



CONSTRUCTION SPECIFICATIONS

for the

MPU

WATER DISTRIBUTION SYSTEM

Revised November 2023

INTRODUCTION

The purpose of these Specifications is to establish basic water distribution system standards. In the interest of providing the best possible service with the least possible cost, the Manitowoc Public Utilities Water Department (MPU) requests mutual cooperation between all parties involved. Both the written and drawing sections of the Specifications are meant to better communicate the current requirements of the MPU.

Construction of domestic water pipelines and appurtenances shall be in accordance with the requirements of these Specifications.

These Specifications are not intended to cover all situations. More detailed specifications may be required for some projects, and shall be provided on an as-needed basis and shown in the Special Conditions and/or the Plans.

The Specifications shall also include by reference the following:

- State of Wisconsin Public Service Commission, Chapter PCS 185, Standards for Water Public Utility Service
- Chapter NR 114 Wisconsin Administrative Code Specification Requirements
- Department of Natural Resources
 - Chapter NR 809 - Safe Drinking Water
 - Chapter NR 810 - Requirements for The Operation and Maintenance of Public Water Systems
 - Chapter NR 811 - Requirements for The Operation and Design of Community Water Systems
- Standard Specifications for Sewer and Water Construction in Wisconsin-latest edition
- City of Manitowoc Plumbing Code
- City of Manitowoc Municipal Code – Chapter 29, Construction Site Erosion Control
- WDNR WPDES Permit No. WI-B057681-05-0
- Manitowoc Public Utility Water Utility Rules

Customers, suppliers, developers, contractors and engineers are advised to obtain prior approval of any proposed work so that specific requirements are understood.

All materials shall be approved by the Water Systems Manager.

Robert Michaelson, P.E.
Water Systems Manager

MATERIALS

1. Ductile Iron Pipe:

- a. All ductile iron pipe shall conform to the latest edition of AWWA C-150 and C-151.
- b. Class: The minimum ANSI class for all pipe shall be Class 52.
- c. Pressure Rating: 350 psi
- d. Coatings/Linings: All ductile iron pipe shall be coated with a layer of arc-sprayed zinc per ISO 8179. The mass of the zinc applied shall be 200g/m². A finishing topcoat shall be applied to the zinc. Interior lining for potable water main shall have an interior protective lining of double cement-mortar in accordance with ANSI/AWWA A21.4/C104.
- e. Gaskets: All gaskets shall be in conformance with the latest edition of AWWA C-111. Areas of soil contamination (petroleum or petroleum by-products) shall require the use of nitrile gaskets if the pipe will be above groundwater, and fluorocarbon gaskets if the main will be below groundwater.
- f. Joints: All underground joints shall be push-on.
 - i. Exceptions include pipe joints with fittings and valves, which shall be mechanical joint.
 - ii. River crossings shall be restrained. Other joint types (i.e. ball and socket) may be used as conditions require, with approval of the Water Systems Manager. Specifications for these joints will be developed for each special use.
 - iii. If pipe restraint is to be provided by the use of colored restraining gaskets, the gaskets shall be ANSI/NSF 61 certified, and the color shall be consistent throughout the entire cross section of the gasket. The color shall not be attained by surface coating; it shall be inherent within the rubber.
- g. Wrapping: All ductile iron pipe shall be encased with polyethylene in accordance with the latest edition of AWWA C-105.

2. Polyvinyl Chloride (PVC) Pipe:

- a. All PVC pipe shall conform to the latest edition of AWWA C-900 (4"-12" diameters).
- b. Prohibited Use: PVC pipe is not to be used in areas of soil contamination (petroleum or petroleum by-products). When possible, the contaminated areas will be shown on the plans. Unexpected areas will be addressed with the Engineer.
- c. Pressure Rating: The pipe shall have a minimum pressure class of 235 PSI and a dimension ratio of 18 (i.e. DR 18).
- d. Gaskets: All gaskets shall be elastomeric, meeting the requirements of ASTM F477.

- e. Joints: All joints shall be push-on and conform with ASTM D3139. Other joint types may be used as conditions require, with approval of the Water Systems Manager. Specifications for these joints will be developed for each special use.

3. Fittings:

- a. All fittings shall be ductile iron and shall conform to the latest edition of AWWA C-110 (ductile iron or gray iron) or AWWA C-153 (ductile iron compact fittings).
- b. The fittings shall be mechanical joint. T-bolts and nuts shall be constructed from corrosion-resistant, high-strength low-alloy steel that conforms to ANSI/AWWA C111/A21.11, and features a baked-on, ceramic-filled fluorocarbon resin. T-bolts and nuts shall be COR-BLUE or approved equal.
- c. Fittings shall have an outside coating of a petroleum asphaltic coating approximately 1 mil thick, per the latest edition of AWWA C-110 or AWWA C-153.
- d. Fittings shall have a cement-mortar lining in accordance with the latest revision of ANSI/AWWA C104/A21.4.

4. Hydrants:

- a. Unless otherwise specified, fire hydrants shall be Waterous Pacer WB-67, conforming to AWWA C-502.
- b. Hydrants shall have a six inch (6") mechanical joint connection, a break-away flange at ground level, a sixteen inch (16") break-away section above ground, with two (2) 2½ inch and one (1) 4½ inch National Standard Thread hose connections.
- c. All exterior valve body bolting shall be type 304 stainless steel and shall be provided with hexagonal heads, with dimensions conforming to ANSI B18.2.1.
- d. The operating nut shall be non-hooded, operating clockwise to close.
- e. All fire hydrants shall be painted RED.

5. Mechanical Joint Restraints:

- a. Restraint devices for mechanical joint fittings and appurtenances shall conform to either ANSI/AWWA C111/A21.11 or ANSI/AWWA C153/A21.53.
- b. All casting bodies shall have a polyester based powder coating that is electrostatically applied and heat cured.
- c. All wedge assemblies and related parts shall have a thermally cured epoxy coating.
- d. All mechanical joint restraints on ductile iron pipe shall be EBAA MEGALUG Series 1100, or approved equal.
- e. All mechanical joint restraints on PVC pipe shall be EBAA MEGALUG Series 2000PV, or approved equal.

6. Valves:

- a. Valves four (4") inch thru twelve (12") inch in diameter shall be resilient wedge gate valves. Valves larger than twelve (12") inch in diameter shall be butterfly valves unless otherwise specified.
- b. Resilient Wedge Gate Valves (R/W): Resilient wedge type gate valves shall be in accordance with the latest edition of AWWA C-515 and shall be supplied with external epoxy coating and mechanical joints. All exterior valve body bolting shall be type 304 stainless steel and shall be provided with hexagonal heads, with dimensions conforming to ANSI B18.2.1. Unless otherwise specified, gate valves shall be American Flow Control Series 2500 Resilient Wedge Gate Valves.
- c. Butterfly Valves: Butterfly valves shall be in accordance with the latest edition of AWWA C-504 for buried services and provided with O-ring shaft seals and rubber seats. The minimum class shall be Class 150B of short-bodied mechanical joint configuration. Butterfly valves shall be equipped with manual operators with an operator nut. Unless otherwise specified, butterfly valves shall be Mueller series B-3211-20 or equal.
- d. Valve Features:
 - i. Valves to have non-rising stem, operating clockwise to close.
 - ii. Provided with an arrow externally cast on the operating nut showing direction of closing.
 - iii. All gate valves 6" and larger shall be designed for an input torque of 400 foot-pounds without distortion of any kind.
 - iv. All exterior valve body bolting shall be type 304 stainless steel and shall be provided with hexagonal heads, with dimensions conforming to ANSI B18.2.1.
 - v. 2" square operating nut.
 - vi. The operating nut attaching nut or bolt shall be 304 stainless steel.

7. Valve Boxes:

- a. Valve boxes shall be three (3) piece screw type made of cast iron construction and have a minimum shaft diameter of 5 ¼ inch. Valve boxes outside of the roadway are permitted to be plastic and shall have a cast iron ring to hold iron cap and be suitable for magnetic detection.
- b. Valve Box Caps: Valve box caps shall be made of heavy cast iron construction, shall fit snugly within valve box top section, and have the structural capability to withstand nominal truck traffic loads. "Water" shall be clearly printed on the cap.
- c. Valve Box Bases: Oversized valve box bases shall be used on all valves.
- d. Valve Box Adaptor: Valve box adaptor shall be installed on all valves to ensure the valve box will be centered and remain centered over the valve operating nut. Unless otherwise specified, the valve box adaptor shall be Adaptor style, as manufactured by Adaptor Inc., or approved equal.

- e. Manholes: Generally, manholes shall not be used for valve installation. However, for river crossings and other specific uses, they may be used as identified on the plans.

8. Water Services:

- a. All water laterals shall be a minimum of 1" in diameter for Type "K" Copper or a minimum of 1¼" Polyethylene (PE) Pressure Pipe and Tubing, CTS (Copper Tubing Size) rated for 200 PSI. Larger diameter water services may be required and are shown on the plans, when applicable.
- b. Type "K" Copper Tubing service laterals, 1" to 2" in size, shall conform to ASTM B88 – Standard Specification for Seamless Copper Water Tube, suitable for underground installation, in sizes and length specified on the design plans. Type "K" Copper is not permitted to be connected to non-metallic (i.e. PVC) watermains.
- c. Polyethylene (PE 3408) Pressure Pipe and Tubing, CTS (Copper Tubing Size) rated for 200 PSI service laterals, 1¼" to 2" in size, shall conform to ANSI/AWWA C901 – Latest Revision in sizes and length specified on the design plans. Polyethylene tubing shall conform to the outside diameter dimensions of Type K Copper. The PE tubing shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions or other defects. It shall be uniform in color, opacity, density and other physical properties. Surfaces of the product shall be free from scratches, gouges, bloom and color imperfections. The PE tubing shall be permanently identified as PE 3408 water service tubing and the markings shall also include manufacturer's brand name or trademark and production record code, nominal size, NSF logo, pressure class (PC 200), AWWA designation number (AWWA C901-02) and date of manufacture. DR 9 200 PSI tubing (CTS-OD) will be color coded with a blue stripe and marked with the word "Tubing" and the dimension ratio. A stainless steel stiffener is required on the inside of the PE tubing at all connections.
- d. All service laterals 4" and larger required for fire protection shall be rated for a Pressure Class 200 PSI and use either Polyvinyl Chloride (PVC) (DR-14) conforming to ANSI/AWWA C900 – Latest Revision or Ductile Iron Pipe (Class 52).

9. Service Saddles:

- a. On all PVC pipe, service saddles shall be provided. On all ductile iron pipe, service saddles shall be provided for a tap larger than one (1") inch.
- b. All service saddles for taps two (2") inch diameter and less shall meet the requirements of ANSI/AWWA C800.
- c. Service saddles shall be 304 Stainless Steel per ASTM A 240. Service saddles shall be Romac Industries, Inc., Style 306, or approved equal.
- d. All taps larger than 2" shall use a solid stainless steel tapping sleeve with a flanged outlet for the tapping valve.

10. Corporation Stops:

- a. Corporation stops shall be a Ball Style Corporation Stop made from No-Lead brass with Male AWWA/CC thread inlet, compression type outlet.
- b. Approved corporations for 1" copper shall be AY McDonald 74701BQ or Ford FB1000-4-NL 1" CTS. Approved corporations for 1 ¼" PE pipe shall be AY McDonald 74701BQ or Ford FB1000-45-NL 1" X 1 ¼" CTS.
- c. 1 ½" and 2" inch taps shall use Ford FB-1000 corporations or approved equal. Larger taps shall use a resilient wedge tapping valve with flanged inlet, mechanical joint outlet and epoxy coating.

11. Curb Stops:

- a. Curb stops shall be no-lead bronze Ball Style Curb compression type.
- b. Approved curb stops for 1" copper shall be AY McDonald 76100Q 1" CTS. Approved curb stops for 1 ¼" PE pipe shall be AY McDonald 76100Q 1 ¼" X 1 ¼" CTS.
- c. For services larger than two (2") inch, the tapping valve shall have a valve box to the surface and serve as the curb stop.

12. Curb Boxes:

- a. Approved Manufacturers: Ford, Mueller, AY McDonald
- b. Extension type curb box with arch pattern base for ½" through 2" curb valves and stops.
- c. 72" when fully extended, Cast iron box, Upper section 1", 48" long stainless steel stationary rod
- d. Curb boxes shall have a 2-hole cast iron cap.

13. Tracer Wire:

- a. The tracer wire shall be a minimum of twelve (12) gauge solid core copper electric wire with blue PVC coating and rated for wet conditions. Stranded tracer wire is unacceptable.
- b. If a tracer wire box is specified to be provided, the tracer wire access box casting shall conform to ASTM specification A-48 Class 30.

14. Tapping Sleeves:

- a. Approved Manufacturers: Smith-Blair, Rockwell, Romac, Ford
- b. Body: Full circumference band. Type 304 stainless steel
- c. Flange: AWWA C207 Class D ANSI 150 lb. drilling. Fusion bonded Flexi-Blue coated finish or stainless steel.
- d. Test Plug: Provide ¾" NPT stainless steel per ASTM A 240, type 304, with standard square head for pressure testing before tap is made.
- e. Gasket: Nitrile (Buna N) compounded to resist oil, hydrocarbon fluids and water. Temperatures up to 180F.
- f. Bolts and Nuts: Type 304 stainless steel heavy hex nuts, stud bolts & washers. Nuts and stud shall have factory applied anti galling coating.

