved equal. Sleeves with service tap shall be Smith – Blair model 238, PowerSeal model 3131, or approved equal.
- B. Sleeves shall use Type 304 Stainless Steel hardware in accordance with ASTM A193/A194. Sleeves shall have conductivity feature.
- C. The repair sleeves shall be of the full circle type designed to repair a fully broken (completely separated) pipe and shall be rated for a working pressure of not less than 150 psi. Repair sleeves 12 inches or under in size will have a single joint.
- D. The length of the sleeves shall not be less than 7 ½ inches. Sleeves shall have no less than three (3) guide bolts of the minimum specified length. Sleeves of longer length shall have an additional guide bolt for every two (2) inches of additional band length.
- E. Each sleeve shall consist of a sealing gasket, a non-magnetic stainless steel band with contact buttons protruding through specially prepared gaskets, clamp lugs, bolts and nuts.
- F. No welding will be permitted in the manufacture of stainless steel repair sleeves except for the addition of the tap to repair sleeve.

- G. The lugs shall not be deformed in the process of attachments to the band during assembly or during removal in the field.
- H. The gasket shall be natural rubber, nitrile or approved equal and shall be of the tapered overlap design to give a pressure tight fit on the pipe surface to form a leak tight, permanent seal when the repair sleeve is installed. The gasket shall have a grid pattern to conform pipe surface irregularities.
- I. The gasket shall have a stainless steel bridge plate flush mounted and securely bonded into the gasket during the molding of the gasket.

2.08 POLYETHYLENE ENCASEMENT

- A. Polyethylene encasement must be manufactured using 8 mil thick virgin polyethylene in accordance with ANSI/AWWA C105/A21.10. Provide the tube size recommended by the manufacturer to protect the pipe and fitting sizes. Provide adhesive tape for the polyethylene tube as recommended by the manufacturer. Tape for repairing damage to the polyethylene must have a life expectancy equal to or greater than the life expectancy of the polyethylene.

2.09 STEEL BLOW-OFF PIPE

- A. Steel pipe shall be hot dipped galvanized meeting the requirements of ASTM A53.

2.10 WATER SERVICES AND APPURTENANCES

A. Copper Service Lines

- 1. Copper pipe shall be used for service lines which are $\frac{3}{4}$ inch, 1 $\frac{1}{4}$ inch and 2-inch. All copper services shall conform to AWWA C800. Water service pipe shall be copper meeting the requirements of ASTM B88, type K.
- 2. All appurtenances on copper service lines shall be flare copper connections. Other connections may be used in lieu of flare copper connections if approved by the Engineer prior to installation.

- B. All water service appurtenances shall meet the requirements of AWWA C800 and be from The Ford Meter Box Company, Inc., A.Y. McDonald Mfg. Co., or as approved by the Engineer. All water service appurtenances for 2 inch and smaller are as follows:

1. $\frac{3}{4}$ inch services:

- a. Corporation Stop $\frac{3}{4}$ inch – FB600-3-NL or AY McDonald 74701B NL (3/4 inch)
- b. Service Saddle – Smith-Blair 311(4 to 12 inch water main), Smith-Blair 313 (16 to 24 inch water main), Romac 101U(4 to 12 inch water main), Romac 202SSU (16 to 24 inch water main), Ford F101(4 to 12 inch water main), or Ford F202(16 to 24 inch water main).
- c. Curb Stop (for use when reducing a 1 $\frac{1}{4}$ inch street service to $\frac{3}{4}$ inch yard service) – Ford B21-555-NL, C18-35-NL, and C28-33-NL
- d. Curb Stop (when using $\frac{3}{4}$ inch street service) – Ford B22-333-NL or AY McDonald 76100 NL ($\frac{3}{4}$ inch)
- e. Brass Fittings – All brass fittings such as tees, elbows, caps, nipples and similar items shall be manufactured in the U.S.A.
- f. Couplings – Ford C22-33-NL or AY McDonald 74758 NL ($\frac{3}{4}$ inch)

2. 1 $\frac{1}{4}$ inch services:

- a. Corporation Stop – Ford FB600-45-NL or AY McDonald 74701B NL (1 x 1 $\frac{1}{4}$ inch)

- b. Service Saddle – Smith-Blair 311(4 to 12 inch water main), Smith-Blair 313 (16 to 24 inch water main), Romac 101U(4 to 12 inch water main), Romac 202SSU (16 to 24 inch water main), Ford F101(4 to 12 inch water main), or Ford F202(16 to 24 inch water main).
 - c. Curb Stop – Ford B22-555-NL or AY McDonald 76100 NL (1 ¼ inch)
 - d. Brass Fittings – All brass fittings such as tees, elbows, caps, nipples and similar items shall be manufactured in the U.S.A.
 - e. Couplings – Ford C22-55-NL or AY McDonald 74758 NL (1 ¼ inch)
3. 2 inch services:
- a. Tapping Valve – Ford B11-777-NL
 - b. Service Saddle – Smith-Blair 313, Romac 202S, or Ford F202
 - c. Brass Fittings – All brass fittings such as tees, elbows, caps, nipples and similar items shall be manufactured in the U.S.A.
 - d. Couplings – Ford C44-77-NL
4. Water meters – All water meters shall be Neptune Water Meters. They shall be supplied and installed by the City of Kalamazoo.
- C. All water service appurtenances larger than 2 inch shall be in accordance with section 2.01.
- D. All multiple meter settings with more than two meters excluding the fire meter shall use a fabricated meter manifold. Fabricated manifold shall be manufactured as follows:
- 1. Water manifold shall be made using 304 Schedule 40 Stainless Steel pipe.
 - 2. Inlet and outlets shall be threaded or welded flange. End cap shall be welded flange with a blind flange for future additions.
- E. Conduit used as sleeves shall be schedule 40 PVC or approved by Engineer.

2.11 METER SETTINGS

- A. Interior meter settings shall use components from the following manufactures.
- 1. 1 inch meter – Ford KV23-454W-NL Angle Valve, Ford C38-44-2-625-NL, Brass Nipple, Apollo 94ALF-105-01A Ball Valve or approved equal
 - 2. 1½ inch and 2 inch meter – Ford FV13-777W-NL Angle Valve, Ford CF35-66NL (1 ½ inch), Ford CF 35-77-NL (2 inch), Brass Nipple, Watts LFFBV-3C Ball valve or approved equal.
 - 3. 3 inch and larger- rubber seated gate valves meeting the requirements of AWWA C515. Valves shall be American Series 2500 Resilient Wedge Gate Valve with hand wheel by American or equal flanged joint with rubber gaskets (per AWWA/ANSI C 111/A21.11), and be equipped with a hand wheel to operate, Hymax 874-56-03008812 (3 inch), 874-56-04010812 (4 inch), 874-56-06016312 (6 inch), or 874-56-08021712 (8 inch) Flange Adaptor, and flange to plain end ductile or type 304 stainless steel spool piece.
- B. Exterior meter settings shall use components from the following manufactures.
- 1. 5/8 inch meter – Ford V81-22-33-NL
 - 2. ¾ inch meter – Ford V83-22-33-NL
 - 3. 1 inch meter – Ford V84-22-55-NL Copper setter

4. 1 ½ inch and 2 inch meter – Watts LFFBV-3C Ball Valve or approved equal. Ford CF-77-1-937-NL Meter Flange, Ford C28-77-NL Coupler, and Brass Nipple.
5. 3 inch and larger – All above ground or in pits/vaults valves 3 inches and larger shall be rubber seated gate valves meeting the requirements of AWWA C515. Valves shall be American Series 2500 Resilient Wedge Gate Valve with hand wheel by American or equal flanged joint with rubber gaskets (per AWWA/ANSI C111/A21.11), and be equipped with a hand wheel to operate, Hymax 874-56-03008812 (3 inch), 874-56-04010812 (4 inch), 874-56-06016312 (6 inch), or 874-56-08021712 (8 inch) Flange Adaptor, and flange to plain end ductile or type 304 stainless steel spool piece.

2.12 FIRE SERVICE APPURTENANCES

- A. All fire service appurtenances shall meet the requirements of AWWA/ANSI C110/A21.10, AWWA C115, and be from the following manufacturers.
 1. Double Check Valve Detector Assembly – Zurn Wilkins Model 350DA or 350ADA with meter setting, AMES Colt LFC300 with meter setting, or approved equal. The City of Kalamazoo will supply the 5/8 inch water meter.
 2. Reduced Pressure Zone Assembly – When using a RPZ in lieu of double check valve for a backflow device, a Zurn Wilkins Model 375DA or 375ADA with meter setting, AMES Colt LFC500 with meter setting, or approved equal shall be required. The City of Kalamazoo will supply the 5/8 inch water meter.

2.13 METER BOXES AND VAULTS

- A. All Meter Boxes, Meter Vaults and components shall be from the following manufactures.
 1. Box – Hancor MP NL1 24 0008 - 24 inch x 48 inch or ADS24X48MP 24 inchx48 inch white corrugated meter pit or Engineer approved equal.
 2. Vault – Precast concrete meter vault shall have a 3 inch minimum wall thickness and size shall be depended on number of meters and meter size. The wall shall have steps that are equally spaced 12 inches apart. Meter vault shop drawings shall be submitted to the Engineer and approved for each installation.
 3. Meter Pit Cover – Vestal 32-497, 32-055, 32-104, and 32-046 or approved equal.
 4. Meter Vault Cover – Ford MC-24HH-MB-T

2.14 VALVE BOXES AND VAULTS

- A. Curb Stop Boxes for 1 ¼ inch Service – Bingham & Taylor Fig. No. 4901-B, 94-F with 2 ½” New Style Flush Fit Cover or approved equal. Cover shall be inscribed with the word “water”.
 1. Curb Stop Box extensions shall be cast iron and manufactured by Bingham & Taylor, capable of being mounted directly to the curb stop box.
- B. Gate Valve Box or 2 inch Service Box – the valve box shall be of adjustable length screw type. The valve box shall be a malleable iron casting conforming to subsection 908.03 of the 2012 Michigan Department of Transportation *Standard Specifications for Construction*. This valve box shall either be a two or three piece screw type and the cover shall be inscribed with the word “water.” Valve box 8550 Series (two piece) or 8560 Series (three piece) manufactured by EJ, 4905 size no. 22 manufactured by Bingham & Taylor, or approved equal.
 1. Gate Valve Box extensions shall be cast iron and manufactured by EJ or Bingham & Taylor, capable of being mounted directly to the gate valve box.
- C. Valve Vaults for Insta-Valves – Valve vaults used in conjunction with Insta-Valves shall be constructed with materials as detailed in WA-8-A of the City of Kalamazoo Standard Plans.

They shall be of the diameter specified and in accordance with subsection 823.02 of the Michigan Department of Transportation *Standard Specifications for Construction* for Gate Wells.

- D. Valve Vaults for Air Release Valves – Valve vaults used in conjunction with Air Release Valves shall be constructed with materials as detailed in the latest WA-4-Series or WA-5-Series of the City of Kalamazoo Standard Plans. They shall be of the diameter specified and in accordance with subsection 823.02 of the Michigan Department of Transportation *Standard Specifications for Construction* for Gate Wells.

2.15 BACKFILL MATERIALS

- A. Use materials meeting the requirements of section 902 of the 2012 Michigan Department of Transportation *Standard Specifications for Construction*.

2.16 BELL JOINT LEAK CLAMP

- A. Bell Joint Leak Clamps shall be Smith-Blair Model 274, Ford Meter Box FBC or MJSC style, or approved equal.
 - 1. The bell spigot ring, section connector, and range spacer shall be ductile iron 80-55-06 in accordance with ASTM 536. Fusion bonded epoxy finish shall meet application methods per AWWA C213. Spigot ring design shall be interlocking to allow ease of installation without interrupting the flow of the pipe. The bolt head pocket shall be integral for one wrench installation.
 - 2. Gasket shall be Nitrile Buna-N per ASTM D2000, and certified to NSF/ANSI 61-G & 372.
 - 3. Restraint Rods and Nuts shall be Type 304 Stainless Steel. Restraint Rod shall have rolled threads, and Nut shall be fluoropolymer coated to prevent galling.
- B. Bell encapsulating couplings shall be Ford Meter Box MJBE style.
 - 1. The coupling shall be designed to fully encapsulate the pipe bell. The coupling shall be of split mechanical joint design with independent end seal and side seal gaskets.
 - 2. All welded components shall be constructed with ASTM A 36 carbon steel.
 - 3. The end seal and side seal gaskets shall be virgin NBR formulated for water service. The gaskets shall not require field trimming, cutting or modification.
 - 4. The end seal compression ring shall be manufactured with ductile iron per ASTM A 526 Grade 65-45-12 or ASTM A 36 carbon steel.
 - 5. The coupling shall be coated to an average of 12 mills thickness with a fusion-bonded epoxy that is NSF 61 listed and meeting application methods of AWWA C213.

2.17 COUPLINGS

- A. Wide range couplings shall be Romac Alpha or approved equal.
 - 1. All cast components shall be ductile iron, meeting or exceeding ASTM A 536, grade 65-45-12
 - 2. Grippers shall be ductile iron, meeting or exceeding ASTM A 536, grade 65-45-12.
 - 3. Gaskets shall be SBR compounded for water service per ASTM D2000 and meet NSF61 classification.
 - 4. Bolts and nuts shall be 304 stainless steel.
 - 5. Body shall be epoxy coated, and NSF61 Certified.

2.18 STRUCTURE CASTINGS

- A. All 24 inch structure covers shall be a malleable iron casting conforming to subsection 908.03 of the 2012 Michigan Department of Transportation *Standard Specifications for Construction*. The structure cover shall be series 1040 manufactured by EJ, inscribed with the word "Water".

2.19 STEEL CASING PIPE AND APPURTENANCES

- A. Steel casing pipe shall meet the requirements in accordance with subsection 909.05.D of the 2012 Michigan Department of Transportation *Standard Specifications for Construction* with the exceptions listed below:

- 1. For steel casing pipe jacked under a railroad, replace in its entirety the entry for 30 inch nominal size listed in Table 909-18 with the following:

Nominal OD and Wall Thickness in Inches Jacked in Place Steel Pipe

Nominal Size	Nominal Outside Diameter	Wall Thickness
30	30.000	0.406(a)
<ul style="list-style-type: none"> a. Coated or cathodically protected (0.469 inch minimum if uncoated and unprotected) 		

- 2. Steel casing must have a minimum yield strength of 35,000 pounds per square inch (psi) and be in accordance with ASTM A53, Type E or S, Grade A or B and be designed for Cooper E80 loading requirements. In all cases, the allowable jacking strength capacity of the casing pipe shall be capable of withstanding the maximum jacking forces imposed by the operation.

- B. Stainless steel band spacer shall be Advance Products & Systems model SSIM or approved equal. The bands shall be constructed of circular stainless steel bands, which bolt together forming a shell around the carrier pipe. The spacers shall be designed with runners to support the carrier within the casing and maintain a minimum clearance of 1.00 inches between the casing inside diameter (ID) and the spacer outside diameter (OD). The spacers shall contain four modular runners – two on each half. Stainless steel bolts, nuts and washers shall be supplied with the casing spacers.

The band shall be manufacture of 8 inch wide 14-guage T-304 stainless steel. Abrasion resistant runners, having a minimum length of 7 inches and a minimum width of 1 inch, shall be attached to each band to minimize friction between the casing pipe and the carrier pipe as it is installed. Runner material shall be of glass filled polymer with compression strength of 33,000 psi, flexural strength of 40,000 psi, and tensile strength of 27,000 psi. The ends of thall runners shall be beveled to facilitate installation over rough weld beads or the welded ends of misaligned or deformed casing pipe.

Interior surfaces of the circular stainless steel band shall be lined with PVC, or EPDM alternate, having a minimum thickness of .090 inches with a harness of Durometer "A" 85-90.

Recommended position of the spacers is one placed not more than one foot from each end of the casing and pipe joint. Subsequent spacers shall be placed every 6-8 feet apart thereafter.

- C. Casing end seal shall be Advance Products & Systems model AC or approved equal. Pull-on casing end seals shall be manufactured of 1/8 inch thick neoprene rubber assuring excellent chemical resistance and resiliency. End seals must be effectively used in the temperature range of -20 degrees to 190 degrees Fahrenheit. End seals shall include ½ inch wide T304 stainless steel bandings with 100% nonmagnetic worm gear mechanism. End seals shall be seamless, have vulcanized edges, and can be pulled on at the time of construction.

PART 3 EXECUTION

3.01 CONSTRUCTION

- A. The plans show the locations of existing utilities in accordance with available data. If the work requires precise information on the location of existing utilities, the Contractor will expose utilities shown on the plans to determine the actual locations.

Do not disturb or cut into existing in-service water mains. If the operation of valves in existing water mains is required, notify the City of Kalamazoo a minimum of 3 working days in advance. Coordinate scheduling of water main connections with the City of Kalamazoo. Secure the Engineer's or authorized representative's approval of the schedule before beginning the work.

The City of Kalamazoo will open or close in service valves and provide on-site inspections for all water main and water service installations. The City of Kalamazoo will perform this work for an estimated time and material charge. The cost of opening and closing valves and on-site inspection will need a separate contract with the City of Kalamazoo prior to start of work. This does not apply to work being contracted by the City of Kalamazoo.

Minimize the out of service time for existing water mains. Make connections at night, on Sundays, or on holidays, as conditions require or as approved by the City of Kalamazoo. Minimize interference with the water supply if abandoning existing water mains and incorporating new water mains into the water system.

No trees or permanent structures shall be placed within 10 feet of the centerline of the water main or service line.

3.02 TRENCH EXCAVATION

- A. Excavate water main trenches to the lines and grades shown on the plans in accordance with modifications approved by the Engineer, or authorized representative, or to meet or bypass existing utility structures. Excavate trenches to the depths shown on the plans to provide 5 feet of cover from top of water main to the final grade. Excavate trenches to the widths shown on Michigan Department of Transportation Standard Plan R-83 Series.
- B. Excavate the bottom of the trench to the required grade to allow 6 inches of bedding for the pipe. Do not block under the pipe.
- C. Maintain trenches for water mains free of ground or surface water by pumping or as otherwise approved by the Engineer or authorized representative
- D. Install, and later remove, temporary timber bracing, as required to prevent movement or damage to new or existing water mains or adjacent utilities.
- E. During backfilling, carefully remove supports for sheeted and braced excavations to prevent earth banks or adjacent streets from collapsing.
- F. The Contractor may leave sheeting and bracing in place during backfilling and remove after completing backfilling operations. The Contractor may leave sheeting and bracing in place, if approved by the Engineer and the Contractor cuts it off 5 feet below the ground surface.

3.03 DISPOSAL

- A. Dispose of waste material as specified in section 205 of the 2012 Michigan Department of Transportation *Standard Specifications for Construction*.

3.04 LAYING OF THE PIPE

- A. Install the pipe joint restraint system in accordance with the manufacturer's recommendations, or as directed by the Engineer. Assemble the pipe in the trench. If deflections at joints are required by changes in grade, alignment, or to plumb valve stems, ensure deflections of bell and spigot joints and mechanical fitting joints do not exceed three-quarters of the maximum deflection recommended by the joint manufacturer or that allowed by AWWA C600, whichever is less. Do not store or leave tools or other objects in the pipe.
- B. Provide restrained joints as indicated on the plans. No tie rods or thrust blocks shall be allowed unless approved by the Engineer or authorized representative.
- C. Proper actuation of the gripping wedges of the mechanical joint restraint shall be ensured with torque limiting twist off nuts.
- D. The Contractor shall provide a written statement of warranty (Warranty Bond) for a period of 2 years from the date of **final acceptance (after meter is installed)**. Warranty work shall cover any necessary cost to repair water main or appurtenance leaks and water main or appurtenance leak damage at no cost to the City of Kalamazoo. Final acceptance will only be given **once the water service meter is installed**.
- E. Pipe shall be laid with bell ends facing the direction of laying, unless otherwise directed by the Engineer or authorized representative. When pipe is laid on a grade of 10 percent or greater, the laying shall start at the bottom and proceed upward with the bell ends of the pipe upgrade.
- F. Install silicon bronze wedges between all push-on joint pipes to allow for underground location and thawing of pipeline. 4 to 6 inch pipe shall use 2 wedges, 8 to 12 inch pipe shall use 3 wedges, and 16 inch and above shall use 4 wedges at each pipe joint.
- G. Pipe shall be restrained in accordance with Table 3.1.

Table 3.1 Pipe Thrust Restraint Table

NON-POLYWRAPPED PIPE								
Pipe Size (Inches)	90° Bend	45° Bend	22.5° Bend	11.25° Bend	Tee*	Reducer (One Size)	Reducer (Two Sizes)	Dead End
4	44	18	9	5	42	-	-	42
6	62	26	13	7	59	31	-	59
8	82	34	17	9	78	33	56	78
10	100	42	20	10	94	32	58	94
12	119	50	24	12	110	33	59	110
16	157	65	32	16	143	61	85	143
20	195	81	39	20	173	61	109	173
24	233	97	47	23	204	61	111	204
30	288	120	58	29	246	86	134	246
POLYWRAPPED PIPE								
Pipe Size (Inches)	90° Bend	45° Bend	22.5° Bend	11.25° Bend	Tee*	Reducer (One Size)	Reducer (Two Sizes)	Dead End
4	62	26	13	7	60	-	-	60
6	88	37	18	9	84	44	-	84
8	117	49	24	12	111	47	80	111
10	142	59	29	14	133	45	82	133
12	170	71	34	17	158	47	84	158
16	224	93	45	23	203	87	121	203
20	278	116	56	28	247	87	155	247
24	332	138	66	33	291	87	159	291
30	411	171	82	41	351	123	191	351
* Length of restraint for branch; use the size of the branch Consult Engineer for scenarios not included in table.								

3.05 INSTALLATION OF PIPE INVOLVING HORIZONTAL DIRECTIONAL DRILLING

- A. Horizontal direction drilling (HDD) is a method of trenchless construction using a surface launched steerable drill tool controlled from a mobile drilling frame, and includes a field power unit, drilling fluid mixing system, and mobile spoils extraction system. The work generally consists of three phases:
1. Drilling a pilot hole from the surface or pit at a starting point to an exit pit at the surface beyond the obstacle or area that is to be avoided.
 2. Reaming the pilot hole to make it large enough for the pipeline to be installed.
 3. Pipeline is pulled into place. During the pipe pulling operation, drilling fluid (a bentonite, water, and polymer solution) is injected to stabilize the hole, remove cuttings, and lubricate the pipe.
- B. Coordination

1. Drilling operations shall not interfere with, interrupt or endanger surface features or surface activities.
2. When rock stratum, boulders, underground obstructions, or other soil conditions that impede the progress of drilling operation are encountered, the Contractor and Engineer shall review the situation and jointly determine the feasibility of continuing drilling operations, making adjustments or switching to an alternative construction method.
3. The contractor shall familiarize themselves with the geologic characterization of the soil stratum at the proposed drilling path. The Contractor shall be responsible for informing the Engineer of any changes that are required in the directional drilling procedure due to geologic conditions.
4. Launching and recovery pits shall be as small as practical. Dewatering of pits and excavations shall be done in accordance with the City of Kalamazoo Standard Specifications. When groundwater is encountered, the Contractor shall provide a dewatering system of sufficient capacity to keep any excavation free from water until the backfill operation is in progress. Dewatering shall be performed in a manner that removal of soil particles is held to a minimum. Water from the dewatering system shall be desilted before discharge. Methods of dewatering and desilting, including all costs shall be the Contractor's responsibility and are included in the Horizontal Directional Drilling Water Main pay item.
5. Utilities shown on the plans are approximate. In areas where there is a potential conflict, the Contractor shall dig up and verify the locations and elevations of the utilities at no additional expense to the City. The Contractor shall assume full responsibility for the protection fall utilities, structures and their foundations which may be affected by the work.
6. Before beginning the drilling process, the Engineer shall stake the proposed drill path.

C. Drill Path Survey

1. The Drill path shall be walked in the presence of the Engineer and the Contractor with the guidance system that shall be used for each segment of drill path. The contractor shall locate and record any surface and subsurface magnetic variations or abnormalities and all points of interference, as well as verifying all utility locations and corresponding utility maps. Should any discrepancies arise between utility maps, field locations and guidance system findings, the Contractor shall clarify all discrepancies prior to beginning drilling operations. The drill path survey shall be performed no earlier than two days prior to commencing drilling operations. Provide the Engineer 48-hour notice of drill path survey.

D. Equipment

1. The drilling equipment shall be capable of placing the pipe within the planned line and grade without inverted slopes.
2. The drilling equipment shall be capable of pulling product pipe from either the downstream or upstream pit locations. The equipment must be adequately sized for the application.
3. The guide system shall have the capability of measuring inclination, roll and azimuth. The guidance system shall have an independent means to ensure the accuracy of the installation. The Contractor shall demonstrate a viable method to eliminate accumulated error due to the inclinometer (pitch or accelerometer). The guidance

system shall be capable of generating a plot of borehole survey for the purpose of a record drawing. The guidance system shall meet the following specifications:

Inclination:	Accuracy	+0.05
	Range	+90
	Repeatability	+0.02
Roll:	Accuracy	+0.05
	Range	+90
Azimuth	Accuracy	+0.05
	Range	+90

4. Equipment setup requirements at the launch and recover locations shall be determined by the Contractor in accordance with the Plans and shall be submitted to the Engineer prior to commencement of drilling operations.

E. Pilot Hole Drilling

1. The entry angle of the pilot hole and the drilling process shall maintain a curvature that does not exceed the allowable bending radii of the carrier pipe per the manufacturer's recommendations.

F. The contractor shall follow the pipeline alignment as shown on the Plans, within the specification requirements. The location and depth of the drill head in relation to the profile and centerline of the alignment shall be determined at a maximum of ten-foot intervals. Acceptable tolerance shall be 0.5 feet variation from the centerline of the pipe in both vertical and horizontal directions (1-foot tolerance window).

G. In the event of difficulties at any time during drilling operation requiring the complete withdrawal from the tunnel, the Contractor shall either be allowed to withdraw and abandon the tunnel and begin a second attempt at a different location. The alternate locations shall be approved by the Engineer before the Contractor withdraws.

H. Access pits shall be at the beginning and end segments shown on the Plans. Intermittent pits shall be approved by the Engineer prior to proceeding with drilling operations. No intermittent access pits shall be allowed in Railroad Right of Ways.

I. Installing the Carrier Pipe:

1. After the pilot hole is completed, the Contractor shall install a swivel to the reamer and commence pullback operations.
2. Reaming diameter shall not exceed 1.5 times the diameter of the carrier pipe being installed.
3. The carrier pipe being pulled into the tunnel shall be protected and supported so that it moves freely and is not damaged by stones and debris on the ground during installation.
4. Pullback forces shall not exceed the allowable forces for the carrier pipe.

J. The Contractor shall allow sufficient lengths of carrier pipe to extend past the termination point to allow connections to adjacent pipe sections, tees, or fittings. Pulled pipe shall be allowed 24 hours of stabilization prior to making tie-ins. The length of extra carrier pipe shall be at the Contractor's discretion.

K. Field Inspection

1. All pipe sections, specials, and jointing materials shall be carefully examined for defects and no piece shall be laid that is known to be defective. Any defective piece discovered installed shall be removed and replaced with a sound one in a manner satisfactory to the Engineer at the Contractor's expense.
2. Defective material shall be marked with an "X" in pink paint and shall be removed from the job site.

L. Drilling Fluid Containment and Disposal Requirements

1. The contractor shall contain, handle, and dispose of drilling fluids in accordance with the following requirements:
 1. All drilling fluid and fluid additives shall be disclosed, and Material Safety Data Sheets (MSDS) shall be provided to the permit agency and the Engineer upon request.
 2. Excess drilling fluid shall be confined in a containment pit at the entry and exit location until recycled or removed from the site.
 3. Precautions shall be taken to ensure that drilling fluid does not enter the roadways, streams, municipal storm or sanitary sewer lines, and/or any other drainage system or body of water.
 4. When installing below railroads, vents shall be installed on either side of the railroad tracks to direct any excess drilling fluid to a containment area and to prevent unintended surfacing of drilling fluid within the Railroad Right of Way.
 5. Unintended surfacing of drilling fluid shall be contained at the point of discharge and recycled or removed from the site.
 6. Drilling fluids that are not recycled and reused shall be removed from the site and disposed at an approved disposal site.
 7. Drilling fluids shall be completely removed from the construction site prior to backfilling or restoring the site.

3.06 ABANDONING WATER MAINS

- A. Remove and dispose of abandoned pipe, gate boxes, or other appurtenances, as necessary for placement of a new water main at no additional cost to the City of Kalamazoo. Remove portions of gate boxes to at least 3 feet below the pavement surface under the road, and to at least 12 inches below the planned grade outside the road. If the Engineer determines abandoned mains may remain in place, cap the end of pipe with cap and megalug or as directed by the Engineer or authorized representative. If shown on the plans or directed by the Engineer or authorized representative, fill abandoned water mains with non-structural flowable fill.

3.07 VALVES

- A. Prior to installation, all valves shall be fully operated open and close to verify its functionality and number of turns. Set and join valves to the water mains as required for cleaning, laying, and jointing the required type of pipe, as shown on the plans. Install valves as required by the contract, or as approved by the Engineer. Place the valve stems plumb. Install valves to not bear on the pipe. Install anchor coupling with valves installed on tees or crosses, with swivel gland located on the valve side of the anchor coupling.
- B. When installing 12 inch and larger valves (Butterfly Valves), the operating nut shall be located on the side of the valve furthest from the centerline of the roadway, unless otherwise directed by the Engineer.

3.08 LIVE TAPS TO IN SERVICE WATER MAINS

- A. Prior to tapping of the main contractor shall disinfect all pipe, appurtenances, tapping machine with chlorinated water.
- B. Contractor shall install all necessary tapping appurtenances according to manufacturer's recommendation.
- C. Contractor shall use equipment which allows the tapping machine to rinse out metal shavings and tap water main per manufacturer's recommendations. No tap 4 inches or larger shall be allowed within 4 feet from any joint, fitting, or exiting tap regardless of location of tap. 1 ¼ inch taps located within 10 feet of previous tap shall be offset 15 degrees.
- D. Once tapping is complete Contractor shall disinfect all exposed water main and appurtenances with chlorinated water.

3.09 VALVE BOXES.

- A. Provide valve boxes that do not transmit shock or stress to the valve. Place valve boxes plumb over the operating nut of the valve, with the box cover flush with the pavement, or as approved by the Engineer or authorized representative. Provide firm support for valve boxes.
- B. Valve boxes shall be installed, centered and plumbed over the operating nut of the gate valve. The area around the valve box shall be back-filled with Granular Material Class II placed in layers not to exceed 12 inches, and thoroughly compacted to the required density. The Contractor shall take due care to prevent the box from shifting during backfilling operations. The tops of the valve boxes shall be flush with the established pavement or ground surface.

3.10 ADJUSTING OR RECONSTRUCTING WATER SHUT OFFS OR VALVE BOXES

- A. Adjust and reconstruct water shutoffs or valve boxes to the final grade or as approved by the Engineer or authorized representative. Replace shutoff or gate box materials damaged during adjustment or reconstruction, as determined by the Engineer, or authorized representative, at no additional cost to the City of Kalamazoo.

3.11 WATER SERVICES

- A. Water Services shall not be connected to the water main until approved by the Engineer or authorized representative.
 - 1. The standard size for all new services shall be 1 ¼ inch. The property owner/developer may request a larger size if needed.
 - 2. ¾ inch service materials may only be used when performing repairs or partial replacements of an existing ¾ inch service, or when replacing the yard service of a ¾ inch service. When replacing a complete street side service of a ¾ inch service, a new 1 ¼ inch tap will be completed, new 1 ¼ inch street service line installed, and reduced down at the curb shut off per section 2.10.
- B. Tap water main per section 3.08.
- C. When more than two meters excluding the fire meter are required to be set on a single service line, a fabricated meter manifold shall be installed.
- D. Water Services 2 inch and Smaller
 - 1. Construct services from the distribution main to the water meter. Lay services in a straight line perpendicular to the water main unless approved by the Engineer or authorized representative. Construct service with a continuous piece of copper from the corporation stop to the curb stop and curb stop to the water meter unless

approved by the Engineer or authorized representative. Services over 300 feet will require an exterior meter setting (meter pit).

2. All couplings shall be located as close to the water main as possible, but outside roadway unless approved by the Engineer.
3. The use of thread sealant shall be not be allowed on flare fittings.
4. No splices shall be allowed for 1 ¼ inch or smaller yard services 90 feet and shorter in length.
5. Tap and curb shut off locations shall be no closer than 5 feet to edge of driveways. If a service is required to be abandoned due to improper location, service shall be fully abandoned at the water main tap location and new service installed the developer's expense. Corporation stop shall be shut off, copper piping removed, and copper disc installed on the corporation stop.
6. If finish grade changes from plan grade after installation of service, curb shutoff shall be adjusted to 5 foot bury depth at the developer's expense.
7. When the street service is installed separately from the yard service a copper disk shall be installed on the yard side of the curb valve per the manufactures recommendations as approved by the Engineer or authorized representative.

E. Water Services Greater than 2 inch

1. For services entering a building with no basement, install the stand pipe flange 12 inch from the finished floor elevation and 6 to 12 inches away from any walls. Install the flange pipe so two bolt holes are parallel from each wall (two hole). For services entering a building with a basement or into a concrete vault, install the stand pipe flange 6 to 12 inches off the wall. Install the flange pipe so that two bolt holes are parallel to the floor, normal to the wall. For all services entering a building, the service line shall be located in room located on an outside wall of the building, with enough room to maintain the service.
2. Contractor shall complete installation of service prior to pressure testing and disinfection. The Contractor shall hydrostatic test the complete fire service from the nearest outside valve to first valve (OS&Y) before installing the fire check valve per section 3.22. Service shall be cleaned, flushed and tested per section 3.23. No connection shall be made to these services until after pressure test is complete and consecutive negative bacterial test results have been received in accordance with sections 3.22 and 3.23 of this specification, and the water main approved by the Engineer or authorized representative.
3. No adapter flange or grooved pipe joint shall be used on any portion of the service to be maintained by the City of Kalamazoo, with the exception of the meter side of an OS&Y fire service valve.
4. For service lines with multiple meter settings, a valve the same size as the incoming service line shall be installed prior to the tee or manifold. If one of the meter settings is for a fire service, the valve shall be an OS&Y valve in accordance with section 2.02.F.

F. Construct the service pipe with at least 5 feet of cover, unless Engineer or authorized representative requires additional depth.

G. Make all service connections, and transfers. Maintain and protect, at no additional cost, existing service connections requiring transfer, but not shown on the plans, until reconnection or disposal.

- H. If relocating a portion of water service, shut down the water service by method approved by the Engineer or authorized representative.
- I. Service lines entry points into the structure shall be sealed with hydraulic cement or mastic putty and oakum to prevent groundwater infiltration. For ductile iron pipe services, link seals should be used as the preferred method.
- J. FIRE SERVICES
 - 1. The Contractor shall notify the Engineer or authorized representative a minimum of 3 working days prior to flushing the fire service or testing the fire system capacity.
 - 2. All fire services shall have an OS&Y valve meeting the requirements of 2.02.F installed. The sample tap on the OS&Y Valve shall be installed on the downstream side of the valve.
- K. INTERIOR METER SETTINGS (PREFERED)
 - 1. Interior valve and meter inlet connection shall be installed by the Contractor in accordance with the Engineer, or authorized representative's recommendations and final approval.
 - 2. The meter setting shall be located in a heated portion of the building. The meter setting shall not be located in a crawl space, above electrical appliance, or near an electrical panel. A clear and unobstructed access to the meter of not less than 24 inches by 24 inches shall be provided.
 - a. 1 ¼ meter settings must be placed in basements. Meter setting shall be placed in the front of the building facing the street or within three feet of the front on the side unless otherwise approved by the Engineer or authorized representative. Water Services shall not be placed under footings. If service enters house under the porch and the porch footing extends below water service, a 2 inch PVC sleeve will be required.
 - b. A ½ inch schedule 40 PVC conduit, or larger, shall be installed from the meter setting to the remote reading point. There shall be no more than 75 feet of conduit between pull boxes. There shall be no more than four (4) 90-degree bends between pull boxes. All pull boxes must be installed no more than 96 inches above the floor. Pull boxes shall not be installed in attics or crawl spaces.
 - 3. The City of Kalamazoo will install the meter, readout, readout wire, copper ground wire, outlet meter connection and valve.
- L. EXTERIOR METER SETTINGS
 - 1. Exterior meter settings shall be installed by the Contractor according to the Engineer's or authorized representative's recommendations, and in accordance with City of Kalamazoo Standard Plans. Meter settings will be required for services greater than 300 feet, slab on grade, crawl spaces, where minimum 5 foot bury depth cannot be maintained, and other reasons. Contractor shall verify proper meter location with the Engineer prior to construction.
 - 2. Meter boxes or vaults shall not be installed in any street, alley, parking area, driveway, or sidewalk. Major landscaping (shrubs, boulders, etc.) and structures (retaining walls, fences, buildings, etc.) shall not be placed within seven and a half (7.5) feet or trees shall not be planted within ten (10) feet of any meter box or vault, unless otherwise directed by the Engineer.

3. The ground surrounding meter boxes, pits and vaults shall slope away from the lid at a minimum grade of 2%
4. No plumbing or electrical connections will be allowed inside the meter box or vault, unless otherwise directed by the Engineer.
5. All tees, connections, and couplings shall be a minimum of five (5) feet downstream from the meter box or vault wall on the outlet side. Tees and connections shall not be installed between the curb stop and the meter setter or copper horn.
6. Meters shall be installed by the City of Kalamazoo upon inspection and acceptance of the meter setting.
7. Meter boxes shall be used for all 1 inch exterior meter settings. The Contractor shall install meter boxes to horizontal location and to final grade as determined by grade stakes. Meter boxes shall be installed 5 feet outside the right of way in private property. All work shall be in accordance with the current WS-8 of the City of Kalamazoo Standard Plans.
8. For services 1 ¼ inch and smaller, curb shutoffs shall be located in the right of way, centered in the curb lawn area, or as directed by the Engineer.
9. The Contractor shall install meter vaults for 1 ½ inch and larger meter settings.
10. Meters shall be installed by the City of Kalamazoo upon inspection and acceptance of the meter setting.

3.12 WATER MAINS, CUT AND PLUG

- A. All work related to water main, cut and plug shall be in accordance with section 3.06.A. If the plans show cutting and plugging water mains, arrange for the City of Kalamazoo to shut down the main. Remove the section of pipe and plug the water main as shown on the plans or as approved by the Engineer or authorized representative. Construct the required restraint as directed by the Engineer or authorized representative.

3.13 FIRE HYDRANTS

- A. Set fire hydrants at the locations shown on the plans and in accordance with City of Kalamazoo standard plans and manufacturer's recommendations or as coordinated with the City of Kalamazoo. When installed, the hydrant shall be located on the side of the water main furthest from the centerline of the roadway, unless otherwise directed by the Engineer. Equip the hydrant with auxiliary valves, as shown on the plans. Stand hydrants plumb, with side nozzles parallel to the curb, and with the pumper nozzle normal to the curb, unless otherwise directed by the Engineer. Place the nozzles at the height specified by the City of Kalamazoo.
- B. For all gate valves connected adjacent to a tee or hydrant, the anchor between the fitting or hydrant and the valve shall be a 6 inch by 13 inch swivel by solid adapter with swivel gland. The swivel gland shall be located on the hydrant side of the solid adapter.
- C. Install a valve box over hydrant valve in accordance with section 3.09.
- D. Hydrants shall have a protective cover placed over hydrants prior to backfilling to ensure the hydrant is not damaged. If hydrant is damaged, the contractor shall repair or replace the hydrant at no cost to the City.
- E. If site conditions are such that it is not desirable for hydrant drain into the surrounding soil (i.e. when hydrant has less than 10 feet of separation from a sewer, high ground water, impervious or contaminated soils, etc.), hydrant drip valve plug(s) shall be installed by the Contractor onsite. Final determination on drip valve plug installation shall be made by the

Engineer or his representative. As constructed records shall be noted whether or not the drip valve plug was installed.

3.14 FIRE HYDRANT MARKER

- A. The sign shall be located between the hydrant and curb and offset from the pumper nozzle, or as directed by the Engineer. The sign shall be placed 3 feet away from the hydrant. The sign shall be single sided or double sided as directed by the Engineer or authorized representative. The sign shall have an installed height to the bottom of the sign of 7 feet above the final grade in areas with sidewalk and 5 feet above the final grade in areas without sidewalk.
- B. A fire hydrant mounted whip may be installed in addition to fire hydrant sign if approved by the Engineer. Fire hydrant whip shall be mounted to the fire hydrant opposite the pumper nozzle in accordance with the manufacturer's specifications.

3.15 FIRE HYDRANT REMOVAL

- A. If the plans show removal of a fire hydrant, remove the entire hydrant assembly, including the following:
 - 1. Auxiliary gate valve and box, unless otherwise approved by the Engineer or authorized representative.
 - 2. Internal valve assembly;
 - 3. Top bonnet;
 - 4. Standpipe; and
 - 5. Hydrant inlet body, unless otherwise approved by the Engineer.
- B. If the City of Kalamazoo approves leaving the auxiliary gate valve and box in place, remove to at least 3 feet below the pavement surface under the road, or at least 12 inches below planned grade outside the road.
- C. Stockpile the removed material at a location accessible to the City of Kalamazoo. The City of Kalamazoo will maintain ownership of the hydrant, and will remove the assembly from the project site

3.16 RELOCATING FIRE HYDRANTS

- A. If the plans show relocating a hydrant, arrange for the City of Kalamazoo to shut down the hydrant auxiliary valve. Remove the hydrant and reinstall at the required location. Reconnect the hydrant to the water main by shutting down the main, tapping a new hydrant outlet, or using the existing outlet. Install piping as required. If the relocated hydrant does not pass testing the hydrant shall be replaced with new at no cost to the City of Kalamazoo.

3.17 MISCELLANEOUS FITTINGS

- A. Install the following at the locations shown on the plans and in accordance with good construction practices and manufactures recommendations:
 - 1. Elbows,
 - 2. Tees,
 - 3. Corporation stops,
 - 4. Blow offs,
 - 5. Pipe adapters,
 - 6. Pipe couplings,

7. Retaining glands, and
8. Other miscellaneous fittings.

3.18 AIR RELEASE VALVES AND VAULTS

- A. Construct air release valves and vaults in accordance with the current WA-4-Series and WA-5-Series of the City of Kalamazoo Standard Plans.
- B. When installing the air release valves in conjunction with new water main construction, the contractor shall use ductile iron fittings.
- C. When installing the air release vaults as a retrofit to existing water main, live taps may be performed as directed by the engineer.

3.19 BACKFILLING AND COMPACTING

- A. Backfill and compaction shall be in accordance with Michigan Department of Transportation Standard plan for utility trenches R-83-Series.
- B. Backfilling Under Existing Conduits – Where it is necessary to undercut or replace existing utility conduits and/or service lines, the excavation beneath such lines shall be backfilled the entire length with granular bedding material tamped in place in 6-inch layers to the required density. The granular bedding shall extend outward from the spring line of the conduit a distance of 2-feet on either side and thence downward at its natural slope.
- C. Backfilling with Excavated Material – Unless otherwise specified or directed, material excavated in connection with the work shall be used for backfilling and other filling purposes, if it meets all requirements given elsewhere in this specification.
- D. Backfill Immediately Following Inspection – All trenches and excavations shall be backfilled immediately after pipe is laid therein, unless otherwise directed by the Engineer or authorized representative. Under no circumstances shall water be permitted to rise in un-backfilled trenches after pipe has been placed.
- E. Service leads shall not be backfilled until the pipe ends are referenced and the Engineer or authorized representative has measured the pipe for payment.
- F. Backfilling around and over structures and pipes shall be carefully done by hand and tamped with suitable tools of approved weight to a point 1-foot above the top of pipe. Selected material or, where specified or ordered by the Engineer, special backfill material shall be used in this area. The material shall be placed in uniform layers not exceeding 6-inch in depth up each side. Each layer shall be placed, then carefully and uniformly tamped to the specified density so as to eliminate the possibility of lateral displacement of pipe or structure.
- G. Backfilling by Machinery – After the backfill has been placed and compacted around the boxes and pipe to a height of 1-foot above the top. The remainder of the trench may be backfilled by machine. The backfill material shall be deposited in horizontal layers and each layer shall be thoroughly compacted to the specified density by approved methods before a succeeding layer is placed. In no case will backfill material from a bucket be allowed to fall directly on a structure or pipe and in all cases the bucket must be lowered so that the shock of the falling material will not cause damage.

3.20 COMPACTION REQUIREMENTS

- A. Compact each layer to 95% (90% if outside the influence of the roadway) maximum density as tested by the Michigan Department of Transportation Density Testing and Inspection Manual.

3.21 COMPACTION TEST

- A. Trenches and excavation around structures shall be backfilled and consolidated in layers, as specified, to the existing ground surface. Compaction tests shall be performed on each layer immediately after compaction.
- B. Initial test series for each type of backfill material shall be continued until the method of consolidation employed has proven to attain the required compaction. Any change in the proven method of consolidations will require additional testing and field verification of compaction.
- C. Subgrade below pavements, curbs, sidewalks, and structures shall be consolidated as specified. Compaction tests shall be performed to verify specified consolidation.

3.22 HYDROSTATIC TESTING

- A. Perform hydrostatic testing of water mains in accordance with AWWA C600.
- B. Ensure City of Kalamazoo personnel witness pressure testing. Give the City of Kalamazoo personnel at least 1 full working day notice before testing.
- C. Provide the personnel, temporary timber bracing, plugs, test pumps, temporary connections to the Municipal water system, and any other required apparatus. Provide the water for hydrostatic testing if not available from the City of Kalamazoo. Water must be pumped from a measurable source in order to determine testing allowance water.
- D. Before applying test pressure, expel air from the pipe in increments of no greater than 1,000 feet. Pressure test each section of water main. If the Contractor chooses not to pressure test against an existing valve, a new valve may be installed at the expense of the Contractor.
- E. Pipe shall be pumped with water to a minimum test pressure of 150 pounds per square inch (psi) at the highest point of elevation to begin test. Test shall last for at least 2 hours, with a maximum drop of pressure of 5 psi. If the pressure drop is greater than 5 psi but less than 20 psi, a testing allowance water test shall be performed. Testing allowance water, as measured by the quantity of water pumped into the pipe to attain the pressure at which the test began must not exceed the testing allowance.
- F. Testing allowance water is determined using the following formula

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

Where

- L= testing allowance water in gallons per hour
- S= length of pipe in feet
- D= actual pipe diameter in inches, and
- P= 150 psi

- G. If testing allowance water is above the allowable limit occurs during hydrostatic testing, remove backfill to expose pipe and repair the joints. Repeat testing after repairs are complete. If multiple leaks occur the contractor may be required to reinstall main at Contractors expense.
- H. Correct visible leaks regardless of the amount of leakage. Replace faulty pipes, fittings, gate valves, or other accessories disclosed by testing. Repeat the test until the pipes, fittings, gate valves, and other accessories meet the requirements.

3.23 DISINFECTION, FLUSHING, AND BACTERIOLOGICAL TESTING

- A. Disinfect the water main in accordance with AWWA C651 and applicable Michigan Department of Environment, Great Lakes, and Energy (EGLE) regulations after successful hydrostatic testing.
- B. Disinfect and flush new, and portions of existing, water mains as required by the EGLE.
- C. Use blow offs, fire hydrants, or other means as shown on the plans or approved by the Engineer, or authorized representative, to flush water mains in accordance with AWWA C651, with a velocity of at least 3 feet per second. Provide hoses and other equipment and arrange a means of disposing of the water without damaging the work or adjacent property.
- D. Use the continuous feed method with chorine added simultaneously with the water. Add chlorine or liquid hypochlorite to meet the requirement of at least 25 milligrams per liter of chlorine. Slowly add the water to the main and allow it to stand for at least 24 hours. At the end of the 24-hour period, ensure the chlorine residual is a minimum of 10 milligrams per liter. If not met, re-chlorinate and flush the water main until a minimum 10 milligrams per liter residual remains after 24 hours.
- E. After completing disinfection, initially flush the water mains with water at a velocity of at least 3 feet per second to replace the entire volume of chlorinated water in the pipeline. After initial flushing, perform final flushing until the residual chlorine content meets the standard level for the water distribution system. The City of Kalamazoo may require a waiting period after flushing and before bacteriological sampling.
- F. Dispose of chlorinated water in accordance with applicable state and local requirements. If necessary, apply a reducing agent to the water to neutralize the chlorine and create a chlorine residual of no greater than 1 ppm. Dechlorination shall be in accordance with AWWA C655.
- G. After flushing, perform bacteriological testing in accordance with AWWA C651 and EGLE requirements. Test chlorine residuals before taking each bacteriological sample. Ensure the chlorine residual is less than 1.5 milligrams per liter before taking a bacteriological sample. The City of Kalamazoo will collect samples from each branch of pipe in the presence of the Engineer, or authorized representative, and contractor personnel. The City of Kalamazoo will be responsible for the transportation of the samples to a State of Michigan approved lab for testing. Two consecutive bacteriologically safe tests at 24-hour intervals for each section of pipe are required. Acceptable tests are negative for bacteria and as otherwise defined by AWWA C651 and EGLE regulations.
- H. If a bacteriological test fails, repeat disinfection, flushing, and testing.
- I. Pressure and chlorination taps shall be removed within one business day of passing tests, so main can be activated.

3.24 POLYETHYLENE ENCASEMENT

- A. Polyethylene encasement will be required for all ductile iron installations when the soil test evaluation is greater than or equal to 10 points based as indicated in AWWA/ANSI C105/A21.5 or as directed by the Engineer. Sampling of the soils is to be completed by the developer or municipality responsible for the installation.
- B. Install polyethylene encasement on water mains and fittings installed through concrete floor and foundations and as indicated on the plans in accordance with the manufacturer's installation instructions and AWWA/ANSI C105/A21.10. Appropriately sized polyethylene encasement shall be used so that there are no longitudinal splices. This may require using one or more size larger diameter encasement than the pipe installed.

- C. Polyethylene encasement shall be required for all installations when groundwater is detected in the utility trench.
- D. Polyethylene encasement shall be required for all directional drilling installations involving ductile iron pipe.

3.25 WATER INFRASTRUCTURE IN STEEL CASING

- A. Work shall be performed in accordance with section 401 of the Michigan Department of Transportation *Standard Specifications for Construction* and as detailed herein. In all cases, the Contractor shall submit a work plan detailing the following:
 - 1. Means and methods for bracing and shoring;
 - 2. Methods of maintaining and adjusting line and grade;
 - 3. Drilled/bored diameter;
 - 4. Drill hole stabilization procedures;
 - 5. Size and location of the auger head relative to the casing;
 - 6. Methods of dealing with cobbles/boulders and obstructions;
 - 7. Estimated jacking thrust required;
 - 8. Method of monitoring casing elevation;
 - 9. Thrust block design calculations;
 - 10. Record keeping system to document casing advance and jacking pressures;
 - 11. Grouting procedures;
 - 12. Temporary dewatering measures and;
 - 13. Mitigation procedures if sinkholes or settlement above the pipe occurs or excessive movement of the settlement monitors is observed.
- B. Minimum Allowable Depths.
 - 1. The minimum allowable depth of the Horizontal Auger Bore (HAB) installed casing pipe shall be in accordance with Table 3.2

Table 3.2 Minimum Allowable Depths Table	
Location	Minimum Depth
Base of Rail	6 Feet
Existing Ground	5 Feet
Roadway	5 Feet
Ditch Flowline	5 Feet

- C. Access Pits.
 - 1. Excavate jacking and receiving pits as necessary. Provide and install all sheeting, shoring, bracing and any other earth retention measures in accordance with section 704 of the Michigan Department of Transportation *Standard Specifications for Construction*. Provide site drainage and subsurface dewatering and other items associated with the operation as necessary to facilitate the proposed work.
- D. Lead Auger/Overcut Allowance.

1. A full-size auger section shall be used as the lead section of the casing. The auger shall not protrude from the leading edge of the casing. However, if soil conditions halt the movement of the casing, the auger shall be allowed to protrude not more than 1 inch in front of the casing during the boring operation. Overcut is the annular space between the excavated hole and the outside diameter of the casing pipe. The allowable overcut diameter is one inch greater than the casing pipe radius.
- E. Watertight joints.
1. Watertight joints are required to ensure the integrity of the road and railroad bed. Casing pipe shall be constructed to prevent water leakage or earth infiltration and must be certified free from any breaks or leaks throughout its entire length.
- F. Lubrication Fluids.
1. Lubrication fluids are specifically required for this method regardless of the soil conditions. Any deviations from the use of lubrication shall require prior approval for the Engineer. The Contractor shall install vents on either side of the casing pipe to prevent fracking during installation. These vents shall also be used as relief in case of a water main break. Lubrication fluids, consisting of a mixture of water and bentonite or bentonite/polymer, shall be used in the annular space between the casing being installed and the native soil to stabilize and lubricate the drill hole. Grease will not be allowed for use as lubrication for this purpose.
- G. Pipe Locating and Tracking.
1. One of the following tracking, locating, and guidance systems shall be used:
 - a. Waterline system.
 - b. Mechanical control head.
 - c. Electronic (inertial) control head.
 - d. Walkover system.
 - e. Laser guided tunnel attachment.
 - f. Laser guided pilot rod.
 2. The Contractor will be responsible for submitting their proposed pipe locating tracking method at the preconstruction meeting for approval.
- H. Settlement/Heaving Monitoring.
1. Settlement/Heaving monitoring shall be performed in a manner that will minimize the movement of the ground in front of, above, and surrounding the horizontal auger bore operation; and will minimize subsidence of the surface above and in the vicinity of the boring. The ground shall be supported in a manner to prevent loss of ground and keep the perimeter and face of the boring stable at all times, including during shutdown periods. A survey shall be performed one day prior to initiating this operation at each required monitoring location. A similar survey shall then be performed at each location, on a daily basis, until the permitted activity has been completed. All survey readings shall be recorded to the nearest one-hundredth (0.01) of a foot. Digital photographs of the pavement and rail conditions shall also be taken prior and after the pipe installation. Specific monitoring locations and requirements may also be provided for railway crossings.
- I. Ground Water Control.

1. Dewatering shall be conducted whenever there is a high ground water table level to prevent flooding and facilitate the operation. The water table elevation shall be maintained at least 1 foot below the bottom of the casing at all times. When needed, dewatering may be initiated prior to any excavation.
2. Minor water seepage or pockets of saturated soil may be effectively controlled through bailing or pumping. This control shall be accomplished without removing any adjacent soil that could weaken or undermine any access pit, its supports, or other nearby structures.
3. Larger volumes of ground water shall be controlled with one or more well points or with staged deep wells. Well points and staged deep well pumping systems shall be installed and operated without damage to property or structures, and without interference with the right of the public, owners of private property, pedestrians, vehicular traffic, or the work of other contractors. Any pumping methods used for dewatering and control of ground water and seepage shall have properly designated filters to ensure that the adjacent soil is not pumped along the water. Well diameter, well spacing and the pump's pumping rate shall provide adequate draw down of the water level. Wells shall be located to intercept ground water that otherwise would enter the access pit excavation and interfere with the work. Upon removal of a well, the hole shall be filled and grouted.
4. Existing storm sewers shall only be used to discharge water from the dewatering operation in accordance with a permit obtained from the appropriate storm sewer owner. Filters or sediment control devices shall be required to ensure that the existing system is not adversely affected by construction debris or sediment.

J. Casing End Seals/Bulkheads

1. Casing ends shall be enclosed using 1/8 inch thick synthetic rubber casing ends seals in accordance with section 2.19.C of this document. Ensure end seals are water tight and attach securely to the casing pipe and the carrier pipe (water main). Ensure end seals are acceptable to the Engineer.

K. Backfill Requirements.

1. Remove the pits and backfill the excavations as necessary with material meeting the standard specifications as approved by the Engineer.

L. Railroad Specific Requirements.

1. For Steel casing pipe jacked in place under a railroad, the following will apply in accordance with the current AREMA Manual;
 - a. When steel casing pipe is used, the joints must be fully closed by welding or mechanical means as approved by the Engineer.
 - b. Minimum cover over the casing must be at least 6.0 feet from the bottom of the railroad tie to the top of the casing pipe at its closest point.
 - c. Casing pipe must extend beyond the limits of the entire railroad right-of-way.
 - d. Jacking construction requirements must be in accordance with the current AREMA Manual, Chapter 1, Part 4.

3.26 INSTALLATION OF LINE STOPS AND INSERTION VALVES

- A. Line Stops and Insertion Valves shall be performed in the locations as detailed on the plans or as directed by the Engineer. Prior to installation of the line stop or insertion valve, coordinate the deactivation of the water main so that all customers have been given proper notification

of the shutdown. No work shall be performed without the Engineer or authorized representative present.

B. Excavate and expose the water main. Remove scale from the water main and make sure there are no flaws which would affect the seal with the saddle.

C. Line Stops

1. Install permanent line stop body on the pipeline and perform line stop according to manufacturer's instructions. Upon completion of the work associated with the line stop, reactivate the water main and install permanent blind flange on the line stop body. Ensure that all as built information is recorded and submitted as detailed in section 1.03.

D. Insertion Valves

1. Install Insertion Valve body on the pipeline and perform valve insertion according to manufacturer's instructions. Operate the valve to ensure that it is fully functional.

2. Construct valve vault as detailed in WA-8-A of the City of Kalamazoo Standard Plans. Ensure that all as built information is recorded and submitted as detailed in section 1.03.

3.27 FINAL RESTORATION

A. Contractor shall restore site to preconstruction condition or better, or as detailed on the plans.

B. Final grade shall be 5 feet above completed water main or water service line, unless otherwise approved by the Engineer. If final grade is changed greater than 6 inches from the approved plans, the Developer or Contractor shall raise or lower water main and water services so that they are maintained at 5 feet below final grade. All costs associated with this work shall be paid for by the Developer or Contractor.

PART 4 MEASUREMENT AND PAYMENT

4.01 PAY ITEMS

Measurement a payment may not apply if construction is not being funded with City of Kalamazoo funds. Please review signed construction contract for actual measurement and payment specifications.

Pay Item	Pay Unit
Water Main, DI __ inch, Tr Det __	Foot
Water Main, DI __ inch, in Casing.....	Foot
Water Main, DI __ inch, HDD.....	Foot
Gate Valve and Box, __ inch,.....	Each
Butterfly Valve and Box, __ inch.....	Each
Polyethylene Encasement.....	Foot
Water Main, __ inch, Cut and Plug	Each
Fire Hydrant	Each
Hydrant, Rem	Each
Hydrant Relocate, Case __	Each
Water Serv	Each
Water Serv, Long.....	Each
Water Serv, Conflict	Each
Water Serv, Yard	Each
Copper Tubing, Additional Length	Foot
Water Serv, 2 inch.....	Each
Water Serv, Conflict, 2 inch	Each
Copper Tubing, Additional Length, 2 inch	Foot

Steel Casing Pipe, __ inch, Jacked in Place.....Foot

4.02 MEASUREMENT OF PAY ITEMS

- A. Payment for Water Mains shall be measured based on the sizes and trench details required, along the centerline of the pipe, with no deductions for fittings. The unit price of Water Main, DI, includes the cost of the following:
 - 1. Excavation and backfill;
 - 2. Dewatering operations (trench and/or pipe);
 - 3. Provide temporary water system to maintain service during construction;
 - 4. Hydrostatic testing;
 - 5. Disinfecting and flushing the water main and bacteriological testing;
 - 6. All material, labor and equipment necessary to remedy an unsatisfactory hydrostatic test, including removing and replacing any backfill;
 - 7. Providing and installing fittings, gaskets, bracing or sheeting, blocking and miscellaneous items for installing pipe and reconnecting to the Municipal Water System;
 - 8. Preparing and providing as-constructed plans.

- D. The City of Kalamazoo may withhold payment and/or final acceptance until the City of Kalamazoo accepts the as-built plans.

- E. The cost of dewatering of trenches, pipe, or both associated with alterations to the Municipal Water System, is included in the unit price for relevant items of work.

- F. The cost of excavating, disposing of excess material, and providing, placing, and compacting the backfill, is included in the unit price for related items of work.

- G. The cost of removing or abandoning existing water mains, gate valve boxes, and other appurtenances to provide clearance for the proposed water main or roadway, is included in the unit price for relevant items of work.

- H. Payment for Gate Valves, Butterfly Valves, and Valve Boxes, shall be as follows:
 - 1. The unit prices of **Gate Valve and Box** and **Butterfly Valve and Box**, of the types and sizes required, include the cost of providing and installing the valve and valve box, complete and ready for use.

- I. Payment for water services 1 ¼ and smaller shall be as follows:
 - 1. **Water Serv** refers to services between the water main and the curb shut off no greater than 33 feet long. **Water Serv, Long** refers to services between the water main and the curb shut off greater than 33 feet long and up to 66 feet in length. **Water Serv, Yard** refers to the services between the curb shut off and the water meter setting, up to 25 feet in length. **Copper Tubing, Additional Length** refers to the additional copper tubing and work needed when services between the curb shut off and the water meter setting are over 25 feet in length, and when the length of the service between the center of the road and the curb shut off exceeds 66 feet. **Water Serv, Conflict** refers to relocating only a portion of a water service.

- J. Payment for water services 2 inches in size shall be as follows:
 - 1. **Water Serv, 2 inch** refers to the services between the water main and the water meter setting no greater than 58 feet in length. **Water Serv Conflict, 2 inch** refers to relocating only a portion of a 2 inch water service. **Copper Tubing, Additional length, 2 inch** refers to the additional copper tubing and work needed when services exceed 58

feet in length.

- K. Services with a diameter larger than 2 inches will be measured and paid for as water mains.
- L. The unit prices for **Water Serv, Water Serv, Long, Water Serv, Yard, Copper Tubing, Additional Length, Water Serv Conflict, Water Serv, 2 inch, Water Serv Conflict, 2 inch,** and **Copper Tubing, Additional Length, 2 inch,** include the cost of the following, unless otherwise accounted for in other pay items:
 - 1. Earth excavation;
 - 2. Removing pavement;
 - 3. Replacing pavement;
 - 4. Jacking and boring;
 - 5. Providing and installing type K copper tubing, service saddle, corporation stops, service stops, and service boxes;
 - 6. Disinfecting;
 - 7. Providing, placing, and compacting backfill;
 - 8. Slope Restoration to equal or better conditions; and
 - 9. Miscellaneous material, equipment, or operations.
- M. Payment for additional service connections, not shown on the plans, but maintained, protected, and reconnected or disposed of by the Contractor will be paid for as **Water Serv,** or **Water Serv, Long.**
- N. The pay item **Water Serv, Conflict** will apply only to portions of water services requiring relocation due to direct conflict with utilities, other items of work, or as otherwise approved by the City of Kalamazoo. Payment for all other relocations requiring replacement of corporation or service stops will be paid for as Water Serv or Water Serv, Long.
- O. Payment for **Water Main, __inch, Cut and Plug** includes the cost of cutting the existing water main, providing and placing the required plug, and thrust blocks.
- P. Payment for **Fire Hydrant** includes the cost of providing and installing the hydrant, hydrant valve, valve box, and all pieces between the valve and hydrant, including the coarse gravel and concrete base, fire hydrant marker at the locations shown on the plans in a ready-for-use condition unless noted otherwise.
- Q. Payment for **Hydrant, Rem** includes the cost of breaking down the auxiliary gate valve, gate box, the hydrant assembly, backfilling, and plugging the opening in the existing main.
- R. Payment for **Hydrant, Relocate, Case __** (of the case required), includes the cost of vertically adjusting the relocated hydrant to final grade and the following:
 - 1. Case 1 includes the cost of removing the hydrant, extending the existing hydrant lead from the gate valve, reinstalling the hydrant in a ready-for-use condition, adjusting the existing gate box and hydrant to final grade, and providing and installing sleeves, fittings, and joint restraints.
 - 2. Case 2 includes the cost of removing the existing hydrant, gate valve and box, and reinstalling the hydrant and gate valve in a ready-for-use condition, adjusting the existing gate box and hydrant to final grade, and providing and installing the cutting-in-sleeve, pipe coupling, tee, elbow, and joint restraints.
- S. Payment for **Steel Casing Pipe, __inch, Jacked in Place** of the size required will be paid for by the length installed. The unit price for **Steel Casing Pipe, Jacked in Place** includes the cost of excavating the pits, providing and installing sheeting, bracing, and any other safety devices, providing jacking equipment: drainage and dewatering; bulkheading and sealing the casing, providing and installing vents, grouting the annular space between the casing and native soil and any other items associated with the operation.

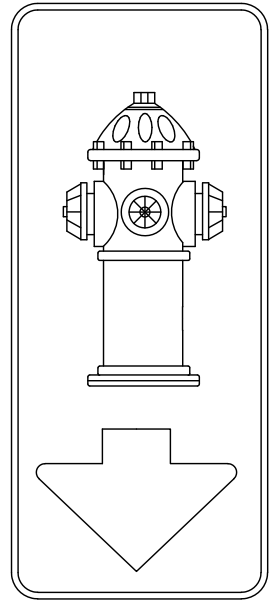
- T. Payment for **Water Main, DI, __inch, in Casing**, of the size required will be paid for by the length installed. The unit price for **Water Main, DI __inch, in Casing** shall include the cost for furnishing and installing the water main and casing spacers inside the casing.
- U. Payment for **Water Main, DI, __inch, HDD**, of the size required will be paid for by the length installed. The unit price shall include the cost of all equipment and materials, excavation and backfill, dewatering operations (trench, pit or pipe), temporary water system to maintain service during construction, hydrostatic testing, disinfecting and flushing the water mains, and bacteriological testing, all materials, labor and equipment necessary to remedy and unsatisfactory hydrostatic test, including removing and replacing any backfill, providing and install all, gaskets, bracing or sheeting, blocking and miscellaneous items for installing pipe of the required size and material and reconnecting to the water system as shown on the plans.

END OF SECTION

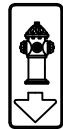
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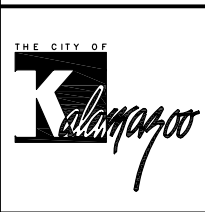
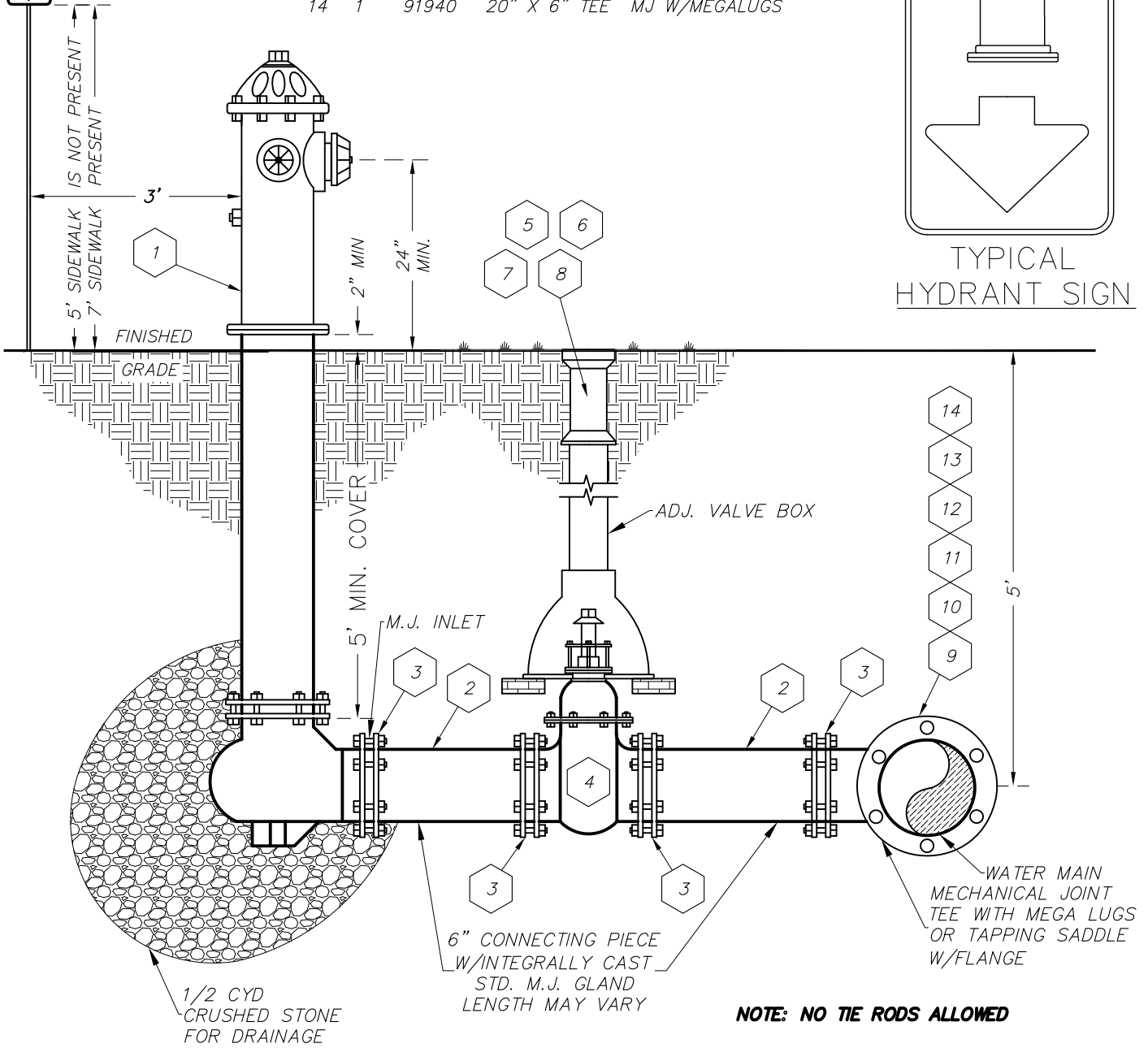
ITEM	QTY.	#	DESCRIPTION
1	1	39887	6" HYDRANT W/CARROLL DRAIN
2	2	70000	CONNECTING PIECE (13")
3	4	33801	6" GASKET (MJ)
4	1	96696	6" GATE VALVE (MJ)
5	1	08550	VALVE BOX BOTTOM
6	1	08520	VALVE BOX TOP SECTION
7	1	08500	VALVE BOX RING CASTING
8	1	08490	VALVE BOX COVER
9	1	91440	6" TEE MJ
10	1	91525	8" X 6" TEE MJ W/MEGALUGS
11	1	91750	10" X 6" TEE MJ W/MEGALUGS
12	1	91825	12" X 6" TEE MJ W/MEGALUGS
13	1	91909	16" X 6" TEE MJ W/MEGALUGS
14	1	91940	20" X 6" TEE MJ W/MEGALUGS



TYPICAL HYDRANT SIGN



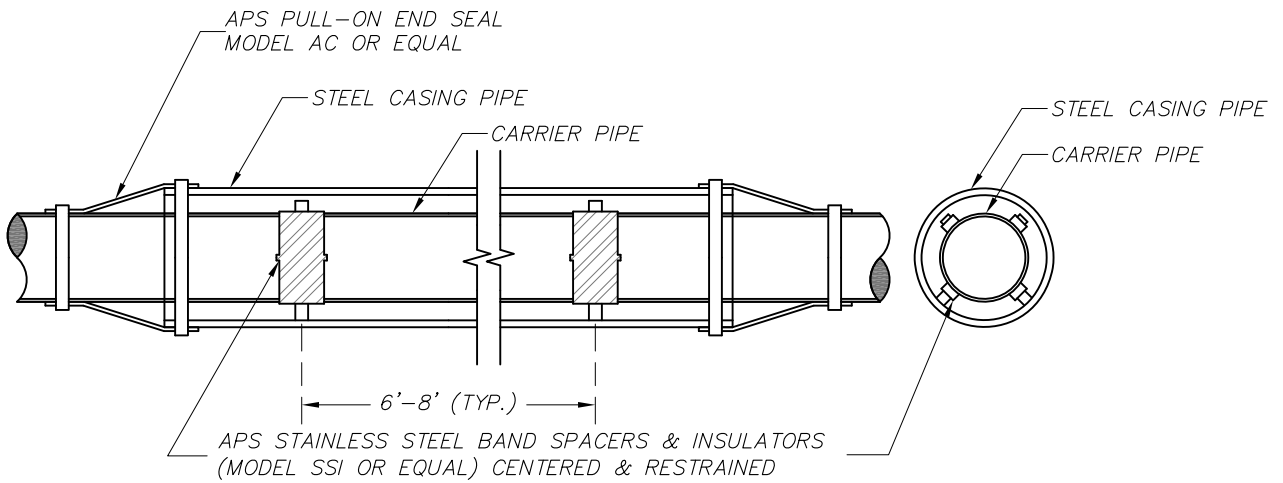
DOUBLE SIDED HYDRANT SIGN



CITY OF KALAMAZOO
 Department Of Public Services

TYPICAL FIRE HYDRANT & GATE VALVE DETAIL

RECOMMENDED BY _____	DATE _____
APPROVED BY _____	
APPROVED BY _____	
ACCEPTED BY _____	



CASING CARRIER PIPE DETAIL

SIZE CASING AND CARRIER PIPES PER PLAN AND SPECIFICATIONS

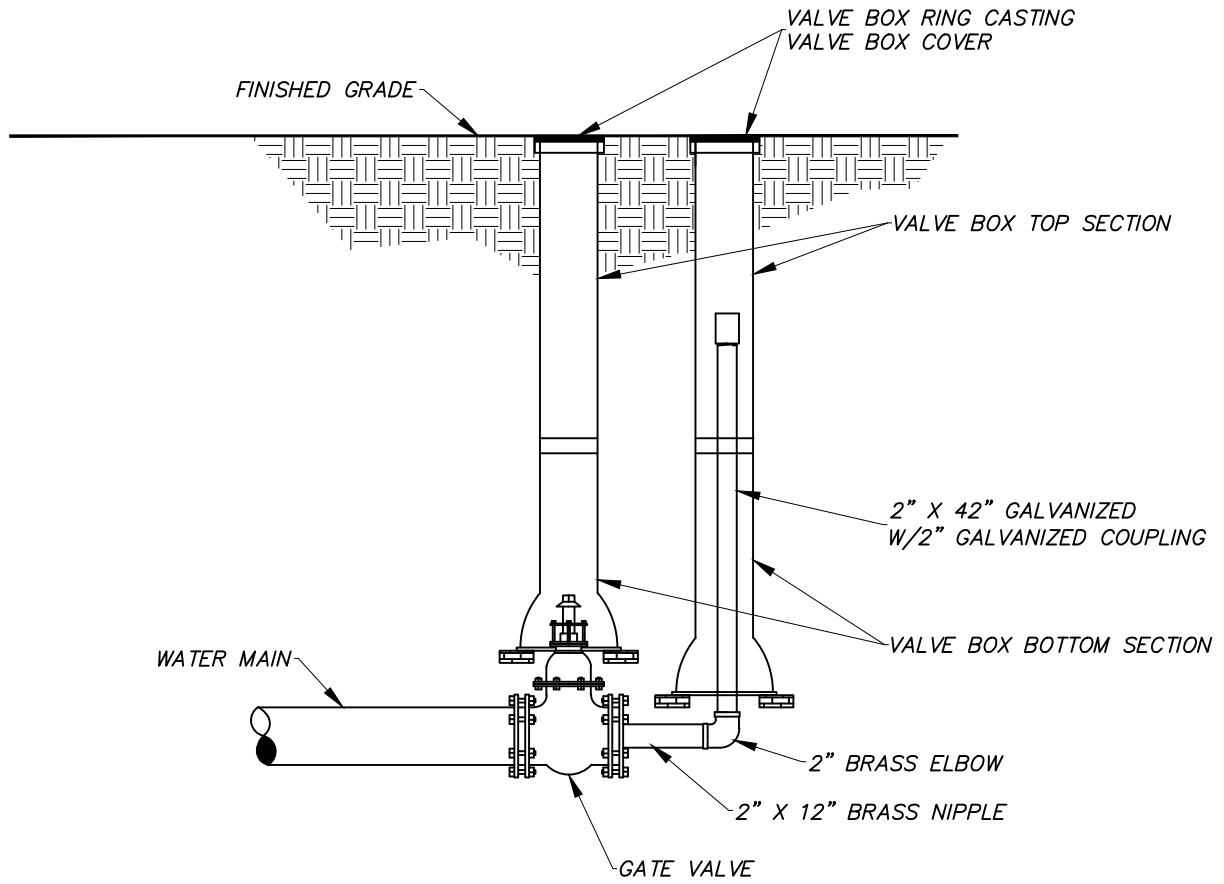
TYPICAL BAND SPACER POSITIONING:
 ONE PLACED NOT MORE THAN 1 FOOT FROM EACH END OF THE CASING AND
 PIPE JOINTS WITH SUBSEQUENT SPACERS PLACED EVERY 6-8 FEET THEREAFTER.
 FOR 18 FOOT PIPE THERE SHALL BE THREE BAND SPACERS.
 FOR 20 FOOT PIPE THERE SHALL BE FOUR BAND SPACERS.