15. Tapping Saddles:

- a. Approved Manufacturers: Ford, Rockwell, Cascade

- b. Body: All type 304 Stainless Steel double bolts
- c. Gasket: Grade 60 Buna N compounded to resist oil, acids, hydrocarbon fluids, and water.
- d. Bolts and Nuts: Type 304 stainless steel heavy hex nuts, stud bolts & washers. Nuts and studs shall have factory applied anti galling coating.

16. Pipe Repair Clamps:

- a. Approved Manufacturers: Romac, Ford, Smith Blair, Cascade
- b. Body: All Stainless Steel
- c. Bolts and Nuts: Type 304 stainless steel heavy hex nuts, stud bolts & washers. Nuts and studs shall have factory applied anti galling coating.

17. Couplings/Cut-in Sleeves

- a. Cut-in sleeves for tie-in to existing water mains shall be Smith Blair 441 solid sleeves or Hymax two-bolt wide-range coupling sleeves.
- b. Bolts and Nuts: Type 304 stainless steel heavy hex nuts, stud bolts & washers. Nuts and studs shall have factory applied anti galling coating.

2. CONSTRUCTION OF WATER MAIN AND APPURTENANCES

2.01 Location of Existing Water Mains: Before excavation of trenches is begun, the Contractor shall uncover the end of existing water main to which the new main is to be connected. This will permit adjustments in line and grade to avoid the use of extra fittings. The exposed end of an existing main must be protected and blocked by the Contractor to prevent the blowing out of the plug or cap at the end of the main.

2.02 Excavation:

- a. For water main construction, the width of the trench shall be such as to leave a clear space of not less than six (6) inches nor more than twelve (12) inches between the earth wall or the supporting sheeting or bracing where such is used and the sides of the pipe. The trench width established by this pipe clearance, measured at the spring line, shall be applicable to that portion of the trench from one (1) foot above the top of the pipe to the bottom of the trench.
- b. On streets opened to traffic, on restricted easements and in such other locations as noted by the Engineer, the width of the trench at the ground surface shall be limited to the outside diameter of the pipe plus two (2) feet, plus the amount necessary for sheeting or bracing. The Engineer reserves the right to limit the extent of excavation depending on the nature of the soil and other conditions.
- c. In general, the minimum depth of installation shall be six (6) feet from the ground elevation to the top of the pipe. In no circumstances shall main be installed less than five (5) feet unless otherwise approved by the Engineer.
- d. Surplus material shall be considered to include vegetation from the trench, excavated rock or cobbles and boulders larger than six (6) inches in diameter, and all other material from excavation not needed or suitable for backfilling trenches. Unless otherwise specified, surplus material shall be the property of the Contractor, and shall be disposed of at no additional cost to the Utility.

- e. **Unsuitable Soils:** If, in the opinion of the Engineer, an artificial foundation is necessary because of the nature of the excavated material, the Contractor shall excavate to a point a minimum of six (6) inches below the bottom of the pipe. Any work involved in forming a satisfactory foundation at depths of six (6) inches or less below the bottom of pipe will be considered as incidental to the work. Excavate to such depth as directed by the Engineer. Refill this portion of the trench with select fill and mechanically compact the select fill prior to laying the pipe. Limit the width of the trench excavation to the outside diameter of the pipe plus two (2) feet, plus the amount necessary for sheeting and/or bracing.
- 2.03 **Handling of Pipe, Fittings, Etc.:** The Contractor shall have sufficient and adequate equipment on the site of work for unloading and lowering pipe and fittings into the trench. Extreme care shall be exercised by the Contractor in handling all pipe, fittings, and special castings so as to prevent breakage and coating damage. Any significant damage to coating or lining shall be repaired or replaced by the Contractor before installation. Under no circumstances shall pipe or fittings be dropped into the trench or so handled as to receive hard blows or jolts. All mud or concentration of dirt shall be removed prior to installation.
- 2.04 **Field Inspection of Materials:** All materials used in the construction of water mains must pass field MPU inspection before installation.
- 2.05 **Direction of Laying:** Unless otherwise ordered, pipe shall be laid with the bell ends facing the direction of installation. When the grade exceeds two (2') feet of rise per one hundred (100') feet of trench, the bells shall face upgrade and the pipe shall be laid uphill.
- 2.06 **Joining Pipe:**
- a. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. MPU may require that before lowering the pipe into the trench, a wrap or bag of suitable size shall be placed over each end and left there until the connection is to be made to the adjacent pipe. During the laying operations, no debris, tools, clothing, or other materials shall be placed in the pipe.
 - b. After placing a length of pipe in the trench, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. Precautions shall be taken to prevent foreign materials from entering the joint space and the joint recess shall be carefully checked for foreign material before the gasket is installed.
 - c. The pipe shall be secured in place with bedding material, placed by hand or equally careful means, keeping the bell end open.
- 2.07 **Bedding of Ductile Iron Pipe:** If not in the roadway, and unless otherwise specified, no special or imported bedding material will be required, however, the pipe shall be laid on an even undisturbed bottom and in accordance with the manufacturer's recommendations. The weight of the pipe shall not rest on the pipe bell. The bedding material immediately below the bell shall be carefully excavated so as to allow the full length of the pipe to lay evenly on the bottom of the trench. Under no circumstances will the pipe be laid on soft spoil piles in the trench. Backfill shall be tamped in layers to adequately support and protect the pipe.

Initial backfilling shall be done in six (6) inch stages to a point twelve (12) inches over the top of pipe with sand or crushed stone. Each stage shall be compacted to 95% Standard Proctor Density. Care should be taken to prevent movement of pipe during backfill.

- 2.08 Bedding of PVC Pipe: The trench bottom shall be relatively smooth and free of rocks and debris, and the trench bottom shall be leveled with crushed stone or coarse sand. The material shall be compacted to a minimum 90% Standard Proctor Density. The pipe shall be uniformly supported for the entire length except at the joint. For unstable soil, use crushed stone for bedding material.

Initial backfilling shall be done in six (6) inch stages to a point twelve (12) inches over the top of pipe with sand or crushed stone. Each stage shall be compacted to 95% Standard Proctor Density. Care should be taken to prevent movement of pipe during backfill.

- 2.09 Tie-in of new main to an existing main: When tying-in a new main to an existing main, a tee is to be cut into the existing main. A valve and the new main are to be connected to the tee branch. After all services have been connected to the new main, the old main is to be cut and plugged as close to the new tee as possible.

- 2.010 Protection of Open Pipe: At all times when pipe laying is not in progress, the open ends of pipe shall be closed by a water-tight plug or other means. This provision shall apply during the noon hour as well as overnight. If there is water in the trench, the seal shall remain in place until the water level in the trench is pumped out to the Owner's satisfaction. No pipe shall be laid in water or when trench conditions are unsuitable. The interior and exterior of all pipe and fittings shall be clean and free from all foreign material before being installed. The Contractor shall provide the necessary means to wipe, brush, swab or air blast or remove any foreign material from the interior of the pipe and fittings.

- 2.011 Installation of Push-On Joint Pipe: The water main shall be joined by means of a compression type push-on rubber gasket. The bell and spigot of each pipe shall be wiped clean and dry. The gasket shall be inserted, large round end first, into the gasket seat inside of the bell. A thin film of food grade NSF 60/61 lubricant shall be applied to the inside surface of that portion of the gasket which comes in contact with the entering pipe. The only type of lubricant used shall be that recommended by the pipe manufacturer. Extreme care shall be exercised when lowering the pipe into place to avoid foreign material from adhering to the spigot, bell, or gasket. The entering pipe shall be placed in approximate alignment with the receiving bell and inserted until it just makes contact with the gasket. Sufficient pressure shall be accomplished by use of a leverage bar or other approved method for pipe twelve (12) inches in diameter or smaller. A jack and two (2) choker-slings, or other approved method, shall be used on pipe larger than twelve (12) inches in diameter.

Whenever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, the amount of deflection shall not exceed that recommended by the manufacturer. All deflecting shall be done after the joint is pushed home.

- 2.012 Installation of Mechanical Joint Pipe: Where specified the water main shall be joined by means of a mechanical joint assembly.

The last eight (8) inches of the outside of the spigot and inside of the bell shall be thoroughly cleaned of all foreign matter and painted with a soap solution. The cast iron gland shall then be slipped on the spigot end with the lip extension toward the socket or bell end. The rubber gasket shall be painted with the soap solution and placed on the spigot end with the thick edge toward the gland.

The entire section of the pipe shall be pushed forward to send the spigot end in the bell. Care shall be taken to locate the gasket evenly around the entire joint. All nuts shall be tightened with a suitable wrench. Care should be taken not to exceed torque limits on the bolts.

Nuts shall be tightened alternately in order to produce an equal pressure on all parts of the gland. After a joint is assembled and securely tightened, the nuts and bolts shall be completely coated. Whenever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, the amount of deflection shall not exceed that recommended by the manufacturer.

All nuts and bolts used in the joint assembly shall be constructed from corrosion-resistant, high-strength low-alloy steel that conforms to ANSI/AWWA C111/A21.11, and feature a baked-on, ceramic-filled fluorocarbon resin. T-bolts and nuts shall be COR-BLUE or approved equal.. Bolts shall be of sufficient length such that a minimum of ½" of threads are exposed beyond the end of the nut when tightened. Tighten the bolts to the normal range of bolt torque in accordance with AWWA C600 – Latest Revision.

2.013 Polyethylene Encasement: Wrap all below ground metal in accordance with AWWA C105, including: ductile iron pipe, fittings, valves and valve boxes, corporations, curb stops and curb boxes (their entire length), all portions of hydrants below grade, copper water services, and all metal restraining devices.

2.014 Installation of Tracer Wire: For all pipe materials and services, a twelve (12) gauge, solid coated copper wire tracer wire is to be installed with the pipe. The wire is to be placed on the top of the pipe and taped in place.

Tracer wire shall be run along pipe from hydrant to hydrant. Wire shall be taped to each length of pipe at a minimum of two points. A maximum of one splice will be allowed between each hydrant. All tracer wire ends must be grounded.

Run tracer wire along polyethylene (plastic) laterals to and up/down all curb boxes and along remaining lateral length into property. Copper laterals do not require tracer wire, but the tracer wire shall be attached to the copper lateral by connecting to the thaw wire type copper tube nut at outlet end of corporation stop, or using a bronze ground clamp.

For transmission water mains, or other installations when there is not a practical location to bring the tracer wire to the surface, a valve box top section may be used at approximately 500' intervals for access to the tracer wire. The valve box top section should be filled with sand to a maximum of one foot from the top. The tracer wire shall not be spliced. Bring the tracer wire to the surface with a minimum of 18" of excess wire at each valve box.

Wire splices shall be soldered with a self-flux 50-50 rosin core solder and tightly wrapped with electrical tape so no copper wire is exposed.

After the Contractor has completed all the underground installation on the project, the Contractor shall test the electrical continuity of all the tracer wire installations on the project with the Engineer. The Contractor shall be responsible for any costs of any repairs that may be required.

- 2.015 Final Backfilling: The Contractor shall be responsible for proper compaction using mechanical compaction. Water jetting is not permitted, unless otherwise approved by the Engineer.

Final backfilling shall be completed by returning excavated material into the trench. However, the final backfill may not contain large stones, frozen clumps or logs. If excavated material is unacceptable by MPU, granular material compacted to 95% Standard Proctor Density shall be placed in twelve (12) inch stages to the top of the trench.

Any excavated material from the trenches that is considered unsuitable by the Engineer, shall be removed from the site by the Contractor. The Contractor shall replace this unsuitable material with a granular backfill material conforming to the gradation requirements found in the Standard Specifications for Sewer & Water Construction in Wisconsin (WSWS) Sixth Edition Section 8.43.4 or pit run material conforming to the gradation requirements found in Section 313 of the WDOT Standard Specification 2016 Edition, EXCEPT that the maximum size of individual stone pieces shall not exceed six (6) inches. Costs associated with removal and disposal of existing material, furnishing, placing, and compaction of the granular backfill material shall be included in the unit price bid per ton of "Granular Backfill for Watermain Trench". The Contractor shall provide MPU's construction inspector with weight slips (by the ton) for all trench backfill placed onsite on a daily basis. MPU shall not pay for any missing or late weight slips.

In lieu of granular material for final backfilling, a "0" bag slurry or road gravel may be used. Slurry is considered a cement-free 50:50 mix of sand and gravel, with adequate water to make it flowable.

The final twelve (12) inches shall be ¾" crushed aggregate with no greater than 25% fines, unless otherwise specified.

All trenches within pavement areas shall be compacted to ninety-five (95%) percent modified proctor density. All other trenches shall be compacted to ninety (90%) percent standard proctor density.

- 2.016 Surplus Excavated Material: All excavated material not needed or not suitable for backfill purposes shall be disposed of by the Contractor, at their expense.

- 2.017 Underground Casing: The Contractor shall furnish all materials required to jack casing under highways or railroads. The casing shall be steel as sized on the drawings with a minimum yield strength of 35,000 PSI. The casing shall have a bituminous coating on the inside.

The Contractor is responsible for providing adequate notice to railroad and highway authorities before jacking starts. The ends of the casing shall be sealed with concrete.

- 2.018 Drawings: Only approved drawings shall be used for the construction of actual improvements.