CITY OF KALAMAZOO
 Department Of Public Services

CASING CARRIER PIPE

RECOMMENDED BY _____	DATE _____
APPROVED BY _____	
APPROVED BY _____	
ACCEPTED BY _____	



NOT TO SCALE

J:\CAD STANDARDS\STANDARD DETAILS\WATER\UPDATED DRAWINGS\ACAD DRAWINGS\WA-3-B BLOW OFF CONNECTION 2 INCH.dwg, 6/12/2016 12:01:24 PM

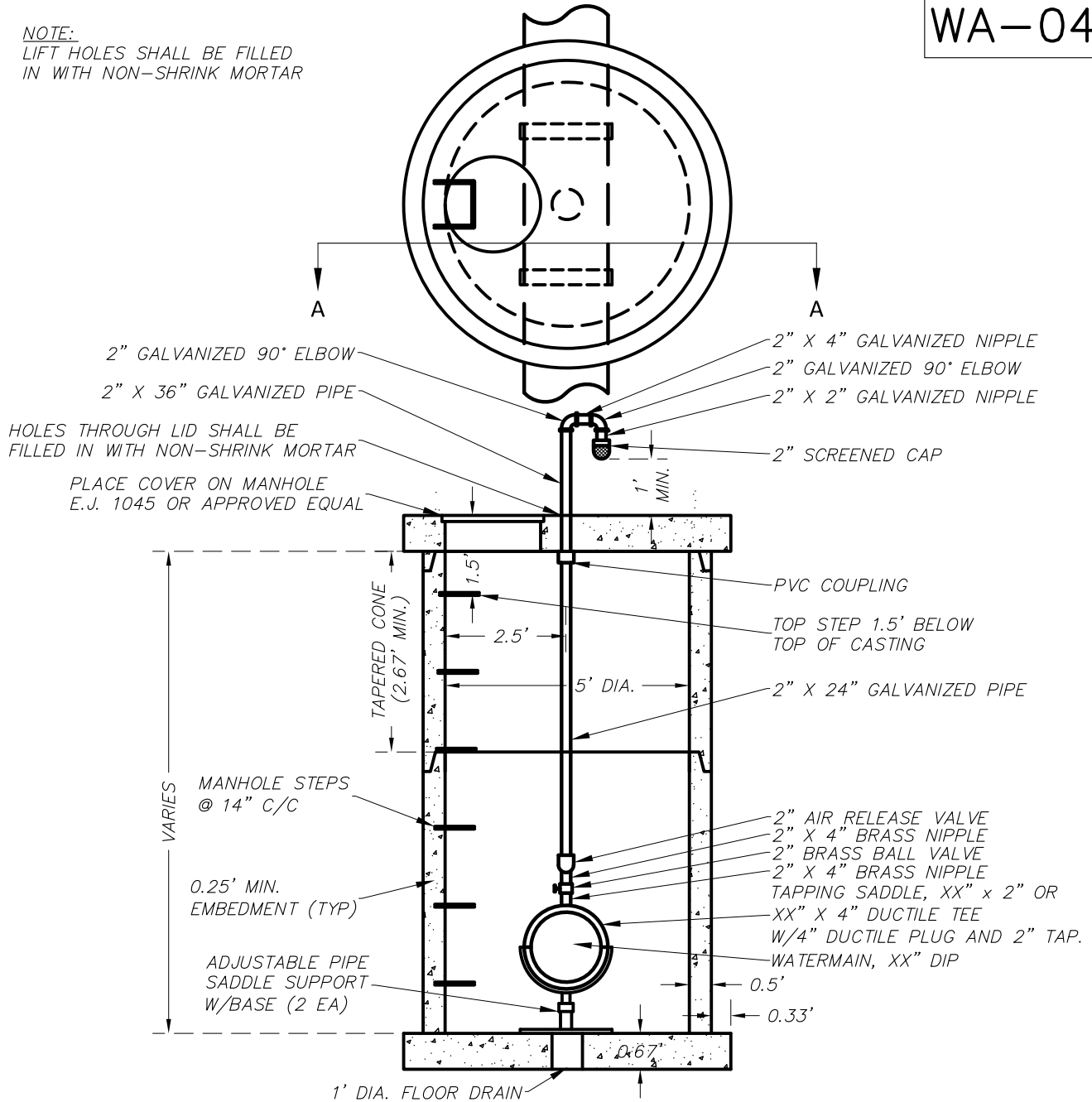


CITY OF KALAMAZOO
Department Of Public Services

**2" BLOW OFF
CONNECTION**

RECOMMENDED BY _____	DATE _____
APPROVED BY _____	
APPROVED BY _____	
ACCEPTED BY _____	

NOTE:
LIFT HOLES SHALL BE FILLED
IN WITH NON-SHRINK MORTAR



TYPICAL 2" AIR RELEASE MANHOLE

PRECAST REINFORCED CONCRETE SHOWN (OTHER OPTIONS INCLUDE CONCRETE BLOCK, BRICK OR CAST IN PLACE WALL SECTIONS)

SCHEDULE OF FITTINGS

ITEM DESCRIPTION	QUANTITY
AIR RELEASE VALVE, 2"	1
GALVANIZED PIPE, 2" X 60"	1
GALVANIZED NIPPLE, 2" X 4"	1
GALVANIZED NIPPLE, 2" X 2"	1
GALVANIZED 90° ELBOW, 2"	2
PIPE SUPPORT BASE	2

ITEM DESCRIPTION	QUANTITY
TAPPING SADDLE, XX X 2"	1
BRASS BALL VALVE, 2"	1
BRASS NIPPLE, 2" X 4"	2



CITY OF KALAMAZOO
Department Of Public Services

AIR RELEASE MANHOLE

RECOMMENDED BY _____

APPROVED BY _____

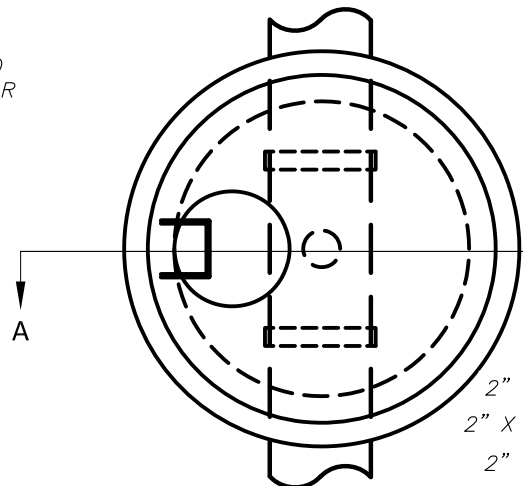
APPROVED BY _____

ACCEPTED BY _____

DATE

WA-05-C

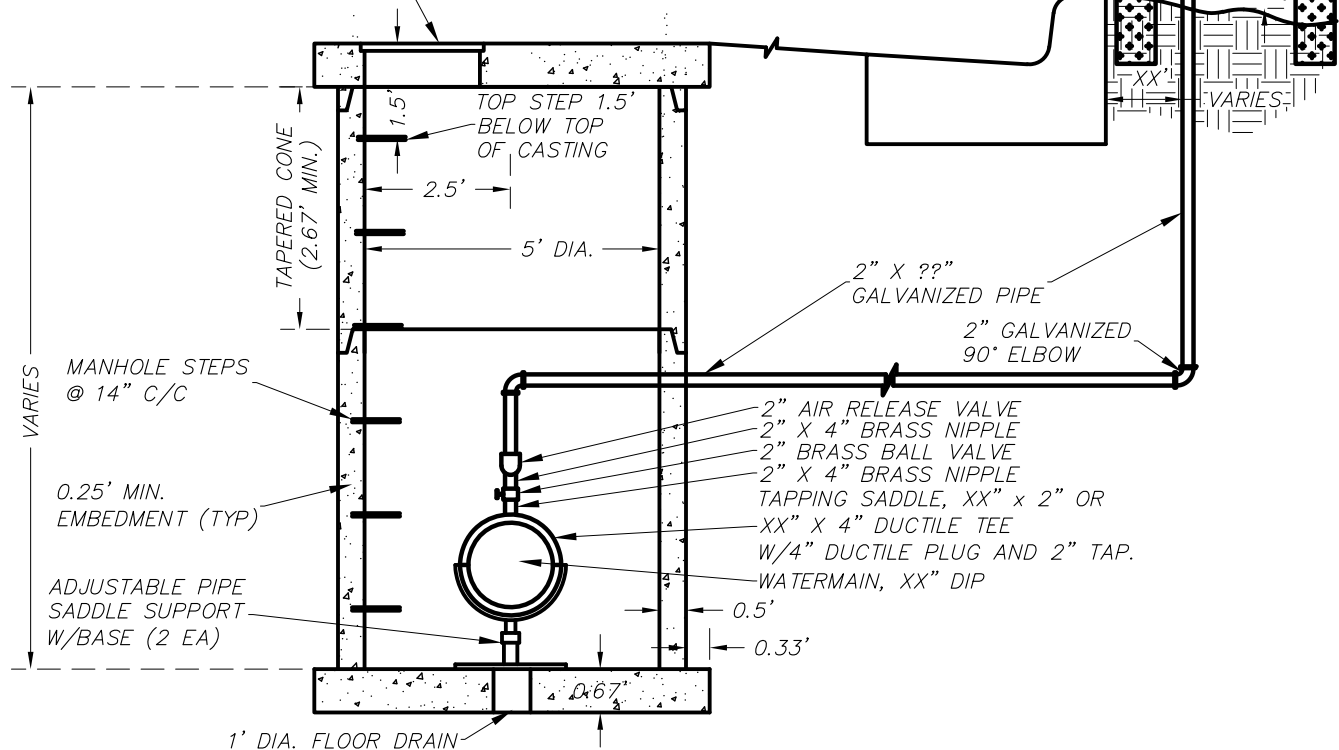
NOTE:
LIFT HOLES SHALL BE FILLED
IN WITH NON-SHRINK MORTAR



- 2" GALVANIZED 90° ELBOW
- 2" X 4" GALVANIZED NIPPLE
- 2" GALVANIZED 90° ELBOW
- 2" X 2" GALVANIZED NIPPLE
- 2" SCREENED CAP

BOLLARD POSTS
AS SPECIFIED
BY ENGINEER

PLACE COVER ON MANHOLE
E.J. 1045 OR APPROVED EQUAL



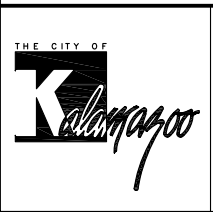
TYPICAL 2" AIR RELEASE MANHOLE

PRECAST REINFORCED CONCRETE SHOWN (OTHER OPTIONS INCLUDE
CONCRETE BLOCK, BRICK OR CAST IN PLACE WALL SECTIONS)

SCHEDULE OF FITTINGS

ITEM DESCRIPTION	QUANTITY
AIR RELEASE VALVE, 2"	1
GALVANIZED PIPE, 2" X 60"	1
GALVANIZED NIPPLE, 2" X 4"	1
GALVANIZED NIPPLE, 2" X 2"	1
GALVANIZED 90° ELBOW, 2"	2
PIPE SUPPORT BASE	2

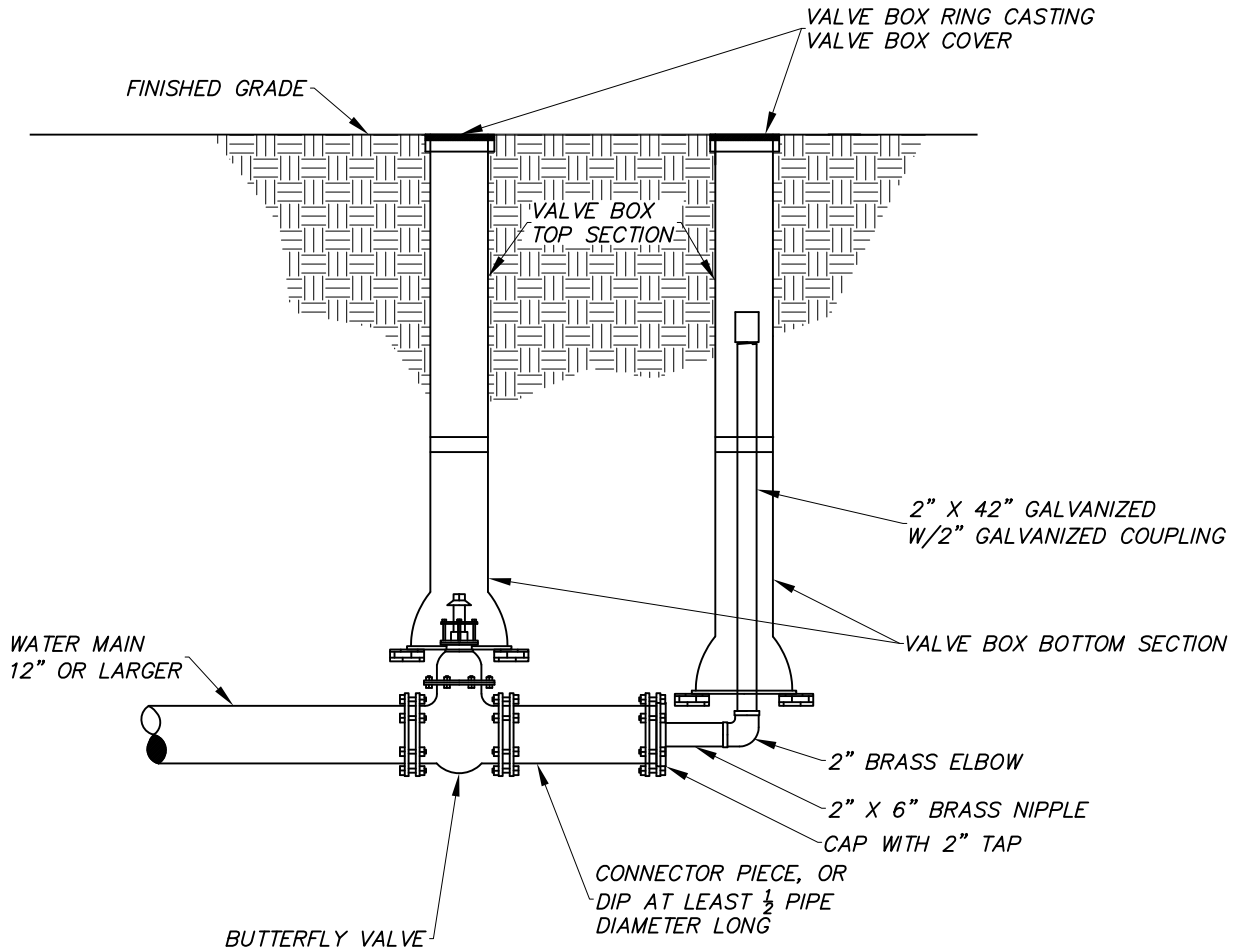
ITEM DESCRIPTION	QUANTITY
TAPPING SADDLE, XX X 2"	1
BRASS BALL VALVE, 2"	1
BRASS NIPPLE, 2" X 4"	2



CITY OF KALAMAZOO
Department Of Public Services

AIR RELEASE MANHOLE IN ROADWAY

RECOMMENDED BY	DATE
APPROVED BY _____	
APPROVED BY _____	
ACCEPTED BY _____	



NOT TO SCALE

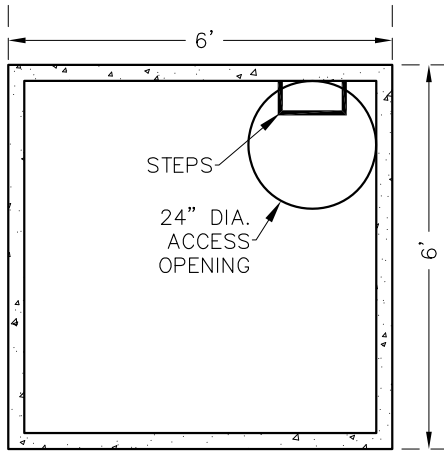


CITY OF KALAMAZOO
Department Of Public Services

**2" BLOW OFF
CONNECTION
12" OR LARGER MAIN**

RECOMMENDED BY _____
APPROVED BY _____
APPROVED BY _____
ACCEPTED BY _____

DATE

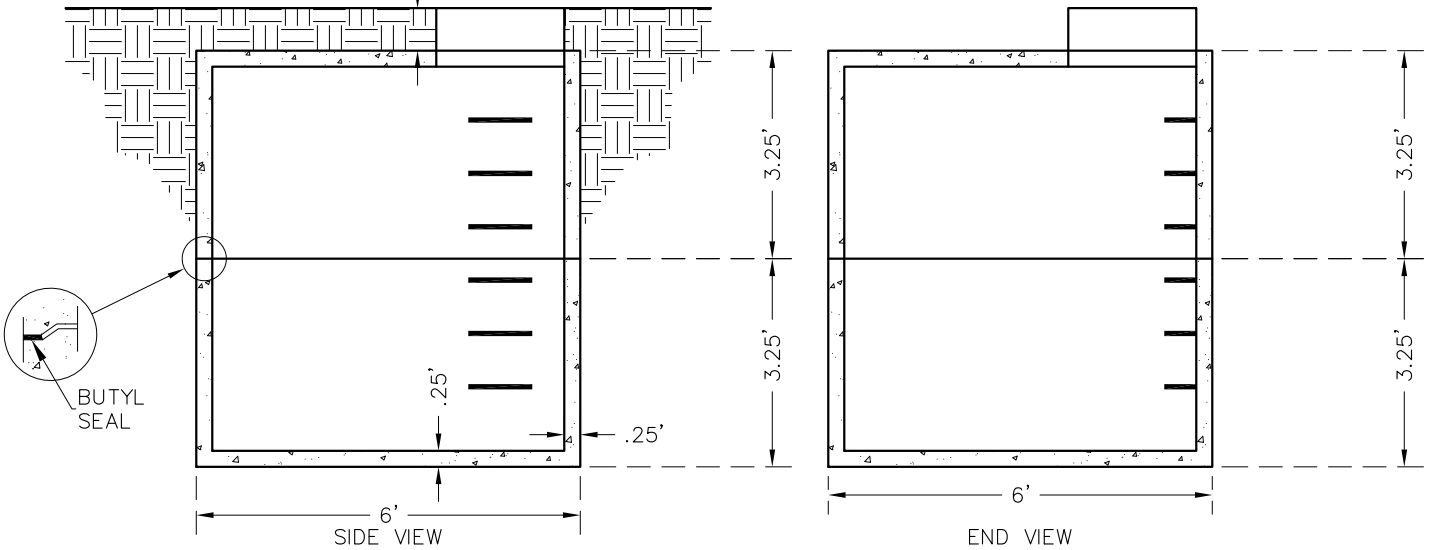


TOP VIEW

NOTES:

1. METER VAULT DESIGN TO BE SUBMITTED AND APPROVED FOR EACH INDIVIDUAL INSTALLATION. DESIGN SHALL CONFORM TO KALAMAZOO WATER ENGINEERING STANDARDS LATEST REVISION.
2. THE DISTANCE BETWEEN RUNGS, CLEATS AND STEPS SHALL NOT EXCEED 12 INCHES AND SHALL BE UNIFORM THROUGHOUT THE LENGTH OF THE LADDER.
3. PLACEMENT OF CURB BOX CAN VARY FROM A MAXIMUM OF 5 FEET OUTSIDE THE PROPERTY LINE TO A MAXIMUM OF 5 FEET INSIDE THE PROPERTY LINE. PLACEMENT OF THE CURB BOX OUTSIDE THE PROPERTY LINE IS PREFERRED.
4. ACCESS COVER - FORD MC-24-MB-T WITH AN INNER LID, VESTAL 32-055, 32-104, AND 32-046 OR APPROVED EQUAL.

TOP OF PIT TO FINAL GRADE SHALL NOT EXCEED 8"



SIDE VIEW

END VIEW



CITY OF KALAMAZOO
Department Of Public Services

STANDARD METER PIT

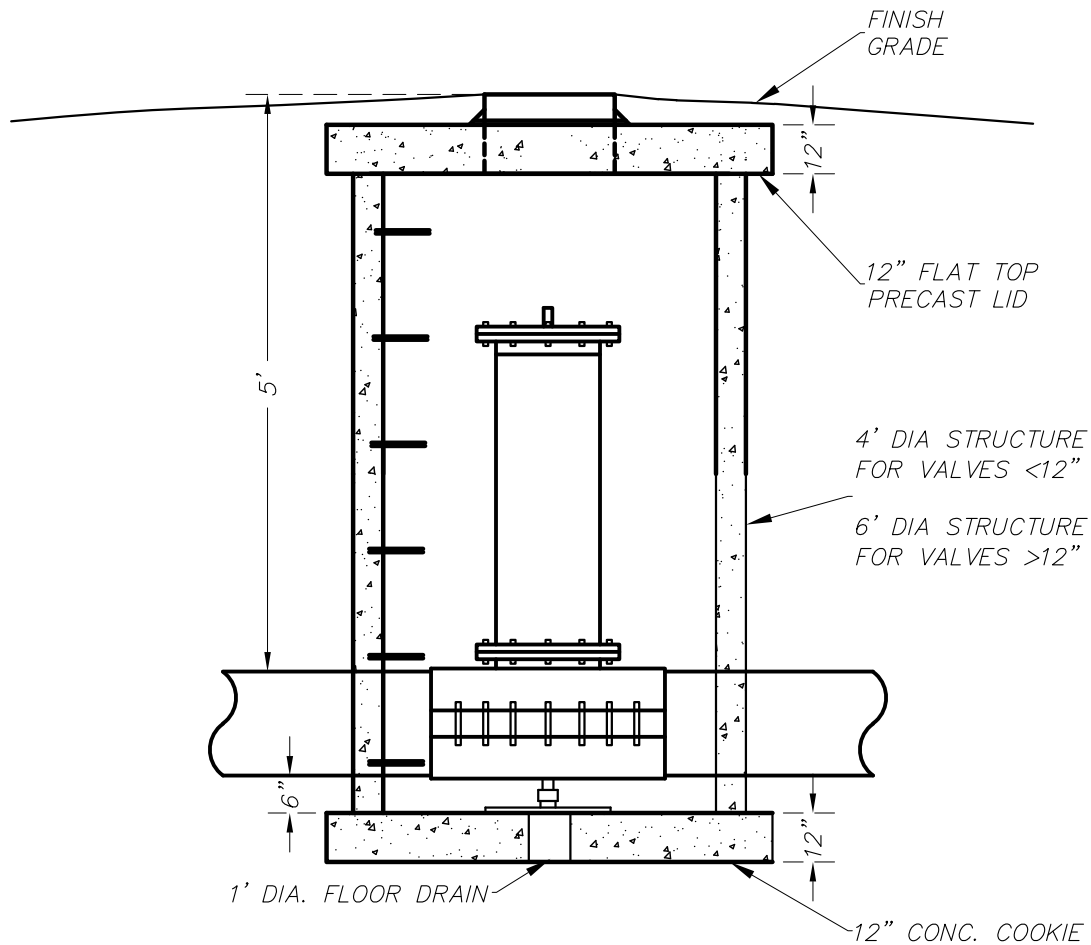
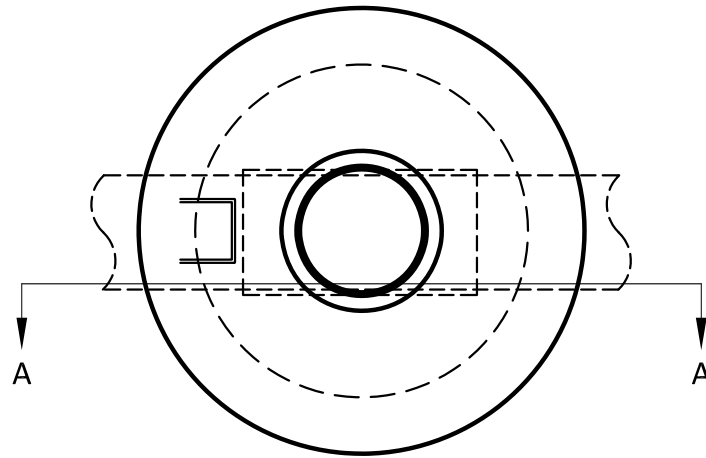
RECOMMENDED BY _____

APPROVED BY _____

APPROVED BY _____

ACCEPTED BY _____

DATE



TYPICAL INSERTA – VALVE
PRECAST REINFORCED CONCRETE SHOWN



CITY OF KALAMAZOO
 Department Of Public Services

**INSERTA-VALVE
 STRUCTURE**

RECOMMENDED BY _____

APPROVED BY _____

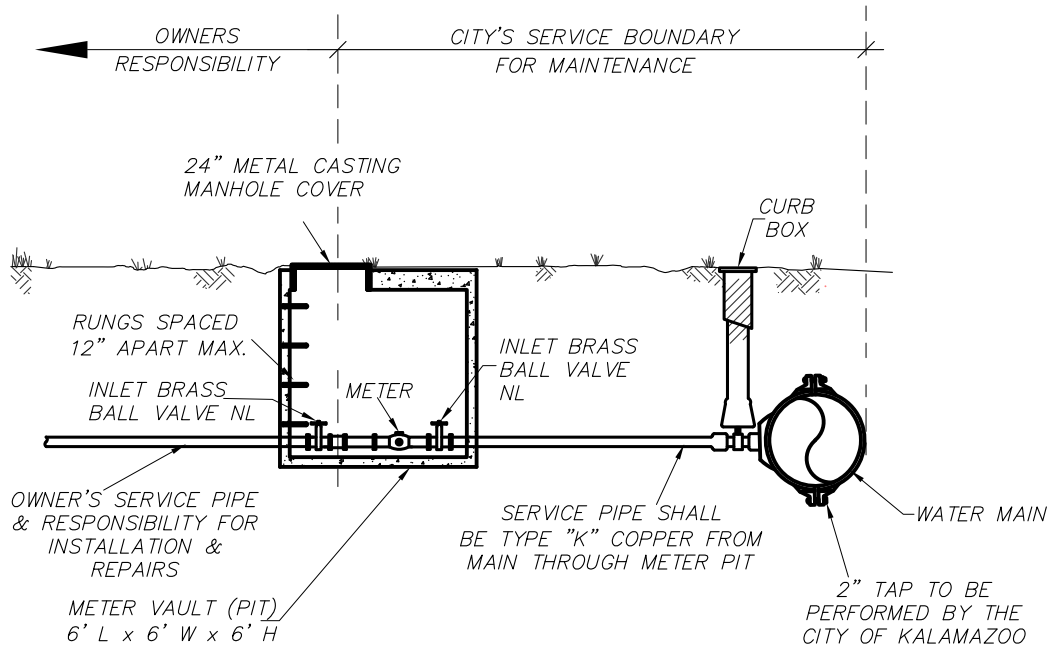
APPROVED BY _____

ACCEPTED BY _____

DATE

NOTES:

1. METER VAULT (PIT) DESIGN MUST BE SUBMITTED AND APPROVED FOR EACH INDIVIDUAL INSTALLATION. DESIGN SHALL CONFORM TO THE CITY OF KALAMAZOO STANDARD SPECIFICATIONS FOR WATER MAIN AND SERVICE INSTALLATION LATEST REVISION.
2. THE DISTANCE BETWEEN RUNGS, CLEATS & STEPS SHALL NOT EXCEED 12 INCHES AND SHALL BE UNIFORM THROUGHOUT THE LENGTH OF THE LADDER.
3. CURB BOX WILL BE INSTALLED AT THE WATER MAIN.
4. COVER FOR METER PIT & CURB BOX SHALL BE INSTALLED & MAINTAINED LEVEL WITH THE ADJACENT GROUND.



CITY OF KALAMAZOO
Department Of Public Services

**2" SERVICE LINE
METER VAULT**

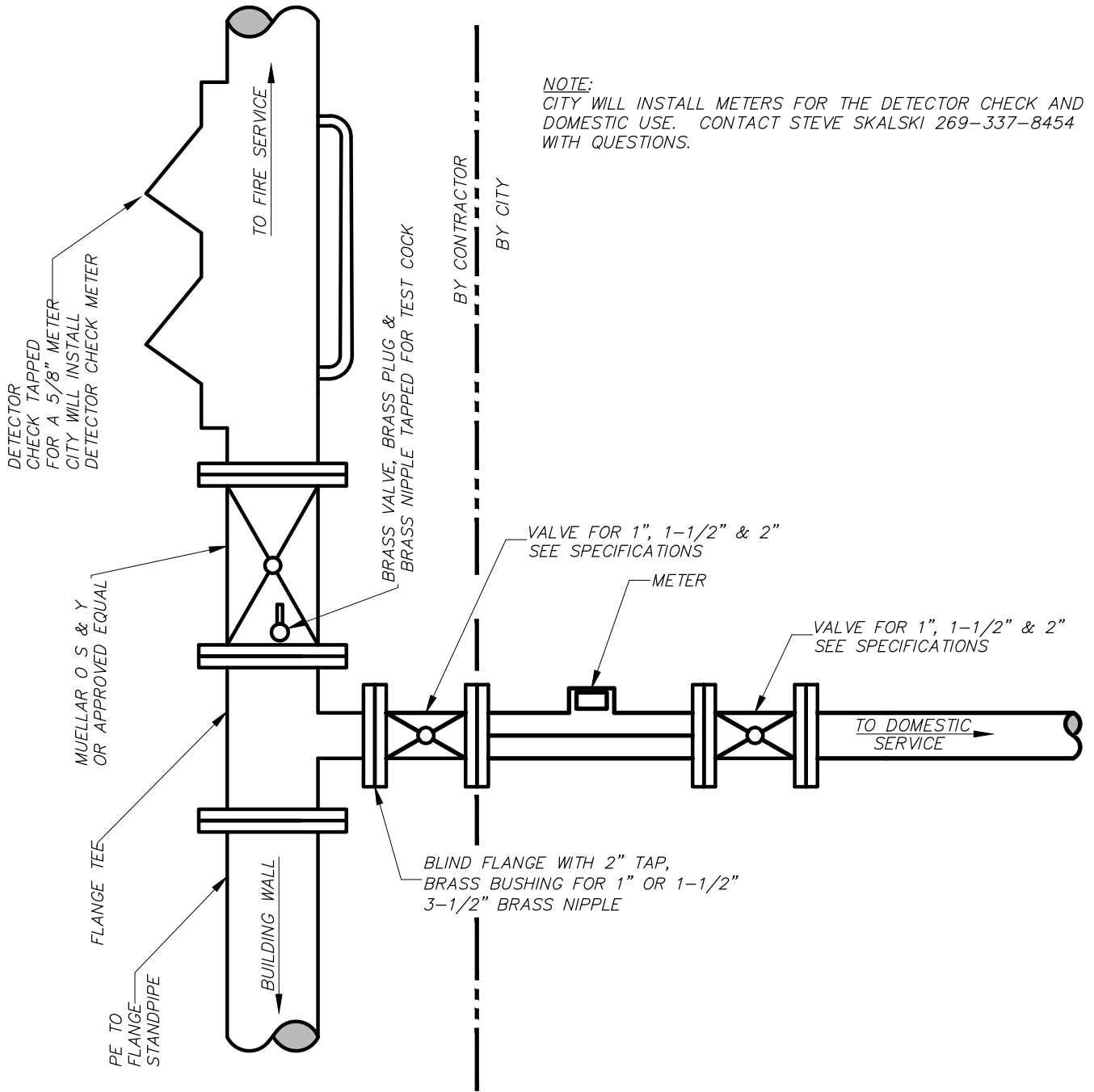
RECOMMENDED BY _____

APPROVED BY _____

APPROVED BY _____

ACCEPTED BY _____

DATE



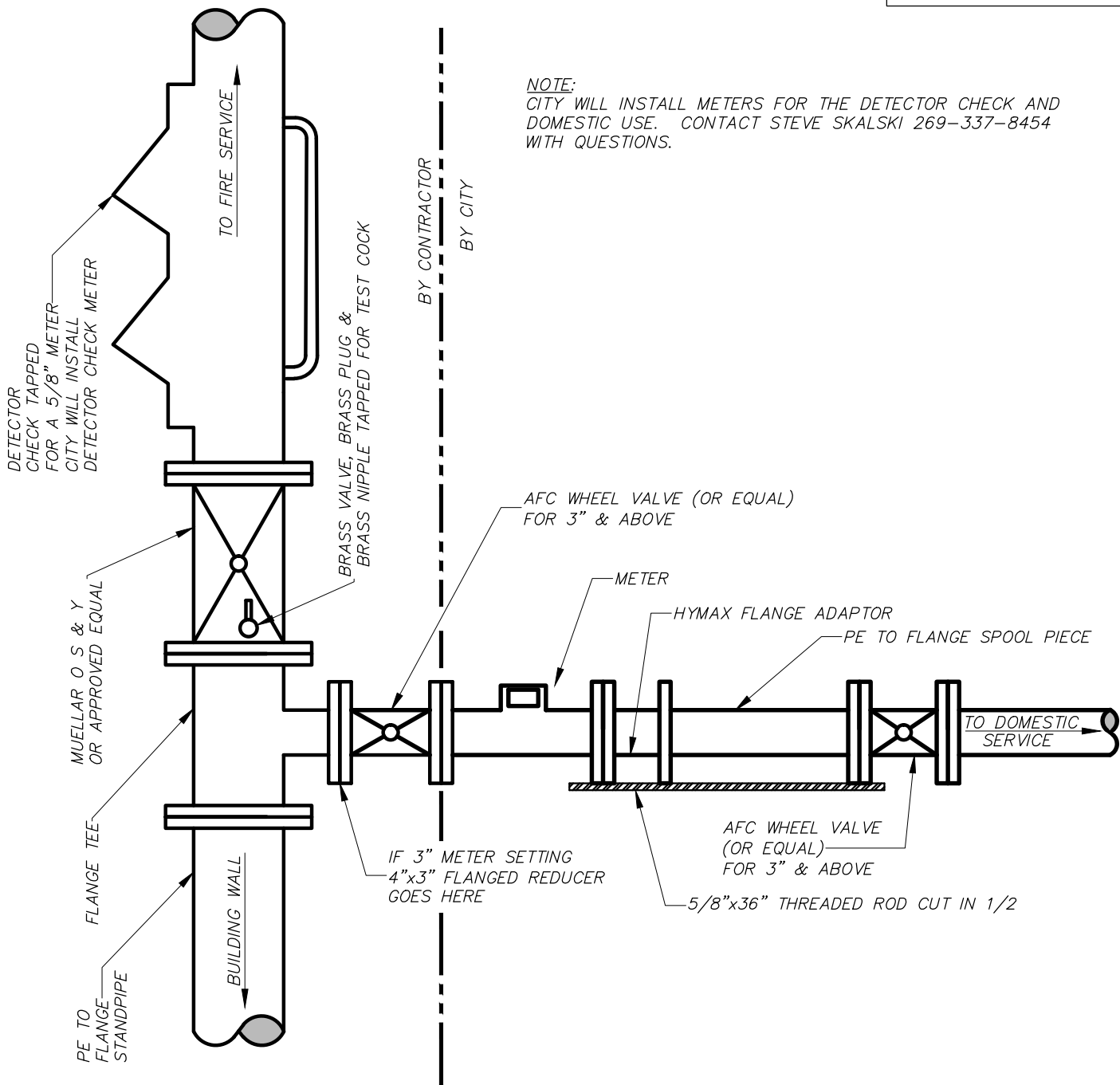
NOTE:
 CITY WILL INSTALL METERS FOR THE DETECTOR CHECK AND DOMESTIC USE. CONTACT STEVE SKALSKI 269-337-8454 WITH QUESTIONS.

BY CONTRACTOR
 BY CITY



CITY OF KALAMAZOO
 Department Of Public Services
**TYPICAL FIRE SERVICE
 DETAIL**
 1" 1-1/2" 2"

RECOMMENDED BY _____	DATE _____
APPROVED BY _____	
APPROVED BY _____	
ACCEPTED BY _____	

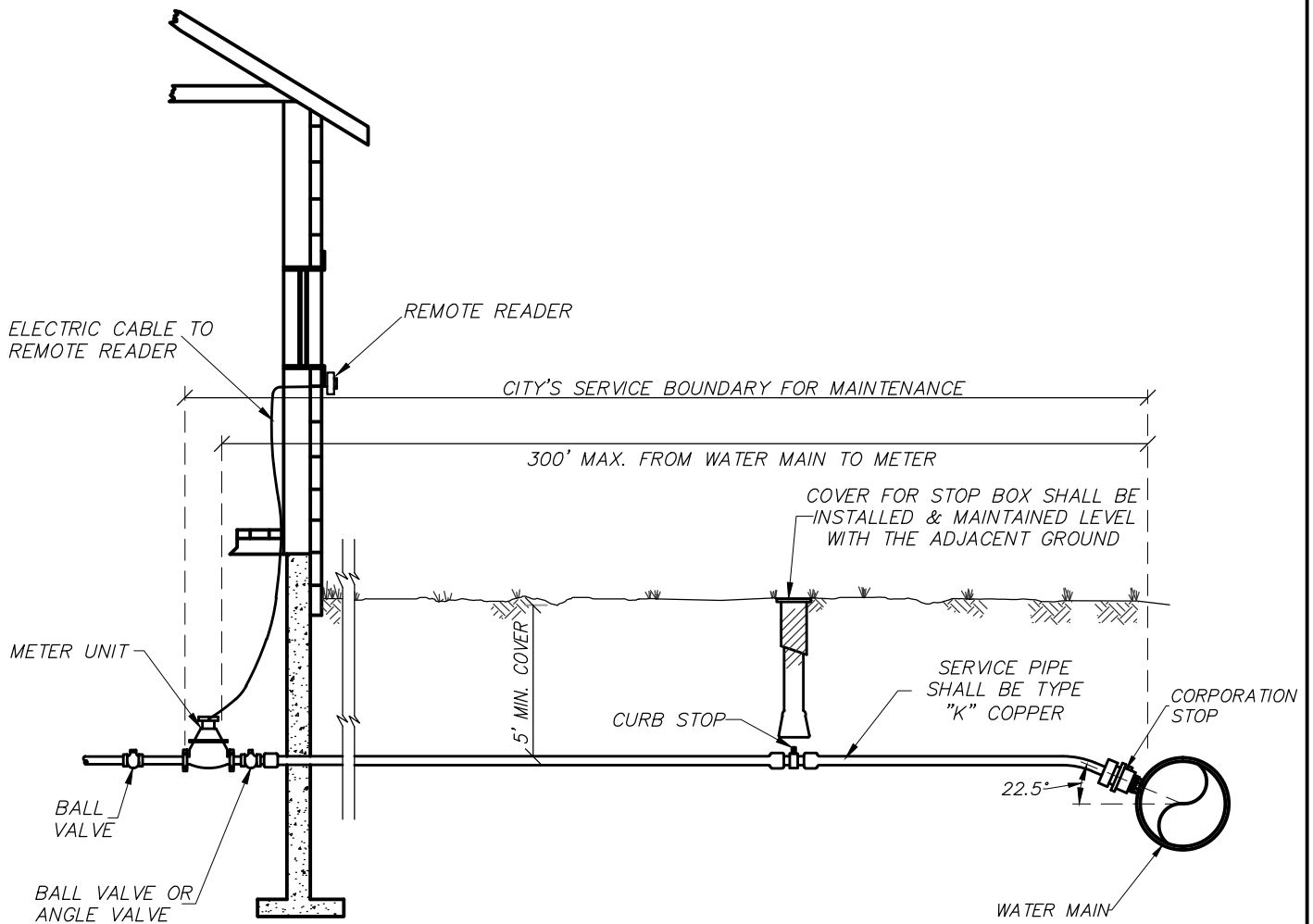


CITY OF KALAMAZOO
Department Of Public Services
**TYPICAL FIRE SERVICE
DETAIL**
3" 4" 6"

RECOMMENDED BY _____	DATE _____
APPROVED BY _____	
APPROVED BY _____	
ACCEPTED BY _____	

NOTES:

1. PLACEMENT OF STOP BOX CAN VARY FROM A MAXIMUM OF 5 FEET OUTSIDE THE PROPERTY LINE TO A MAXIMUM OF 5 FEET INSIDE THE PROPERTY LINE. PLACEMENT OF THE STOP BOX OUTSIDE THE PROPERTY LINE IS PREFERRED.
2. CITY WATER WILL REPAIR LEAKS ON SERVICE LINES WHEN NOTIFIED, FROM THE CORPORATION STOP TO METER.



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CITY OF KALAMAZOO
Department Of Public Services

**SERVICE LINE, STOP BOX AND
INSIDE METER INSTALLATION
1-1/4" SERVICE & 1" METER**

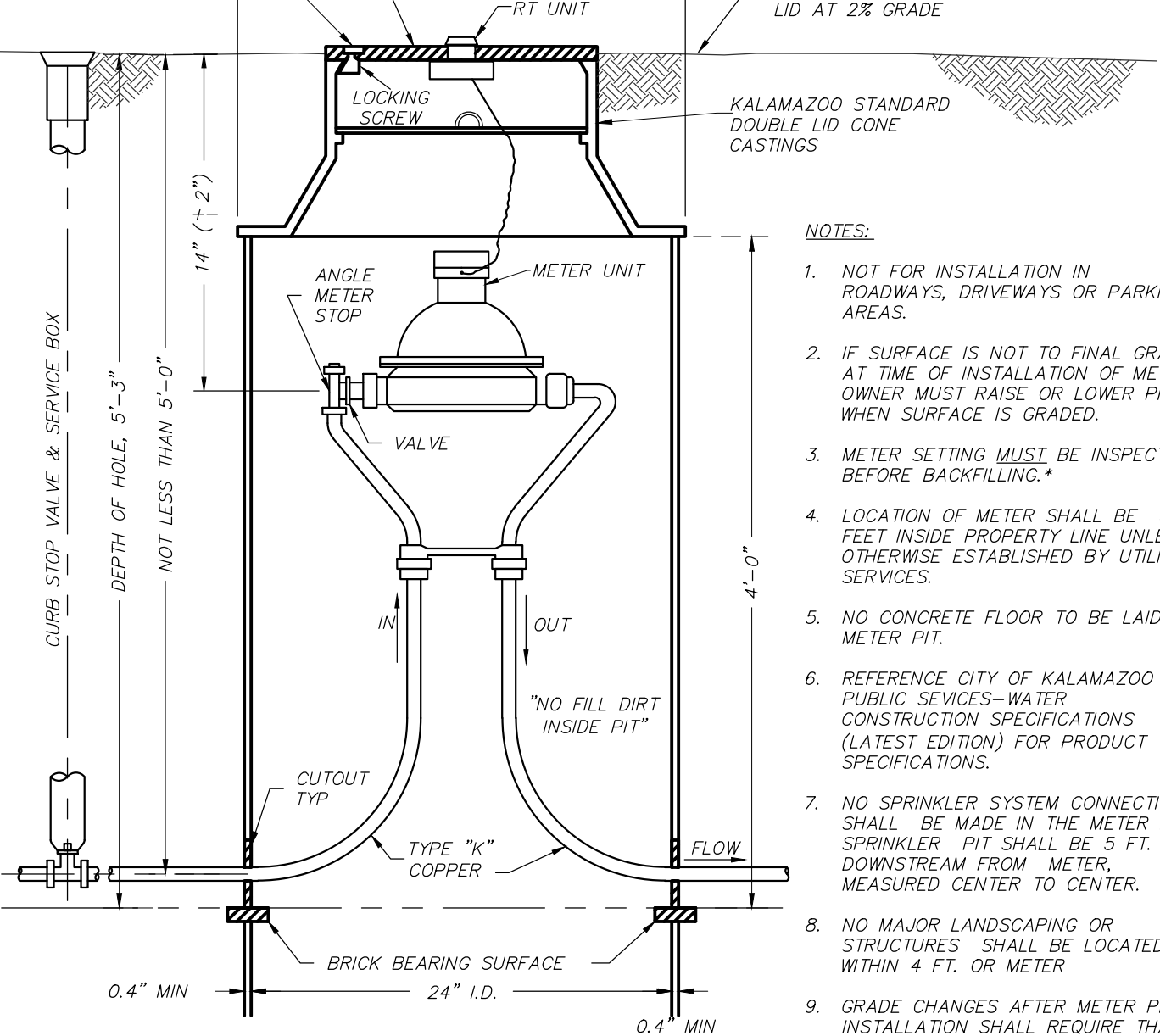
	RECOMMENDED BY _____	DATE
APPROVED BY _____		
APPROVED BY _____		
ACCEPTED BY _____		

WS-7-A

FORGED BRASS PENTAGON BOLT
(STANDARD KALAMAZOO
PENTAGON HEAD)

INSTALL TOP LID
1/2" ABOVE GROUND

GROUND SURROUNDING METER
PIT SHALL SLOPE AWAY FROM
LID AT 2% GRADE



NOTES:

1. NOT FOR INSTALLATION IN ROADWAYS, DRIVEWAYS OR PARKING AREAS.
2. IF SURFACE IS NOT TO FINAL GRADE AT TIME OF INSTALLATION OF METER, OWNER MUST RAISE OR LOWER PIT WHEN SURFACE IS GRADED.
3. METER SETTING MUST BE INSPECTED BEFORE BACKFILLING.*
4. LOCATION OF METER SHALL BE 5 FEET INSIDE PROPERTY LINE UNLESS OTHERWISE ESTABLISHED BY UTILITY SERVICES.
5. NO CONCRETE FLOOR TO BE LAID IN METER PIT.
6. REFERENCE CITY OF KALAMAZOO PUBLIC SERVICES-WATER CONSTRUCTION SPECIFICATIONS (LATEST EDITION) FOR PRODUCT SPECIFICATIONS.
7. NO SPRINKLER SYSTEM CONNECTIONS SHALL BE MADE IN THE METER PIT. SPRINKLER PIT SHALL BE 5 FT. DOWNSTREAM FROM METER, MEASURED CENTER TO CENTER.
8. NO MAJOR LANDSCAPING OR STRUCTURES SHALL BE LOCATED WITHIN 4 FT. OF METER
9. GRADE CHANGES AFTER METER PIT INSTALLATION SHALL REQUIRE THAT THE OWNER ADJUST METER PIT COVER TO 1/2" ABOVE FINAL GRADE.
10. IF PRESSURE REDUCING VALVE IS REQUIRED BY PLUMBING CODE, IT SHALL BE INSTALLED INSIDE THE BUILDING, IMMEDIATELY FOLLOWING THE MAIN SHUT OFF VALVE.
11. COPPER PIPE SHALL SHOW NO VISIBLE CRIMPING.

* FOR INSPECTION CALL (269) 998-6433 INSPECTOR
* FOR INSPECTION CALL (269) 337-8769 ENGINEER

J:\COK CAD STANDARDS\STANDARD DETAILS\WATER\UPDATED DRAWINGS\WS-7-A OUTSIDE METER 1 INCH.dwg, 4/1/2014 8:18:07 AM



CITY OF KALAMAZOO
Department Of Public Services

OUTSIDE SETTING FOR
1" METER

RECOMMENDED BY _____	DATE _____
APPROVED BY _____	
APPROVED BY _____	
ACCEPTED BY _____	

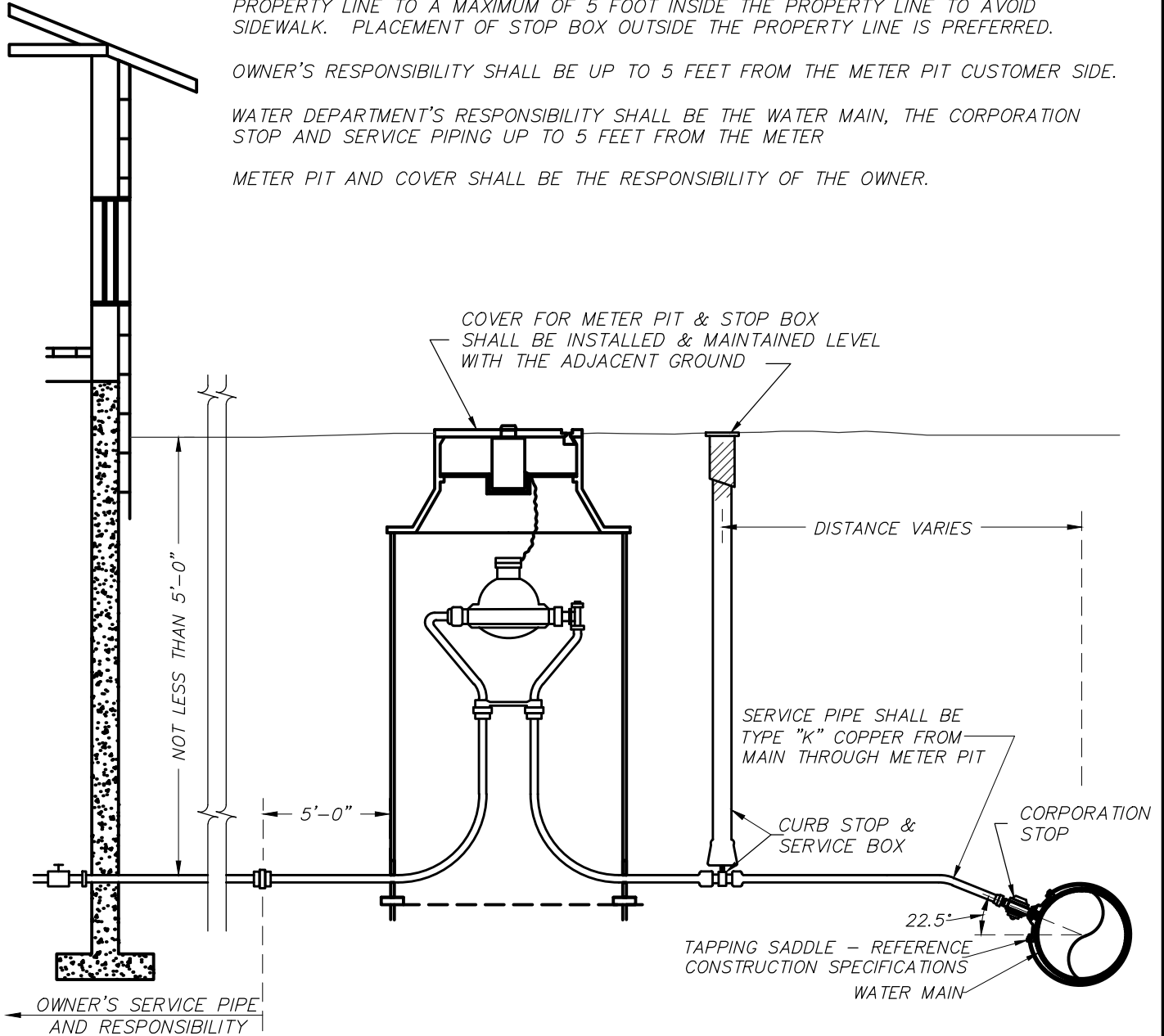
NOTES:

PLACEMENT OF STOP BOX CAN VARY FROM A MAXIMUM OF 5 FOOT OUTSIDE THE PROPERTY LINE TO A MAXIMUM OF 5 FOOT INSIDE THE PROPERTY LINE TO AVOID SIDEWALK. PLACEMENT OF STOP BOX OUTSIDE THE PROPERTY LINE IS PREFERRED.

OWNER'S RESPONSIBILITY SHALL BE UP TO 5 FEET FROM THE METER PIT CUSTOMER SIDE.

WATER DEPARTMENT'S RESPONSIBILITY SHALL BE THE WATER MAIN, THE CORPORATION STOP AND SERVICE PIPING UP TO 5 FEET FROM THE METER

METER PIT AND COVER SHALL BE THE RESPONSIBILITY OF THE OWNER.



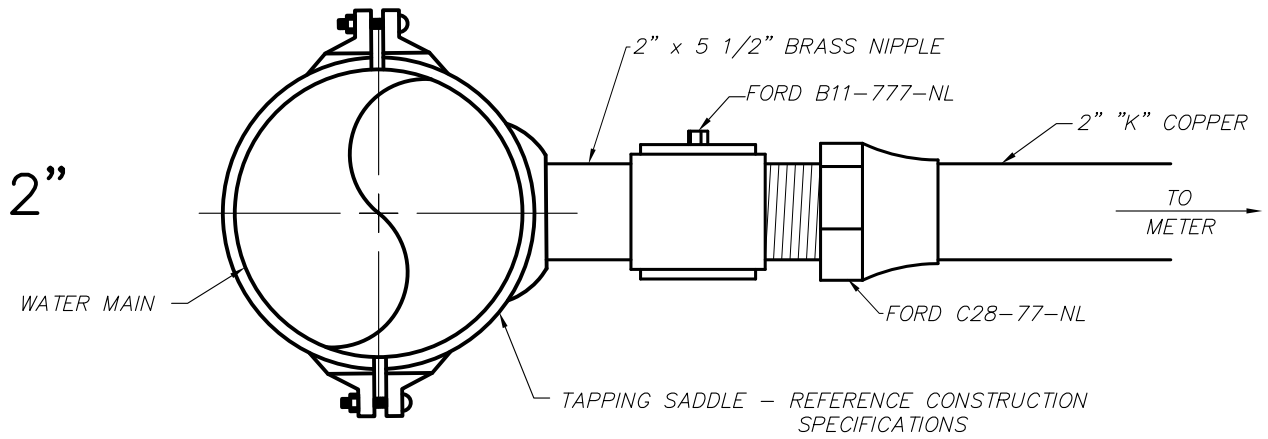
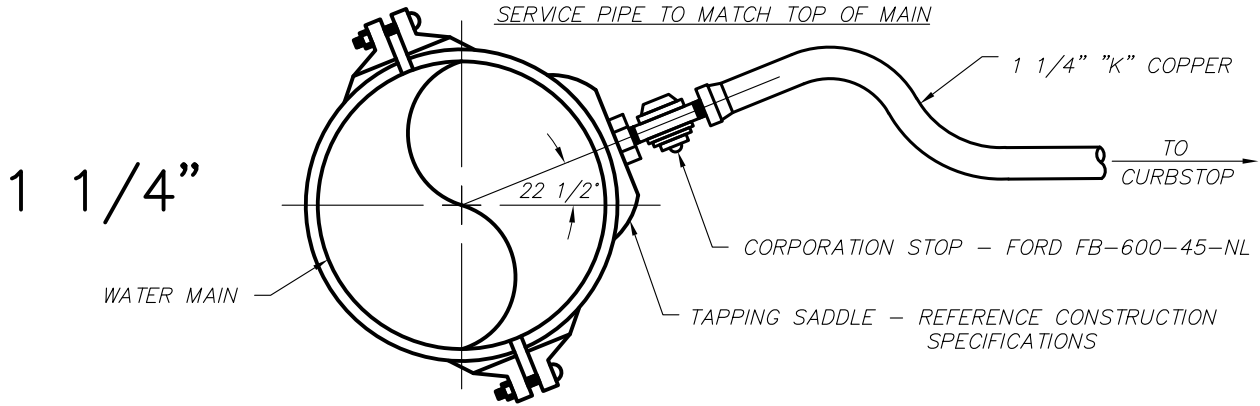
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CITY OF KALAMAZOO
Department Of Public Services

**1-1/4" SERVICE LINE,
STOP BOX AND OUTSIDE
METER INSTALLATION**

RECOMMENDED BY _____	DATE
APPROVED BY _____	
APPROVED BY _____	
ACCEPTED BY _____	



CITY OF KALAMAZOO
Department Of Public Services

**WATER SERVICE
TAPPING SLEEVE**

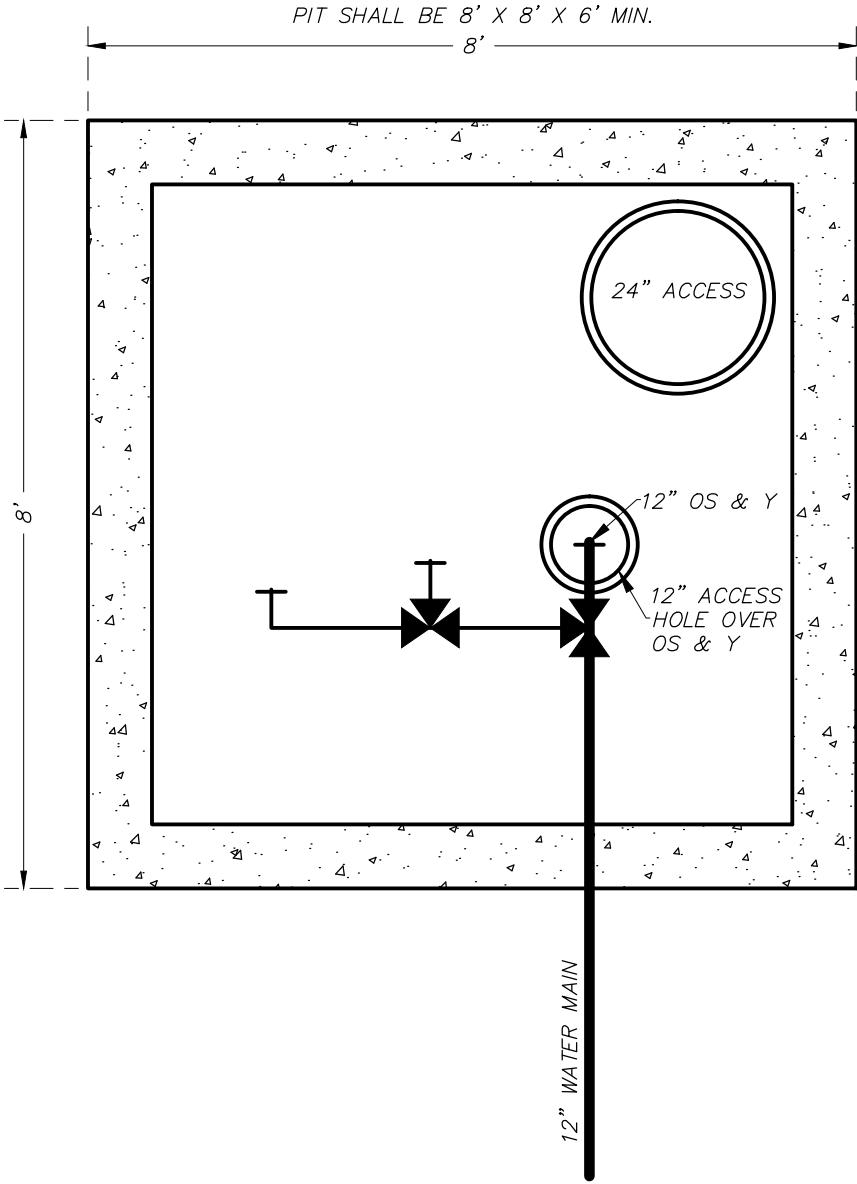
RECOMMENDED BY _____

APPROVED BY _____

APPROVED BY _____

ACCEPTED BY _____

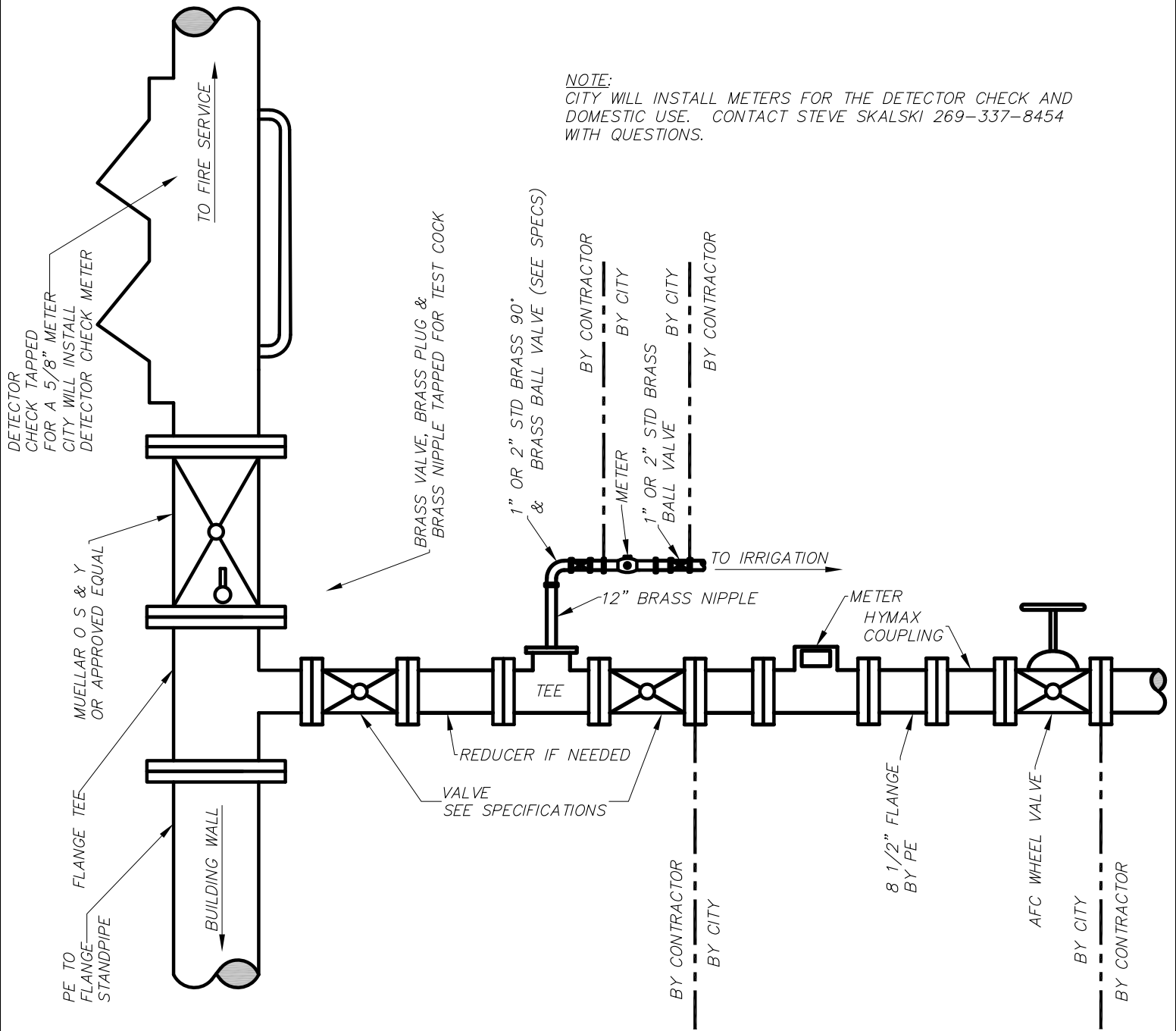
DATE



CITY OF KALAMAZOO
Department Of Public Services

12 INCH METER PIT

	DATE
RECOMMENDED BY _____	
APPROVED BY _____	
APPROVED BY _____	
ACCEPTED BY _____	



NOTE:
 CITY WILL INSTALL METERS FOR THE DETECTOR CHECK AND DOMESTIC USE. CONTACT STEVE SKALSKI 269-337-8454 WITH QUESTIONS.



**TYPICAL FIRE SERVICE
 DETAIL, DOMESTIC 3", 4",
 & 6" & IRRIGATION 1" OR
 2" VERTICAL SETTING**

RECOMMENDED BY _____

APPROVED BY _____

APPROVED BY _____

ACCEPTED BY _____

DATE

_____	_____
_____	_____
_____	_____
_____	_____

NOTE:
 CITY WILL INSTALL METERS FOR THE DETECTOR CHECK AND
 DOMESTIC USE. CONTACT STEVE SKALSKI 269-337-8454
 WITH QUESTIONS.

1" OR 2" STD. 90°
 W/1" OR 2" BRASS BALL VALVE
 OR FORD ANGLE VALVE
 (FV13-777W-NL) 2"
 (KV13-444W-NL) 1"

1" OR 2" X 12" BRASS NIPPLE

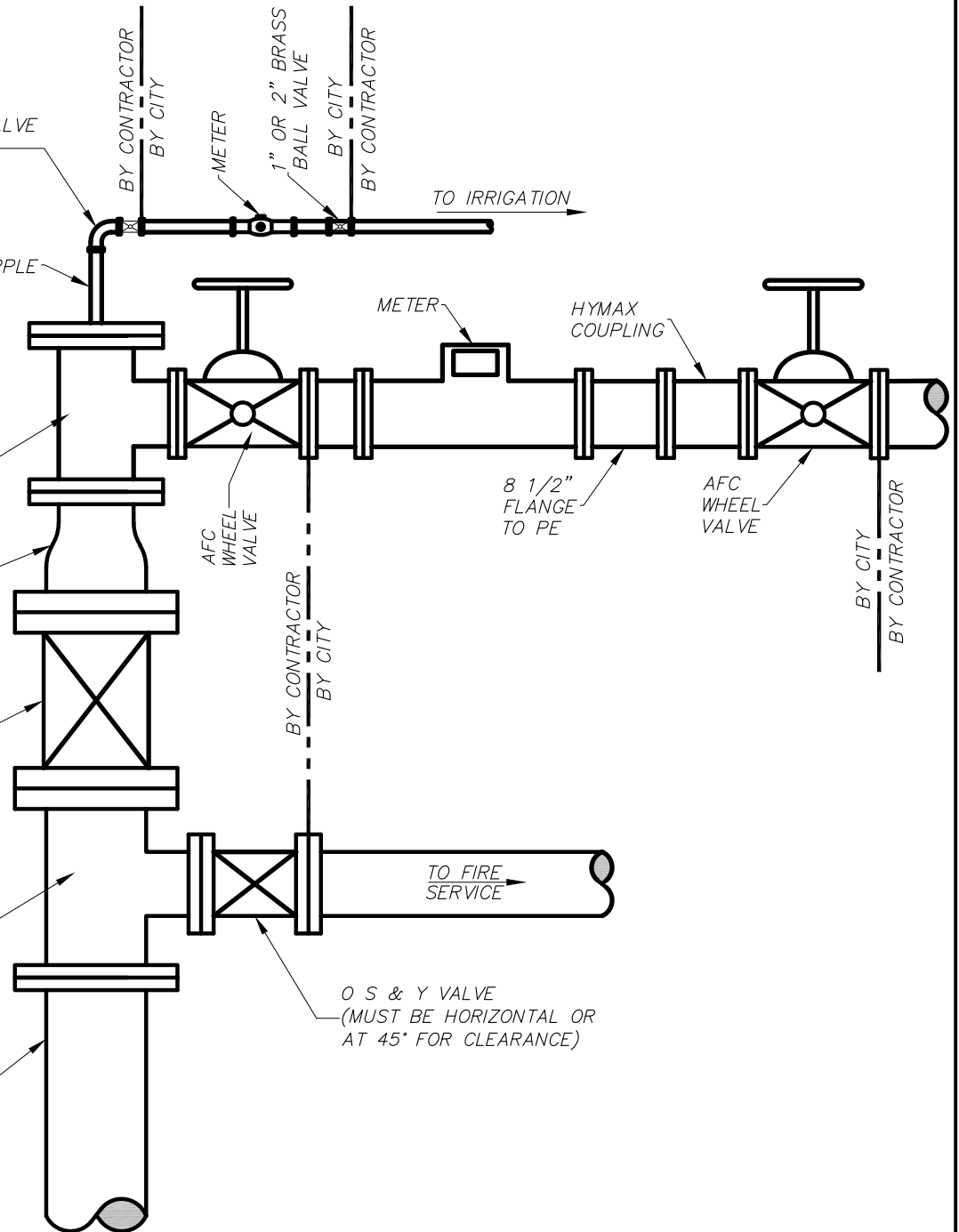
VALVE
 SEE SPECIFICATIONS

REDUCER
 (IF NEEDED)

TEE

TEE

PE TO
 FLANGE
 STANDPIPE



O S & Y VALVE
 (MUST BE HORIZONTAL OR
 AT 45° FOR CLEARANCE)

TO FIRE
 SERVICE

8 1/2"
 FLANGE
 TO PE

HYMAX
 COUPLING

METER

AFC
 WHEEL
 VALVE

AFC
 WHEEL
 VALVE

TO IRRIGATION

BY CONTRACTOR
 BY CITY

BY CONTRACTOR
 BY CITY

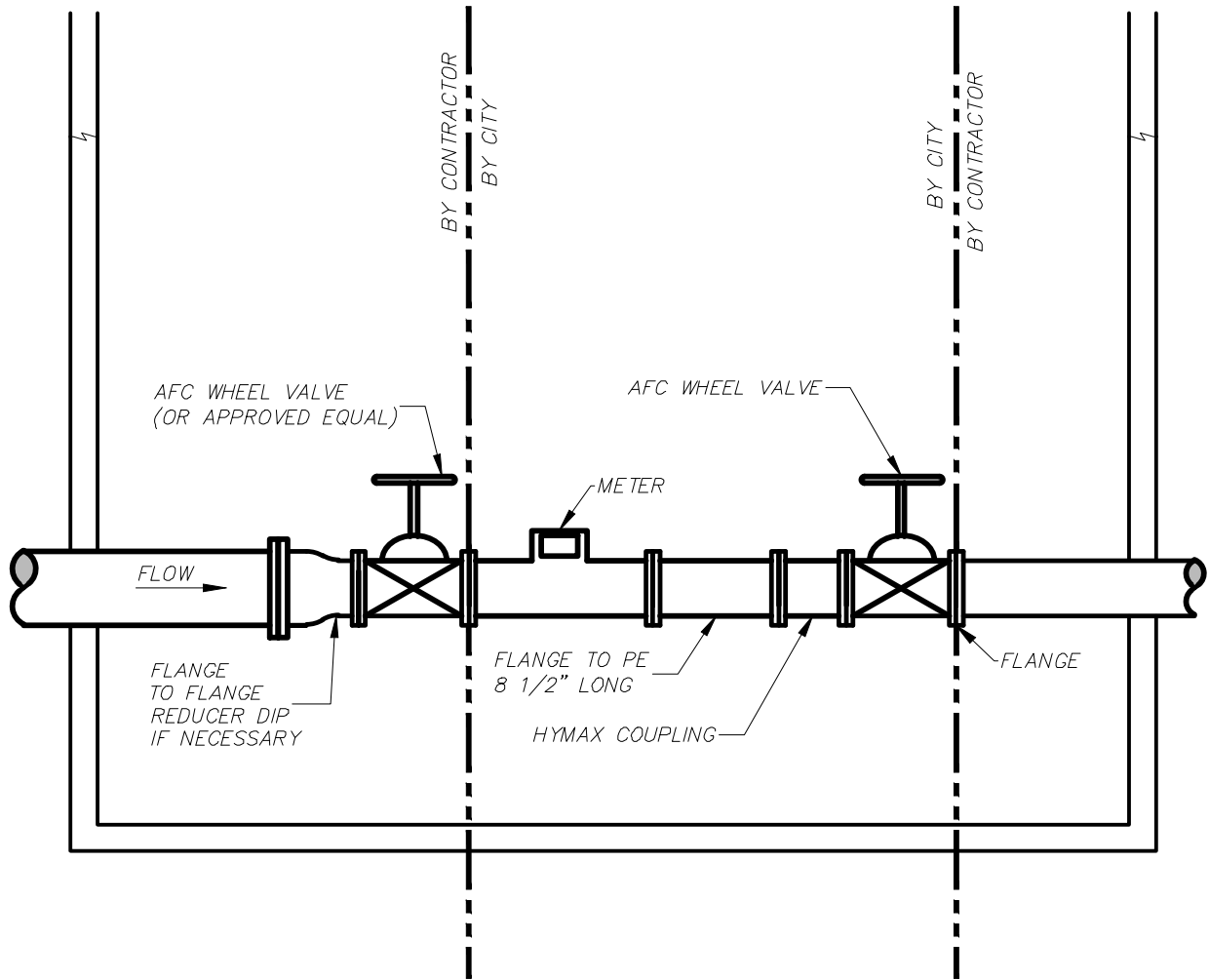
BY CONTRACTOR
 BY CITY



CITY OF KALAMAZOO
 Department Of Public Services
TYPICAL FIRE SERVICE DETAIL
HORIZONTAL SETTING
W/3", 4", OR 6" DOMESTIC
& 1" OR 2" IRRIGATION

RECOMMENDED BY _____	DATE _____
APPROVED BY _____	
APPROVED BY _____	
ACCEPTED BY _____	

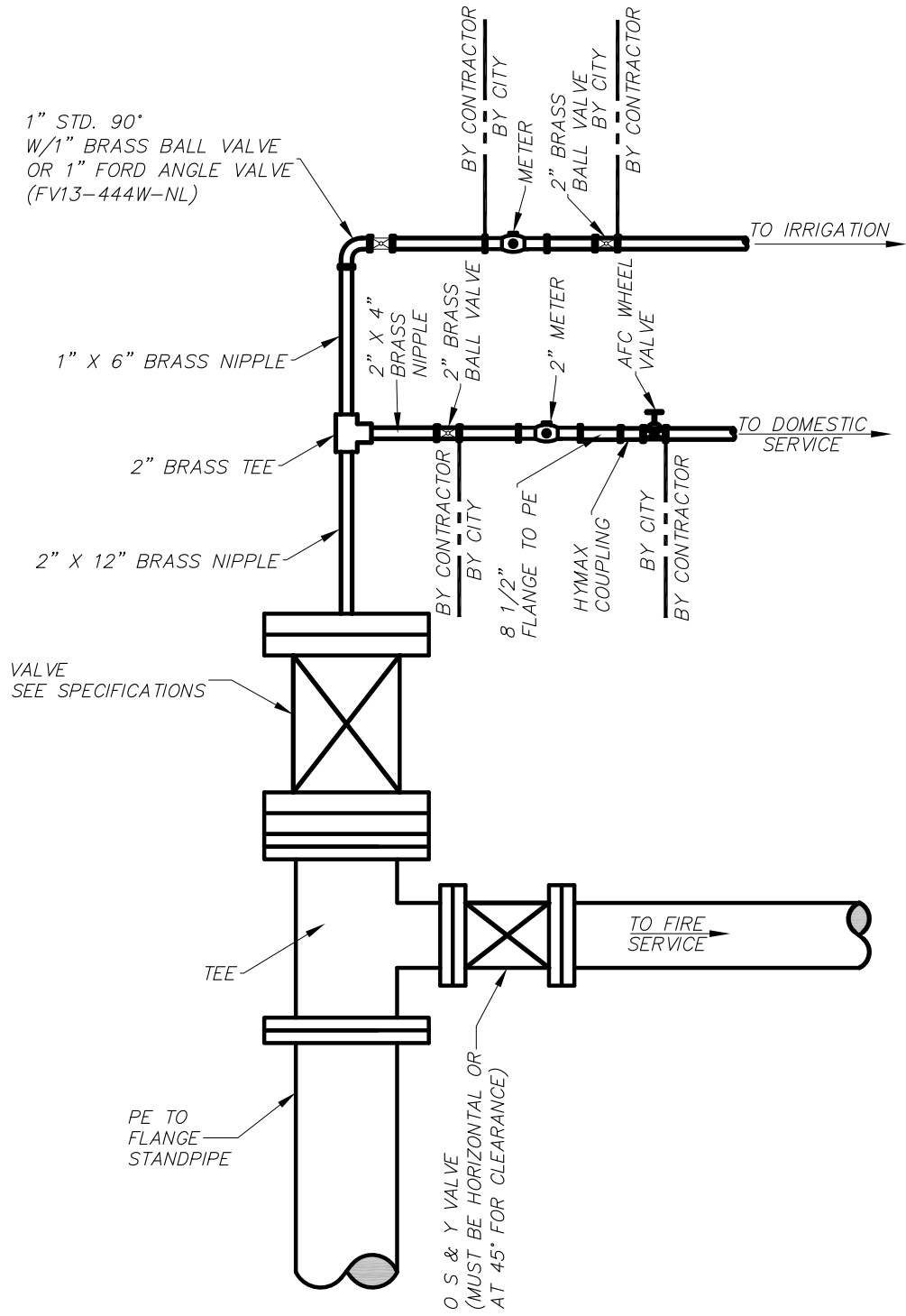
NOTE:
 CITY WILL INSTALL METERS FOR THE DETECTOR CHECK AND
 DOMESTIC USE. CONTACT STEVE SKALSKI 269-337-8454
 WITH QUESTIONS.