2.019 Modifications to Drawings: Field conditions often require adjustments to locations and/or grade of pipeline and appurtenances. Adjustments may be made in the field with MPU approval. At the conclusion of the work, the Contractor is to submit a set of as-built drawings showing all adjustments made.

2.020 VALVES

- a. Installation: All valves and their installation shall conform to all appropriate requirements of Part IV of the Standard Specifications for Sewer and Water Construction in Wisconsin. Prior to installation, inspect all valves for cracks, handling damages, direction of opening, number of turns to open, freedom of operation and cleanliness of valve ports, especially seating surfaces. Check all nuts and bolts on the valve bonnet and packing gland to be tightened to manufacturer's specifications, before the valve is lowered into the ditch.

All perpendicular valve joints shall be made with an approved joint restraining device.

To prevent foreign material from entering the valve and causing damage, always install valves in the closed position. Adjust valves following installation so they will work easily and properly.

All valves shall be wrapped with polyethylene wrap.

Any valve nut that needs to be placed deeper than seven (7) feet below finished grade, the Contractor shall install a valve extension on the nut. The top of the valve nut extension shall be between 4' and 6' from the finished grade.

A three-piece valve box and valve box adapter is required for every valve. The valve box shall not transmit shock or stress to the valve and shall be centered over the operating nut of the valve by the use of a valve box adaptor.

The valve box cover shall be set ½" below the binder grade for asphalt and shall be flush with the surface of the final asphalt lift or concrete pavements. No ramping will be allowed. Reset any valve boxes that have shifted at any time throughout construction until formal acceptance of the project by the Water Utility so they are plumb and centered over the valve at final acceptance.

All valve boxes shall be inspected by the Contractor and accepted by MPU prior to final paving, to ensure the valve box provides direct access to the valve operating nut.

- b. Operation: Only MPU crews shall operate valves. If needed, this shall be arranged through the MPU inspector.

2.021 FIRE HYDRANTS

- a. General: All hydrants and their installation shall conform to all appropriate requirements of Part IV of the Standard Specifications for Sewer and Water Construction in Wisconsin.

The Water Utility Inspector shall be present when all hydrants are set, when any hydrant extension is installed and when hydrants are disassembled for adjustment or maintenance. The Water Utility Inspector shall inspect the hydrant setting before backfilling. The Contractor shall be responsible for the proper

operation of all hydrants on the project until the Water Utility formally accepts the water mains and the warranty period has expired.

- b. Location: Install hydrants at the locations and grade shown on the drawings. The Water Utility Inspector must authorize in writing any variation from the locations or grades shown on the drawings.

An anchoring tee is permitted to be used to attach the hydrant lead to the water main. The auxiliary valve shall be directly attached to the anchoring tee.

- c. Installation: Install a solid concrete masonry unit, laid flat, in the excavation to provide a firm base for the hydrant. Set the hydrant in a truly vertical position and securely brace it until backfilling is complete. With the three-nozzle hydrant, the small nozzles shall be parallel with the curb and the pumper nozzle shall be perpendicular to the curb. The hydrant nozzle elevations shall be located 18" to 24" above finished grade or top of curb. Break away flange and break away shaft coupling shall be positioned just above finished grade.

Restrain the full length of all hydrant leads from the tee on the water main to the hydrant, including the hydrant valve and any associated fittings, with approved mechanical joint restraints. Install the required restraints to fully secure the hydrant.

The space around the lower portion of the hydrant from below the hydrant to six inches above the drain holes shall be backfilled with a minimum of one cubic yard of #2 washed stone. When placing the stone, special care shall be taken to have the drain holes open for drainage. Cover the washed stone with six (6)-mil polyethylene or suitable geotextile fabric to prevent loose dirt from filling in the voids in the stones. Place a wooden block or a brick under the hydrant lead to prevent the hydrant from leaning after being set. Fill the remainder of the excavation with the excavated material and compact it evenly in 12-inch lifts, so that the pressure of the backfill on the stem is equally distributed.

All ductile iron pipe and fittings shall be wrapped with polyethylene wrap. The wrap shall also be cut at the drain holes.

- d. Operating: Only MPU crews shall operate hydrants and flush mains. This shall be arranged through the MPU inspector.

2.022 SERVICES

- a. General: The Contractor shall provide all water service materials, piping and/or tubing. The service shall include the corporation stop, stop box, service line, shut-off valves and meter. The Contractor shall provide all excavation, backfilling materials, road and other repairs. In general, no tap smaller than one (1") inch shall be made unless approved by MPU.

Services shall terminate at the property line.

Unions and/or couplings may not be used unless approved by MPU.

- b. Installation: All services connected to PVC water main shall require a tapping saddle. All services 1¼" and larger connected to Ductile Iron Pipe shall require a tapping saddle. A direct tap for 1" services connected to Ductile Iron Pipe will be

allowed with a proper tap machine. A tapping saddle for 1" services would also be allowed on Ductile Iron Pipe.

A minimum of 6' of cover shall be maintained on all water laterals, including any area crossing a drainage ditch. Services with inadequate cover, or within 24" of a crossing under a storm sewer, shall be insulated with at least 4" of polystyrene foam board insulation.

The corporation stop shall be tapped at a 45° angle on the upper half of the main and located on the side of main to which the service is to be extended. A 'gooseneck' shall be installed to minimize the potential for pulling the service line from the corporation stop. Lay service laterals perpendicular to the water main.

All copper service lines shall have sand for bedding and cover material.

- c. **PE Services:** Polyethylene (PE) Pressure Pipe and Tubing shall include a straight coupling and a one foot (1') section of PE pipe or tubing beyond straight coupling and tape the end of pipe. Prior to installation, all Polyethylene (PE) Pressure Pipe and Tubing shall be inspected for cuts, punctures or excessive abrasion which may have resulted from shipping, storage or handling damage. If tubing is cut to a depth greater than 10% of its wall thickness or kinked, the damaged portion shall be removed, discarded and replaced. Pipe cutters designed for cutting plastic pipes are recommended. Avoid dragging pipe over rough terrain or having it come in contact with sharp objects which may cut or puncture the product. Never allow PE pipe to come in contact with fire, excessive heat or chemicals harmful to the pipe.

Trench bottoms shall be free of rocks or sharp objects. The bedding and cover for PE pipe shall be sand, crushed stone chips or crushed stone screening conforming to the requirements in Section 8.43.2 and 8.43.3 of the current Standard Specifications for Sewer and Water Construction in Wisconsin. Backfill shall be uniform and free of rocks, sharp or heavy objects. PE pipe or tubing may be curved to avoid obstacles; however, bends in PE pipe/tubing should not occur closer than 10 diameters from any fitting or valve. Minimum radius of curvature for any bends shall be no less than 30 diameters or the coil radius when bending with the coil. Bending of coiled pipe against the coil shall not go beyond straight. PE pipe expands and contracts when exposed to temperature changes. Allowances for this should be made during installation. Normally PE pipe will "snake" itself in the trench enough to provide sufficient slack. An extra six inches (6) per 100 feet of pipe per 45° F temperature change will compensate for thermal contraction in normal underground installations.

To aid in fitting installation, the pipe may be softened by immersing in hot water. Do not heat the pipe with other types of heat sources. Do not use any lubricants other than water. The use of pipe joint compounds, pipe sealing compounds, pipe dope and detergent type lubricants is not acceptable.

CAUTION: Potable water service PE pipe or tubing installation is prohibited in areas of known chemical contamination of the soil or where there is a high risk of potential chemical spills. PE pipe shall not be used in areas known to be contaminated with organic solvents or petroleum distillates.

PE pipe or tubing shall not be used in soil near hazardous waste disposal sites or underground chemical or petroleum storage tanks.

A stainless steel stiffener is required on the inside of the PE tubing at all connections.

Following installation of service lateral, open the corporation stop and the curb stop and flush out the service lateral. Once flushed out, close the curb stop and tape the end of the PE tubing.

Any existing water lateral to be removed shall be removed at the water main.

- d. Large Services: An anchoring tee shall be used to attach all 6" and 8" service laterals to all water mains. The auxiliary valve shall be directly attached to the anchoring tee.
- e. Curb Box Setting: All curb boxes shall be installed in the approximate middle of each lot, approximately 4 feet behind the back of curb. They shall be set to final grade. If they are installed in the sidewalk or driveway, a curb box receptacle shall be supplied at applicant's cost and must be used.
- f. Wrapping: Copper service lines shall be wrapped and taped in polyethylene from the water main to the curb stop, entirely covering any exposed copper. The curb stop and curb box shall also be wrapped and taped in polyethylene.
- g. Installation of Tracer Wire on Services: Run tracer wire along polyethylene (plastic) laterals to and up/down all curb boxes and along remaining lateral length into property. Copper laterals do not require tracer wire.

Wire splices shall be soldered with a self-flux 50-50 rosin core solder and tightly wrapped with electrical tape so no copper wire is exposed.

After the Contractor has completed all the underground installation on the project, the Contractor shall test the electrical continuity of all the tracer wire installations on the project with the Engineer. The Contractor shall be responsible for any costs of any repairs that may be required.

2.023 CONCRETE THRUST DEVICES

- a. General: If mechanical joint restraints are not used, a thrust device shall be provided on valves, fittings, dead ends and fire hydrants.
- b. Materials: Thrust devices shall be concrete to transmit load to undisturbed soil, accompanied with steel rod tying the pipe together. When undisturbed soil is not available, a mass of concrete may be used to offset loads.
- c. Concrete Thrust Devices: Concrete thrust devices shall be made of Class E concrete as described in Chapter 6.35.0 of the Standard Specifications for Sewer and Water Construction in Wisconsin.
- d. Size: Thrust blocks shall be designed to have sufficient bearing area and shall be so placed as to safely transmit to the surrounding earth, the maximum forces which may occur in the pipeline at that point. MPU will approve all thrust device sizes and placement.
- e. Installation of Concrete Thrust Devices: Concrete thrust blocks shall be placed between the fitting and undisturbed trench wall or trench bottom, as may be

applicable. The bearing faces of the concrete thrust block shall be placed against freshly cut and undisturbed trench wall or bottom of sound material. Formwork shall be constructed whenever necessary to confine the concrete to the prescribed dimension for the block. Form lumber shall be removed prior to testing.

- f. Upward Thrust: At vertical bends where upward thrust will occur, concrete thrust blocks utilizing reinforced steel bar collars shall be installed below the bend. At no times may the fitting be buried in concrete.
- g. Curing: Concrete thrust blocks shall be allowed to cure for at least forty eight (48) hours prior to pressure tests on the pipelines.
- h. Excavation, Bedding and Backfill: Excavation, bedding and backfill for thrust devices shall be in accordance with Section 3, "Construction of Water Main and Appurtenances", of these specifications.
- i. Field Tests: After completion of the installation of the thrust device and before acceptance thereof, the Contractor shall perform such tests as may be necessary to assure proper functioning of the thrust device. Defects disclosed by such testing shall be repaired to the satisfaction of the MPU representative, and at the expense of the Contractor.

2.024 HYDROSTATIC TESTS

- a. General: All new mains shall be tested, under the supervision of the MPU representative, by the Contractor and shall successfully pass the pressure and leakage tests.
- b. Pressure Test: After the test connections are made, air is removed and the main filled with water, the test section shall be subjected to water pressure normal to the area. After examination of exposed parts of the system, the test pressure will be increased to 150 pounds per square inch. The main shall be examined and if any defects are found, the Contractor shall immediately make the necessary repairs at their expense. The pressure test shall be repeated until no defects can be found. **The duration of the final pressure test shall be one (1) hour and the pressure shall not vary by more than +/-5 psi.**
- c. Leakage Test: The leakage test shall be conducted simultaneously with the pressure test and at the same pressure as the pressure test.

Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved section of it, necessary to maintain the specified leakage test pressure after the main has been filled with water and the air expelled.

Leakage shall not exceed the number of gallons per hour as determined by the following formula for rubber-sealed joints:

From AWWA C600-05:

For PVC or DIP pipe,

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

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

In case the section under test contains joints of various diameters, the allowable leakage will be the sum of the computed leakage for each size joint.

Should any test section fail to meet the leakage test, the Contractor shall immediately make the necessary repairs at their own expense. **The duration of the final leakage test shall be one (1) continuous hour.**

2.025 DISINFECTION AND FLUSHING OF MAINS AND APPURTENANCES

- a. General: After pressure testing and prior to acceptance of work, the entire main including, but not limited to, valves, fittings, fire hydrants, service lines, and other appurtenances shall be disinfected in accordance with the latest edition of Department of Natural Resources NR809, NR811, AWWA C-601, and AWWA C-651 specifications.
- b. Forms of Chlorine for Disinfection: Sodium Hypochlorite or Calcium Hypochlorite shall be used to disinfect the water system.
 - i. Sodium hypochlorite contains approximately 5 percent to 15 percent available chlorine, and the storage conditions and time must be controlled to minimize its deterioration. Liquid chlorine (bleach) is commonly used for the continuous-feed method of chlorination.
 - ii. Calcium hypochlorite is available in granular form or in 5-g tablets and must contain approximately 65 percent available chlorine by weight. The material should be stored in a cool, dry, and dark environment to minimize its deterioration. Tablets are used for the tablet method of chlorination.
 - a) CAUTION: Tablets dissolve in approximately 7 hr and must be given adequate contact time. Do not use calcium hypochlorite intended for swimming pool disinfection, as this material has been sequestered and is extremely difficult to eliminate from the pipe after the desired contact time has been achieved.
- c. Continuous-feed Method. The continuous-feed method consists of completely filling the main with potable water, removing air pockets, then flushing the completed main to remove particulates, and refilling the main with potable water

that has been chlorinated to 25 mg/L. After a 24-hr holding period in the main there shall be a free chlorine residual of not less than 10 mg/L.