CITY OF KALAMAZOO
 Department Of Public Services
**PIT METER SETTING
 DETAIL FOR
 3", 4", 6" & 8"**

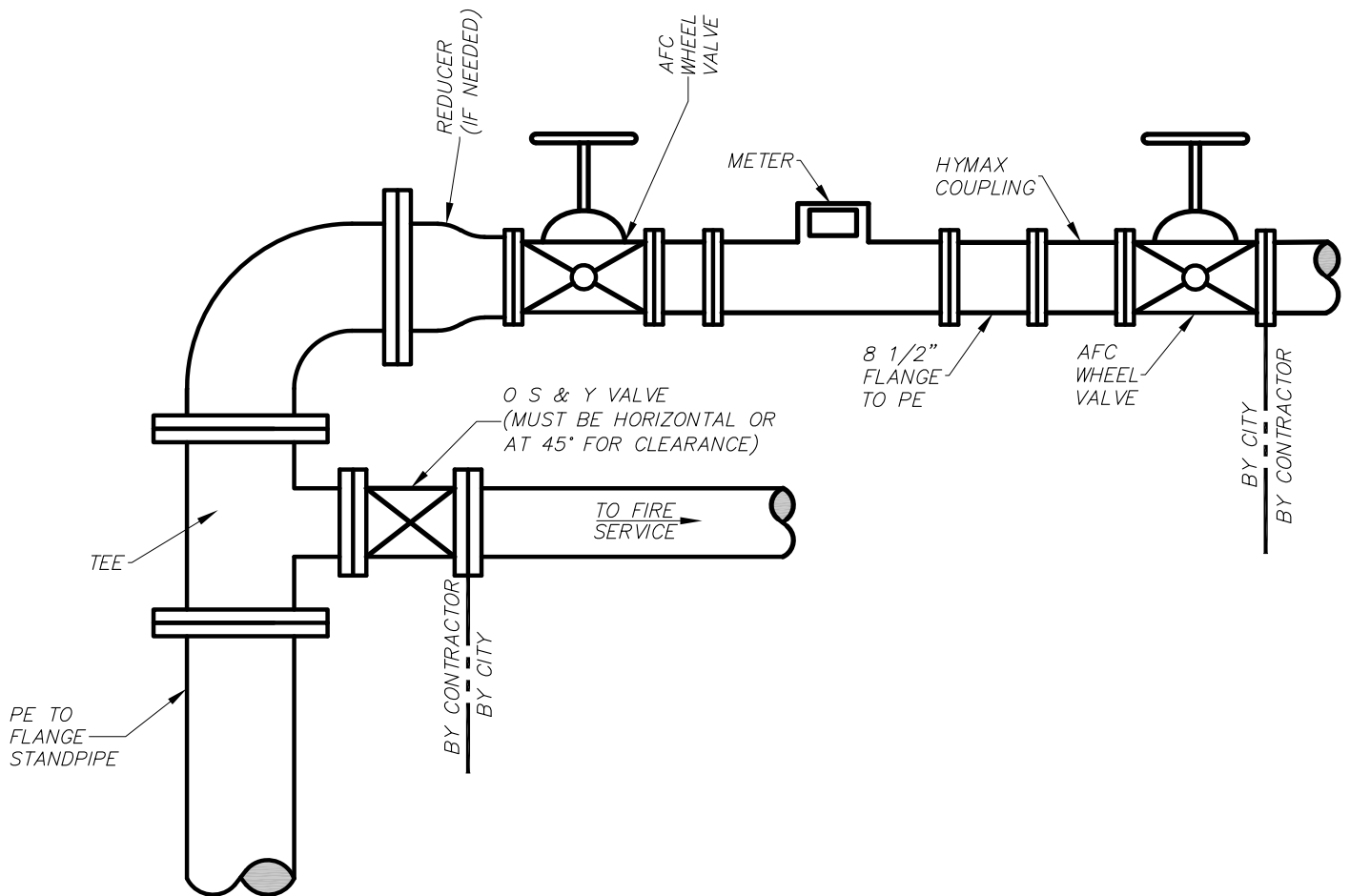
RECOMMENDED BY _____	DATE _____
APPROVED BY _____	
APPROVED BY _____	
ACCEPTED BY _____	

NOTE:
CITY WILL INSTALL METERS FOR THE DETECTOR CHECK AND DOMESTIC USE. CONTACT STEVE SKALSKI 269-337-8454 WITH QUESTIONS.



	CITY OF KALAMAZOO Department Of Public Services	RECOMMENDED BY _____	DATE _____
	TYPICAL FIRE SERVICE DETAIL HORIZONTAL SETTING 2" DOMESTIC 1" IRRIGATION	APPROVED BY _____	
		APPROVED BY _____	
		ACCEPTED BY _____	

NOTE:
 CITY WILL INSTALL METERS FOR THE DETECTOR CHECK AND
 DOMESTIC USE. CONTACT STEVE SKALSKI 269-337-8454
 WITH QUESTIONS.



CITY OF KALAMAZOO
 Department Of Public Services

**TYPICAL FIRE SERVICE DETAIL
 HORIZONTAL SETTING
 W/3", 4", OR 6" DOMESTIC**

RECOMMENDED BY _____

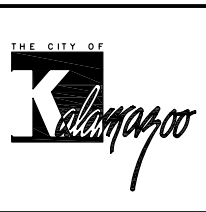
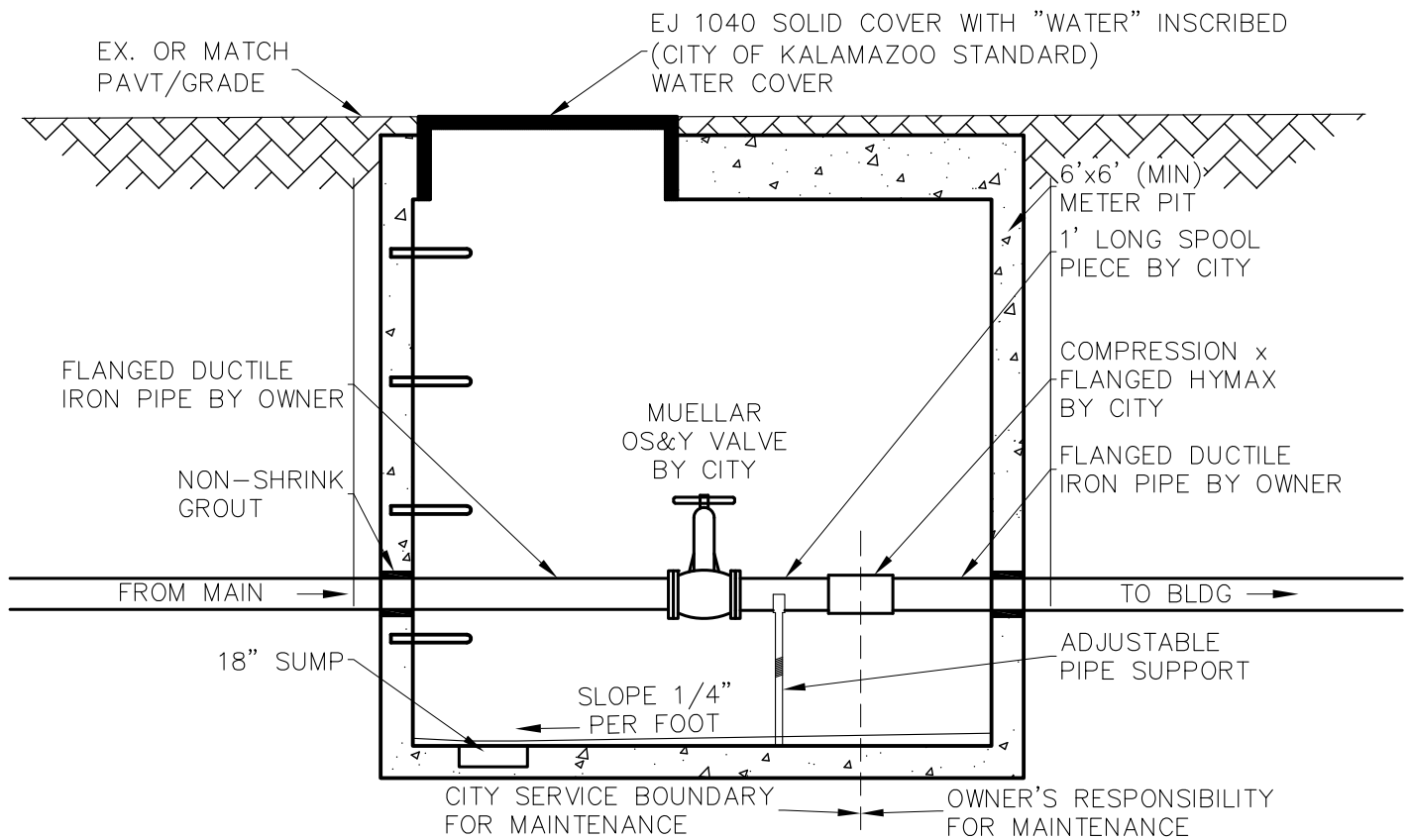
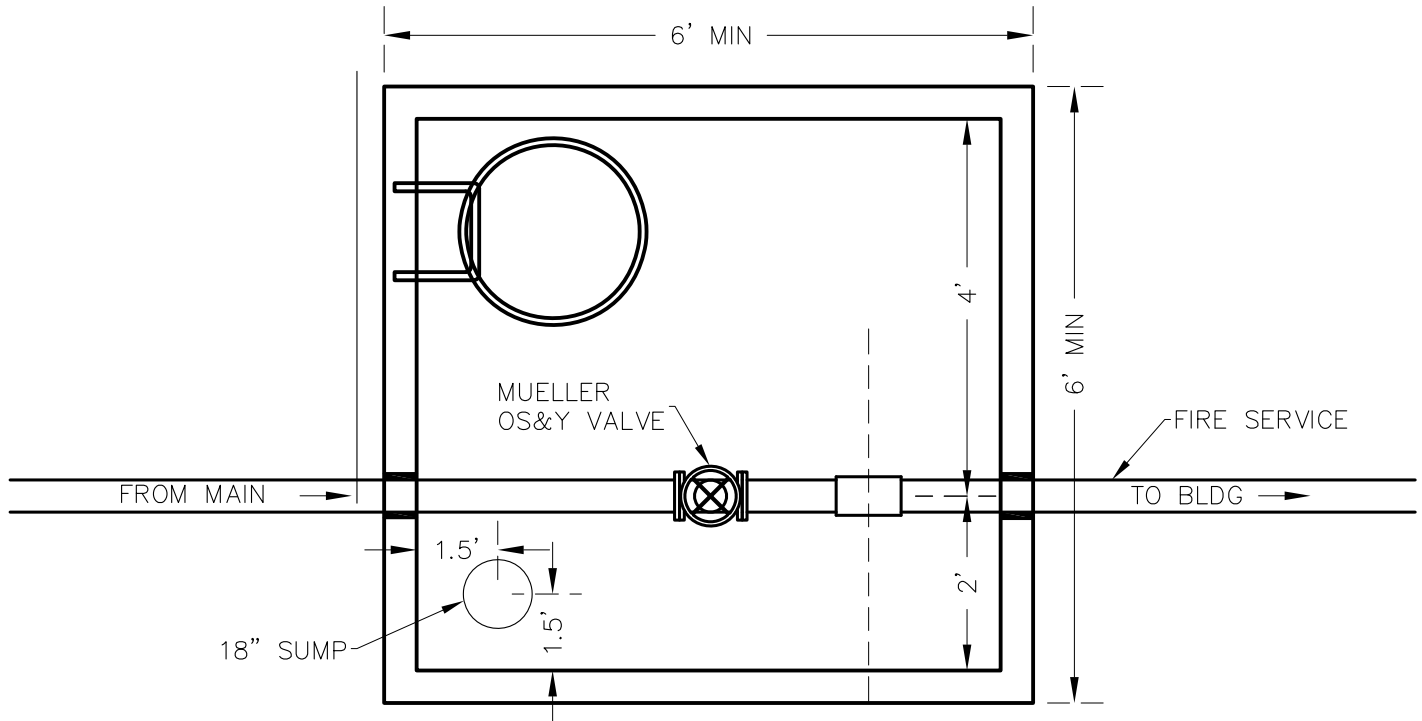
APPROVED BY _____

APPROVED BY _____

ACCEPTED BY _____

DATE

WS-16-A



CITY OF KALAMAZOO
Department Of Public Services

**FIRE SERVICE
IN PIT DETAIL**

RECOMMENDED BY _____	DATE _____
APPROVED BY _____	
APPROVED BY _____	
ACCEPTED BY _____	

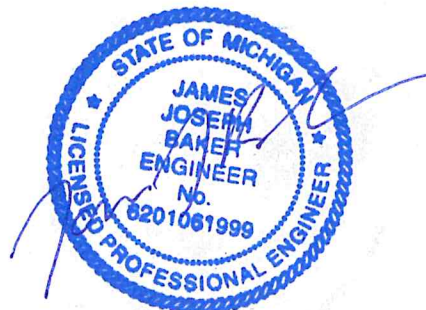
**CITY OF KALAMAZOO
DEPARTMENT OF PUBLIC SERVICES**

WASTEWATER DIVISION



PUBLIC SERVICES DEPARTMENT
WASTEWATER DIVISION
1415 N. HARRISON ST.
KALAMAZOO, MI 49007
PHONE: 269-337-8736
FAX: 269-337-8551

**STANDARD SPECIFICATIONS FOR
COLLECTOR SEWERS AND SERVICE INSTALLATIONS
2026**



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APPROVAL	
CITY OF KALAMAZOO, MICHIGAN	
JAMES J. BAKER, PE PUBLIC SERVICES DIRECTOR & CITY ENGINEER	2-10-26 DATE

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SPECIFICATIONS FOR SANITARY SEWER

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

This section includes furnishing and installing sanitary sewer (gravity and force main) pipe of the specified sizes in a trench and includes the construction of manholes, lateral connections to adjacent properties, valves, air release valves and other appurtenant work, including excavating, trenching and backfilling, and surface restoration. The work also includes the necessary clearing, sheeting and shoring, boring and jacking, dewatering, pipe embedment, and other appurtenant work.

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

Codes and standards referenced in the following specifications must be the current code or standard in effect at the time proposals are received.

1.02 SUBMITTALS

A. Submittals shall be the responsibility of the Contractor:

1. Shop Drawings for Review:
 - a. Manufacturer's Shop Drawings indicating physical dimensions, and joint details for each size, type, and class of pipe, fittings and specials furnished for the project.
2. Information for the Record:
 - a. Manufacturer's certification indicating that the pipe and joints meet specifications for each production run for each size, type, and class of pipe furnished. The Engineer may request test results to verify certification. Certification documents must be according to the Source Quality Control of this Section.
 - b. Manufacturer's installation instructions.
 - c. The laboratory must submit test certifications of pipe ordered tested under "Field Quality Control", of this Section.
3. Engineer may request additional Shop Drawings or Information for the Record as required.
4. Requests for approved equals must be submitted to the Engineer for review a minimum of two (2) weeks prior to bid.

1.03 AS CONSTRUCTED RECORD

A. During construction the Contractor must be required to keep current a set of "as constructed" drawings. Before final payment can be made, the Contractor must submit for approval to the City of Kalamazoo the complete set of as constructed drawings. Each set of "as constructed" drawings must be labeled "As Constructed", dates, and contain at a minimum the following information (additional information may be required by the City of Kalamazoo):

Structures:

1. Rim Elevations
2. Diameter
3. Pipe Sizes
Orientation &
Invert Elevations
4. Depth of Structure

Pipes:

1. Diameter
2. Length
3. Material
4. Slope

Laterals:

1. Address
2. Wye Station
3. Wye Elevation
4. Property Line Elevation
5. Wye Depth
6. Cleanout Depth
7. Diameter
8. Lead Length
9. Riser Height
10. Distance from DS MH
11. Tie downs of CO and
horizontal bends

PART 2 MATERIALS

All materials furnished by the Contractor must conform to the following specifications. Contractor must provide certified affidavits of compliance and/or manufacturer strength test reports to the Engineer upon request.

GRAVITY SEWER**2.01 SEWER PIPE**

All sewer pipe must be of the materials and strengths shown on the Drawings or as specified below.

A. Polyvinyl Chloride (PVC) Solid Wall Pipe

PVC solid-wall pipe less than 18 inches in diameter must conform to the requirements of ASTM D3034, with a minimum wall thickness equal to a standard dimension ratio of 35 (SDR-35).

PVC solid-wall pipe 18 inches in diameter and larger must conform to the requirements of ASTM F679, with a minimum pipe stiffness of 46 psi (PS-46).

Installations over 18 feet deep, based on the average depth of the manholes for each section of pipe, must utilize SDR-26 or PS-115 pipe.

Pipe must be made of PVC compound having a cell classification of 12454 or 12364 in accordance with ASTM D1784.

B. PVC Composite (Truss Pipe)

PVC Truss Pipe must conform to the requirements of ASTM D2680.

The PVC compound used in the Truss pipe must have a minimum cell classification of 12454 in accordance with ASTM D1784.

C. Profile PVC Pipe

Profile PVC pipe may be used only when specifically approved by the Owner and Engineer.

Profile PVC pipe must conform to the requirements of ASTM F794 and F949 for dual wall corrugated profile pipe, and ASTM F1803 for closed profile pipe.

Pipe must have a minimum pipe stiffness of 46 psi (PS-46).

Pipe must be made of PVC compound having a cell classification of 12454 or 12364 in accordance with ASTM D1784.

D. PVC Pipe Joints

Joints must be flexible elastomeric sealed type joint in accordance with ASTM D3212.

Gasket materials must meet requirements of ASTM F477.

Joint lubricant must be supplied and/or approved by the pipe manufacturer and must have no detrimental effect on the gasket or pipe.

2.02 SEWER FITTINGS

Fittings must be cast of the same material as the main sewer or may be an approved fabricated special fitting. Fitting joints must meet the same standards as the adjoining sewer.

Fittings must be manufactured and supplied in accordance with ASTM D3034 or ASTM F679. PVC molded and fabricated fittings may be supplied in accordance with ASTM F1336. Fittings must be heavy wall SDR 26, unless otherwise specified. Pipe used in fabricated fittings must have a wall thickness equal to or greater than the wall thickness of the pipes to which the fitting will be joined.

A. Wyes and Tees

Details of special fittings and/or adapters for connecting laterals of a material different from the main sewer must be approved by the Engineer before they are manufactured. Fabricated special fittings must provide a suitable connection for the lateral to the main sewer.

Wyes and Tees will be required as follows:

6" Wyes on main sewer of up to 24" diameter

6" Inserta-Tee, Kor-N-Tee, or approved equal, on main sewer of 24" diameter or larger.

B. Couplings

Couplings used to connect new and existing sanitary sewer piping must be gasketed solid sleeve PVC couplings where possible. PVC couplings must meet sewer fittings specification herein.

Where solid sleeve PVC couplings cannot be utilized, flexible transition couplings in accordance with ASTM C1173 and ASTM D5926 may be utilized, subject to Engineer approval.

Flexible transition couplings must be appropriately sized for the connecting materials and must include stainless steel clamp bands and an external stainless steel shear ring with a minimum thickness of 0.012". Coupling must be Fernco Strong Back RC Couplings, Indiana Seal Couplings with Amazon Shear Rings, or Engineer approved equal.

2.03 SANITARY SEWER LATERALS

A. Lateral Piping

Sewer lateral piping must be PVC solid-wall pipe conforming to the requirements of ASTM D3034, with a standard dimension ratio of 26 (SDR-26).

PVC pipe joints and PVC compound must meet the sanitary sewer pipe material specification herein.

B. Lateral Fittings

Sewer lateral fittings must be manufactured and supplied in accordance with ASTM D3034. Molded and fabricated fittings may be supplied in accordance with ASTM F1336. Fittings must be heavy wall SDR 26, unless otherwise specified. Pipe used in fabricated fittings must have a wall thickness equal to or greater than the wall thickness of the pipes to which the fitting will be joined.

Any specified bends must be smooth, long-radius type curves. No mitered or segmental type bends will be approved.

Joints must be flexible elastomeric sealed type joint in accordance with ASTM D3212. Gasket materials must meet requirements of ASTM F477 or ASTM F913.

Fittings must be made of PVC compound having a cell classification of 12454 or 13343 in accordance with ASTM D1784.

C. Lateral Couplings

Lateral couplings must meet the requirements for sanitary sewer pipe couplings.

D. Lateral Plugs

Plugs, stoppers, or glued caps for plugging the ends of laterals or risers which are not extended must make a watertight seal and be of such a design that they can be readily removed without damage to the pipe.

2.04 CEMENT MORTAR

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

The sand and cement must be mixed dry in a clean tight box until a mixture of uniform color is produced, after which water must be added until the required consistency is obtained. Mortar must be mixed only in such quantities as needed for immediate use. The retempering of mortar will not be permitted.

A. Cement

Portland Limestone Cement must conform to the requirements for Type 1L of the MDOT 2020 Standard Specifications for Construction for Portland Cement, ASTM C595.

B. Masonry Sand

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

C. Water

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

2.05 CONCRETE

Concrete for pipe encasement, special pipe embedment, manhole bases and similar items must meet the requirements of the MDOT 2020 Standard Specifications for Construction for Grade 3000 concrete. Grade 3000 concrete must have a minimum compressive strength of 3,000 psi at 28 days.

2.06 MANHOLE MATERIALS

A. Precast Units

Unless otherwise specified, all manholes must be precast and watertight.

Where manholes are anticipated to have corrosive conditions due to septicity, force main connection or other causes, additional corrosion protection or alternative manhole materials may be specified on the Drawings or in the Project Specifications.

Precast reinforced concrete manhole risers and precast reinforced concrete manhole conical top sections must conform to the requirements of ASTM C478. Bituminous waterproofing must be applied to the outer surface of the manhole at a rate of one gallon per 100 square feet. Manholes must be free of holidays and open pinholes.

Unless otherwise specified, joints for precast sections must be premium rubber joints conforming to the requirements of ASTM C443. Rubber gaskets must meet the physical requirements of ASTM C1619.

B. Steel Reinforcement

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

C. Flexible Manhole Connectors (Rubber Boots)

Flexible manhole connectors (also called rubber boots) must be "Kor-N-Seal" by Trelleborg, "PSX: Direct Drive" by Press Seal Gasket Corporation; or approved equal. Flexible manhole connectors must conform to the requirements of ASTM C923.

D. Manhole Steps

Unless otherwise specified, manhole steps must be plastic coated steel steps conforming to the requirements of ASTM Designation C478, or approved equal, spaced at sixteen inches (16") on center.

E. Adjusting Rings

Unless otherwise specified, adjusting rings must be:

1. Precast and conform to the requirements of ASTM C478.
2. Black Expanded Polypropylene (EPP) adjusting rings.
3. Black Recycled Rubber adjusting rings.
4. Cretex Pro-Rings.

Products:

- Flex-O-Ring, American Highway Products
- Pro-Ring, Cretex Specialty Products
- Infra-Riser, East Jordan Iron Works

F. 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 provided with a minimum 24-inch opening and must be as follows:

General use: EJ No. 1045Z Frame and EJ No. 1040A Cover (Part Number 00104076) or approved equal.

Off Road/Cross Country Locations: EJ No.1045ZPT Frame and EJ No. 1040APT (bolted) or approved equal.

G. Adjusting Drainage Structures

Furnish materials in accordance with subsection 403.02 of the Standard Specifications for Construction with the following exceptions:

Furnish Concrete, Grade 3500 or Grade P-NC as directed by the Engineer in accordance with sections 1004 and 1006 of the Standard Specifications for Construction, respectively. Furnish epoxy anchored lane ties in accordance with section 914 of the Standard Specifications for Construction. Ensure the lane ties are #5 bar size with a nominal length of 18 inches. Ensure the circular bar for the rotary cut application is epoxy coated #5 bar of a diameter that will center it between the structure cover and the existing surrounding pavement. Select epoxy for anchoring lane ties into the concrete from section 712.03J of the Qualified Products List. Furnish hot-poured joint sealant in accordance with section 914 of the Standard Specifications for Construction.

For concrete curb, concrete curb and gutter, or concrete traffic island repairs furnish materials in accordance with the standard specifications.

FORCE MAIN SEWER

2.07 DUCTILE IRON PIPE

A. Pipe

Ductile iron pipe must conform to the requirements of AWWA C151 (ANSI A21.51). Ductile iron pipe must be Class 53 unless otherwise specified.

All pipe must have a cement mortar lining with seal coat conforming to the requirements of AWWA C104 (ANSI A21.4).

B. Fittings

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

C. 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. Joints on fittings must be restrained in accordance with Section 3.15.

D. Plastic Wrap for Pipe

Where indicated on the drawings or in the specifications, the pipe must be encased in a seamless polyethylene tube, 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.

When plastic wrap is being used, the wrap must be extended beyond the exposed portion of existing mains being connected to and secured to the pipe.

2.08 POLYVINYL CHLORIDE (PVC) AND MOLECULARLY ORIENTED PVC (PVCO) PIPE

(When approved by Engineer or specified in project specifications.)

A. Pipe

Polyvinyl chloride (PVC) pipe, four (4) inch through twelve (12) inch diameter, must conform to ANSI/AWWA C900. The pipe must have a pressure rating of 305 psi. The PVC pressure pipe must have an outside diameter equivalent to cast iron and ductile iron pipe.

Molecularly Oriented Polyvinyl Chloride (PVCO) pipe four (4) inch through twelve (12) inch diameter must conform to ANSI/AWWA C909. The pipe must have a pressure rating of 305 psi. The PVCO pressure pipe must have an outside diameter equivalent to cast iron and ductile iron pipe.

B. Fittings

Fittings must be ductile iron as specified in Section 2.07 Item B.

Anchorage (restraint) of bends, tees, plugs and all other fittings must be per Section 3.15 of this specification.

C. Joints

Joints must be bell and spigot with elastometric rubber gasket conforming to Section 4 of AWWA C900, C905, or C909, as applicable.

2.09 HIGH DENSITY POLYETHYLENE (HDPE)

(When approved by Engineer or specified in project specifications.)

A. Materials

Pipe must be manufactured from a PE 4710 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material must meet the specifications of ASTM D3350 with a minimum cell classification of PE445474C. Pipe must have a manufacturing standard of ASTM D3035 and be manufactured by an ISO 9001 certified manufacturer. The pipe must contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. The pipe must be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects. The polyethylene compound must be suitably protected against degradation by ultraviolet light by means of carbon

black of not less than 2 percent. The manufacture of the HDPE resin must certify the cell classification indicated.

Pipe sizes three-inch and larger must have a manufacturing standard of ASTM F714. Dimension Ratio (DR) and Outside Diameter (IPS/DIPS) must be as specified on the drawings.

The pipe must have a minimum working pressure rating of 160 psi. Pipe must be supplied with a permanently co-extruded green stripe on the pipe outside surface as part of the pipe's manufacturing process.

B. Fittings

1. Butt Fusion Fittings:

Fittings must be manufactured from a PE 4710 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material must meet the specifications of ASTM D3350 with a minimum cell classification of PE445474C. Molded butt fusion fittings must be in accordance with ASTM D3261 and must be manufactured by injection molding. Fabricated fittings must be in accordance with ASTM F2206 and be manufactured by a ISO 9001 certified facility. All fittings must be pressure rated to provide a working pressure rating no less than that of the pipe. The fitting must be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.

2. Electrofusion Fittings:

Electrofusion fittings must be manufactured from a PE 4710 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material must meet the specifications of ASTM D3350 with a minimum cell classification of PE445474C and be the same base resin as the pipe.

Electrofusion fittings must have a manufacturing standard of ASTM F1055. All fittings must be pressure rated to provide a working pressure rating no less than that of the pipe.

3. Flanged and Mechanical Joint Adapters:

Flanged and mechanical joint adapters must be PE 4710 HDPE, cell classification of 445474C as determined by ASTM D3350 and be the same base resin as the pipe. Flanged and mechanical joint adapters must have a manufacturing standard of ASTM D3261. All adapters must be pressure rated to provide a working pressure rating no less than that of the pipe.

2.10 RESILIENT SEATED GATE VALVES

Resilient seated gate valves must be added at manifolds of force main or as shown on the drawings.

All valves must conform to AWWA C509 or 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 conform to the Owners standards.

Valves must be EJ FlowMaster, Clow Valve Co. R/W Resilient Wedge, American Resilient Wedge, or equal.

2.11 VALVE BOXES

Valve boxes must be screw type, three sectional, 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 "SEWER". The valve boxes must be designed to withstand heavy traffic.

PIPE EMBEDMENT

2.12 GENERAL

Unless otherwise specified or shown on the Drawings, all pipe embedment must be Class B pipe embedment as shown on the Standard details. When the soil in the bottom of the trench at pipe subgrade meets all the requirements for Granular Material Class III as specified in the MDOT 2020 Standard Specifications for Construction, Section 902.07 and in the opinion of the Engineer will provide suitable bedding for the pipe, such soil may be utilized as bedding material and prepared to receive the pipe as specified without undercutting and subsequent replacement.

2.13 FLEXIBLE PIPE EMBEDMENT

Plastic pipe embedment must comply with ASTM D2321. Bedding material must meet the requirements of Section 902.07 of the MDOT 2020 Standard Specifications for Construction for granular materials Class II, modified to 100% passing a 1" sieve must be used. If stone is used for bedding, it must meet the requirements of ASTM D2321 (Table 1 – Embedment Classes for Plastic Pipe) for Class 1A crushed stone. An Engineer approved geotextile filter fabric must wrap around all stone in areas where Class 1A crushed stone pipe embedment is used. Transition zones between crushed stone and sand embedment must be separated by a geotextile fabric.

2.14 TRENCHLESS CASING INSTALLATION (BORE & JACK)

A. Materials

1. Casing:

Casing must meet the requirements of ASTM A53, Type E or S, Grade B steel with a minimum yield strength of 35,000 psi. and be designed for Cooper E80 loading requirements. In all cases, the allowable jacking strength capacity of the casing pipe must be capable of withstanding the maximum jacking forces imposed by the operation. The casing pipe size and thickness must be as shown on the drawings.

Exterior coating and interior lining of the casing is not required.

Casing joints must be continuously welded. Joints must be watertight and capable of withstanding stresses due to handling and installation.

Casing ends must be free of burs or sharp edges.

2. Carrier Pipe:

Carrier pipe must be as specified in the applicable pipe specifications.

Exterior coating and interior lining systems are to be continuous through the casing.

3. Casing Spacers:

Casing spacers must be provided by the carrier pipe manufacturer. Spacers must electrically isolate the carrier pipe from the casing.

Timber blocking with straps is prohibited.

Location of casing spacers to be per pipe and casing spacer manufacturer requirements. Spacers must be designed to support the weight of the carrier pipe full of water assuming no support from interstitial material. Spacers must also be designed to prevent floatation of the carrier pipe assuming it is empty.

4. Casing End Seals:

Casing end seals must meet the requirements of the authority having jurisdiction over the facility affected. End seals must prevent soil migration and must be constructed so as not to damage the carrier pipe coating.

5. Controlled Low Strength Material (CLSM) (Flowable Fill):

CLSM mix design must produce a consistency that results in a flowable product which is non-segregating, does not require consolidation, and following hydration can be excavated with hand tools.

Materials must comply with the recommendations of ACI 229R.

Portland Cement: ASTM C 150, Type I, or II.

Fly Ash: ASTM C 618, Class C.

Coarse Aggregate: Maximum aggregate size of 3/8-inch.

Fine Aggregate: Concrete sand. No more than 12 percent of fine aggregate must pass the No. 200 sieve, and no plastic fines must be present.

Combined aggregate must be graded to produce flowable fill that has optimum flow and consolidation characteristics.

Proportion CLSM mixture to meet the following requirements:

Compressive Strength: Minimum 150 psi, maximum 200 psi at 28 days.

Slump Limit (Flowability): As required for Contractor's methods. Must not promote segregation and must be 9 inches maximum.

Shrinkage: CLSM must have minimal bleed water shrinkage.

Mix Design: The CLSM mix design must be proportioned such that the final product meets the strength, flow consistency, and other requirements of this specification.

Flowable fill must be protected from freezing for at least 24 hours after placement. The ambient temperature must be 35 degrees and rising at the time of placement.

PART 3 EXECUTION

3.01 INSPECTION

A. Shop Inspection

All materials furnished by the Contractor are subject, at the discretion of the Owner, 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 Owner.

B. Field Inspection

It must be the responsibility of the Contractor to inspect all materials for cracks, flaws or other defects before they are incorporated into the work.

C. 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 Engineer. 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.

3.02 RESPONSIBILITY FOR MATERIAL

A. 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.

B. 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 shall 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 to 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 Engineer.

C. 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 it has been incorporated in the completed project. The interior of all pipe, fittings, and other accessories must be kept free from dirt and foreign matter at all times.

D. Replacement for 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.

3.03 HANDLING OF MATERIAL

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

Material handling and storage must be in accordance with manufacturer's guidelines.

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

3.04 LAYING OF GRAVITY PIPE

Pipe must be installed in accordance with ASTM D2321 for PVC pipe and ASTM D2680 for PVC Truss pipe, in addition to manufacturer instructions and the following specifications for all pipe types.