- d. Tablet Method: The tablet method consists of placing calcium hypochlorite tablets in the water main during installation and then filling the main with potable water to create a 25 mg/L chlorine solution. Because the preliminary flushing step must be eliminated, this method shall be used only when scrupulous cleanliness has been exercised.
 - i. Calcium hypochlorite tablets (5-grams, 65% available chlorine) shall be placed in the upstream end of each section of pipe to be disinfected, including branch lines. Also, at least one tablet shall be placed in each hydrant branch and in other appurtenances. Calcium hypochlorite tablets shall be attached by an adhesive meeting the requirements of NSF/ANSI 61. There shall be adhesive only on the broadside of the tablet attached to the surface of the pipe. Attach tablets inside and at the top of the main.

When installation has been completed, the main shall be filled with water such that the full pipe velocity is no greater than 1 ft/sec (0.3 m/sec). Fill rate must be carefully controlled to ensure tablets do not come loose from pipe. Precautions shall be taken to ensure that air pockets are eliminated.

- a) The chlorinated water shall remain in the pipe for at least 24 hr. If the water temperature is less than 41°F (5°C), the water shall remain in the pipe for at least 48 hr. A detectable free chlorine residual (~0.2 mg/L) shall be found at each sampling point after the 24- or 48-hr period.
- e. Rechlorination: In the event the final chlorine residual is less than required, or the disinfection needs to be repeated, the “continuous feed” method shall be used by and at the expense of the Contractor. Rechlorination will be preceded by flushing as required by these specifications.
- f. Flushing: After disinfection in accordance with the latest edition of AWWA C-601 and C-651, the main shall be flushed with a flushing velocity of not less than 2.5 ft/sec and sustained for a period of time not less than twice the minimum theoretical time necessary to flush the entire length of the main. If so directed by the MPU representative, portions of certain appurtenances may be required to be temporarily reconfigured for flushing purposes. In the event of possible adverse effects of flushing on system operation, flushing shall be conducted during the hours of least demand or as directed by the MPU representative. The Contractor shall be responsible for loss or damage to grading and landscaping resulting from the flushing operations.
- g. Discharge of flushing water from the cleaning, disinfecting, and/or flushing water distribution and storage systems: MPU and the Contractor must comply with the GENERAL PERMIT TO DISCHARGE UNDER THE WISCONSIN POLLUTANT DISCHARGE ELIMINATION SYSTEM, WPDES Permit No WI-B057681-05-0.
 - i. The Contractor shall monitor and report to MPU the:
 - a) Daily flow rate of the discharge (gallons per day)

- b) Total Suspended Solids (TSS) and limit the TSS concentration to a daily maximum of 40 mg/L
 - c) Total Residual Chlorine (TRC) and limit the TRC concentration to a daily maximum of 19 µg/L or less
 - d) Dissolved Oxygen (DO) and limit the DO of the discharge to the minimum DO level of 5 mg/L if the department determines that the permittee adds chemicals prior to discharge that are known to scavenge or remove oxygen and does not discharge to a vegetative swale system, storm water pond system or combination of storm water conveyance system and storm water pond system that will convey the water to a surface water or wetland.
 - ii. Discharge of flushing water directly to the sanitary sewer does not need to comply with the requirements of WPDES Permit No WI-B057681-05-0.
- h. Safe Bacteriological Sample: In accordance with NR809.10(4), at least one bacteriologically safe sample shall be obtained before waterworks are placed into service. When new distribution systems or extensions on a number of streets are installed, bacteriological samples shall be taken at representative locations to establish that all of the improvements are free of contamination.
- i. Sampling Instructions (by MPU staff only):
 - i. Avoid plastic, swing, goose-neck, leaky, chrome and outside faucets.
 - ii. Remove any faucet aerator, gasket, screen or hose and run the water until cold.
 - iii. Sterilize the faucet using a propane or butane torch. Hold the flame beneath the faucet opening for 20 seconds. Move the flame continuously to prevent damage to the faucet. Plastic or chrome faucets will melt when heated.
 - iv. Run the cold water at medium force for at least 5 minutes before collecting samples. Do not change the flow rate or wash or wipe the tap before collecting the sample.
 - v. Remove the security seal, and then remove the sample bottle cap without touching the inside of the cap or bottle. Hold onto the cap while sampling.
 - vi. Fill bottle to within one inch of the top or to the fill line. Replace cap securely. Write name on the side of the bottle.
 - vii. Send the water sample and this completed form to the MPU Water laboratory, which is certified under the Safe Drinking Water Act for the testing of total coliform and fecal coliform/E. Coli bacteria by an enzyme substrate method. MPU will report the results electronically to the Department.

3. INSULATION

- 3.1 General: Water mains shall be insulated over the watermain wherever the depth of cover is less than five (5) feet. Water mains shall be insulated under the watermain wherever the watermain crosses a storm sewer, gas main, or other similar conductor of cold temperature.
- 3.2 Materials: Insulation shall be with polystyrene foam boards with a minimum thickness of four (4) inches. If only two (2) inch material is available, multiple layers shall be used.
- 3.3 Placement: Prior to placement of the polystyrene boards, bedding material shall be placed to a height of six (6) inches over the top of the pipe, leveled and compacted. The insulating boards shall be placed on the cover material with the long side parallel to the centerline of the water main for a minimum width of O.D. + twenty four (24) inches. The boards shall be placed in a staggered arrangement so as to eliminate continuous transverse joints. If two (2) or more layers of insulation boards are used, each layer should be placed so as to cover the joints of the layer immediately below.

The first lift of backfill material shall consist of six (6) inches of bedding material which shall be end or side dumped onto the insulation board and spread in such a manner that construction equipment does not operate directly on the insulation. This layer shall be compacted with equipment that exerts a contract stress of 70 to 80 PSI. Once this layer has been compacted to the specified density, the remaining layers of backfill may be constructed utilizing conventional procedures.

4. **ABANDONMENT OF EXISTING FACILITIES**

- 4.1 Water Main: Unless otherwise indicated on drawings, where water mains are abandoned, they shall be disconnected and left in place. The open end of the abandoned pipe shall be plugged with concrete.
- 4.2 Valves: When only a valve is abandoned in place, it shall be left in an open position, and the valve box or manhole removed.

All existing water valve manholes are to have the top ring removed and the manhole filled with "0" bag slurry. If construction warrants, the manhole could be removed completely and the hole backfilled as appropriate.

Existing valves and valve manholes shall not be abandoned until existing mains are abandoned.

- 4.3. Services: When services are permanently abandoned, they must be shut-off at the corporation stop and disconnected. If the service is to be reused, it may be shut-off at the curb stop. (Peening shut the end of the service and closing the curb stop is not an acceptable method to permanently abandon a service.)

Curb boxes shall be removed or cut-off and abandoned below grade.

Old lead and galvanized iron services shall not be reused.

A new service may not be created through the Siamese connection of two (2) or more existing services with a wye or tee.

- 4.4. Hydrants: All existing hydrants that are to be removed are to be disconnected at the elbow, removed and transported to the Manitowoc Public Utilities storage facilities. The hole is to be backfilled as appropriate.

Existing hydrants that are to be abandoned are permitted to be cut off at least 18" below grade and transported to the Manitowoc Public Utilities storage facilities. The hole is to be backfilled as appropriate.

5. **BARRICADES, WARNING SIGNS AND FLAGMEN**

- 5.1 General: Erecting and maintaining traffic signs, barricades, lights and signals, flagging and guidance of traffic is the responsibility of the Contractor. It shall be carried forth in accordance with the latest revision of "Manual of Uniform Traffic Control Devices". Sign sizes smaller than the standard sizes described in the manual shall not be used.

6. **TRAFFIC**

- 6.1 General: If it is necessary to close down sections of the street for short periods while installing water main and appurtenances, the Contractor shall request permission from the City of Manitowoc Department of Public Infrastructure. If approved, the Contractor shall provide all detour signs and alternate route signs for the convenience of the public. No driveway shall remain inaccessible at the end of any working day unless agreed to by the property owner.

7. **PERMITS, UTILITY LOCATES, STAKING**

- 7.1 General: All permits, approvals and easements shall be acquired by the Contractor before construction begins. Any specific requirements of these documents shall be made known to the Contractor.

7.2 Utility Locates: Locates for all utilities shall be the responsibility of the Contractor.

7.3 Staking: Staking of the route for construction shall be the responsibility of the MPU. However, any measurements required for field adjustments shall be the responsibility of the Contractor.

7.3.1 Field Checking: The Contractor shall have available a transit, as necessary, to check elevations and alignments. If it is found that the installation does not correspond to the approved drawings, the Contractor shall make the necessary adjustments at their cost.

8. **RESTORATION**

- 8.1 General: The Contractor shall comply with all terms and conditions with the City of Manitowoc Department of Public Infrastructure Right-of-Way Excavation Permit.

After completion of all water main work, the street, sidewalk and/or lawn shall be restored to original condition or better.

- 8.2 Paving: Temporary repairs to streets and sidewalks may be made with crushed stone or cold or hot mix bituminous materials as approved by the City of Manitowoc Department of Public Infrastructure.

Final repairs to bituminous and concrete streets shall be done by the City of Manitowoc and billed to MPU unless otherwise specified.

Unless otherwise specified, final repairs to sidewalks and driveways shall be by the Contractor in accordance with City requirements.

In the event any settling of such permanent resurfacing (street or sidewalk) occurs within three (3) years after the date of the completion of the work performed, the Contractor shall make or cause to be made, any necessary resultant repairs as directed by and to the full satisfaction of the City's Director of Public Infrastructure. The Director of Public Infrastructure, at his option, may elect to have the City perform any such necessary repairs or hire someone to perform such repairs, in which case Contractor agrees to fully reimburse the City for the cost to itself or any contractor for the required repairs.

Street signs and other improvements, if disturbed, shall be restored to original condition.

- 8.3 Lawns/Vegetated Areas: Lawns and/or vegetated areas shall be restored to a condition as good or better than when the job began. Seed or sod may be used depending on the circumstances. Trees and shrubs may be dug-up and replanted after construction or may be replaced. If sod is specified, or used by the Contractor, the pricing and/or payment shall include 14-days of watering by the Contractor (or sub-contractor) to ensure the sod takes root.

- 8.4 Drainage: Grading for drainage shall be as for the original conditions. Culverts shall be carefully removed and replaced when the job is completed.

9. **EROSION CONTROL**

- 9.1 General: Erosion control shall be in accordance with Wisconsin Construction Site Best Management Practice handbook and **City of Manitowoc Municipal Code, Chapter 29 – Soil Erosion Control**. Should there be a discrepancy between this standard specification and the above referenced Municipal Code, the Municipal Code shall govern.

- 9.2 Installation: Erosion control shall be installed by the Contractor prior to the start of construction. Erosion control shall include, but not be limited to, silt fence around the perimeter of the project, inlet protection and/or diversion, stabilization of disturbed areas (sod, erosion, mat, etc.), tracking pads, and reducing runoff velocities (i.e. straw bales in ditches). Unless otherwise noted, the cost of soil erosion control shall be incidental to the installation of watermain.

The Contractor shall furnish and install an Erosion Control Blanket over sloped areas that are steeper than 3:1, or as directed by the Water Systems Manager. The erosion control blanket shall be a Type S-150 (North American Green), or equal. The erosion control blanket shall be installed in accordance with the manufacturer's instructions. All costs for furnishing and installing the erosion control blanket shall be incidental to Topsoil/Seeding/Mulching.

- 9.3 Maintenance: All erosion and sediment control practices shall be checked by the Contractor for stability and operation following every runoff-producing rainfall, but in no case less than once every week. Any needed repairs shall be made immediately to maintain all practices as designed.

Sediment shall be removed from behind the silt fence when it becomes six (6) inches in depth at the fence. The silt fence shall be monitored weekly and repaired as necessary to maintain a barrier.

Inlet control measures (i.e. geotextile or filter fabric over catch basins) shall be monitored weekly and removed when the control measure becomes more than 50% clogged with debris.

Straw bales, or similar means or reducing the velocity of concentrated runoff, shall be placed in small swales, ditches, or diversions to prevent erosion and catch sediment. These measures shall be monitored weekly and repaired as necessary.

- 9.4 Responsibility/Contact: The Contractor shall provide a list of persons that shall serve as the contacts for erosion and maintenance. The list shall provide the name and phone number for personnel to be contacted in the event that the erosion control measures need to be installed, maintained, or repaired.

10. **CATHODIC PROTECTION**

- 10.1 When specified by MPU, the Contractor shall install cathodic protection on ductile iron watermain and/or fittings.

Spacing and size of magnesium anodes will be as specified in Contract Documents. Each anode shall be placed in a horizontal position parallel with the pipe, with centerline axis of the anode at least 6 inches below the bottom of the water pipe. The centerline axis of the anode shall also be placed at least 2 feet from the exterior wall of the water pipe. Care shall be taken to ensure that the cloth bag is not damaged and no backfill lost during installation. Each anode shall be centered in the cloth bag. It may be necessary to re-center the anode in the cloth bag by rolling it on the ground prior to installation. Each prepackaged anode shall be lowered into the trench using a sling or rope. The anode shall not be lowered, transported, handled or lifted by the lead wire. The anode lead wire shall be long enough to reach from the pipe to the anode without a splice. The anode lead wire shall be attached to the pipe using the thermite weld process.