Pipe layers must have demonstrated experience in the laying and joining of the specific products to be utilized.

A. Alignment and Grade

The Contractor must use the laser beam method of maintaining line and grade for sewer construction, unless otherwise approved by the Engineer. The Contractor must provide a qualified operator to handle the laser beam equipment during construction.

The Engineer will place line and grade stakes at each manhole, or more often, as determined by the Engineer. The Contractor must check the line and grade at every point at which a stake has been placed.

Unless otherwise specified, horizontal alignment must be within 0.5' and vertical grades must be within 0.03' of the design line and grades shown on the Drawings.

B. Handling

Pipe and piping materials must be handled with care to avoid damage.

Contractor must only use nylon ropes, slings, or other lifting devices that will not damage the surface of the pipe.

C. Direction of Laying

Excavation of trenches and laying of pipe must begin at the outlet for the sewer and proceed upgrade with the individual pipe being laid with the spigot end downstream.

D. Placing

Prior to installation, each pipe length must be carefully inspected for damage and the pipe ends carefully cleaned.

The pipe must be placed on the prepared sub-grade and held firmly in place during subsequent pipe jointing and embedment operations. Successive pipes must be carefully positioned so that when laid, they form a sewer with a uniform invert true to line and grade.

E. Joint Making

Pipe joints must be installed in strict accordance with the pipe and fitting manufacturer's recommendations and the following requirements.

A thin film of joint lubricant must be applied to the inside of the gasket and the outside of the spigot prior to inserting the spigot into the bell. Lubricated spigot ends must be kept free of soil and debris.

The spigot end of the pipe must be carefully inserted into the bell and sufficient pressure applied until the reference mark or maximum insertion mark on the spigot is flush with the bell. The spigot must not be inserted into the bell past the reference mark or maximum insertion mark.

When using a field cut plain end piece of pipe, the pipe end must be beveled to the same angle and length as provided on the factory-finished pipe and an insertion mark redrawn on the pipe end using a factory-marked spigot from the same manufacturer as a guide.

Care must be exercised to prevent joint movement as successive lengths of pipe are placed. The Contractor must take the necessary precautions when using a trench box to prevent joint separation when the box is pulled ahead.

Joint deflection is not permitted unless specifically noted on the Drawings or in the Project Specification. If permitted, joint deflection must not exceed the Pipe Manufacturer's recommendation.

F. Connections to Structures and Casings

For sewers 18" in diameter and greater, a pipe joint must be located within two-to-four feet (2'-4') of all structure faces and casing ends, unless otherwise specified.

G. Protection of Existing Sewer

The interior of the sewer must be kept clean of all jointing material, dirt, and debris. In smaller sewer where cleaning after laying may be difficult, a swab or drag may be required in the pipeline to satisfactorily complete this work.

Where possible, a plug must be installed on the downstream end of the sewer to prevent any sand and debris from entering the existing sewer. The plugs must not be removed until the new sewer has been cleaned and accepted by the Owner.

At the end of the workday, the open ends of the pipe must be sealed with a water-tight plug or other means approved by the Engineer.

3.05 LOCATION OF WYES AND TEES

Location of proposed wyes or tees shown on the Drawings is approximate and may be adjusted where necessary to best serve the various properties. Contractor must coordinate with the Engineer in advance of mainline sewer construction to determine exact wye and tee location.

On existing and/or replacement sewer runs with existing lateral connections, Contractor is required to locate the existing sanitary lateral at the proposed connection point prior to commencing mainline sewer installation to ensure proper location of the wye and tee.

Contractor must keep an accurate record of measurements from the nearest downstream manhole to each wye or tee which is installed and furnish a copy of these measurements to the Engineer.

3.06 SANITARY SEWER LATERALS

A. General

Installation of sanitary sewer laterals must meet all requirements specified for sanitary sewers. All laterals must be inspected by the Engineer before the trench is backfilled.

In general, sanitary sewer laterals must be laid at right angles to the sanitary sewer mainline unless otherwise shown on the Drawings.

The minimum grade on laterals is 2 percent (1/4 in/ft). When minimum grade cannot be obtained and when approved by the Engineer, minimum grades may be reduced to 1 percent (1/8 in/ft).

Cleanouts are required at lateral connections where alignment and/or grade are not continuous, or as directed by the Engineer. Cleanouts must be constructed in accordance with the standard details or as shown on the Drawings.

B. Replacement Laterals

Connections to existing sanitary laterals must be made within one foot of the street right of way or easement limit unless otherwise directed or shown on the Drawings.

If the outer diameter of the existing sanitary lateral is less than the inner diameter of the proposed sanitary lateral, then a minimum 2" of the existing sanitary lateral must extend into the proposed sanitary lateral.

The Engineer must be notified if existing lateral grades prohibit minimum grade on the replacement lateral.

Installation of a main line riser must be approved by the Engineer. Riser must be constructed in accordance with the standard details or as shown on the Drawings. Backfill must be carefully placed and compacted around the riser in an approved manner which will not damage the sewer or riser.

C. New Laterals

It is intended that the ends of laterals at property lines will be deep enough to service the lowest floor of all existing buildings by gravity flow.

Where the elevation of the end of the lateral to serve an existing structure is not shown on the drawings it must be set at 3 feet below basement grade for standard houses (11 feet below first floor) or 4 feet below basement grade for houses with walkout basements (12 feet below first floor) where the setback is 50 feet or less.

When the house is set back further than 50 feet it may be set at 2 feet below the basement elevation for standard houses (3 feet for walkouts) plus an additional depth of 2 percent multiplied by the setback distance to the structure.

The minimum depth of the end of the lateral at the property line in all cases must be a minimum 9 feet below center line of the street.

Main line risers must only be installed where specified and must be constructed in accordance with the standard details or as shown on the Drawings. Backfill must be carefully placed and compacted around the riser in an approved manner which will not damage the sewer or riser.

Property line risers must be constructed at the end of the lateral and must extend to one (1) foot above the normal groundwater table or four (4) feet below grade, whichever is the closest to finished grade. In all cases the lateral must have a minimum of two (2) feet of cover.

New sanitary laterals must extend to a point one foot outside the street right of way or easement limit unless otherwise directed. No payment will be made for pipe laid beyond this point unless specifically required by the Engineer.

Contractor must provide and install a 2" x 2" wood marker and 1/2" diameter by 3' long metal stake for each service. The wood marker must be set vertically from the end of the lateral to twelve (12) inches above finish surface elevations and the metal stake must be set adjacent to the wood marker with 6 inches of cover.

D. Record Measurements

Contractor must keep accurate records for each lateral installed and furnish a copy of the measurements shown in the Standard Lateral As-Built Detail, or owner-specific measurements, to the Engineer.

3.07 MANHOLE CONSTRUCTION

Manholes must be constructed in accordance with the standard details and as specified herein. Manholes must be watertight.

Precast bases must be installed on sand or gravel subbase in such a way as to provide a uniform bearing under the manhole base.

Precast manholes with integral bottom and channel may be used; however, any changes to the structure due to minor field adjustments in alignment and grade required to meet construction conditions, must be made by the Contractor at no additional cost to the Owner.

Benches must be constructed from the invert to the crown on the pipe for the entire length of the manhole or junction point. Benches must be sloped no less than ½ inch per foot (4 percent). No lateral sewer, service connection, or drop manhole pipe must discharge onto the surface of the bench.

Stubs must be provided in manholes for future connections as shown on the drawings or as directed by the Engineer. All such stubs must be sealed with standard watertight, removable plugs.

All openings in manholes for the purpose of receiving pipes (including openings for future pipes) must be fitted with a flexible manhole connector. Flexible manhole connectors must be factory installed. Openings for future connections must be sealed by an approved prefabricated cap or plug.

Precast concrete adjusting rings must be used to bring existing and new manhole structure covers to grade. Adjusting rings and casting frame must be set on a full mortar bed, and all cracks and gaps in the mortar bed must be filled and finished to create a smooth surface. All castings must be recessed one-quarter (1/4) to one-eighth (1/8) inch below the top of HMA pavement and flush with the top of concrete pavement. After the cover is brought to grade, the entire hole created by excavating to raise the casting must be filled in three-inch (3") lifts with Hot Mix Asphalt (HMA) to the top of the leveling course and air tamped to achieve proper compaction. HMA mixture must be the same mixture placed for the leveling course, unless otherwise approved by the Engineer. Special care must be taken to prevent debris from entering sewers.

3.08 CASTING ADJUSTMENTS

A. Description

This work consists of adjusting drainage structures, including utility manhole covers, in accordance with section 403 of the Standard Specifications for Construction, as shown on the plans, as directed by the Engineer, and as stated herein.

B. Construction

For structures within the pavement area remove pavement adjacent to the drainage structure cover using a rotary or sawing method. When using a rotary coring method, remove a minimum 4 foot diameter section of pavement around the drainage structure frame and cover. If the frame outside diameter measurement is greater than 36 inches, use a rotary coring head to remove a minimum 4.5 foot diameter section of pavement. When using a sawing method, saw cut clean and remove a 6 foot by 6 foot pavement square.

For structures within the curb line, saw cut and remove a 4 foot by 6 foot section of pavement around the frame with the 6 foot dimension measured along the curb line. Remove curb and/or curb and gutter associated with the adjustment of structures, as directed by the Engineer.

For structures located adjacent to concrete traffic control islands, remove concrete island full- width or up to 6 feet wide to facilitate adjustment of the drainage structure cover frame, as directed by the Engineer.

Prior to setting the frame, compact exposed soil using a method approved by the Engineer.

Support the cover frame over the structure matching the adjacent roadway cross slope. Secure the frame in-place to allow for placement of concrete using brick or block as required on a full bed of mortar without altering frame position.

Install epoxy anchored lane ties in accordance with section 603 of the Standard Specifications for Construction to anchor the concrete to adjacent composite pavement. Install circular epoxy coated bar as detailed herein. For structures within the pavement area, replace pavement around the frame with Concrete, Grade 3500 or Grade P-NC as directed by the Engineer matching the finished elevation and cross-slope of the roadway. Construct plane of weakness joint as directed by the Engineer.

For structures within the curb line, replace pavement around the frame with Concrete, Grade 3500 or Grade P-NC as directed by the Engineer and HMA top course as shown on the detail herein. Install epoxy anchored lane ties to anchor the concrete to adjacent composite pavement for curb drainage structures located in curbed areas. Replace concrete curb, concrete curb and gutter, or concrete traffic control islands in-kind in accordance with Standard Plan R-30 Series and section 802 of the Standard Specifications for Construction.

Immediately remove any debris that falls into drainage structures or other utility manholes due to Contractor operations.

Ensure saw overcuts are cleaned and sealed with hot-poured joint sealant.

3.09 CUT-INS

When cutting into an existing manhole, the opening must be no larger than is necessary to admit the new sewer. The opening must be made by a concrete drilling or coring machine

and must have a mechanically compressed flexible joint connection installed. All broken or surplus material falling inside the structure must be removed.

Flow channels and/or drop connections must be constructed as specified or as directed to accommodate the sewer being cut-in.

Unless otherwise specified, cut-ins will be considered part of the major items of work, and no specific payment will be made therefor.

3.10 ACCEPTENCE TESTS

A. Alignment and Grade

Each section of sewer may be checked by the Engineer for alignment and grade using lights and mirrors, television inspection, or other similar means. The Contractor must assist the Engineer in the performance of these tests when necessary.

If a section of sewer is determined by the Engineer not to be acceptable for alignment or grade, the Contractor must relay the sewer at no additional cost to the Owner.

B. Leakage Tests

The completed sewer must be free from leaks. Manholes will be visually inspected for leakage. No more than 1,000 feet of main sewer will be considered for partial payment until it has been satisfactorily tested and approved.

The Contractor must provide all necessary labor, equipment, and supervision to perform leakage testing in accordance with these requirements.

1. Air Test:

All sewers must be subjected to an air test, unless otherwise specified in the Project Specifications. In lieu of air testing reconstructed sanitary sewer pipe and/or sanitary laterals, Contractor may perform a Televising inspection, subject to Engineer approval.

The air test must be performed on each section of pipe between manholes after laterals are installed. Testing must conform to ASTM F1417. The section of pipe being tested must be sealed at each manhole using inflatable plugs or other approved devices. All plugs must be adequately braced.

Testing pressure is determined by the expected water table level in a dewatered or partially dewatered trench and by the actual groundwater level in a non-dewatered trench, as determined by the soil borings. In a non-dewatered trench, the test pressure is determined by adding 0.43 psi per foot of groundwater above the invert of the pipe to a baseline of 3.5 psig.

For example, in a non-dewatered trench with a groundwater table approximately 2 feet above the pipe invert, the beginning test pressure would be 4.36 psi ($3.5 + 0.43 \times 2 = 4.36$).

At no time must internal pressure exceed 9 psig.

BEGINNING AIR TESTING PRESSURE FOR LEAKAGE TEST

Dewatered Trench	Expected Groundwater Level Above Pipe Invert [ft]	Beginning Test Pressure [psig]
	0'-7'	3.5
	7'+	4.5
Non-Dewatered Trench	Groundwater Level Above Pipe Invert [ft]	Beginning Test Pressure [psig]
	1	3.9
	2	4.4
	3	4.8
	4	5.2
	5	5.7
	6	6.1
	7	6.5
	>7	Coordinate with Engineer

The air pressure in the section under test must be raised to an initial pressure of 0.5 psig above the beginning test pressure and allowed to stabilize for a minimum of five (5) minutes. Air must be added during this stabilization period as required to maintain the pressure at or above the beginning test pressure.

The minimum time interval for a satisfactory test is in accordance with Table 1 on the following page. Ending test pressure after the minimum time interval must not be less than 1.0 psig below the beginning test pressure. Makeup air must not be added during the time interval.

In the event the Engineer determines that the results of the air test are inconclusive because of visible infiltration, unsatisfactory or incomplete records, or improper application of testing methods or equipment, or other similar reasons, the Engineer may require additional leakage testing for the section or sections of sewer involved.

TABLE 1 – PVC PIPE

Pipe Diameter, in.	Minimum Time, min:s	Length for Minimum Time, ft	Time for Longer Length, s	Specification Time for Length (L) Shown, min:s								
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	
4	3:46	597	0.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	0.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24	
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48	
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38	
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04	
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41	
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31	
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33	
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48	
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15	
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53	
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46	

Note: Table to be used when testing one diameter only.

When testing two sizes of pipe simultaneously, time shall be computed by the ratio of lengths involved.

$$\text{Time} = \frac{\text{Length 1} \times \text{Time 1} + \text{Length 2} \times \text{Time 2}}{\text{Length 1} + \text{Length 2}}$$

2. Infiltration and Exfiltration Tests:

Infiltration and exfiltration testing are not required unless otherwise specified in the Project Specifications or directed by the Engineer due to a failed leakage test.

Allowable leakage rate from an infiltration and exfiltration test must not exceed 25 gal/in of internal pipe diameter/mile/day.

C. Pipe Deflection Tests

A pipe deflection test is required for all pipe with a stiffness of 115 psi or less as defined under the requirements of ASTM Designation D2412. Truss pipe will not require a deflection test if it has less than twelve feet (12') of cover.

Deflection requirements are for the flexible pipe only. Where the pipe interacts with other appurtenances, such as connections to structures, laterals, other pipes or other materials, deflection requirements may be more prescriptive.

The completed installation of flexible pipe less than 24" in diameter must at no point have out-of-round deflections in the main sewer pipe greater than five percent (5%) of the pipe's base inside diameter.

The completed installation of flexible pipe 24" in diameter and greater must at no point have out-of-round deflections in the main sewer pipe greater than three percent (3%) of the pipe's base inside diameter.

Go/no go gauging tests, using an approved pointed mandrel with nine (9) points, must be performed by the Contractor in the presence of the Engineer, or his authorized representative after the trench is backfilled, and prior to pavement surfacing or completion of final grade.

Pipe with deflections greater than the amount specified must be relaid by the Contractor at no additional expense to the Owner. Use of mechanical devices or equipment to complete the go/no go tests and vibratory rerounding of failed sections are prohibited. A minimum of thirty (30) days must elapse between backfilling and deflection testing.

D. Televising

After the pipe deflection test, placement of base course (when the pipe is proposed under pavement), and pipe cleaning (when the sewer has been live prior to televising), the Contractor must conduct a continuous video recording inspection of all sanitary sewers. The inspection and documentation must meet the requirements of the National Association of Sewer Service Companies (NASSCO) specification for television inspection of sewers. Closed-circuit television (CCTV) recording must be conducted in compliance with the North American Pipeline Assessment and Certification Program (PACP) standards for sewer defect identification and assessment. Work must be performed by a PACP- certified operator and delivered on professional quality recording media. The televising software must be PACP-certified by NASSCO and must be capable of both exporting to and importing from the standard PACP database.

If the television inspection of an entire section (manhole to manhole) cannot be successfully performed from one manhole, a reverse setup must be performed per PACP requirements as a second survey.

Each pipe inspected must include a video file in .mp4 or .mpeg format, a PDF report showing inspection results, and inspections and observations in GIS format (Shapefile or Esri File Geodatabase). The video file must show the name of the project, the purpose of inspection, the date and approximate time of recording, the name of the street, and the manhole numbers of each end of each run (the “from” and “to” manholes). The inspection must clearly show the pipe interior, joints, alignment, and wye locations and stations. The inspection will be reviewed by the Engineer for evidence of compliance with the Contract Documents for workmanship and materials. Data can be delivered via portable hard drive or cloud-based file sharing site.

3.11 LAYING OF FORCE MAIN PIPE

A. Alignment and Grade

1. General:

The force main must be laid and maintained to the required lines and grades with fittings at the required locations. All force mains must maintain a ten (10) feet horizontal separation and eighteen (18) inch vertical separation from water main.

2. 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 Engineer has the authority to change the drawings and order a deviation from the line and grade or arrange with the owner 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.

3. Depth of Pipe:

All pipe must be laid with the top of the pipe a minimum depth of five (5) feet below established street center line grade, and with a minimum cover of five (5) feet below existing grade at the force main, unless specified otherwise. When elevations and grades are provided on the drawings, the Contractor must install in accordance with those elevations and grades.

B. Laying

1. Lowering of Force 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 and fittings must be carefully lowered into the trench by means of suitable tools or equipment, in such a manner as to prevent damage to force main material and protective coatings and linings. Under no circumstances may force main materials be dropped or dumped into the trench.

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

2. 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 Engineer, who will prescribe corrective repairs or rejection.

3. Cleaning of Pipe and Fittings:

All lumps, blisters, and excess coating must be removed from the bell and spigot ends 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. 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 may be stored in the pipe at any time.

For bell and spigot pipe 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. For force main construction, the spigot end must be installed in the direction away from the pump station so as to minimize effluent material hanging up on the pipe joints. 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 Engineer. 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.

5. Cutting of Pipe:

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 method of cutting pipe will be subject to the approval of the Engineer.

6. Locator Wire and Marking Posts:

A 12 AWG insulated copper locator wire must be attached to the force main pipe (regardless of material type) at approximately five (5) feet intervals using tape or other suitable methods to assure that the wire is not dislocated during pipe installation and backfilling. Locator wire must be 12 AWG (min.) high strength locator wire with a minimum break load of 1,150 lbs. Protective insulating coating must be High Molecular Weight, High Density Polyethylene (HWD-HDPE) 45 mil. (min.).

All wire connectors must be dielectric silicone filled to seal out moisture and must be able to provide electrical conductivity. Connectors must be similar to Copperhead SnakeBite™ Locking Connectors or approved equal.

The locator wire must be brought to the surface at all cleanouts and attached to a cleanout plug bolt. At air release valve manholes, the locator wire must be brought to the ground surface and attached to a marking post above grade.

The marking post must be a Rhino TriView™ Marking System including a test station similar to the Rhino TriView™ or approved equal. Marking posts must be colored green and have Force Main labels. Posts must be buried per the manufacturer's recommendations. The marking post and test station must be placed at maximum 1,000-foot intervals with one testing station located at the beginning and the end of the force main and at the air release structures. Testing stations must be located on the right-of-way line.

Approximate testing station and marking post locations are indicated on the drawings; however, the Contractor must coordinate actual locations of the marking posts and test stations with the Owner and Engineer.

Prior to acceptance of the force main the Contractor must verify the continuity of the locator wire in the presence of the Owner or Engineer and repair any breaks in the line. Testing of the locator wire must be completed using a low frequency (512 Hz or similar) line locating equipment. Continuity testing of the locator wire system in lieu of using locator equipment will not be accepted.

3.12 JOINING OF MECHANICAL - JOINT PIPE

A. General Requirement

The general requirement in Sec. 7.06 - 7.07 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.

B. 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 as supplied or recommended by the pipe manufacturer and approved by the Engineer. 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.

C. 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>Size</u> Inches	<u>Range of Torque</u> Foot – Pounds
5/8	45 - 60
3/4	75 - 90
1	100 - 120
1-1/4	120 - 150

Nuts spaced 180 degrees apart must be tightened alternately in order 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. Unless otherwise specified, Mega-lugs as manufactured by EBAA Iron Sales, Inc. or approved equal must be used for restraining gland.

D. Permissible Deflection in Mechanical Joint Pipe

Whenever it is desirable to deflect mechanical-joint pipe in order to form a long radius curve, the amount of deflection must not exceed the maximum limits shown in Table 2.

TABLE 2
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

3.13 JOINING OF PUSH-ON JOINT PIPE

A. General Requirements

The general requirements in Section 3.10 - 3.11 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 push-on joint pipe.

B. 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.

A 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.

Gasket lubricant must be as supplied or recommended by the pipe manufacturer and approved by the Engineer.

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.

C. Permissible Deflection in Push-On Joint Pipe

Whenever it is desirable to deflect push-on joint pipe, in order to form a long radius curve, the amount of deflection must not exceed the maximum limits shown in Table 3, unless recommended by the pipe manufacturer and approved by the Engineer.

TABLE 3
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

3.14 JOINING HDPE PIPE

A. Butt Fusion

Sections of polyethylene pipe must be joined into continuous lengths on the jobsite above ground when possible. The joining method must be the butt fusion method and must be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures must be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 400 - 450 degrees Fahrenheit, alignment, and an interfacial fusion pressure of 75 PSI. The butt fusion joining must produce a joint weld strength equal to or greater than the tensile strength of the pipe itself.

Qualifications of the fusion technician must be demonstrated by evidence of electrofusion training within the past year on the equipment to be utilized for this project.

B. Sidewall Fusion

Sidewall fusions for connections to outlet piping must be performed in accordance with HDPE pipe and fitting manufacturer's specifications. The heating irons used for sidewall fusion must have an inside diameter equal to the outside diameter of the HDPE pipe being fused. The size of the heating iron must be 1/4 inch larger than the size of the outlet branch being fused.

The qualifications of the fusion technician must be demonstrated by evidence of electrofusion training within the past year on the equipment to be utilized for this project.

C. Mechanical

Bolted joining may be used when connecting to other pipe materials. Flange joining must be accomplished by using a HDPE flange adapter with a ductile iron back-up ring. Mechanical joint joining must be accomplished with a molded mechanical joint adapter with a ductile iron mechanical joint gland.

D. Electrofusion

At locations shown on drawings or approved by the Engineer, electrofusion sleeves may be allowed where butt fusion is not possible.

Electrofusion joining must be done in accordance with the manufacturers recommended procedure and ASTM F 1290 and PPI TN 34. The electrofusion processor must be capable of reading and storing the input parameters and the fusion results for later download to a record file.

The qualifications of the fusion technician must be demonstrated by evidence of electrofusion training within the past year on the equipment to be utilized for this project.

E. Other

Socket fusion, hot gas fusion, threading, solvents, and epoxies may not be used to join HDPE pipe.

3.15 ANCHORAGE

A. Restrained Joint Pipe - Ductile Iron

The use of restrained joint pipe must be approved by the Owner. If approved, 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 actually installed.

B. 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.

Joint restraining glands for PVC must be EBAA Iron Sales “Megalug Series 2000PV” for C900 and 19MJG for C909 or approved equal.

Restraint of PVC push on joints must be accomplished using Megalug Series 1900 restraint harness as manufactured by EBAA Iron Sales, Inc. or approved equal.

C. Anchorage for Plugs, Caps, Tees, Bends, and Valves - Ductile Iron and PVC

Unless otherwise specified or approved by the Engineer, 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 4 (pipes larger than 20-inch must have restraint as shown on the drawings).

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.

TABLE 4
DUCTILE IRON 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"	23	9	5	2	57		
6"	32	13	6	3	82	43	63
8"	41	17	8	4	104	43	55
12"	58	24	12	6	149	80	120
16"	74	31	15	7	192	82	110
20"	89	37	18	9	233	82	104

***A multiplier of 1.43 must be used if the pipe is installed with polyethylene wrap and for PVC pipe.**

**If the straight run of pipe on the small side of the 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 a bare ductile iron pipe with 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.

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.

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.

D. Reaction Backing (Thrust Blocks) - Ductile Iron and PVC

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

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 Engineer. 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 2.07 Item D.

Minimum Bearing Area against undisturbed trench wall, in square feet, for sand is indicated in Table 5 below. Details of placement are shown in Standard Details.

TABLE 5
REACTION BACKING

Pipe Size	Tees, Plugs, Wyes, 45° Els	90° Els	Wyes, 22-1/2° Els 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

Muck – secure all fittings with restrained joint pipe or joint restraining glands, with concrete reaction backing the same as listed for sand conditions.

E. Restraint Collars - HDPE

HDPE pipe must have restraint collar(s) as shown in the locations and as detailed on the drawings. Restraint collars or restraining flanges may be required at locations where HDPE pipe connects to other pipe or when connecting to a manhole.

To limit the range of thermal expansion or contraction, HDPE force main must be in place and backfilled a minimum of 72 hours prior to installation of pipe restraint and connections to other pipes.

After the concrete collar has cured a minimum of 12-hours, Contractor must install compacted sand backfill around collar.

3.16 CLEAN OUTS - DUCTILE IRON AND PVC

Single and double clean outs must be constructed as shown on the standard detail or shown on the drawings. All pipe and fittings for the clean out must match the force main pipe, unless otherwise specified.

Unless otherwise specified, manhole castings must be EJ No. 1040 with Type A solid cover or approved equal.

3.17 AIR RELEASE VALVES

A. Air Release Valve

Air release valves must be as specified in the Project Specifications. Riser and fittings to be stainless steel, valves to be ¼ turn stainless steel ball valves. Location of air release valves must be as shown on the construction drawings.

B. Air Release Valve Manhole

Air release valve manholes for Ductile Iron and PVC/MPVC force mains must be constructed in accordance with the Standard Details and as specified herein. Air release valve manholes for HDPE force mains must be as detailed on the construction drawings and project specifications.

Precast bases must be installed on the subbase in such a way as to provide a uniform bearing under the manhole base.

Precast manholes with integral bottom may be used; however, any changes to the structure due to minor field adjustments in alignment and grade required to meet construction conditions, must be made by the Contractor at no additional cost to the Owner.

C. Flexible Manhole Connectors (Rubber Boots)

Flexible manhole connectors (also called rubber boots) must be "Kor-N-Seal" by National Pollution Control Systems, Inc., "P.S.X." or "Press Wedge II" by Press Seal Gasket Corporation, "Lock Joint Flexible Manhole Sleeve" by Inter Pace Corporation, "A-LOK," "Z-LOK," or "QUIK-LOK" by A-LOK Products, Inc. or approved equal. Flexible manhole connectors must conform to the requirements of ASTM Designation C923, Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.

3.18 HYDROSTATIC TESTS

A. Procedure

All tests must be made by the Contractor using its own equipment, operators, and supervision, in the presence of the Engineer or its duly authorized representative. The length of the section to be tested must be as approved by the Engineer, or as shown on the drawings.

B. 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 procedure may begin.

C. Hydrostatic Test - Ductile Iron

A leakage test must be conducted during the hydrostatic pressure test in the presence of the Engineer. The Contractor must furnish the pump, pipe, connections, gauges, and all other necessary apparatus, and must furnish the necessary assistance to conduct the test. The duration of the leakage test must be a minimum of two (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 gauge.

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 Owner must be furnished 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. The report must be signed by the Contractor and the Engineer.

D. Hydrostatic Test - HDPE Pipe

The hydrostatic test procedure for HDPE pipe must conform to ASTM F2164. Testing must be performed with the pipe in the trench following backfill placement. Subject the lowest element in the system to a test pressure that is 1.5 times the design pressure or a minimum of 100 psi, whichever is greater, and check for any leakage.

The test procedures consist of two steps: the initial expansion and the test phase. When test pressure is applied to a water-filled pipe, the pipe expands. During the initial expansion of the pipe under test, sufficient make-up water must be added to the system as needed for up to four (4) hours to maintain the test pressure. After four (4) hours, initial expansion should be complete, and the actual test can start.

After four (4) hours of maintaining pressure as described above, the pressure must then be dropped by 10 psi. At this point do not increase pressure or add make-up water. If the pressure then remains within five (5%) percent of the target value for one (1) hour, this indicates there is no leakage in the system.

Note: Under no circumstances must the total time under test exceed eight (8) hours at 1½ times the system pressure rating. If the test is not complete within this time limit (due to leakage, equipment failure, etc.), the test section must be permitted to “relax” for eight (8) hours prior to the next test sequence.

E. Variation from Permissible Leakage or Pressure Loss

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

F. Time for Making Test

The pipe may be subject 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 or restraint blocks, the hydrostatic pressure test must not be made until at least seven (7) days have lapsed after the concrete was installed. If high-early-strength cement is used, the hydrostatic pressure test must not be made until at least two (2) days have elapsed.

3.19 BORE & JACK

A. Casing Installation

A casing pipe must be jacked into place and a carrier pipe installed within the casing pipe. The casing pipe must be jacked into place by method approved by the authority having jurisdiction over the facility affected.

Bore and Jacking (Horizontal Auger Boring) or Pipe Jacking with a Tunnel Boring Machine (TBM) are acceptable methods; however, method of casing installation must also be approved by the authority having jurisdiction over the facility affected.

Prior to casing pipe installation, Contractor must field verify size, material, alignment, and depth of existing utilities within the influence of the installation. Contractor must coordinate with Owner, Engineer, Road Commission, Railroad, and MDOT as they apply regarding jurisdiction if adjustments to casing alignment are required.

Bore operations must progress on a 24-hour basis without stoppage until the leading edge of the pipe has reached the receiving pit.

The front of the casing pipe must be provided with mechanical arrangements or devices that will prevent unsupported excavation ahead of the pipe.

The face of the cutting head must be arranged to provide a reasonable obstruction to the free flow of soft or poor material into the casing pipe. The cutting head must be able to be removed in the case of an obstruction.

Casing grade vertical tolerance is +/- 0.1 feet and horizontal tolerance is 0.5 feet from design line and grade. Contractor must continuously monitor and plot grades during casing installation and notify Engineer immediately if grades drift from specified tolerances. Method of monitoring is subject to the authority having jurisdiction over the facility affected.

Subsidence monitoring is required. Degree of monitoring is subject to the authority having jurisdiction over the facility affected. Subsidence monitoring must be performed in a manner that will minimize the movement of the ground in front of, above, and surrounding the horizontal auger bore operation; and will minimize subsidence of the surface above and in the vicinity of the boring. The ground must be supported in a manner to prevent loss of ground and keep the perimeter and face of the boring stable at all times, including during shutdown periods.

A survey must be performed one day prior to initiating this operation at each required monitoring location. A similar survey must then be performed at each location, on a daily basis, until the permitted activity has been completed. At minimum, Contractor must measure and record baseline location (northing, easting, elevation) of critical surface features (top of rail, edge of paved surface, center line of paved surface, etc.) along the top of proposed casing alignment and within 10' either side of the casing

alignment. Baseline measurements must be taken prior to any dewatering within the influence of the crossing. Following initiation of dewatering, Contractor must take the same measurements daily until the permitted crossing and dewatering has been completed. All survey readings must be recorded to the nearest one-hundredth (0.01) of a foot. Digital photographs of the pavement and rail conditions must also be taken prior and after the pipe installation.

B. Carrier Pipe Installation

The carrier pipe must be joined together to form a continuous run through the casing. Carrier pipe must be supported on casing spacers securely fastened to the pipe.

After the pipe has been inspected and accepted, the annular space between the pipe and the casing will be filled with flowable fill. Contractor must vent casing and monitor CLSM pressures as necessary to prevent collapse of the pipeline. Contractor may fill the carrier pipe with water prior to CLSM installation. After the casing has been filled, the ends of the casing must be sealed.

3.20 HORIZONTAL DIRECTIONAL DRILLING

A. Horizontal directional drilling (HDD) is a method of trenchless construction using a surface launched steerable drill tool controlled from a mobile drilling frame, and includes a field power unit, drilling fluid mixing system, and mobile spoils extraction system. The work generally consists of three phases:

1. Drilling a pilot hole from the surface of pit at a starting point to an exit pit at the surface beyond the obstacle or area that is to be avoided.
2. Reaming the pilot hole to make it large enough for the pipeline to be installed.
3. Pipeline is pulled into place. During the pipe pulling operation, drilling fluid (a bentonite, water, and polymer solution) is injected to stabilize the hole, remove cuttings, and lubricate the pipe.

B. Coordination

1. Drilling operations must not interfere with, interrupt or endanger surface features or surface activities.
2. When rock stratum, boulders, underground obstructions, or other soil conditions that impede the progress of drilling operation are encountered, the Contractor and Engineer must review the situation and jointly determine the feasibility of continuing drilling operations, making adjustments or switching to an alternative construction method.
3. The Contractor must familiarize themselves with the geologic characterization of the soil stratum at the proposed drilling path. The Contractor must be responsible for informing the Engineer of any changes that are required in the directional drilling procedure due to geologic conditions.
4. Launching and recovery pits must be as small as practical. Dewatering of pits and excavations must be done in accordance with these specifications. When groundwater is encountered, the Contractor must provide a dewatering system of sufficient capacity to keep any excavation free from water until the backfill operation is in progress. Dewatering must be performed in a manner that removal of soil particles is held to a minimum. Water from the dewatering

system must be desilted before discharge. Methods of dewatering and desilting, including all costs, must be the Contractor's responsibility and are included in the Horizontal Direction Drilling pay item.

5. Utilities shown on the plans are approximate. In areas where there is a potential conflict, the Contractor must dig up and verify the locations and elevations of the utilities at no additional expense to the City. The Contractor must assume full responsibility for the protection of all utilities, structures and their foundations which may be affected by the work.
6. Before beginning the drilling process, the Engineer must stake the proposed drill path.

C. Drill Path Survey

1. The drill path must be walked in the presence of the Engineer and the Contractor with the guidance system that must be used for each segment of the drill path. The Contractor must locate and record any surface and subsurface magnetic variations or abnormalities and all points of interference, as well as verifying all utility locations and corresponding utility maps. Should any discrepancies arise between utility maps, field locations and guidance system findings, the Contractor must clarify all discrepancies prior to beginning drilling operations. The drill path survey must be performed no earlier than two days prior to commencing drilling operations. Provide the Engineer 48-hour notice of drill path survey.

D. Equipment

1. The drilling equipment must be capable of placing the pipe within the planned line and grade without inverted slopes.
2. The drilling equipment must be capable of pulling product pipe from either the downstream or upstream pit locations. The equipment must be adequately sized for the application.
3. The guide system must have the capability of measuring inclination, roll and azimuth. The guidance system must have an independent means to ensure the accuracy of the installation. The Contractor must demonstrate a viable method to eliminate accumulated error due to the inclinometer (pitch or accelerometer). The guidance system must be capable of generating a plot of borehole survey for the purpose of a record drawing. The guidance system must meet the following specifications:

Inclination:	Accuracy	+0.05
	Range	+90
	Repeatability	+0.02
Roll:	Accuracy	+0.05
	Range	+90
Azimuth	Accuracy	+0.05
	Range	+90

4. Equipment setup requirements at the launch and recover locations must be determined by the Contractor in accordance with the plans and must be submitted to the Engineer prior to commencement of drilling operations.

- E. Pilot Hole Drilling
1. The entry angle of the pilot hole and the drilling process must maintain a curvature that does not exceed the allowable bending radii of the carrier pipe per the manufacturer's recommendations.
- F. The Contractor must follow the pipeline alignment as shown on the Plans, within the specification requirements. The location and depth of the drill head in relation to the profile and center line of the alignment must be determined at a maximum of ten-foot intervals. Acceptable tolerance must be 0.5 feet variation from the center line of pipe in both vertical and horizontal directions (1-foot tolerance window).
- G. In the event of difficulties at any time during drilling operation requiring the complete withdrawal from the tunnel, the Contractor will be allowed to withdraw and abandon the tunnel and begin a second attempt at a different location. The alternate location must be approved by the Engineer before the Contractor withdraws.
- H. Access pits must be at the beginning and end segments shown on the Plans. Intermittent pits must be approved by the Engineer prior to proceeding with drilling operations. No intermittent access pits must be allowed in Railroad Right-of-ways.
- I. Installing the Carrier Pipe
1. After the pilot hole is completed, the Contractor must install a swivel to the reamer and commence pullback operations.
 2. Reaming diameter must not exceed 1.5 times the diameter of the carrier pipe being installed.
 3. The carrier pipe being pulled into the tunnel must be protected and supported so that it moves freely and is not damaged by stones and debris on the ground during installation.
 4. Pullback forces must not exceed the allowable forces for the carrier pipe.
- J. The Contractor must allow sufficient lengths of carrier pipe to extend past the termination point to allow connections to adjacent pipe sections, tees, or fittings. Pulled pipe must be allowed 24 hours of stabilization prior to making tie-ins. The length of extra carrier pipe must be at the Contractor discretion.
- K. Field Inspection
1. All pipe sections, specials, and jointing materials must be carefully examined for defects and no piece must be laid that is known to be defective. Any defective piece discovered installed must be removed and replaced with a sound one in a manner satisfactory to the Engineer at the Contractor's expense.
 2. Defective material must be marked with an "X" in pink paint and must be removed from the job site.
- L. Drilling Fluid Containment and Disposal Requirements
1. The Contractor must contain, handle, and dispose of drilling fluids in accordance with the following requirements:
 - a. All drilling fluid and fluid additives must be disclosed, and Material Safety Data Sheets (MSDS) must be provided to the permit agency and the Engineer upon request.

- b. Excess drilling fluid must be confined in a containment pit at the entry and exit location until recycled or removed from the site.
- c. Precautions must be taken to ensure that drilling fluid does not enter the roadways, streams, municipal storm or sanitary sewer lines, and/or any other drainage system or body of water.
- d. When installing below railroads, vents must be installed on either side of the railroad tracks to direct any excess drilling fluid to a containment area and to prevent unintended surfacing of drilling fluid within the Railroad Right-of-way.
- e. Unintended surfacing of drilling fluid must be contained at the point of discharge and recycled or removed from the site.
- f. Drilling fluids that are not recycled and reused must be removed from the site and disposed at an approved disposal site.
- g. Drilling fluids must be completely removed from the construction site prior to backfilling or restoring the site.

3.21 REMOVAL OF SURFACE IMPROVEMENTS

Surface improvements such as sidewalks, improved lawns, drives, curb and gutter, and all types of pavement must be removed just prior to excavating or trenching operations. All improvements must be cut at the expected trench width prior to excavating using suitable equipment which does not damage the improvement outside of the trench area.

Concrete and bituminous pavement and drives must be cut with a pavement cutting saw. The depth of the cut must be the full depth of the pavement. Pavement crushers or breakers of any type are prohibited unless specifically authorized by the Engineer. Pavement which is removed must not become mixed with backfill material. Power equipment may be used for pavement removal, provided that damage is not caused to improvements which are to remain.

Removal of surface improvements must be included in the major items of work and no specific payment will be made therefore unless specific Proposal items are provided, in which case the prices bid must be payment in full for performing this work as specified herein.

3.22 EXISTING SOIL / SUBSURFACE CONDITIONS

Where provided, the soil borings shown on the construction drawings are being furnished for the convenience and general information only. The data shown on the boring logs represents soil and ground water conditions encountered at the respective boring locations at the time of boring. Variations may occur between these locations. Additionally, the stratigraphic lines represent the approximate boundaries between soil types; however, transitions may be more gradual than what is shown. The Contractor will be responsible for making themselves familiar with subsurface conditions by whatever means they deem necessary and shall make their own determinations therefrom.

3.23 EXISTING UNDERGROUND UTILITIES & STRUCTURES

A. Location

No less than three (3) working days prior to excavating, the Contractor is to call "MISS DIG" at 1-800-482-7171 or 811. Existing utilities are shown only at their approximate locations based on information and data furnished to the Engineer by the owners of such underground facilities. Neither the Engineer nor the Owner

guarantees the accuracy or completeness of any such information or data. The Contractor shall be solely responsible for determining their exact elevations and location in the field. The Contractor must notify the owners of all underground utilities before starting any work. House sewer connections, water and gas services, and other utility lines may not be indicated on the drawings. However, the Contractor must make every effort to locate all underground utilities from information obtained from the utility owner or by prospecting in advance of trench excavation.

B. Replacement

Certain underground utilities such as sewers may require removal and subsequent replacement in lieu of supporting or bracing during the proposed construction, or the Contractor may elect this option when temporary provisions to maintain essential services have been previously approved by the Engineer.

Unless otherwise specified, any utilities removed during the proposed construction must be replaced by the Contractor. Materials and installation must be equal to or better than original construction in every way. Salvaged materials may be reused when they are in good condition, and a satisfactory installation can be accomplished in the judgment of the Engineer.

Replacement of existing utilities must be considered included in the major items of work unless specific items have been provided in the Proposal, in which case the prices bid must be payment in full for performing this work as specified herein.

C. Relocation

Should any pipe or other existing utility require raising or lowering or moving to another location because of interference with the pipe or structure being constructed under these specifications, such changes which in the opinion of the Engineer are necessary must be made by the Contractor unless otherwise specified. Relocation of the utility shall be coordinated with the utility owner and comply to their requirements. Relocation of existing utilities must be included in the major items of work unless specific items are provided in the Proposal.

D. Reconnection

Where lateral services, house connections, or other pipelines require reconnection to the proposed utility, as is the case when an existing utility is being reconstructed, the Contractor must make these connections as specified or as shown on the drawings. All costs for making these connections, including provisions for maintaining flows and providing temporary service during the proposed construction, must be included in the major items of work unless specific items are provided in the Proposal.

E. Utilities to be Abandoned

When pipes, conduits, sewers, or other structures are removed from the trench leaving dead ends in the ground, such ends must be fully plugged or sealed with brick and mortar by the Contractor to obtain a soil-tight condition. Abandoned structures such as manholes or chambers must be entirely removed unless otherwise specified or shown on the drawings.

All materials from abandoned utilities which can be readily salvaged must be removed from the excavation by the Contractor and stored on the site or loaded on the Owner's truck as directed by the Engineer. Owner must have first claim to

salvageable materials. The Contractor is responsible to dispose of salvageable materials not desired to be kept by the Owner.

All costs for abandoning utilities and for removing and salvaging materials, when required, must be considered included in the major items of work unless specific items have been provided in the Proposal, in which case the prices bid must be payment in full for performing this work as specified herein.

3.24 EXCAVATING & TRENCHING

A. General

Excavating and trenching operations must at all times be conducted in a safe, orderly manner using methods and equipment designed and suited to the intended use by personnel experienced in the work being performed.

None of the requirements or provisions specified herein or shown on the drawings must nullify or restrict any safety provisions required by any regulation or law governing the protection and/or safety of persons or property.

B. Width of Trench

The width of the trench must be ample to permit the pipe to be laid and joined properly and the pipe embedment material and backfill to be placed and compacted per pipe manufacturer's recommendations. Trenches must be of sufficient extra width when required as will permit the convenient placing of trench supports, sheeting, and bracing.

When the trench width above the top of the pipe is appreciably greater than that which is reasonably required by project conditions in the judgment of the Engineer, any additional cost for backfill material, surface restoration, or other items that are the result of such excess width must be borne by the Contractor.

When installing pipes in areas of rock, refer to section 2.06.05 for minimum trench clearance.

1. Width of Trench for Rigid Pipe:

In order to limit excessive loads on rigid pipe, the maximum width of trench for pipe 36 inches and larger in diameter must not be more than twice the nominal diameter. For smaller sizes of pipe, the maximum width of trench must be not more than 3 feet greater than the nominal diameter of the pipe except as otherwise specified or directed. The above limiting restrictions on trench width apply from outside bottom of pipe to outside top of pipe.

Where the width of trench within these limits exceeds the maximum limit specified, the Contractor must install a heavier class of pipe or use other means to provide additional load-carrying capacity at no additional cost to the Owner. Any changes in class of pipe or other variation must be approved in writing by the Engineer before the work progresses.

2. Width of Trench for Flexible Pipe:

Unless otherwise specified or approved by the Engineer, the minimum width of trench must be per pipe manufacturer's recommendation based on the pipe material, native soil conditions, and selected embedment material, or the minimum width to achieve specified compaction, whichever is greater.

C. Excavating to Grade

The trench must be excavated to a depth required for the proper installation of the pipe and placing of the pipe embedment material as specified.

Any part of the bottom of the trench excavated below the specified subgrade must be refilled with approved materials compacted to 95% of maximum unit weight in accordance with MDOT procedures at no additional cost to the Owner. If additional excavation is required to correct unstable foundation conditions, payment will be made as specified in Section 2.07.

D. Sheeting, Shoring, Bracing, & Shelving

1. General:

The Contractor must brace or slope back the sides of all excavations in accordance with current MIOSHA regulations. The Contractor must be responsible for compliance to such regulations and for the design, installation, and maintenance of all excavation safety measures.

3.25 DEWATERING

The Contractor must provide and maintain adequate dewatering equipment to remove and dispose of all surface and groundwater including water or sewage from exposed sewers or water mains, from all excavations and trenches, or other parts of the work. Each excavation must be kept dry during the preparation of the subgrade and continually thereafter until the structure to be built or the installation of the pipeline is completed to such extent that no damage from hydrostatic pressure, flotation, or other cause will result.

Where work is in soil containing an excessive amount of water, the Contractor must provide, install, and maintain suitable well points or wells connected to manifolds or reliable pumping equipment, or other suitable groundwater dewatering methods, and must so operate the dewatering system to ensure proper construction of the work.

Contractor must submit a groundwater dewatering plan to the Owner. The plan must include the proposed dewatering strategy, including anticipated discharge rate(s) and location(s). Trench underdrain systems, or similar, will require additional information subject to project specific requirements. Discharge of water from groundwater dewatering operations shall be in accordance with all Federal, State and Local requirements, including discharge rate limitations. The Contractor must filter groundwater dewatering discharge and make every effort to prevent sand, sediment, or debris from entering any existing pipeline or conduit which they may use for drainage purposes.

The repair or cleaning of drainage structures made necessary by the Contractor's operations must be performed by and at the expense of the Contractor. Arrangements for discharge of groundwater into any public sewer must be previously approved by the Owner of the receiving sewer. Should the Contractor identify potential contamination in the water from the groundwater dewatering operation, via visual and/or odor, the Contractor shall immediately notify the Engineer.

Dewatering including the use of stone or gravel for dewatering purposes when required will not be paid for separately but will be included in the contract price for the major items of work.

The Contractor must limit the dewatering operation to the minimum time and depth required for construction. The Contractor will be required to furnish temporary water service and/or

provide potable water at the direction of the Engineer to property owners whose wells are affected by the dewatering operations.

3.26 SUBGRADE

The subgrade for pipe and/or structures must be firm, dense, and thoroughly compacted and consolidated, free from mud and muck, and sufficiently stable to remain firm and intact underfoot.

A. Unstable Foundation

When the soil beneath the normal pipe embedment area is soft or unstable, even with adequate dewatering, or in the opinion of the Engineer cannot support the pipe or utility, further depth must be excavated and refilled to the proposed grade with MDOT Class II granular material (for plastic pipe the material must comply with ASTM D2321) compacted in twelve (12) inch layers to 95% of maximum unit weight in accordance with MDOT procedures, or other approved means must be employed to assure a firm foundation for the utility. The volume of unstable foundation removed and replaced with approved materials for which payment will be allowed will be determined in cubic yards of material, compacted in place, unless otherwise specified on the drawings or in the proposal. Volume will be based on the actual width and depth of material removed and replaced, subject to Engineer review and approval.

3.27 PIPE EMBEDMENT

A. General

Pipe embedment must include the furnishing and placing of approved materials as specified or as directed from 4 inches under the outside bottom of the pipe to 12 inches over the outside top of the pipe. Various classes of pipe embedment may be specified or shown on the drawings or details in which case the limits of the various types will also be specified.

B. Flexible Pipe Embedment

Flexible pipe is any pipe having a pipe stiffness of less than 60 psi. as defined under the requirements of ASTM Designation D2412 (this includes all plastic pipe except Composite (Truss) pipe, and may include corrugated metal pipe, ductile iron pipe, and steel pipe, depending on pipe diameter and wall thickness).

3.28 PLACING PIPE EMBEDMENT MATERIAL

Pipe embedment material must be placed in the bottom of the trench and shaped by hand to provide a firm and uniform bearing for the barrel of the pipe with additional shaping to accommodate the bells on bell and spigot pipe. After each pipe has been graded, aligned, and placed in final position on the bedding material and jointing is complete, additional embedment material must be carefully placed, not exceeding 6-inch lifts, and compacted under and around each side of the pipe and over the pipe until it is completely covered by 12 inches of embedment material. Said material must be distributed along both sides of the pipe uniformly and simultaneously to prevent lateral displacement of the pipe. All granular embedment material must be compacted to 95% of maximum unit weight in accordance with MDOT procedures.

All the work of placing pipe embedment must be considered an integral part of installing the pipe and must be completed immediately after the pipe is laid to the correct alignment and grade.

3.29 BACKFILLING ABOVE PIPE EMBEDMENT

A. General

All backfill material must be free from cinders, ashes, refuse, sod, organic material, boulders, or rocks larger than 3 inches in diameter, frozen material or other material which in the opinion of the Engineer is unsuitable. The soil excavated from the trenches must be used for backfilling when it is classified as suitable by the Engineer. If all or a portion of the excavated material is classified as unsuitable for backfilling, the Contractor must remove and dispose of the unsuitable material and must furnish and place granular material meeting the requirements of Section 902.07 of the MDOT 2020 Standard Specifications for Construction for Granular Material Class II.

All backfilling and compaction must be performed by the Contractor using methods and equipment approved by the Engineer.

B. Trenches Requiring Compacted Granular Backfill

Trenches and excavations in the following locations must be backfilled with approved granular material meeting the requirements of Section 902.07 of the MDOT 2020 Standard Specifications for Construction for Granular Material Class II:

1. Improved areas, including drives, sidewalks, parking areas, around structures, etc.
2. Within the limits of the roadway (within a 1 on 1 slope beginning two (2) feet from the edge of pavement or back of curb towards the right-of-way line).
3. Within the limits of future improvements (shown on Drawings).
4. Within limits specified on Drawings.
5. All sanitary sewer lateral trenches within the limits of the right-of-way.

All backfill within these areas must be placed in layers not exceeding twelve (12) inches thick and must be compacted to 95% of maximum unit weight in accordance with MDOT procedures. Trenches transverse to undisturbed roadway shall be compacted to 98% of maximum unit weight in accordance with MDOT procedures. Tests for compaction will be made by the Engineer or other representative designated by the Engineer at no cost to the Contractor. When tests indicate a density which is less than that required, the methods or equipment being used must be modified to obtain the density specified, and the section in question must be recompacted until the required density is obtained. The cost of retesting must be borne by the Contractor.

C. Trenches Not Requiring Compacted Granular Backfill

Where not otherwise specified or directed, backfilling above the pipe embedment must be made with material which is originally excavated, which is suitable. Backfill materials must be consolidated by mechanical equipment working longitudinally in the trench, or by other approved methods, so as to be free of large voids with any excess material mounded over the trench or removed as directed by the Engineer. The trench must be graded to a reasonable uniformity and left in a neat condition.

3.30 DISPOSAL OF EXCESS EXCAVATION

All excavated material in excess of that needed for backfill or that material classified as unsuitable by the Engineer must be disposed of by the Contractor. However, the Engineer

reserves the right to direct the Contractor to haul all or a portion of the material not required for backfilling to an area designated by the Engineer which is not more than 1,000 feet outside the project and which is reasonably accessible. This work, when directed, must be performed at no additional cost to the Owner.

3.31 LIMITATIONS ON OPERATIONS

The Contractor must at all times conduct their work so that there is a minimum of inconvenience to the residents and businesses in the vicinity of this project. To this end, the Contractor must complete their backfill and remove all debris and unsuitable backfill to a point as close to the actual pipe installation as is practical and keep the area where the pipe construction and backfill has been completed in a neat condition. Open excavations must be protected by signs, lights, barricades, and/or fence at all times when work is not actually taking place at that excavation. The placement of excavated earth along the line of the trench must be controlled by the public's use of the street or right-of-way and must always be confined to approved limits.

Not more than 300 consecutive feet of street must be closed at one time, and vehicular traffic through any street must not be stopped for a period longer than two weeks without the written permission of the Engineer. Not more than one cross street must be closed to vehicular traffic at the same time except by permission of the Engineer. Contractor must maintain access for emergency vehicles at all times.

3.32 RESTORATION

A. Description of Work

All areas disturbed by construction operations must be reconstructed per the Drawings. Disturbed areas with no specific reconstruction plans must be restored to the original condition thereof as determined by the Engineer using information from drawings, surveys, and photographs or video when available.

The work must be performed in accordance with the Drawings and the MDOT 2020 Standard Specifications for Construction

B. Earthwork

All streets, walks, and other improved surfaces disturbed by construction operations must be replaced to uniform lines and grades established by the Engineer. The finish grade line will be established within three (3) inches of the existing ground profile shown on the Drawings unless a proposed grade is shown which indicates otherwise.

The Contractor must perform all grading, compacting, shaping, and related work required to prepare the subgrade to the satisfaction of the Engineer.

PART 4 MEASUREMENT AND PAYMENT

GRAVITY SEWER

4.01 GENERAL

All proposed construction will be measured for payment by the Engineer in accordance with the items listed in the Proposal.

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

4.02 SANITARY SEWERS

Measurement of the length of the sewer will be in lineal feet along the center line of the sewer from center of manhole to center of manhole.

Where depth classifications are provided, the depth of the sewer connecting two adjacent structures will be considered as being the average of the depth from earth grade to the sewer invert at these structures.

Unit price for sanitary sewer includes all specified acceptance testing.

4.03 MANHOLES

Manholes will be paid for in accordance with the units established in the Proposal. When no Proposal item is provided for castings, the castings and their installation are considered part of the major items of work.

4.04 SANITARY SEWER LATERALS

The length of sewer laterals will be measured horizontally from the center of the main sewer to the end of the lateral as specified and must include wyes and all lateral risers.

4.05 SANITARY SEWER TAP AND SANITARY MANHOLE TAP

Sanitary Sewer Tap and Sanitary Manhole Tap, __ inch shall be measured per unit installed based on the size of the connecting sewer pipe.

4.06 STUBS

Stubs are considered part of the major items of work and no specific payment will be made therefor.

FORCE MAIN SEWER

4.07 GENERAL

All proposed construction will be measured for payment by the Engineer in accordance with the items listed in the Proposal.

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

4.08 FORCE MAIN: OPEN CUT

Measurement of the length of the force main will be in feet along the center line of the force main. Payment of locator wire furnishing, installation and testing must be included in the Force Main item.

The Payment of locator wire furnishing, installation and testing must be included in the Force Main item.

4.09 FORCE MAIN: HDD

Measurement of the length of the force main installed by HDD will be in feet along the center line of the force main. Payment for pipe required for entry and exit pits shall be included as part of the major items of work.

The Payment of locator wire furnishing, installation and testing must be included in the Force Main item.

4.10 FITTINGS

When a specific item is provided in the Proposal for Bends, Tees, or Wyes, the unit price bid must be the additional cost of furnishing and placing the Bend, Tee or Wye over and above the cost of furnishing and laying the force main.

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

4.11 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.

4.12 THRUST BLOCKS AND RESTRAINT COLLARS

Thrust Blocks and Restraint Collars will be measured as single units and must include all concrete, steel reinforcement, wall anchors or restraint fins, and labor.

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

4.13 CLEANOUTS

Sanitary cleanouts shall be measured per unit installed and include the riser pipe, plug/cap, and any additional items as detailed on the drawings. Connection to the existing service shall be considered incidental to construction and will not be paid for separately.

4.14 AIR RELEASE VALVES

Air release valves will be paid for in accordance with the units established in the Proposal and must include furnishing and installing the precast manhole in accordance with the standard detail.

4.15 LOCATOR WIRE AND MARKING POSTS

Locator wire will be considered included in the cost of the force main pipe. Marking posts will be paid in accordance with the units established in the Proposal and must include furnishing and installation of the marking posts and test stations.

SUBGRADE

4.16 UNSTABLE FOUNDATION

Payment for removal, disposal and replacement of unstable foundation will be paid under the contract provisions for extra work, unless specific Proposal items have been provided, in which case, the unit price bid must be payment in full for performing the work as specified. If the soil in the bottom of the trench is soft due to excessive amounts of groundwater, and/or the Contractor's method of operation, stabilization of the trench bottom must be at the Contractor's expense.

4.17 SPECIAL BACKFILL

When an item has been provided in the Proposal for Special Backfill, approved granular material obtained off the site which is required by these specifications or authorized by the Engineer must be included in this item. Special backfill will be measured compacted in place. The Contractor must furnish a delivery ticket for each truck load at the time the material is delivered to the project. The delivery ticket must be prepared at least in duplicate, one copy of which must be furnished to the Engineer or their representative, and the other copy to be retained in the Contractor's file. No payment will be made for special backfill unless the

individual truck delivery tickets are furnished in this manner. The Engineer will use the delivery tickets when calculating the compacted in place quantity.

The Proposal unit price per cubic yard for special backfill must include payment in full for furnishing, placing, and compacting the special backfill and for disposing of the material excavated from the trench as directed and in accordance with the drawings and specifications.

Stone used specifically for dewatering procedures must not be classified as special backfill and no specific payment will be made therefore.

4.18 DISPOSAL OF EXCESS EXCAVATION

All excavated material in excess of that needed for backfill or that material classified as unsuitable by the Engineer must be disposed of by the Contractor. However, the Engineer reserves the right to direct the Contractor to haul all or a portion of the material not required for backfilling to an area designated by the Engineer which is not more than 1,000 feet outside the project, and which is reasonably accessible. This work, when directed, must be performed at no additional cost to the Owner.

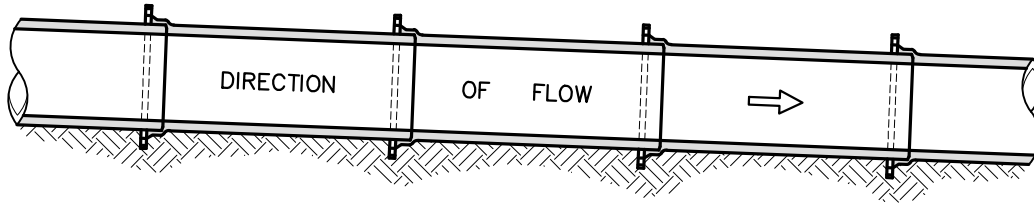
GENERAL

4.19 ADJUSTING DRAINAGE STRUCTURE, CASE 1, MODIFIED

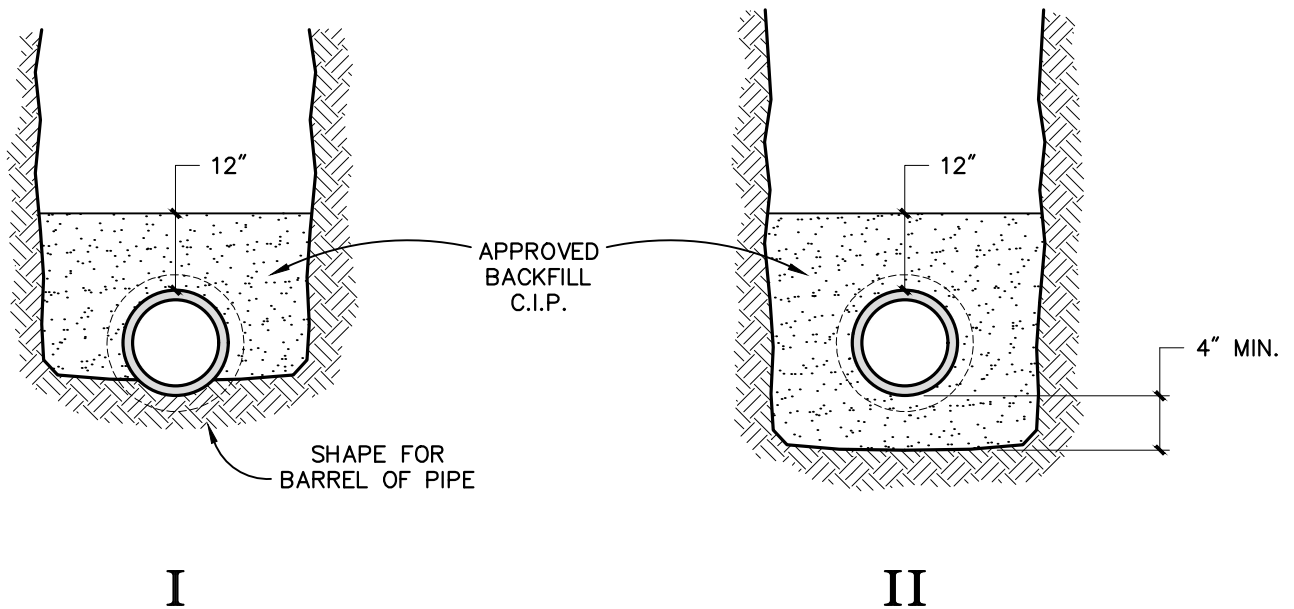
Dr Structure Cover, Adj, Case 1, Modified includes furnishing all materials, saw cutting, removal and disposal of existing pavement and curb or curb and gutter, adjustment of cover to required elevation and cross-slope, installation of epoxy anchored lane ties and epoxy coated circular bars, placement and finishing of new curb or curb and gutter, placement and finishing of new concrete and HMA, placement and removal of temporary HMA wedging for maintaining traffic, if required, placement of cover on open structures to prevent accumulation of debris and cleaning existing drainage structures due to Contractor operations.

4.20 STEEL CASING PIPE

Steel Casing Pipe, __ inch, jacked in place of the size required will be paid for by the length installed. Steel Casing Pipe, __ inch, jacked in place includes the cost of excavating the pits, providing and installing sheeting, bracing, and any other safety devices, providing jacking equipment, drainage and dewatering, bulkheading and sealing the casing, providing and installing vents, grouting the annular space between the casing and native soil and any other items associated with the operation.



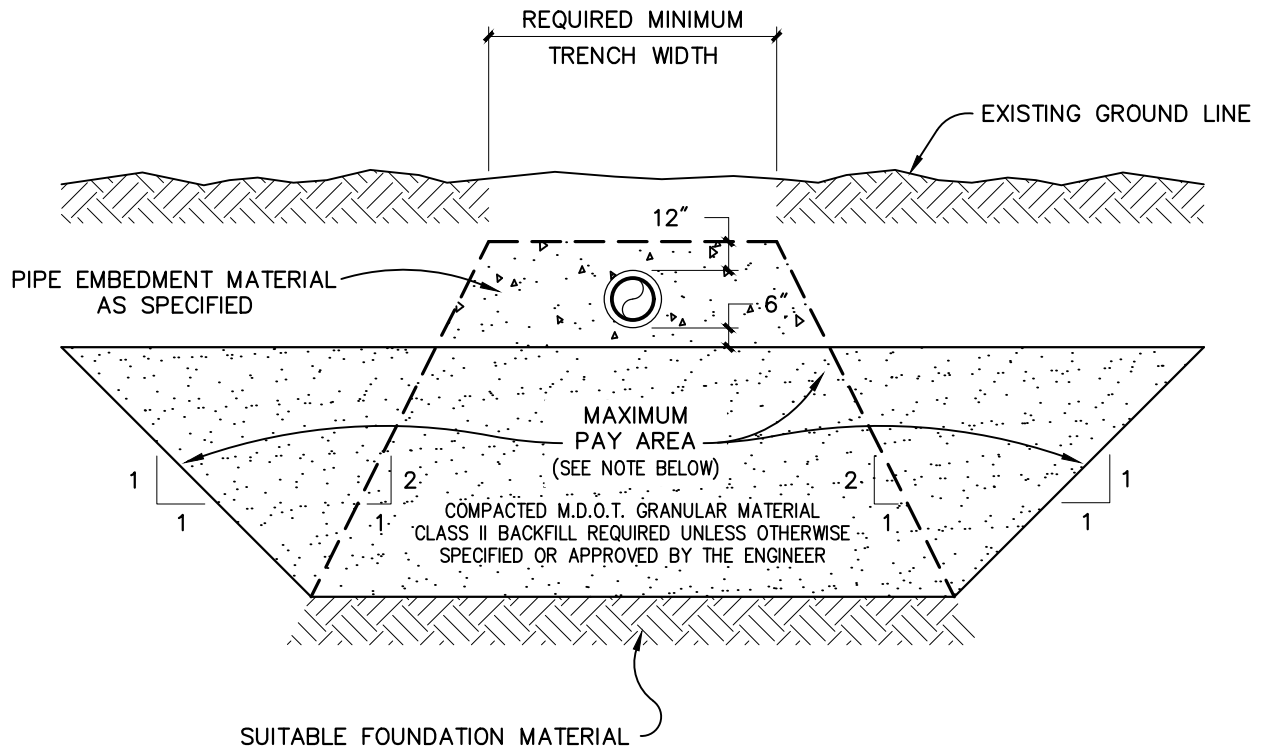
EXCAVATION FOR BELLS



CLASS B PIPE EMBEDMENT

NOTES

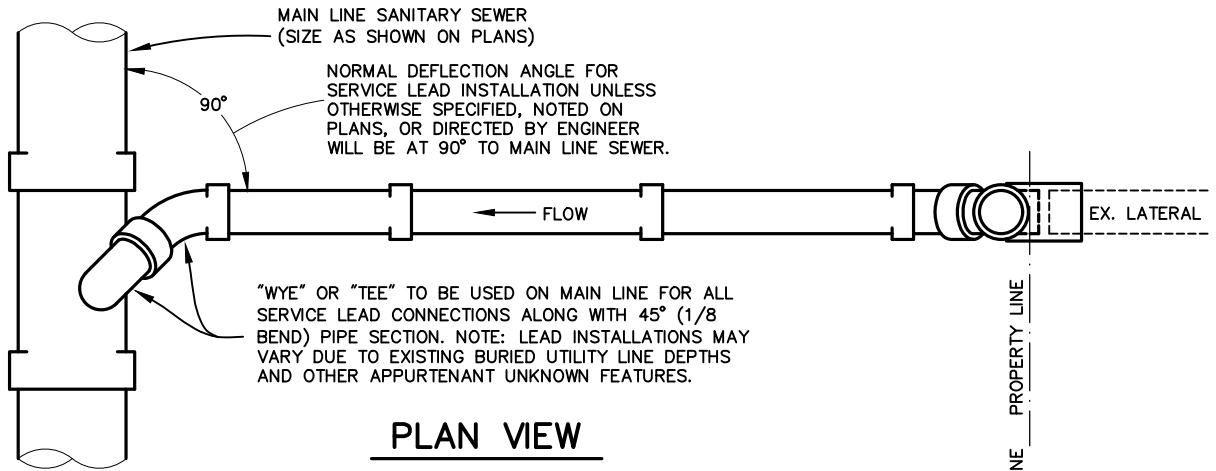
- | |
|---|
| <ol style="list-style-type: none"> 1. ALL BACKFILL INDICATED MUST BE COMPACTED TO 95% OF MAXIMUM DENSITY IN ACCORDANCE WITH M.D.O.T. PROCEDURES. 2. METHOD I MUST BE USED IN AREAS OF UNCONSOLIDATED SOILS. (e.g. SAND, GRAVEL) 3. METHOD II MUST BE USED IN AREAS OF CONSOLIDATED SOILS (e.g. CLAY, HARDPAN, ROCK) 4. IF STONE IS USED FOR BEDDING, A NON-WOVEN GEOTEXTILE SEPARATOR (PER MDOT 910) MUST BE PLACED AROUND ALL AREAS WHERE STONE PIPE EMBEDMENT IS USED. 5. TRANSITION ZONES BETWEEN STONE AND SAND EMBEDMENT MUST BE SEPARATED BY A NON-WOVEN GEOTEXTILE SEPARATOR. |
|---|



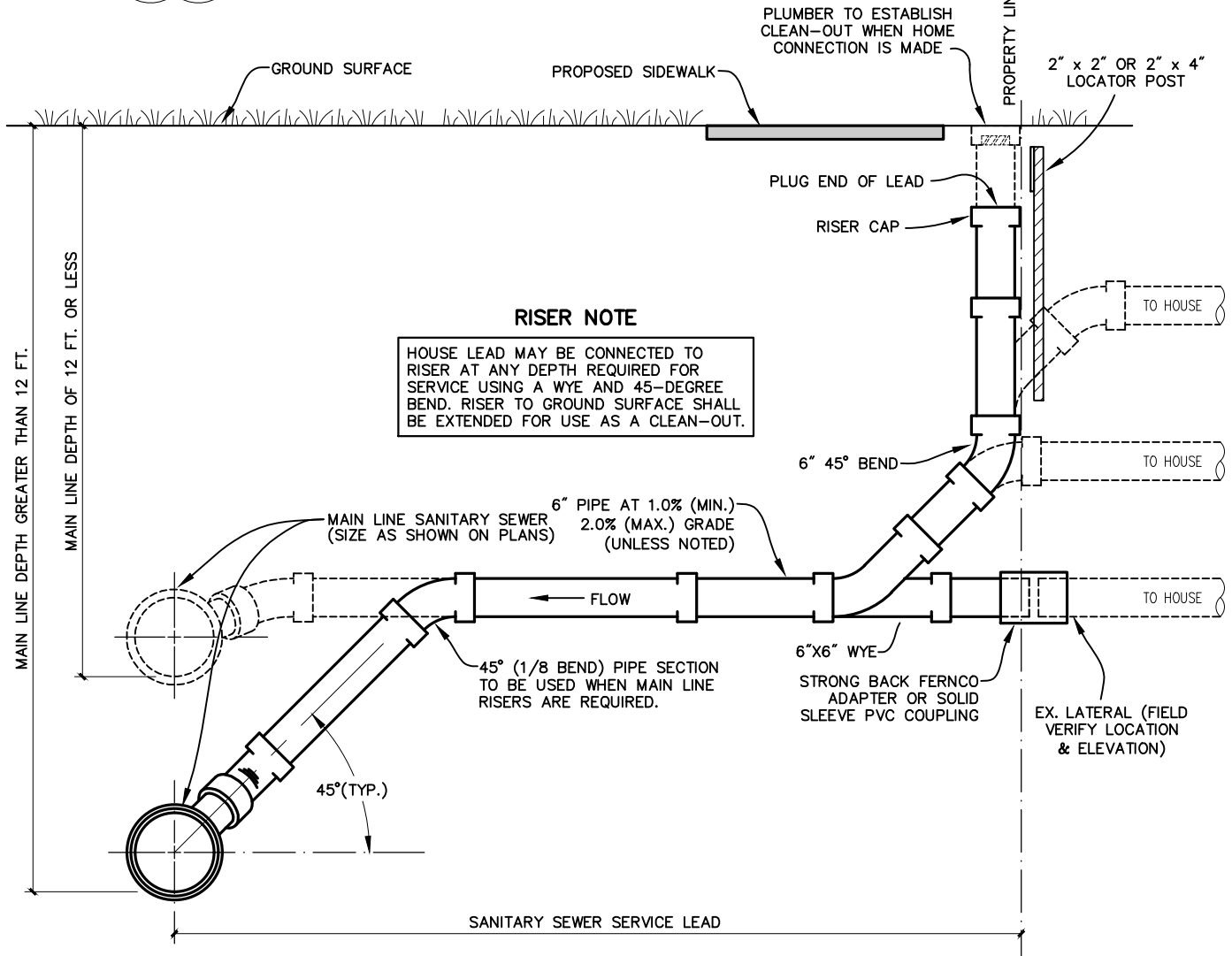
UNSTABLE SOIL REMOVAL FOR UTILITY

NOTE

PAYMENT WILL BE PER CUBIC YARD OF MATERIAL, COMPACTED IN PLACE. VOLUME WILL BE BASED ON THE ACTUAL WIDTH AND DEPTH OF MATERIAL REMOVED AND REPLACED, SUBJECT TO ENGINEER REVIEW AND APPROVAL, BUT SHALL NOT EXCEED THE CROSS-SECTION OF THE DETAIL ABOVE.