- 10.2 Anodes that are installed at cathodic protection test stations are not to be directly connected to the water pipe or fitting. When the anode lead wire is not long enough to reach the test station terminal board with sufficient slack, the lead wire may be lengthened by splicing on an additional length of lead wire. Splice shall be made using an approved splice connector suitable for buried applications.
- 10.3 To connect anode lead wire to ductile iron pipes that are encased in a polyethylene tube, the Contractor shall first cut back the polyethylene tubing to expose the pipe. The Contractor shall make an "X" shaped cut in the polyethylene and temporarily fold back the polyethylene at the point where the anode lead wire will be connected to the pipe.
- 10.4 Using a mechanical grinder, remove the minimum area of coating from pipe or fitting surface required for placement of weld mold, creating a bright, shiny surface. Prepare the anode lead wire and pipe surface for thermite welding by assuring that they are dry. Wire and pipe surface shall be free of dirt, grease and other foreign products. Remove insulation at end to be welded in a manner that will avoid damage to wire. Install adapter sleeves for anode lead wire as recommended by thermite weld manufacturer prior to welding. Hold wire at an approximate 30 degree angle to pipe surface when welding.
- 10.5 When weld has cooled, remove weld slag and test weld for strength by striking a sharp blow to the weld with a hammer while pulling firmly on the wire. Re-weld unsound welds and retest weld. Thoroughly clean mold and mold covers after completion of each weld to remove all excess slag. After soundness of weld has been verified, thoroughly clean with a stiff wire brush and brush with an approved bitumastic coating over entire weld area. Lift wire away from pipe and apply bitumastic coating completely around and underneath the wire. Push wire back down on the pipe. Apply a protective bitumastic coating where any original pipe coatings have been disturbed.
- 10.6 After the anode lead wire is connected to the pipe, the Contractor shall repair the polyethylene tubing using polyethylene compatible adhesive tape. The polyethylene tubing shall be folded back against the pipe and the repair tape shall be applied on anode lead wire. The repair tape shall completely cover the area of the polyethylene tubing that was cut and shall completely cover all exposed ductile iron pipe.
- 10.7 Extra anode lead wire for each anode shall be coiled. The wire shall have sufficient slack to allow for pipe and anode movement and to protect against undue stress during backfilling. Prior to backfilling the anode, water shall be applied to the anode to moisten its pre-packed backfill.
- 10.8 The area immediately surrounding the anode shall be backfilled with native soil. Cushion sand shall be backfilled around the water pipe or fitting so that the sand covers the pipe or fitting to a minimum depth of 12 inches on top, and along both sides of the pipe or fitting. The excavation shall be backfilled in stages using select granular backfill material free from stone, rocks, roots, organic material, trash or other debris, and carefully tamped to ensure that no voids exist around the bag and that the bag and wire are not damaged.
- 10.9 Anodes on Copper Water Services on PVC or non-metallic Water Mains:

One 5 pound anode shall be connected to new copper water services on PVC or non-metallic water mains, For copper services 1 inch diameter and less, anode lead wire shall be attached to thaw wire type copper tube nut at outlet end of corporation stop. For copper services larger than 1 inch diameter, anode lead wire is to be attached to copper service using bronze ground clamp.

10.10. Anodes on Existing Ductile and Cast Iron Water Mains:

Magnesium anodes shall be installed at every pipe joint or every other pipe joint, as designated in the Contract Documents or directed by the Project Manager, on existing cast and ductile iron water main pipe to cathodically protect both pipes on either side of the joint. Two or more anodes will be installed at pipe joint locations, with one or more anodes connected to each pipe on either side of the joint. Pipe joints shall be located by the Contractor utilizing field notes from the original pipe installation records. A test pit shall be excavated to verify the location of the first pipe joint. The Contractor shall layout the location of remaining joints to be excavated using the record field notes. At each excavated joint, an area shall be excavated that is large enough to expose top and one or both sides of existing water main pipe and safely install both anodes in one operation. Basic general size of the area to be excavated will be as noted in Contract Documents and will be dependent on the depth and location of the water main.

Magnesium anodes are not required to be installed on existing water main fittings or valves encountered in an excavation, unless otherwise required in the Contract Documents or directed by the Project Manager.

10.11 Anodes on Existing Ductile and Cast Iron Hydrant Branches and Water Services:

10.11.1 Hydrant branches shall be excavated along the branch pipe with the branch gate valve centered in the trench. One 17 pound anode shall be attached to the branch pipe between the water main and the gate valve and one 17 pound anode on the branch pipe between the gate valve and the hydrant.

10.11.2 Water services 4 inch diameter and larger shall be excavated along the service pipe with the curb shut off valve centered in the excavation. One anode shall be connected to the service pipe between the water main and the curb valve and a second anode shall be connected to the service pipe between the curb valve and the customer's property. For services with no curb valve, one anode shall be connected to the service pipe in the vicinity of the curb. Anode sizes shall be based on the service diameter, with 17 pound anodes installed on 4 and 6 inch diameter services; 32 pound anodes installed on 8 and 10 inch diameter services and 48 pound anodes installed on services 12 inch diameter and larger.

10.12 The unit price bid shall include the cost of: installing the prepackaged magnesium anode; all thermite weld equipment and materials; attaching the anode lead wire to the pipe or fitting; splicing the lead wire at test stations, bitumastic coating; repairing the polyethylene tubing; locating joints on existing pipe and furnishing all labor and equipment necessary to complete the work.

11 TEMPORARY WATER SERVICE DESCRIPTION.

This bid item will apply to the areas as described in these Specifications, and consist of the cost of furnishing, installing, maintaining and removing:

- All temporary bypass pipe and pipe fittings
- Valves including large service valves as required
- Service lines
- General hardware
- Water supply connection backflow preventers and reduced pressure zone devices
- Testing, flushing, and sampling taps

Work may also include but is not limited to:

- Disinfecting, scheduling and assisting with obtaining health samples
- Ramping, pavement cutting, excavation, and burial at road crossings/sidewalks/driveways
- Preparation and distribution of service interruption notices
- Maintenance of the bypass system throughout the duration of project
- Site restoration excluding final pavement restoration
- Furnishing all labor, additional material and equipment necessary to complete work as described

11.1 MATERIALS.

All materials furnished for use as temporary bypass pipe, service hose, connections and related appurtenances that come into contact with drinking water are to be certified for compliance with ANSI/NSF Standard 61. All materials shall be fully adequate to withstand the required water pressure and all other conditions of use, and shall provide adequate water tightness before being put into service. All previously used materials may only have been used in potable water applications.

All sample taps shall be smooth-bore taps.

All materials for use as main temporary bypass lines, service lines, connections and related appurtenances shall have a minimum working pressure rating of 200 psi and be made of materials that will not have an adverse effect on the taste or odor of the water.

The temporary bypass lines must be at least 2-inch in diameter. Match the diameter of the temporary service line with the existing service lateral diameter for all services 1½-inch diameter to ¾-inch diameter. Use a ¾-inch temporary service line for any service lateral smaller than ¾-inch diameter. Use hoses or piping that are hydraulically equivalent to the service size for all services 2 inch in diameter and larger.

11.2 CONSTRUCTION METHODS.

The Contractor shall submit a proposed Temporary Water Service plan depicting the proposed components, configuration/locations, protection measures, proposed disinfection methods, bulk chlorine disinfection station(s) and contact information for the Contractor's representative(s) responsible for routine maintenance and emergency response.

The temporary water service plan must also indicate if any customer water meters are to be temporarily removed or otherwise affected in order to accommodate the temporary water service or other construction activities. The Temporary Water Service Plan must be approved by the Engineer before installing any section of the temporary distribution piping.

The temporary bypass system shall maintain a continuous supply of water to all affected customers for the duration of time the existing main is out-of-service for rehabilitation or replacement. The temporary bypass system shall be maintained in a safe and operative condition at all times.

For protection of the work and the public, flashers and barricades shall be installed at apt locations and as directed by the Engineer or Construction Inspector. The flashers and barricades shall be in proper operating condition. Temporary water piping shall be protected from freezing weather at all times.

Additionally, the work is to be in conformance with the requirements of the Standard Specifications, Provisions and AWWA C602 Cement Mortar Lining of Water Pipelines in Place – 4 In. and Larger, Section 4.6 Temporary Bypass to Customers.

If any water meters are to be removed or otherwise affected to establish temporary water service or accommodate any other construction activities, notify and coordinate with MPU prior to performing any meter related work.

Perform any required or indicated meter removals on the approved Temporary Water Service Plan. Notify MPU of all meter removal appointments and allow the Water Utility to inspect the existing conditions during the removal appointment. Do not reinstall any meter which has been removed. See Meter Reinstatement requirements.

If customer water meters are not affected or removed to accommodate construction, the meter reinstatement requirements shall still apply.

All associated temporary water bypass work, including any work required to schedule appointments and coordinate with MPU for meter removals and reinstallations, will be paid under Bid Item – Temporary Water Service.

11.3 TEMPORARY BYPASS WATER SYSTEM SET-UP

Disinfect hydrant standpipes prior to connecting bypass pipes to the hydrants, by pouring 1 quart of commercially available bleach (solution containing approximately 5% sodium hypochlorite) into each hydrant. The hydrants shall be filled with clean water that is allowed to stand for a minimum of 20 minutes. The hydrants shall then be flushed and the bypass pipes connected to it. All hydrant nozzles shall be capped when not in use.

Connect only to the 2½-inch hydrant nozzles; the 4½ -inch nozzles shall remain capped and accessible for Fire Department use. Support, as necessary, all appurtenances attached to hydrants.

All temporary water service connections to hydrants shall be made in such a manner that they can be removed with minimum effort so that the hydrants can be fully used for firefighting purposes.

When a connection cannot be made on hydrants, a bulkhead connection may be required. Install compatible bulkheads (temporary line caps) on the existing water main in place of a solid cap or plug fitting to keep the section of the existing water main

pressurized and capable of supplying a continuous flow of water. The bulkheads shall be fitted with a compatible outlet fitting so the temporary bypass pipe can be fed through the end of the bulkhead. The coupling shall be slid over the end of the water main, and braced or restrained so that it will support normal operating pressure without leaking.

Temporary valves shall be installed on the temporary bypass pipe at all appropriate locations and as designated on the approved Temporary Bypass Service Plan. Valve spacing should, at a minimum, schematically match the existing water main configuration, and also as required to isolate the temporary piping from the existing system. Spacing between adjacent valves shall not exceed 500 feet, unless approved by the Engineer.

Any hydrants within the project taken out of service shall be reported to the Engineer and the Fire Department. Completely cover and secure black plastic sheeting around all existing or newly-installed hydrants while they are out-of-service. Maintain the plastic covering until the hydrant is returned to service or removed and salvaged.

Hydrants must remain in service such that no property within the project is within less than 1,000-feet (measured from the hydrant to the property along accessible streets) from an active hydrant.

All hydrants are subject to inspection at any time by either MPU or the Fire Department. If they are found to be unserviceable or unsatisfactory in any way, immediate correction shall be made.

Install bypass piping on the house-side of sidewalks and in ditches or along City-owned greenways whenever possible to minimize or avoid crossing traffic or pedestrian routes. Where not possible, provide a ramping system to protect the bypass pipe at each location where pipe crosses roads or driveways. All piping and/or hosing crossing a bus service route or regularly traveled roadway shall be trenched, buried, and backfilled to adequately withstand the traffic loads and be flush to the existing pavement grade. ADA compliance shall be provided at sidewalk or sidewalk ramp crossings.

All ramping material is to be furnished, installed, maintained and removed by the Contractor. Any required trenched roadway crossings, including pavement cutting, excavation, backfill, maintenance and removal are the responsibility of the Contractor, not MPU. MPU will provide the final pavement restoration at these locations.

Water from the temporary bypass pipes will NOT be allowed for any purpose other than to supply the bypass pipes. Water for filling water tanks or any other purpose other than supplying water to bypass pipes must be obtained from the MPU Bulk Water Station (1323 S 7th Street).

Any unconnected threaded main taps must be capped prior to disinfecting the temporary system, and remain capped for the duration of the time that the temporary system is in place.

Under no circumstances shall any portion of the temporary water system lie in a gutter, ditch or any other line of surface water flow.

If previously used material is employed for use in the temporary bypass water system,

clean and/or pressure wash the piping such that it inspires confidence in the system.

11.4 TEMPORARY CUSTOMER SERVICE LINES

Connect customer services that are 1½ inch and smaller, to the temporary bypass system using a hose connected to an outside hose bib. Use a double-valved "Y" connector to connect temporary hose to the customer's hose bib. When a hose bib connection is not possible, an alternate manner of connection shall be reviewed and approved by the Engineer.

After completing the temporary bypass disinfection per these Specifications, thoroughly flush hoses to be used for temporary services with potable water immediately prior to connection to the customer's service. Notify customers prior to shutting off and transferring the service to the bypass. Do not transfer services to the bypass earlier than necessary to allow the work to progress without delay.

11.5 TEMPORARY WATER SYSTEM DISINFECTION

All bypass pipes and services shall be properly disinfected and yield a safe-water sample prior to connecting any customers to the temporary bypass system. The temporary service connections shall have valves at both the connection to the bypass pipe and near the point of connection to the private plumbing system so the entire bypass system including temporary service lines can be disinfected.