PLAN VIEW



RISER NOTE

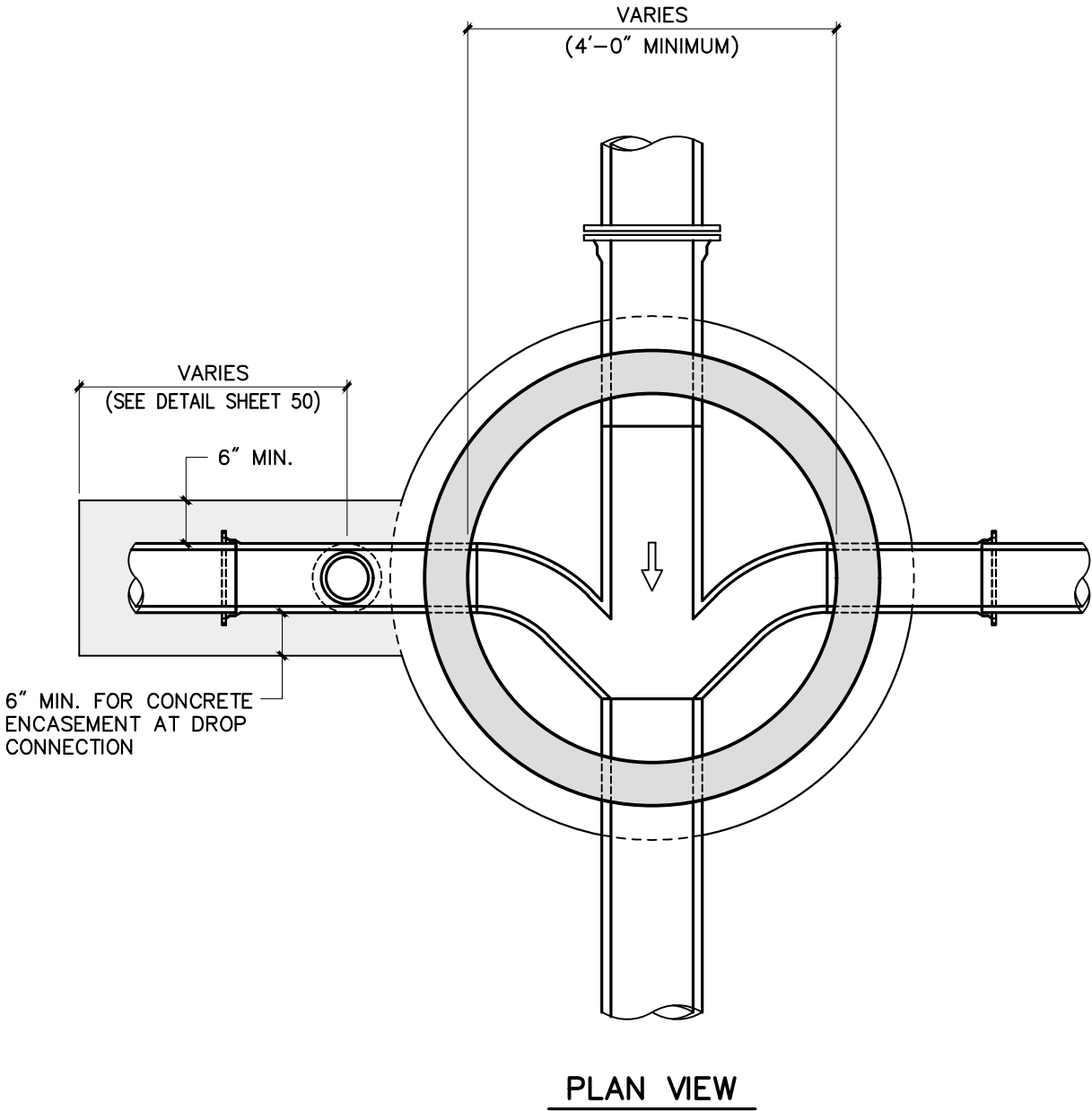
HOUSE LEAD MAY BE CONNECTED TO RISER AT ANY DEPTH REQUIRED FOR SERVICE USING A WYE AND 45-DEGREE BEND. RISER TO GROUND SURFACE SHALL BE EXTENDED FOR USE AS A CLEAN-OUT.

LATERAL & PROPERTY LINE RISER DETAIL

NOTE

THE NORMAL DEPTH OF A SANITARY SEWER LATERAL SHALL BE 12 FEET BELOW THE EXISTING GRADE AS MEASURED IN FRONT OF THE HOUSE, OR AT THE PROPERTY LINE ON VACANT LOTS. THIS DEPTH MAY BE INCREASED FOR ADVERSE TOPOGRAPHY OR LARGE BUILDING SET BACKS, AS DETERMINED BY THE ENGINEER. IF THE DEPTH OF THE MAIN IS SUCH THAT THE ABOVE LATERAL DEPTH CAN NOT BE ACHIEVED, THE LATERAL SHALL BE PLACED AT A 1% GRADE FROM THE MAIN LINE TO THE PROPERTY LINE.

T:\DWG\3D PROJECTS\2024\240987_CITY OF KALAMAZOO STD SPECS\4_PROD\SECTION 6 - SANITARY SEWER\48_SS_SANITARY_LATERAL & PROPERTY LINE RISER.DWG - NSMTH - Nov, 20 2025 - 10:57am - PreshMehrotra



STANDARD SANITARY SEWER MANHOLE

(PRECAST CONCRETE)

NOTES

1. IF BOTTOM IS PRECAST CONCRETE, SET ON MINIMUM 4" SAND SUBBASE (CIP) OR CLASS 1A CRUSHED STONE WRAPPED WITH GEOTEXTILE FABRIC.
2. CONE MAY BE ROTATED TO ALIGN STEPS TO VARIOUS LOCATIONS IN MANHOLE.
3. FLOW CHANNEL WALL HEIGHT SHALL BE EQUAL TO CROWN OF PIPE.

FRAME EJ 1045ZPT,
COVER EJ 1040 (NON-BOLTED) OR
EJ 1040APT (BOLTED) AS SPECIFIED

SET FRAME IN
SOFT MORTAR BED
FINISH GRADE

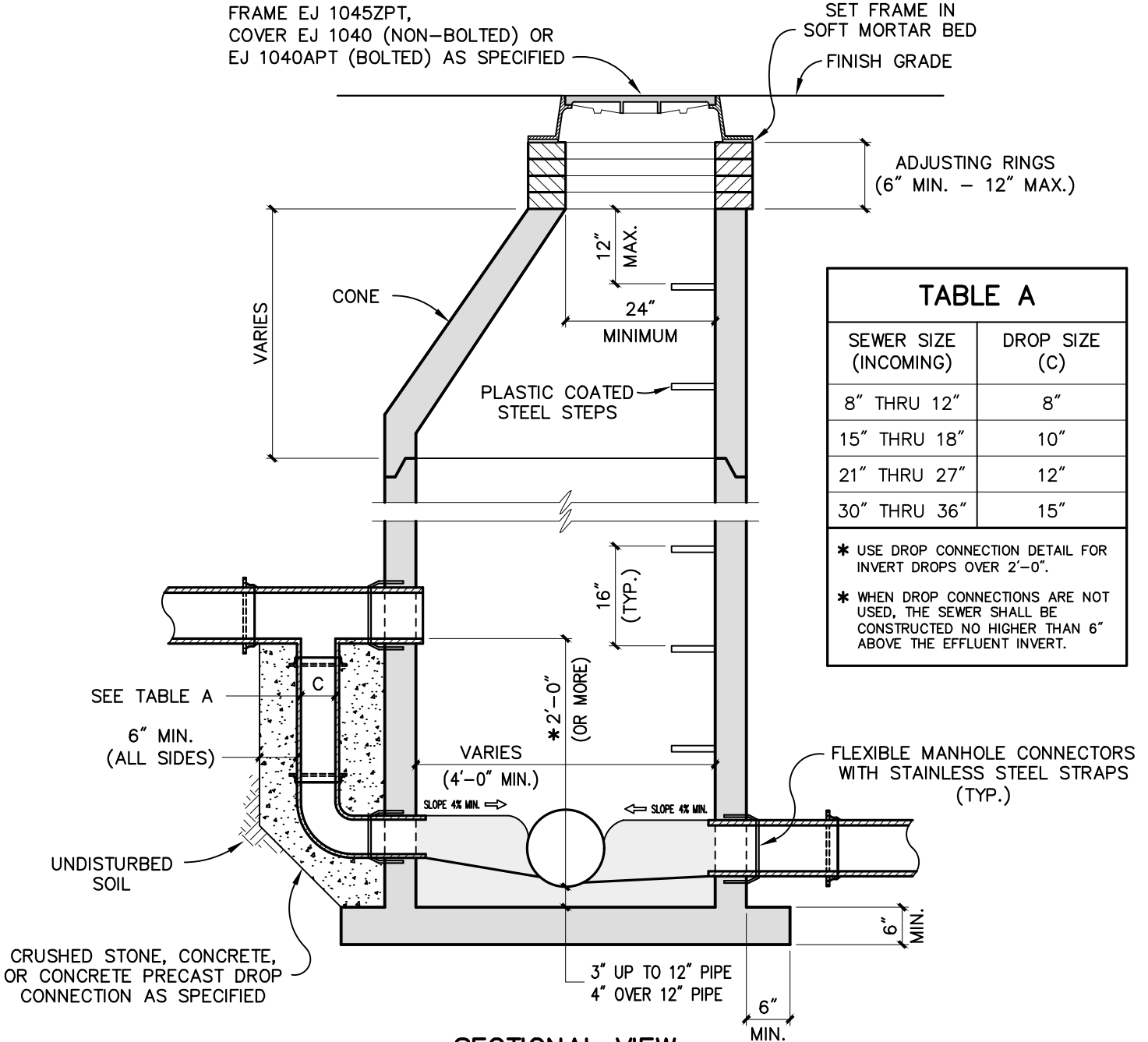
ADJUSTING RINGS
(6" MIN. - 12" MAX.)

TABLE A

SEWER SIZE (INCOMING)	DROP SIZE (C)
8" THRU 12"	8"
15" THRU 18"	10"
21" THRU 27"	12"
30" THRU 36"	15"

* USE DROP CONNECTION DETAIL FOR INVERT DROPS OVER 2'-0".

* WHEN DROP CONNECTIONS ARE NOT USED, THE SEWER SHALL BE CONSTRUCTED NO HIGHER THAN 6" ABOVE THE EFFLUENT INVERT.

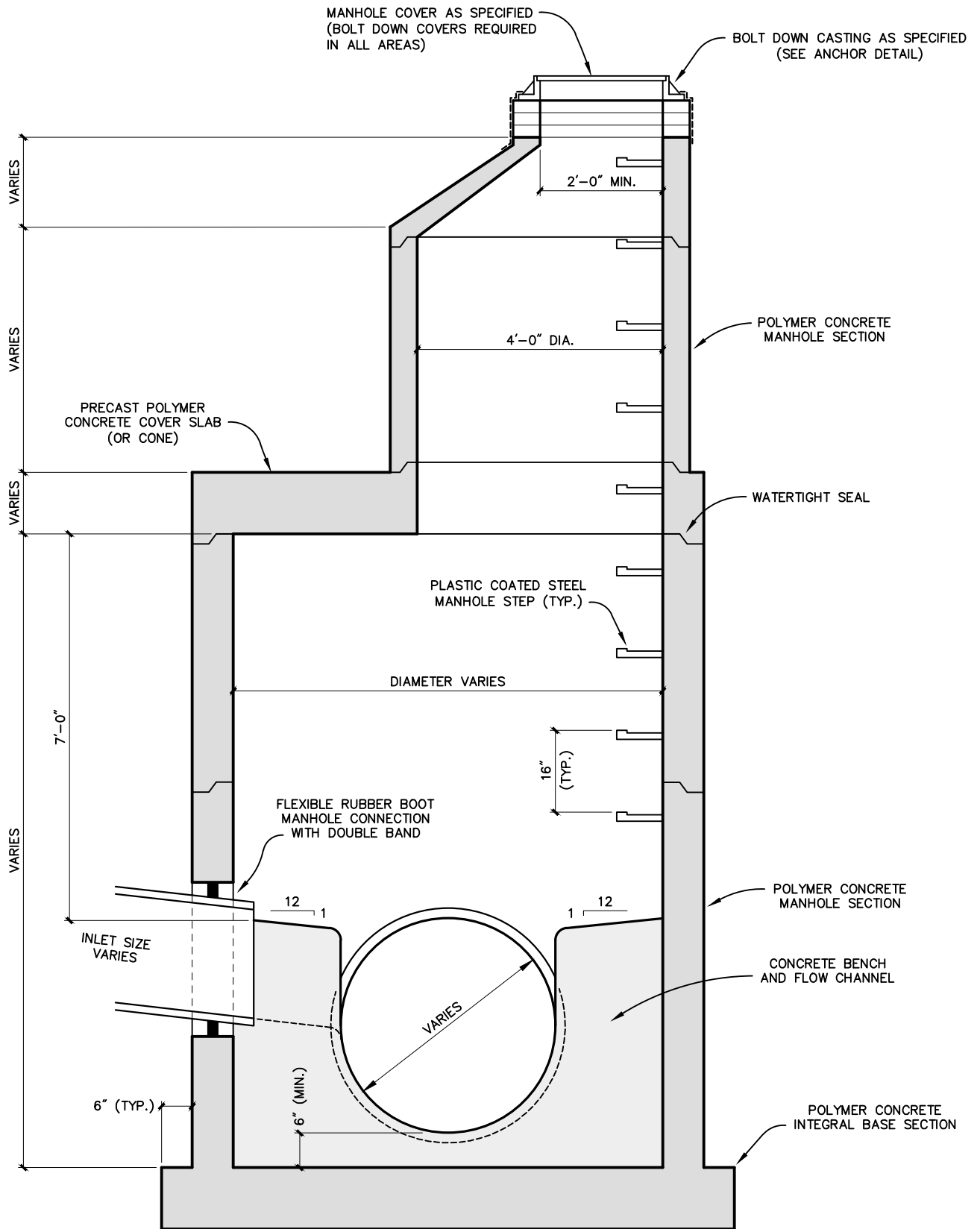


SECTIONAL VIEW

**STANDARD SANITARY SEWER MANHOLE
(PRECAST CONCRETE)**

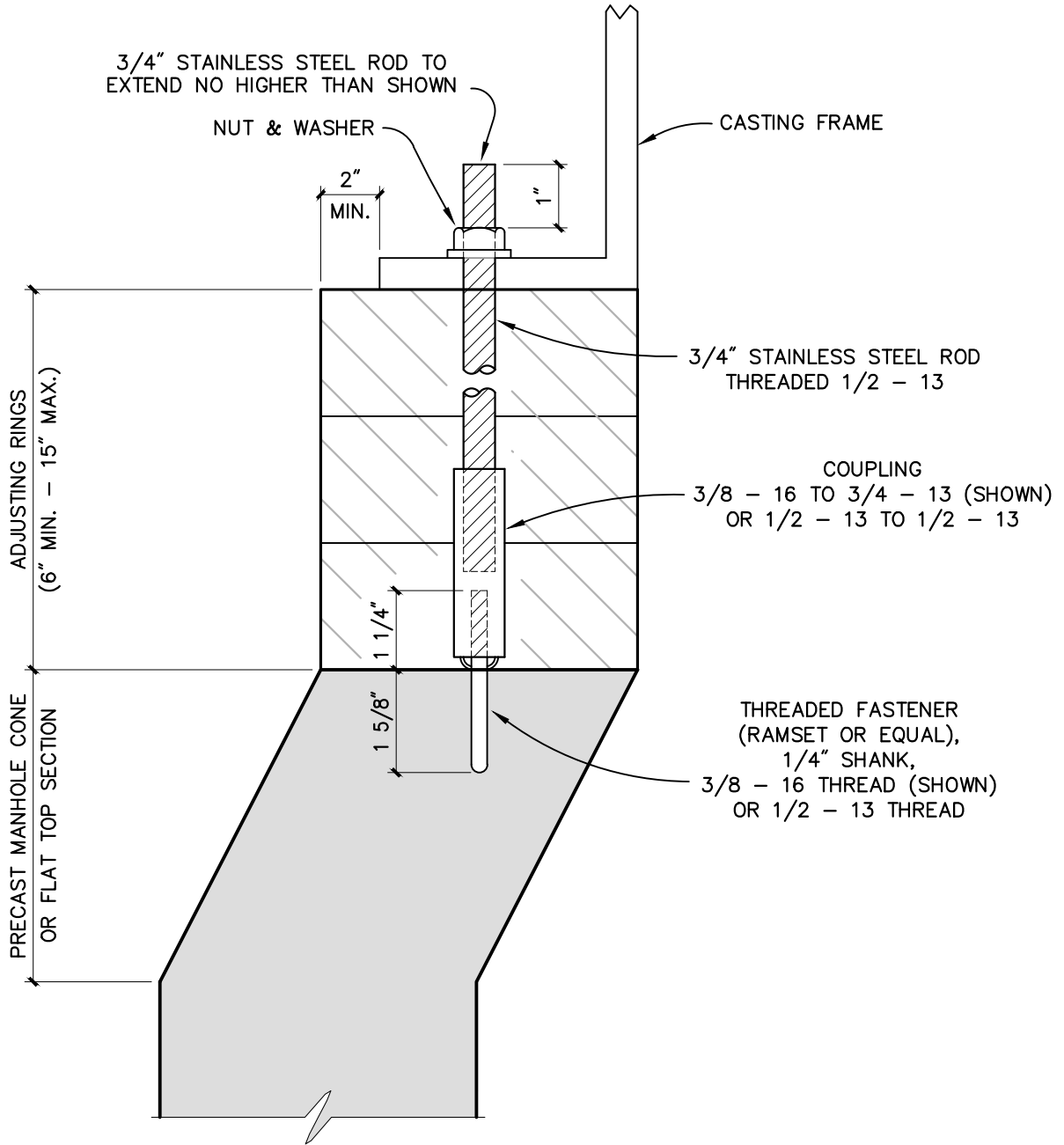
NOTES

1. PRECAST CONCRETE MANHOLE SHALL MEET ASTM C478.
2. IF BOTTOM IS PRECAST CONCRETE, SET ON MINIMUM 4" SAND SUBBASE (CIP) OR CLASS 1A CRUSHED STONE WRAPPED IN GEOTEXTILE FABRIC.
3. CONE MAY BE ROTATED TO ALIGN STEPS TO VARIOUS LOCATIONS IN MANHOLE.
4. FLOW CHANNEL WALL HEIGHT SHALL BE EQUAL TO CROWN OF PIPE.
5. ALL CASTINGS LOCATED IN CROSS COUNTRY AREAS ARE TO BE INSTALLED WITH BOLT DOWN COVERS AND ANCHORED TO THE MANHOLE STRUCTURE.



MANHOLE DETAIL (16'-1" & GREATER)

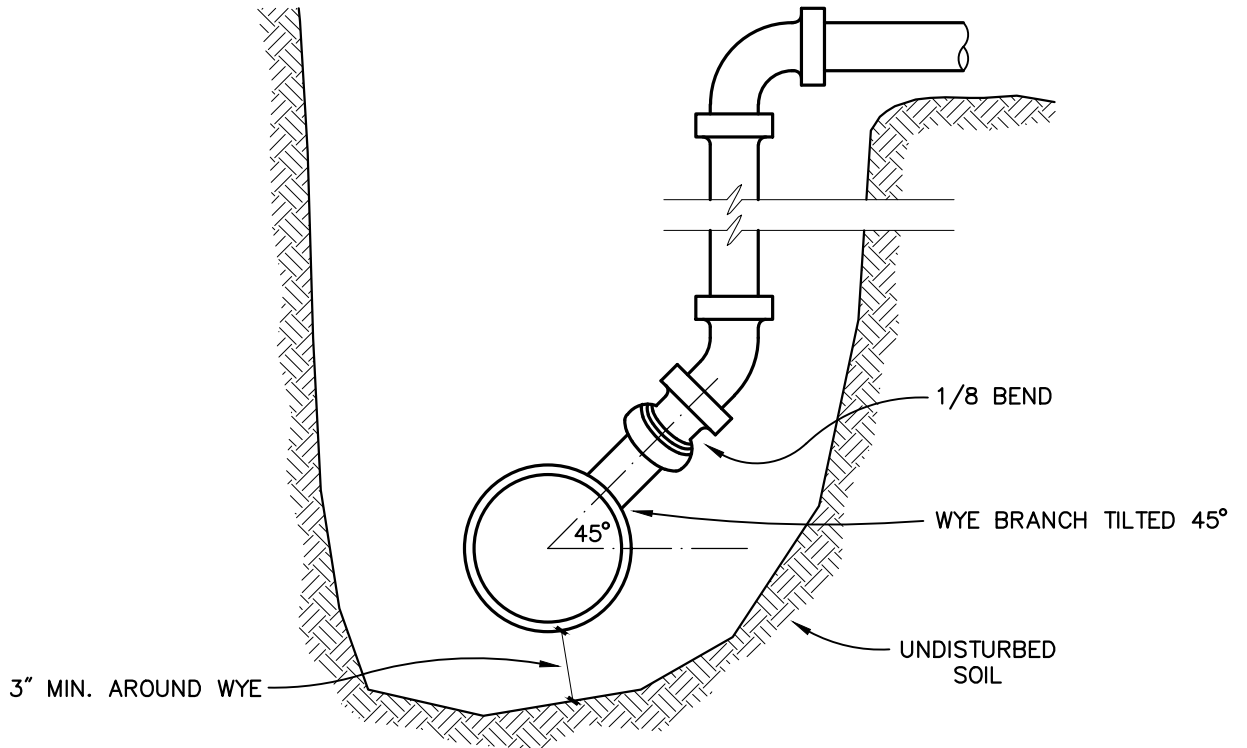
SCALE : NONE



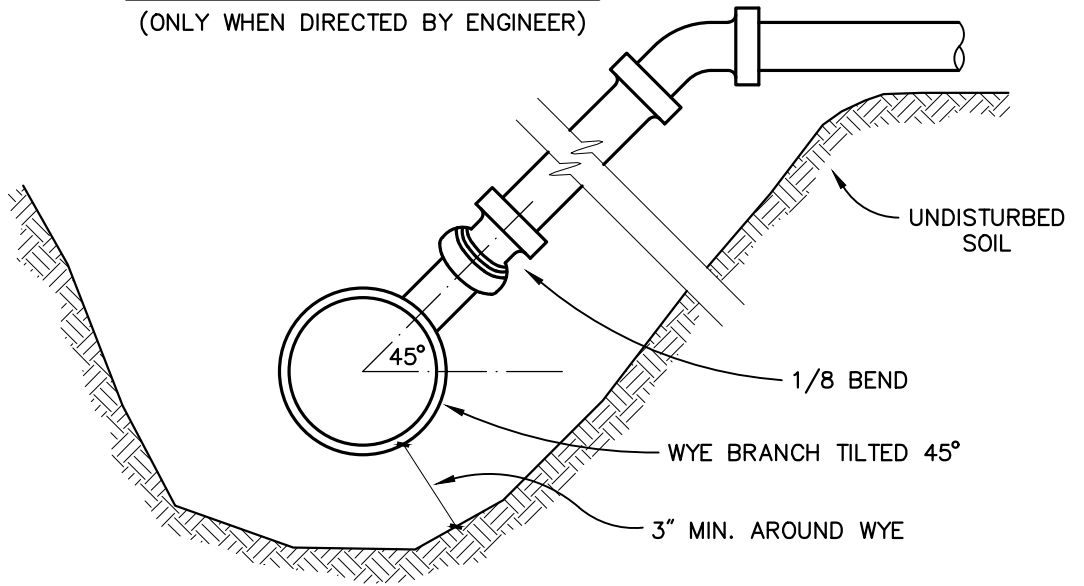
ANCHOR DETAIL

NOTE

FOR ALL PRESSURE TIGHT OR WATERTIGHT COVERS IN UNIMPROVED AREAS, FOUR (4) ANCHORS PER COVER



VERTICAL TRENCH
 (ONLY WHEN DIRECTED BY ENGINEER)



SLOPING TRENCH
 (STANDARD)

STANDARD RISER DETAILS

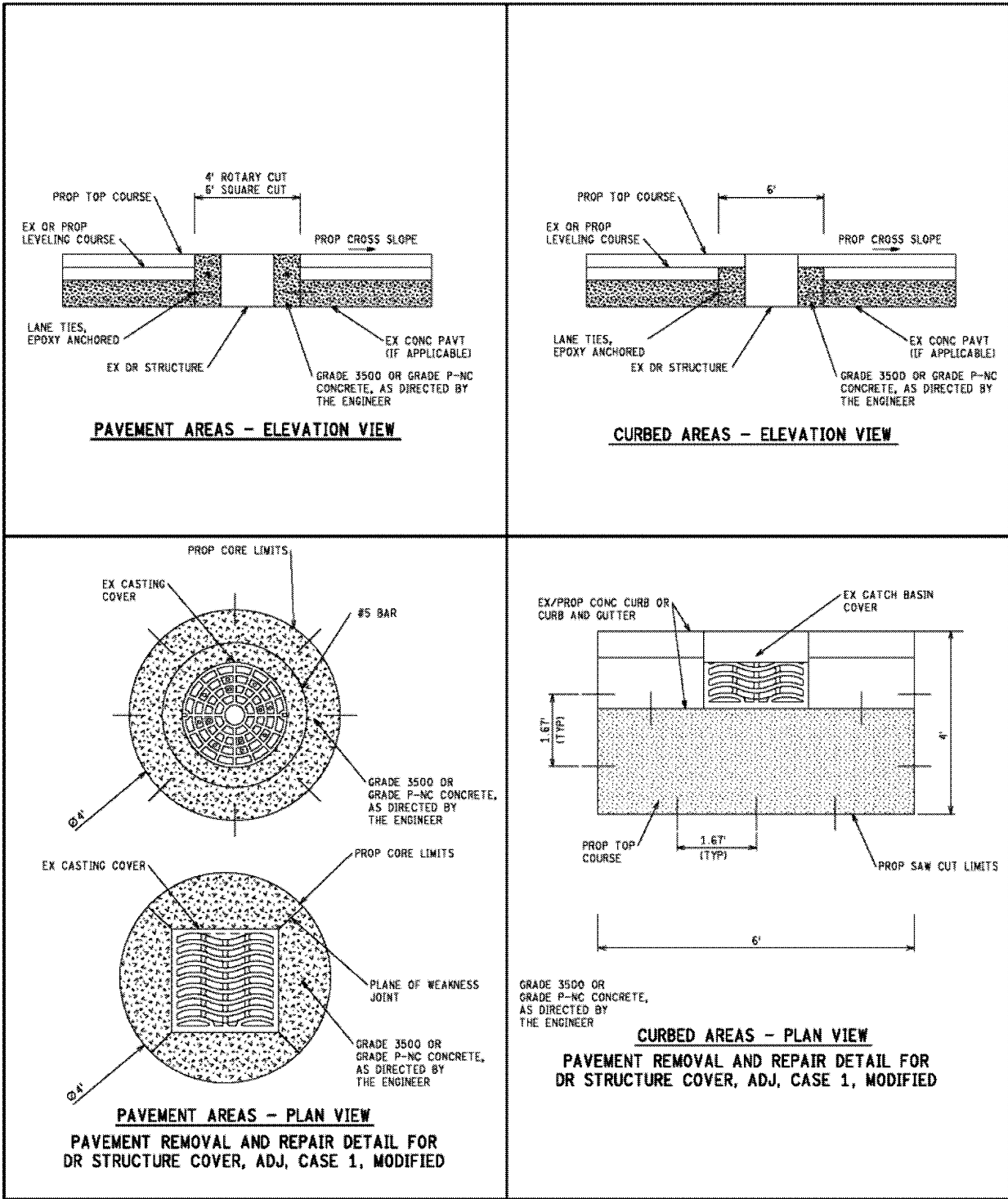
NOTE

SEE PLANS OR SPECS FOR SIZE AND DEPTH OF LATERAL

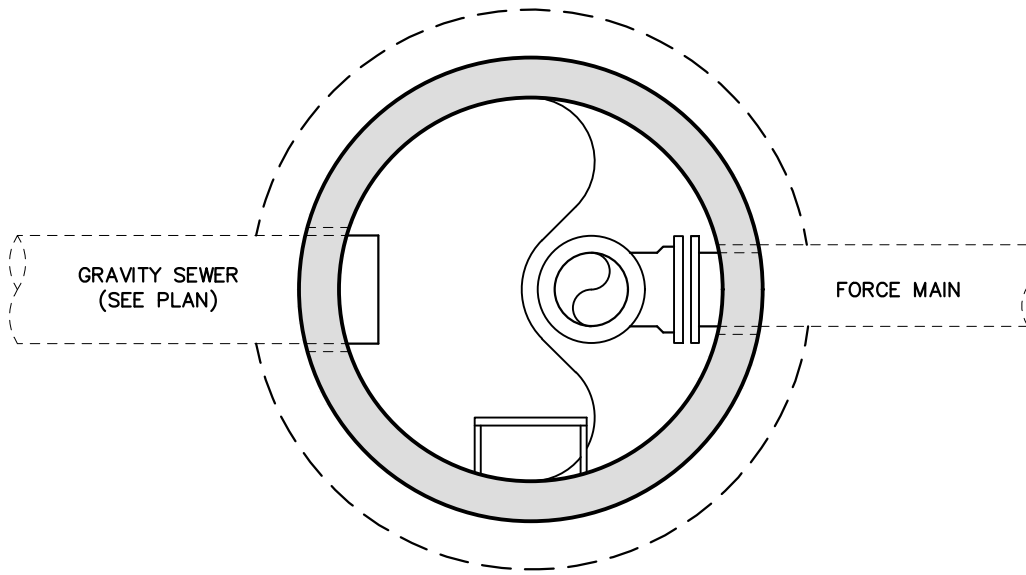
PROJ. NAME: _____ SHEET #: _____
 DATE: _____ INSP. INTIALS: _____
 TWP: _____ CONTRACTOR: _____
 STREET NAME: _____
 LOT # _____ HOUSE #: _____
 M.H. # _____ M.H. STA.: _____
 DISTANCE FROM DOWNSTREAM M.H.: _____
 IDENT. AS TYPE 1, 2, OR 3: _____
 DIST. FROM MAIN LINE TO END LAT: _____
 ELV. INV. LAT. @ MAIN: _____ DIA. _____
 ELV. INV. @ TERM. OF LAT.: _____
 TOP OF RISER ELEV.: _____
 GROUND ELEV. @ RISER: _____
 HSE. FINISHED FLOOR ELEV.: _____
 MARKER POST _____
 REMARKS: _____

SKETCH

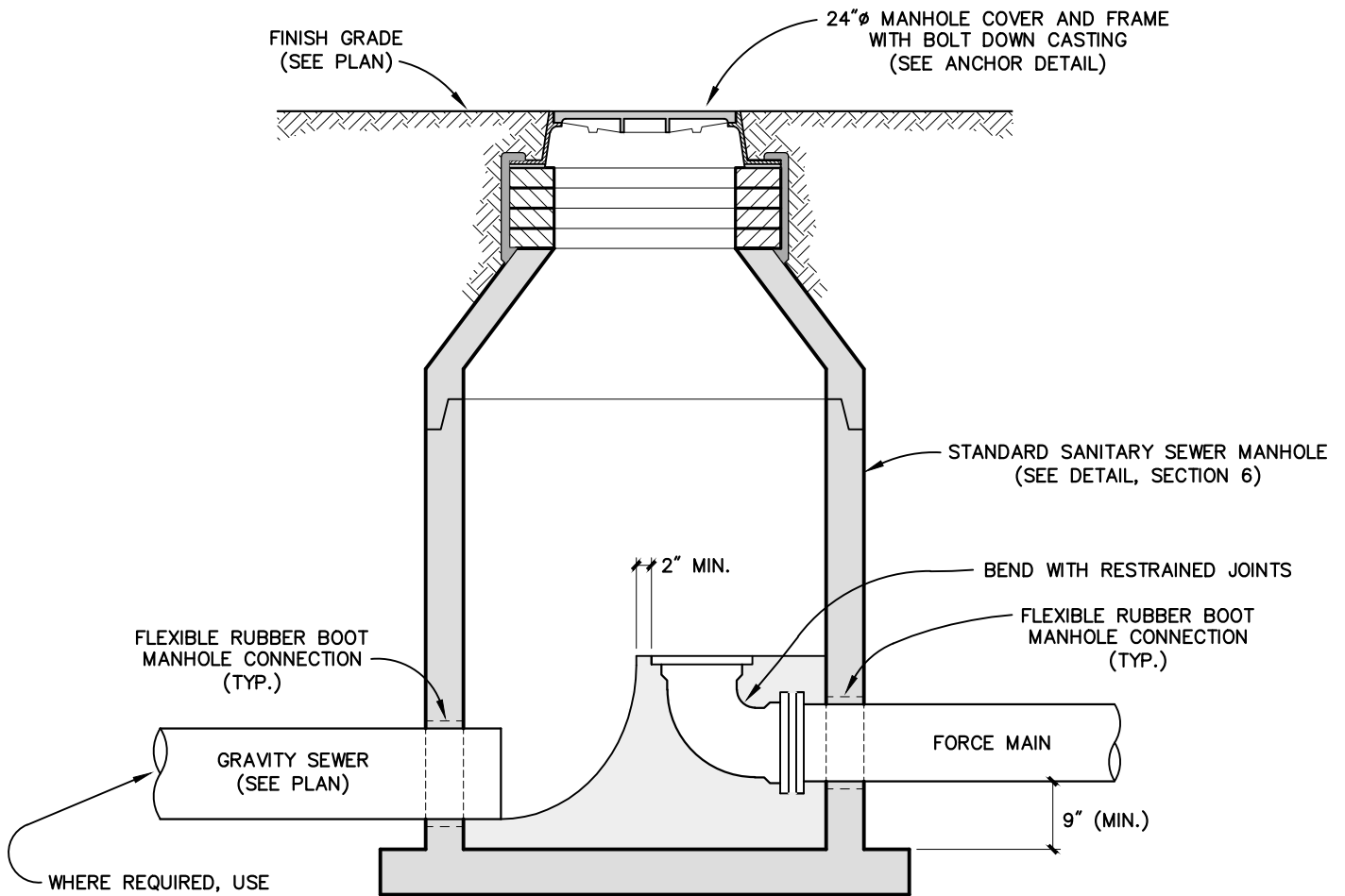
LEAD CARD



PAVEMENT REMOVAL & REPAIR DETAIL



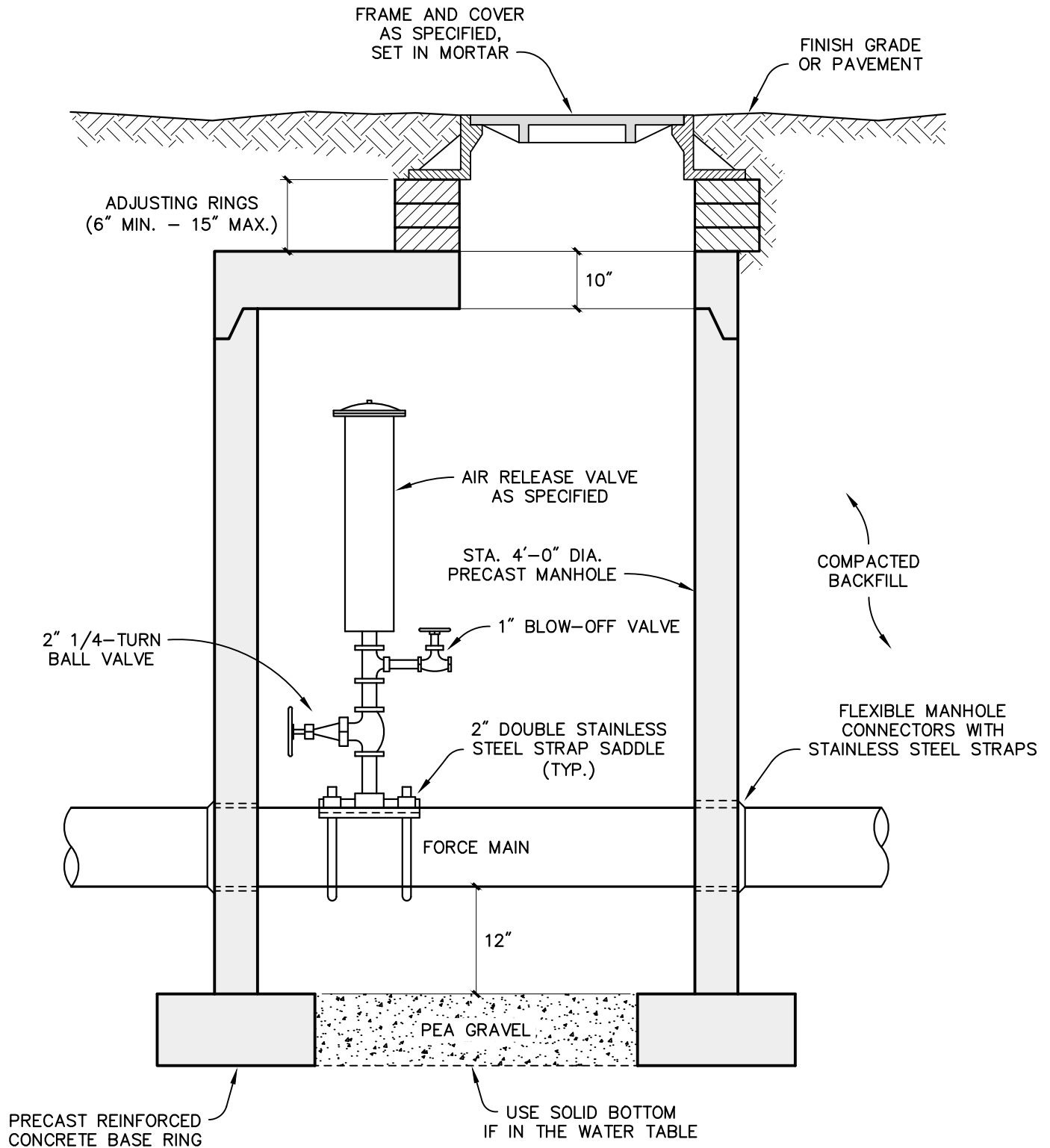
PLAN VIEW



SECTIONAL VIEW

STANDARD FORCE MAIN DISCHARGE MANHOLE

T:\DWG\3D PROJECTS\2024\240987_CITY OF KALAMAZOO STD SPEC\4_PROD\SECTION 7 - FORCE MAIN\56_ST_FORCE MAIN_DROP CONNECTION.DWG - MSW/TH - Nov, 26 2025 - 08:53am - Print&WebPlot



STANDARD AIR RELEASE VALVE – MANHOLE

NOTE

1. PRECAST CONCRETE MANHOLE MUST MEET ASTM C478.
2. INSTALL AIR RELEASE VALVE AT THE VERY HIGHEST ELEVATION OF THE FORCE MAIN.