Install a bulk chlorine disinfection station or stations for the disinfection of temporary service laterals. Stations shall consist of a large drum or container filled with disinfectant solution with an attached spigot. Disinfect and flush each lateral adequately before entering it into service.

As part of the Temporary Water Service plan, include the proposed disinfection, flushing, and applicable customer notification procedures required for the proposed temporary bypass system. These procedures shall be in accordance with AWWA C651 – Disinfecting Water Mains and the Standard Specifications, which require 48-hours of disinfection prior to flushing and sampling.

Properly dispose of any highly-chlorinated water to the sanitary sewer.

11.6 METER REINSTATEMENT.

Schedule all appointments and any necessary customer notifications at all properties being served by the temporary water system prior to reconnection to the existing water system. Notify and coordinate with MPU prior to performing any meter-related work.

Prior to transferring service lines from the bypass system to the existing water system, clear lines by back flushing with potable water or as otherwise approved in the disinfection and flushing plan. Disconnect the hose, restore the water service line back to normal conditions, and restore water flow. All areas used while providing temporary service shall be properly restored to pre-construction status, or better.

After flushing is completed and service lines have been restored to the permanent laterals, remove the bypass and all associated materials used for maintenance and ramping. Complete the restoration of all areas damaged by temporary bypass pipe and

service connections.

11.7 METHOD OF MEASUREMENT.

These bid items are measured as one lump sum to include all temporary water service work performed in accordance with these Specifications.

11.8 BASIS OF PAYMENT.

These bid items shall be paid for at the Contract lump sum unit price. Lump sum payment shall be full compensation for all temporary water service work as specified. A partial payment of 50 percent of the unit price bid may be made for the bypass pipe system after assembly has been completed, disinfected, tested and safe water samples have been obtained. The remaining 50 percent of the unit price may be paid when the bypass system has been removed and associated site restorations have been completed.

SECTION 02600

FUSIBLE POLYVINYL CHLORIDE (PVC) PIPE FOR INSTALLATION BY HORIZONTAL DIRECTIONAL DRILLING (HDD)

PART 1 –GENERAL

1.01 DESCRIPTION

A SCOPE

1. This section specifies fusible polyvinyl chloride (PVC) pipe, including standards for dimensionality, testing, quality, acceptable fusion practice, safe handling, storage and installation of the pipe by horizontal directional drilling, directional boring, or guided boring.

B REQUIREMENTS:

1. Contractor shall provide fusible polyvinyl chloride (PVC) pipe conforming to all standards and procedures, and meeting all testing and material properties as described in this specification for installation by horizontal directional drilling, directional boring, or guided boring.
2. Contractor shall be responsible for all installation processes and procedures associated with the installation by horizontal directional drilling, directional boring, or guided boring in accordance with this specification.

C PIPE DESCRIPTION

1. Pipe Supplier shall furnish fusible polyvinyl chloride (PVC) pipe conforming to all standards and procedures, and meeting all testing and material properties as described in this specification.
2. Pipe shall conform to the following table of dimensions and designations:

<u>Pipe Name & Reference Standard</u>	<u>Nominal Diameter (in.) & Convention (e.g., CIOD, IPS, or other)</u>	<u>Dimension Ratio (DR)</u>	<u>Pressure Class or Rating (psi)</u>	<u>Required Inside Diameter (in.)</u>

1.02 QUALITY ASSURANCE

A REFERENCES:

1. This section contains references to the following documents. They are a part of this section as specified and modified. In the event of a conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of design.

Reference	Title
ANSI/AWWA C110/A21.10	Standard for Ductile-Iron and Gray-Iron Fittings
ANSI/AWWA C111/A21.11	Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
ANSI/AWWA C153/A21.53	Standard for Ductile-Iron Compact Fittings for Water Service
AWWA C605	Standard for Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
AWWA C651	Standard for Disinfecting Water Mains
AWWA C900 ¹	Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 60 in. (100mm Through 1,500mm)
AWWA C907	Standard for Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water, Wastewater, and Reclaimed Water Service
AWWA M23	AWWA Manual of Practices for PVC Pipe—Design and Installation
ASTM C923	Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM D1784	Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D1785	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D2241	Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2665	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D3034	Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F679	Standard Specification for Poly(Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F1417	Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air
UNI-B-6	Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe
UNI-PUB-08	PVC Pressure Pipe Tapping Guide
NSF/ANSI – 61-G	Drinking Water System Components--Health Effects
PPI TR-2	PVC Range Composition Listing of Qualified Ingredients

¹ Prior to 2017, AWWA C905 was the standard for PVC pipe and fabricated fittings larger than 12 in. (300 mm). “AWWA C905” marking on pipe larger than 12 in. is acceptable.

B MANUFACTURER REQUIREMENTS

1. All piping shall be made from PVC compound having a minimum cell classification of 12454 per ASTM D1784.

C FUSION TECHNICIAN REQUIREMENTS

1. Fusion technician shall be qualified by the pipe supplier to install fusible polyvinyl chloride (PVC) pipe of the type(s) and size(s) being used. Qualification shall be current as of the actual date of fusion performance on the project.

D SPECIFIED FUSION PROCESS AND PIPE SUPPLIERS

1. The pipe fusion joining process shall be that of Underground Solutions, Inc., Poway, CA, Patent No. 6,982,051.
2. The pipe manufacturers shall be fully experienced, reputable, and qualified in the manufacture of fusible polyvinyl chloride (PVC) products for Underground Solutions, Inc., Poway, CA, (858) 679-9551. Fusible polyvinyl chloride (PVC) pipe marking shall include either Fusible PVC[®], Fusible C-900[®], or FPVC[®].

E WARRANTY

1. The pipe shall be warranted for one year per the pipe supplier's standard terms.
2. In addition to the standard pipe warranty, the fusion services shall be warranted for one year per the fusion service provider's standard terms.

F PRE-CONSTRUCTION SUBMITTALS

1. The following PRODUCT DATA is required from the pipe supplier and/or fusion provider:
 - 1) Pipe Size
 - 2) Dimensionality
 - 3) Pressure Class or Pressure Rating per applicable standard
 - 4) Color
 - 5) Recommended Minimum Bending Radius
 - 6) Recommended Maximum Safe Pull Force
 - 7) Fusion technician qualification indicating conformance with this specification
2. The following WORK PLAN AND INFORMATION is required from the contractor and/or horizontal directional drilling Contractor. This WORK PLAN AND INFORMATION shall also be supplied to the pipe supplier upon request:
 - 1) Work plan shall include for each HDD installation any excavation locations and dimensions, interfering utilities, bore dimensions and locations including bend radii used, and traffic control schematics.

- 2) A project safety and contingency plan which shall include but shall not be limited to drilling fluid containment and cleanup procedures, equipment and plan for compromised utility installations including electrical and power lines, water, wastewater and any other subsurface utility in the area.
- 3) An HDD schedule identifying daily work hours and working dates for each installation.

G POST-CONSTRUCTION SUBMITTALS

1. The following is required from the contractor and/or fusion provider to the owner or pipe supplier upon request:
 - 1) Approved datalogger device reports
 - 2) Fusion joint documentation containing the following information:
 - a) Pipe Size (Diameter) and Wall Thickness
 - b) Fusion Machine Size (Make & Model Number)
 - c) Fusion Technician Identification
 - d) Job Identification (Name, location & project number)
 - e) Fusion Joint Number
 - f) Fusion, Heating, Cool Down and Drag Pressure Settings
 - g) Heat Plate Temperature
 - h) Time Stamp
 - i) Fusion Heating and Cool Down Time
 - j) Ambient Temperature and Weather Conditions
 - 3) As-recorded Information
 - a) The as-recorded plan and profile will reflect the actual installed alignment, and reflect the horizontal offset from the baseline and depth of cover.
 - b) All fittings, valves, or other appurtenances will also be referenced and shown.
 - c) A daily project log, along with tracking log sheets, should they be used, shall be provided. Tracking log sheet data, should it be employed, shall include all that apply, including inclination, depth, azimuth, and hydraulic pull-back and rotational force measured.

PART 2 - PRODUCTS

2.01 FUSIBLE POLYVINYL CHLORIDE (PVC) PIPE FOR POTABLE WATER, RECLAIMED WATER, AND WASTEWATER

- A Fusible polyvinyl chloride (PVC) pipe shall conform to AWWA C900, ASTM D2241 or ASTM D1785, as applicable. Testing shall be in accordance with the test methods provided or referenced in the applicable pipe standard.
- B Fusible polyvinyl chloride (PVC) pipe shall be extruded with plain ends. The ends shall be square to the pipe and without any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe unless specified for connections with appurtenances or for connections at the fusible pipeline termination locations.
- C Fusible polyvinyl chloride (PVC) pipe shall be manufactured in a standard 40' or 45' nominal length, or custom lengths as specified.
- D Fusible polyvinyl chloride (PVC) pipe for potable water use shall be blue in color.
- E Marking on the pipe shall include:
 - 1. Pipe size (nominal diameter)
 - 2. PVC
 - 3. Pipe Dimension Ratio (DR), Standard Dimension Ratio (SDR), or Schedule (SCH)
 - 4. AWWA pressure class, or ASTM pressure rating, as applicable,
 - 5. Designation of the applicable AWWA or ASTM standard, (e.g., "AWWA C900")
 - 6. Extrusion production-record code
 - 7. Trademark or trade name
 - 8. Cell Classification 12454 and/or PVC material designation code 1120 may also be included
 - 9. NSF-61-G (designating suitability for potable water service, including the lead-free requirements of the Safe Drinking Water Act) on all potable water pipe.
- F Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.

2.02 FUSION JOINTS

- A Unless otherwise specified, fusible polyvinyl chloride (PVC) pipe lengths shall be assembled in the field with butt-fused joints. The Contractor shall follow the pipe supplier's written guidelines for this procedure. All fusion joints shall be completed as described in this specification.

2.03 CONNECTIONS AND FITTINGS

A DUCTILE IRON MECHANICAL AND FLANGED FITTINGS

Acceptable fittings for use with fusible polyvinyl chloride (PVC) pipe shall include standard ductile iron fittings conforming to AWWA/ANSI C110/A21.10, or AWWA/ANSI C153/A21.53 and AWWA/ANSI C111/A21.11.

- 1. Connections to fusible polyvinyl chloride (PVC) pipe may be made using a restrained or non-restrained retainer gland product for PVC pipe, as well as for MJ or flanged fittings.

2. Ductile iron fittings shall be restrained with the use of thrust blocking or other means as indicated in the construction documents.
3. Ductile iron fittings and glands must be installed per the manufacturer's guidelines.

B PVC GASKETED, PUSH-ON FITTINGS

Fittings for use with fusible polyvinyl chloride (PVC) pipe shall include standard PVC pressure fittings conforming to AWWA C900 or AWWA C907.

1. Fittings for use joining fusible polyvinyl chloride (PVC) pipe with other sections of fusible polyvinyl chloride (PVC) pipe or other sections of PVC pipe shall include gasketed PVC, push-on type couplings and fittings, including bends, tees, and couplings as shown in the construction documents.
2. PVC gasketed, push-on fittings and mechanical restraints, if used, shall be installed per the manufacturer's guidelines.

C FUSIBLE POLYVINYL CHLORIDE (PVC) SWEEPS OR BENDS

1. Fusible polyvinyl chloride (PVC) sweeps or bends shall be manufactured from the same fusible polyvinyl chloride (PVC) pipe being used for the installation and be of the same sizing convention, diameter, wall thickness and pressure class of the pipe being joined using the sweep or bend.
2. Fusible polyvinyl chloride (PVC) sweeps or bends shall have at least 2 feet of straight section on either end of the sweep or bend to allow for fusion of the sweep to the pipe installation. Unless otherwise specified, there shall be no gasketed connections utilized with a fusible polyvinyl chloride (PVC) sweep.
3. Standard fusible polyvinyl chloride (PVC) sweep or bend angles shall not be greater than 22.5 degrees, and unless otherwise specified, shall be used in nominal diameters ranging from 4-inch through 16-inch.

D SLEEVE-TYPE COUPLINGS

1. Sleeve-type mechanical couplings shall be manufactured for use with PVC pressure pipe.
2. Sleeve-type couplings shall be rated at the same or greater pressure carrying capacity as the pipe itself.

E EXPANSION AND FLEXIBLE COUPLINGS

1. Expansion-type mechanical couplings shall be manufactured for use with PVC pipe, and may be restrained or unrestrained as indicated in the construction documents.
2. Expansion-type mechanical couplings shall be rated at the same or greater pressure carrying capacity as the pipe itself.

F CONNECTION HARDWARE

Bolts and nuts for buried service shall be made of non-corrosive, high-strength, low-alloy steel having the characteristics specified in ANSI/AWWA C111/A21.11, regardless of any other protective coating.

G CONNECTION TO SANITARY SEWER MANHOLES AND STRUCTURES

1. Fusible polyvinyl chloride (PVC) pipe shall be connected to manholes and other structures to provide a leak-free, properly graded flow into or out of the manhole or structure.
2. Connections to existing manholes and structures shall be as indicated in the construction documents.
 - 1) For a cored or drilled opening provide a flexible, watertight connection that meets and/or exceeds ASTM C923.
 - 2) For a knock out opening, provide a watertight connection (waterstop or other method) meeting the material requirements of ASTM C923 that is securely attached to the pipe with stainless steel bands or other means.
 - 3) Grout opening in manhole wall with non-shrink grout. Pour concrete collar around pipe and outside manhole opening. Provide flexible pipe joint or flexible connector within 2 feet of the collar.
3. Connections to a new manhole or structure shall be as indicated in the construction documents.
 - 1) A flexible, watertight gasket per ASTM C 923 shall be cast integrally with riser section(s) for all precast manhole and structures.
 - 2) Drop connections shall be required where shown on drawings.
 - 3) Grout internal joint space with non-shrink grout.

2.04 DRILLING SYSTEM EQUIPMENT

A GENERAL

1. The directional drilling equipment, as a minimum, shall consist of a directional drilling rig of sufficient capacity to perform the bore(s) and pull-back of the pipe(s), a drilling fluid mixing & delivery system of sufficient capacity to successfully complete the crossing, a guidance system to accurately guide boring operations, and trained and competent personnel to operate the system. All equipment shall be in good, safe operating condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of this project. All required equipment shall be included in the emergency and contingency plan as submitted per these specifications.

B DRILLING RIG

1. The directional drilling machine shall consist of a hydraulically powered system to rotate, push and pull drill pipe while delivering a pressurized fluid mixture to a drill head. The machine shall be anchored to withstand the pulling, pushing and rotating forces required to complete the project.
2. The drilling rig hydraulic system shall be of sufficient pressure and volume to power drilling operations. The hydraulic system shall be free from leaks.

3. The drilling rig shall have a system to monitor pull-back hydraulic pressure during pull-back operations.

C DRILL HEAD

1. The horizontal directional drilling equipment shall produce a stable fluid lined tunnel with the use of a steer-able drill head and any subsequent pre-reaming heads.
2. The system must be able to control the depth and direction of the drilling operation.
3. Drill head shall contain all necessary cutters and fluid jets for the operation, and shall be of the appropriate design for the ground medium being drilled.

D DRILLING FLUID SYSTEM

1. DRILLING FLUID (DRILLING MUD)

- a) Drilling fluid shall be composed of clean water and the appropriate additive(s) for the fluid to be used. Water shall be from a clean source and shall meet the mixing requirements of the mixture manufacturer(s).
- b) The water and additives shall be mixed thoroughly to assure the absence of any clumps or clods. No hazardous additives may be used.
- c) Drilling fluid shall be maintained at a viscosity sufficient to suspend cuttings and maintain the integrity of bore wall(s).
- d) Drilling fluid shall be disposed of off-site in accordance with local, state and federal requirements and/or permit conditions.
- e) No additional chemicals or polymer surfactants shall be allowed to be added to the drilling fluid unless they have been submitted per this specification.

2. MIXING SYSTEM

- a) A drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid for the project.
- b) The mixing system shall be able to ensure thorough mixing of the drilling fluid. The drilling fluid reservoir tank shall be sized for adequate storage of the fluid.
- c) The mixing system shall continually agitate the drilling fluid during drilling operations.

3. DRILLING FLUID DELIVERY AND RECOVERY SYSTEM

- a) The drilling fluid pumping system shall have a minimum capacity to supply drilling fluid in accordance with the drilling equipment pull-back rating at a constant required pressure.
- b) The delivery system shall have filters or other appropriate in-line equipment to prevent solids from being pumped into the drill pipe.
- c) Used drilling fluid and drilling fluid spilled during drilling operations shall be contained and properly disposed of. The use of spill containment measures shall be maintained around drill rigs, drilling fluid mixing

system, entry and exit pits and drilling fluid recycling system (if used) to prevent spills into the surrounding environment. Pumps, vacuum truck(s), and/or storage of sufficient size shall be in place to contain excess drilling fluid.

- d) A closed-loop drilling fluid system and a drilling fluid cleaning system should be used to whatever extent practical, depending upon project size and conditions. Under no circumstances shall drilling fluid that has escaped containment be reused in the drilling system.

E DRILLING CONTROL SYSTEM

1. Calibration of the electronic detection and control system shall be verified prior to the start of the bore.
2. The drilling head shall be remotely steer-able by means of an electronic or magnetic detection system. The drilling head location shall be monitored in three dimensions:
 - a) Offset from the baseline,
 - b) Distance along the baseline, and
 - c) Depth of cover.
3. Point of rotation of the head shall also be monitored.
4. For gravity application and on-grade drilling, sonde/beacon or approved equipment applicable for grade increments of 1/10th of one percent shall be used.

2.05 PIPE PULL HEADS

- A Pipe pull heads shall be utilized that employ a positive through-bolt design assuring a smooth wall against the pipe cross-section at all times.
- B Pipe pull heads shall be specifically designed for use with fusible polyvinyl chloride (PVC) pipe, and shall be as recommended by the pipe supplier.

2.06 PIPE ROLLERS

- A Pipe rollers, if used, shall be of sufficient size to fully support the weight of the pipe during handling and pullback operations.
- B A sufficient quantity of rollers and spacing, per the pipe supplier's guidelines shall be used to assure adequate support and excessive sagging of the product pipe.

PART 3 – EXECUTION

3.01 DELIVERY AND OFF-LOADING

- A All pipe shall be bundled or packaged in such a manner as to provide adequate protection of the ends during transportation to the site. Any pipe damaged in shipment shall be replaced as directed by the owner or engineer.
- B Each pipe shipment shall be inspected for damage and to determine if the load has shifted prior to unloading. The owner or engineer shall be notified immediately if more than immaterial damage is found. Each pipe shipment should be checked for quantity

and proper pipe size, and type.

- C Pipe should be loaded, off-loaded, and otherwise handled following all of the pipe supplier's guidelines.
- D Off-loading devices such as chains, wire rope, chokers, or other pipe handling implements that may scratch, nick, cut, or gouge the pipe are strictly prohibited.
- E During off-loading and handling, care shall be taken to avoid the pipe striking hard objects. Significant impact could cause damage, particularly during cold weather.
- F If appropriate unloading equipment is not available, pipe may be unloaded by removing individual pieces. Care should be taken to ensure that pipe is not dropped or damaged. Pipe should be carefully lowered, not dropped, from trucks.

3.02 HANDLING AND STORAGE

- A Visibly damaged pipe sections, or sections with suspected damage shall be cut out and removed. Cutting shall be performed per the pipe supplier's recommendations.
- B Any scratch or gouge greater than 10% of the wall thickness will be considered significant and can be rejected unless determined acceptable by the owner or engineer.
- C Pipe lengths should be stored and placed on level ground. Pipe should be stored at the job site in the unit packaging provided by the manufacturer. Caution should be exercised to avoid compression, damage, or deformation to the ends of the pipe. The interior of the pipe, as well as all end surfaces, should be kept free from dirt and foreign matter.
- D Pipe shall be handled and supported with the use of woven fiber pipe slings or approved equal. Care shall be exercised when handling the pipe to not cut, gouge, scratch or otherwise abrade the piping in any way.
- E If pipe is to be stored for periods of 1 year or longer, the pipe should be shielded from direct sunlight. The pipe cover should be opaque and provide for adequate air circulation above and around the pipe to prevent excess heat accumulation.
- F Pipe shall be stored and stacked per the pipe supplier's guidelines.

3.03 FUSION PROCESS

A GENERAL

1. Fusible polyvinyl chloride (PVC) pipe will be handled in a safe manner before, during, and after the fusion process and in accordance with this specification and pipe supplier's guidelines.
2. Fusible polyvinyl chloride (PVC) pipe will be fused by qualified fusion technicians, as documented by the pipe supplier.
3. Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine.
4. Only appropriately sized and outfitted fusion machines that have been approved by the pipe supplier shall be used for the fusion process. Fusion machines must incorporate the following elements:

- a) HEAT PLATE - Heat plates shall be in good condition with no deep gouges or scratches. Plates shall be clean and free of any debris or contamination. Heater controls shall function properly; cord and plug shall be in good condition. The appropriately sized heat plate shall be capable of maintaining a uniform and consistent heat profile and temperature for the size of pipe being fused, per the pipe supplier's guidelines.
 - b) CARRIAGE – Carriage shall travel smoothly with no binding at low pressure. Jaws shall be in good condition with proper and clean inserts for the pipe size being fused. Insert pins shall be installed with no interference to carriage travel.
 - c) GENERAL MACHINE - Overview of machine body shall yield no obvious defects, missing parts, hydraulic leaks or potential safety issues prior to fusion.
 - d) DATA LOGGING DEVICE – An approved, fully functional datalogging device, with the current version of the pipe supplier's software shall be used. Datalogging device operations and maintenance manual shall be kept with the unit at all times. If fusing for extended periods of time, an independent 110V power source shall be available to extend battery life.
5. Other equipment specifically required for the fusion process shall include the following:
- a) Pipe rollers shall be used for support of pipe to either side of the machine
 - b) An infrared (IR) pyrometer, with an accuracy of 1% or better, for checking pipe and heat plate temperatures.
 - c) Fusion machine operations and maintenance manual shall be kept with the fusion machine at all times.
 - d) Facing blades specifically designed for cutting fusible polyvinyl chloride (PVC) pipe shall be used.
 - e) For fusion in inclement weather, and/or windy conditions; a weather protection canopy with sides that allow full machine motion of the heat plate, fusion assembly and carriage shall be provided per the pipe supplier's recommendations. When the pipe temperature is below 40°F, the pipe supplier's cold weather operating procedures shall be followed.

B JOINT RECORDING

Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine hydraulic system. The fusion data logging and joint report shall be generated by software developed specifically for the butt-fusion of fusible polyvinyl chloride (PVC) pipe. The software shall register and/or record the parameters required by the pipe supplier and these

specifications. Required data not logged by the data logger shall be logged manually and be included in the Fusion Technician's joint report.

3.04 DRILLING OPERATIONS

A GENERAL

1. Bore path and alignment are as indicated in the contract documents. The path of the bore may be modified based on field and equipment conditions. Entry and exit locations and control-point elevations shall be maintained as indicated in the contract documents.
2. Bend radii shown in the contract documents are minimum allowable radii and shall not be reduced.

B LOCATION AND PROTECTION OF UNDERGROUND UTILITIES

1. Correct location of all underground utilities that may impact the HDD installation is the responsibility of the Contractor, regardless of any locations shown on the drawings or previous surveys completed.
2. Utility location and notification services shall be contacted by the Contractor prior to the start of construction.
3. All existing lines and underground utilities shall be positively identified, including exposing those facilities that are located within an envelope of possible impact of HDD installation as determined for the project specific site conditions. It is the Contractor and HDD system operator's responsibility to determine this envelope of safe offset from existing utilities. This will include, but is not limited to, soil conditions and layering, utility proximity and material, HDD system and equipment, and foreign subsurface material.

C SITE LOCATION PREPARATION

1. Work site as indicated on drawings shall be graded or filled to provide a level working area. No alterations beyond what is required for operations are to be made.
2. Contractor shall confine all activities to designated work areas.

D DRILLING LAYOUT AND TOLERANCES

1. The drill path shall be accurately surveyed with entry and exit areas placed in the appropriate locations within the areas indicated on drawings. If using a magnetic guidance system, drill path will be surveyed for any surface geomagnetic variations or anomalies.
2. Instrumentation shall be provided and maintained at all times that accurately locates the pilot hole, measures drill-string axial and torsional loads and measures drilling fluid discharge rate and pressure.
3. Entry and exit areas shall be drilled so as not to exceed the bending limitations of the pipe as recommended by the pipe supplier.

E PILOT HOLE BORE

1. Pilot hole shall be drilled along bore path. In the event that the pilot bore does deviate from the bore path, it may require contractor to pull-back and re-drill from the location along bore path before the deviation.

2. The Contractor shall limit curvature in any direction to reduce force on the pipe during pull-back. The minimum radius of curvature shall be no less than that specified by the pipe supplier and as indicated on the drawings.

F REAMING

1. After successfully completing the pilot hole, the bore hole shall be reamed to a diameter which meets the requirements of the pipe being installed. The following table is offered as an estimated guide:

Nominal Pipe Diameter	Bore Hole Diameter
< 8 inches	Pipe Dia. + 4 inches
8 inches to 24 inches	Pipe Dia. X 1.5
> 24 inches	Pipe Dia. + 12 inches

2. Multiple reaming passes shall be used at the discretion of the Contractor and shall conform to this specification.
3. In the event of a drilling fluid fracture, returns loss or other loss of drilling fluid, the Contractor shall be responsible for restoring any damaged property to original condition and cleaning up the area in the vicinity of the damage or loss.

3.05 PIPE PULL-BACK AND INSERTION

- A** Pipe shall be fused prior to insertion, if the site and conditions allow, into one continuous length.
- B** Contractor shall handle the pipe in a manner that will not over-stress the pipe prior to insertion. Vertical and horizontal curves shall be limited so that the pipe does not bend past the pipe supplier's minimum allowable bend radius, buckle, or otherwise become damaged. Damaged portions of the pipe shall be removed and replaced.
- C** The pipe entry area shall be graded as needed to provide support for the pipe and to allow free movement into the bore hole.
1. The pipe shall be guided into the bore hole to avoid deformation of, or damage to, the pipe.
 2. The fusible polyvinyl chloride (PVC) pipe may be continuously or partially supported on rollers or other Owner and Engineer approved friction decreasing implement during joining and insertion, as long as the pipe is not over-stressed or critically abraded prior to, or during installation.
 3. A swivel shall be used between the reaming head and the fusible polyvinyl chloride (PVC) pipe to minimize torsion stress on the pipe assembly.
- D** Buoyancy modification shall be at the sole discretion of the Contractor, and shall not exceed the pipe supplier's guidelines in regards to maximum pull force or minimum bend radius of the pipe. Damage caused by buoyancy modifications shall be the responsibility of the Contractor.
- E** Once pull-back operations have commenced, the operation shall continue without

interruption until the pipe is completely pulled through the bore hole.

- F The pipe shall be installed in a manner that does not cause upheaval, settlement, cracking, or movement and distortion of surface features. Any damages caused by the Contractor's operations shall be corrected by the Contractor.
- G Pneumatic hammer shall not be used to dislodge a stuck pipe.

3.06 INSTALLATION CLEANUP

- A Following the installation, the project site shall be returned to a condition as required in the construction documents. All excavations will be backfilled and compacted per the construction documents and jurisdictional standards. All pavement and hardscape shall be repaired per applicable jurisdictional standards. All drilling fluid shall be properly disposed of per these specifications and all applicable jurisdictional laws.
- B Contractor shall verify that all utilities, structures, and surface features in the immediate project area are sound.

3.07 PREPARATION PRIOR TO MAKING CONNECTIONS INTO EXISTING PIPING SYSTEMS

- A Prior to making connections into existing piping systems, the contractor shall:
 1. Field verify location, size, piping material, and piping system of the existing pipe.
 2. Obtain all required fittings, which may include saddles, sleeve type couplings, flanges, mechanical restraints, tees, or others as shown in the construction documents.
 3. Have installed all temporary pumps and/or pipes in accordance with established connection plans.
- B Unless otherwise approved, new piping systems shall be completely assembled and successfully tested prior to making connections into existing pipe systems.

3.08 PIPE SYSTEM CONNECTIONS

- A Pipe connections shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines and as indicated in the construction documents. Pipe connections to structures shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines.
- B If possible, pipe installed via HDD shall be filled with water prior to making any connections to the existing system or other portions of the project.

3.09 TAPPING FOR POTABLE AND NON-POTABLE PRESSURE WATER APPLICATIONS

- A Tapping shall be performed using standard tapping saddles designed for use on PVC piping in accordance with AWWA C605. Tapping shall be performed only with use of tap saddles or sleeves. **NO DIRECT TAPPING WILL BE PERMITTED.** Tapping shall be performed in accordance with the applicable sections for Saddle Tapping per UNI-PUB-08, "PVC Pressure Pipe Tapping Guide".
- B All connections requiring a larger diameter than that recommended by the pipe supplier, shall be made with a pipe connection as specified and indicated on the drawings.
- C Equipment used for tapping shall be made specifically for tapping PVC pipe:

1. Tapping bits shall be slotted “shell” style cutters, specifically made for PVC pipe. ‘Hole saws’ and drill bits made for cutting wood, steel, ductile iron, or other materials are strictly prohibited.
 2. Manually operated or power operated drilling machines may be used.
- D Taps may be performed while the pipeline is filled with water and under pressure (‘wet’ tap,) or when the pipeline is not filled with water and not under pressure (‘dry’ tap).

3.10 TESTING

A Testing shall comply with all applicable jurisdictional building codes, statutes, standards, regulations, and laws.

B HYDROSTATIC TESTING AND LEAKAGE TESTING FOR FUSIBLE POLYVINYL CHLORIDE (PVC) PRESSURE PIPING

1. Hydrostatic and leakage testing shall be conducted in accordance with the requirements of AWWA C605.
2. Unless agreed to or otherwise designated by the owner or engineer, for a simultaneous hydrostatic and leakage test following installation, a pressure equal to 150% of working pressure at point of test, but not less than 125% of normal working pressure at highest elevation shall be applied. Unless otherwise agreed to, the duration of the pressure test shall be for two (2) hours.
3. If hydrostatic testing and leakage testing are performed at separate times, follow procedures as outlined in AWWA C605.
4. In preparation for pressure testing the following parameters must be followed:
 - 1) All air must be vented from the pipeline prior to pressurization. This may be accomplished with the use of the air relief valves or corporation stop valves, vent piping in the testing hardware or end caps, or any other method which adequately allows air to escape the pipeline at all high points. Venting may also be accomplished by ‘flushing’ the pipeline in accordance with the parameters and procedures as described in AWWA C605.
 - 2) The pipeline must be fully restrained prior to pressurization. This includes complete installation of all mechanical restraints per the restraint manufacturer’s guidelines, whether permanent or temporary to the final installation. This also includes the installation and curing of all required thrust blocking. All appurtenances included in the pressure test, including valves, blow-offs, and air-relief valves shall be checked for proper installation and restraint prior to beginning the test.
 - 3) Temporary pipeline alignments that are being tested, such as those that are partially installed in their permanent location shall be configured to provide for the removal of trapped air in the pipeline.

C LEAKAGE TESTING FOR NON-PRESSURE FUSIBLE POLYVINYL CHLORIDE (PVC) PIPING

1. Gravity sanitary sewers that contain mechanical jointing in addition to fused PVC joints may need to be tested for excessive leakage.
2. Gravity sanitary sewer leakage testing may include appropriate water or low-

pressure air testing. The leakage outward or inward (exfiltration or infiltration) shall not exceed 25 gallons per inch of pipe diameter per mile per day for any section of the system. An exfiltration or infiltration test shall be performed with a minimum positive head of two feet. The air test, if used, shall be conducted in accordance with one of the following Standards:

- 1) ASTM F1417
- 2) UNI-B-6
3. The testing method selected shall properly consider the existing groundwater elevations during the test.

D DEFLECTION TESTING FOR NON-PRESSURE PIPING

1. After completion of the backfill, the engineer or owner may require that a deflection test be performed.
2. Deflection tests can be conducted using a go/no-go mandrel. The mandrel's outside dimension shall be sized to permit passage through no more than 7.5 percent deflection. The percent deflection shall be established from the base inside diameter of the pipe. When the internal fusion beads are not removed, the base inside diameter shall include the height of the internal bead. The mandrel shall be approved by the owner or engineer prior to use. Other deflection test options, such as direct measurements, can be used for lines large enough for safe entry.

E INTERMEDIATE TESTING

1. Segments of the pipe may be tested separately in accordance with standard testing procedure, as approved by the owner and engineer. Testing of each HDD installation prior to connection to the system or other piping is preferred.

3.11 DISINFECTION OF POTABLE WATER PIPING

Chlorine granules shall not be used or present near the pipe ends while the pipe sections are being joined. After installation, the pipeline, having passed all required testing, shall be disinfected prior to being put into service. Unless otherwise directed by the owner or engineer, the pipeline will be disinfected per AWWA C651.

****END OF SECTION****

CERTA-LOK SPECIFICATIONS

Directional Drilling

PART 1 GENERAL **WORK INCLUDED**

- A. Furnish all labor, materials and equipment required to install (Pipe Size) potable water main, reclaim main and force main pipe using the directional drilling method of installation, all in accordance with the requirements of the Contract Documents. The pipe size, type and length shall be as specified herein and as shown on the Drawings. Work shall include and not be limited to proper installation, testing, restoration of underground utilities and environmental protection and restoration.
- B. The directional drill shall be accomplished by first drilling a pilot hole to design standards, and then enlarging the pilot hole to at a minimum of 1.5 times larger than the outer diameter of the Certa- Lok C900/RJ coupling to accommodate the pull back of the pipe through the enlarged hole.
- C. Soil borings as required for certain subsurface soil conditions shall be provided by the Directional Drilling Contractor within the scope of this project.
- D. See CONDITIONS OF THE CONTRACT and GENERAL REQUIREMENTS, which contain information and requirements that apply to the Work specified herein and are mandatory for this project.

REFERENCE SPECIFICATIONS, CODES AND STANDARDS CERTAINTeed - CERTA-LOK C900 / RJ RESTRAINED JOINT PIPE

1.0 Scope

This specification covers restrained joint Polyvinyl Chloride (PVC) Pipe, 4" – 12", with cast-iron pipe (CI) outside diameters. Pipe is intended for use in pressure-rated potable water delivery systems, as well as in sewer and fire protection piping systems.

2.0 Reference Documents American Society for Testing and Materials (ASTM)

ASTM D1784 Standard Specification for Rigid PVC Compounds and Chlorinated PVC Compounds

ASTM D2837 Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials

ASTM D3139 Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

ASTM F477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

American Water Works Association (AWWA)

AWWA C900 Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. through 12 In. (100 mm through 300 mm), for Water Distribution

NSF International

NSF 61 Drinking Water System Components – Health Effects

3.1 Requirements

3.2 General

Products delivered under this specification shall be manufactured only from water distribution pipe and couplings conforming to AWWA C900. The restrained joint pipe system shall also meet all short and long term pressure test requirements of AWWA C900. Pipe, couplings, and locking splines shall be completely non-metallic to eliminate corrosion problems.

3.3 Materials

Pipe and couplings shall be made from un-plasticized PVC compounds having a minimum cell classification of 12454, as defined in ASTM D1784. The compound shall qualify for a Hydrostatic Design Basis (HDB) of 4000 psi for water at 73.4°F, in accordance with the requirements of ASTM D2837.

3.4 Approvals

Restrained joint PVC pipe products shall have been tested and approved by Underwriters Laboratories for continuous use at rated pressures as follows:

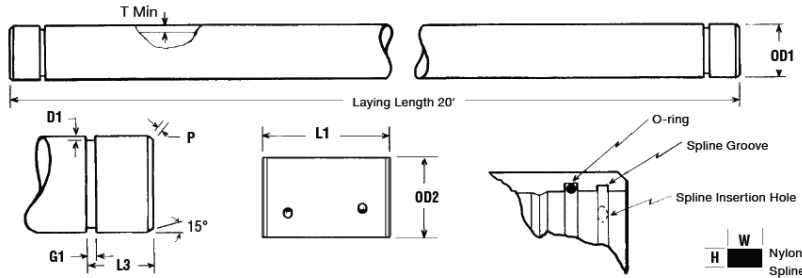
Pipe Size	4"	6"	8"	10"	12"
DR18	UL Listed for Underground Restrained Joint Water Mains				
DR14	UL Listed for Underground Restrained Joint Water Mains			UL Listed for Conventional Underground Water Mains Installed with Thrust Blocks	

Note: All approvals shown are for a locking-joint system suitable for directional drilling.

Copies of agency approval reports or product listings shall be provided to the Engineer. Products intended for contact with potable water shall be evaluated, tested, and certified for conformance with NSF 61 by an acceptable certifying organization.

3.5 Dimensions

Nominal outside diameters and wall thicknesses of restrained joint pipe shall conform to the requirements of AWWA C900. Restrained joint pipe shall be furnished in 4", 6", 8", 10" and 12" sizes, in DR18 and DR14. Pipe shall be furnished in standard lengths of 20 feet.



Dimensions of the pipe are shown as follows:

Pipe Dimensions

Sizes	OD1	T Min.		P	L3	G1	L1	OD2	D1		Approx. Weight with Coupling (lbs/ft)	
		DR18	DR14						Min.	Max.	DR18	DR14
4"	4.80	.267	.343	.313	3.000	.375	8.250	5.964	.125	.135	2.6	3.2
6"	6.90	.383	.493	.313	3.000	.375	8.250	8.366	.125	.135	5.4	6.7
8"	9.05	.503	.646	.656	3.163	.500	10.500	10.947	.130	.140	9.3	11.5
10"	11.10	.617	.793	.656	3.500	.500	11.125	13.361	.200	.215	14.2	17.8
12"	13.20	.733	.943	.656	3.500	.500	12.000	15.836	.200	.215	20.4	24.7

3.6 Joints

Pipe shall be joined using non-metallic couplings to form an integral system for maximum reliability and interchangeability. High-strength, flexible thermoplastic splines shall be inserted into mating, precision machined grooves in the pipe and coupling to provide full 360° restraint with evenly distributed loading. Couplings shall be designed for use at or above the pressure class of the pipe with which they are utilized, and shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F477. Joints shall be designed to meet the zero leakage test requirements of ASTM D3139.

3.7 Workmanship

Pipe and couplings shall be homogeneous throughout and free from voids, cracks, inclusions and other defects, and shall be as uniform as commercially practicable in color, density and other physical characteristics.

3.8 Quality Control

Every pipe and machined coupling shall pass hydrostatic proof test requirements (DR18 600 psi, DR14 800 psi)

3.9 Marking

Pipe and couplings shall be legibly and permanently marked in ink with the following minimum information:

Pipe

- Nominal size (for example, 4")
- PVC
- Dimension ratio (for example, DR18)
- Pressure class
- AWWA C900
- Manufacturer's name or trademark and production record code
- Seal(mark) of the testing agency verifying the suitability of the pipe Material for potable water service
- Seal (mark) of the certifying agencies that have tested and approved the pipe for use in fire protection systems

Couplings

- Nominal size (for example, 4")
- PVC
- Pressure class
- AWWA C900
- Manufacturer's name or trademark
- Seal (mark) of the testing agency verifying the suitability of the pipe material for potable water service
- Seal (mark) of the certifying agencies which have tested and approved the pipe for use in fire protection systems

4.0 Approved Manufacturers

C900/RJ™ PVC restrained joint pipe from CertainTeed Corporation, or approved equal

SUBMITTALS

1. Directional drilling contractor's qualifications and experience.
2. Work plan: Prior to beginning work, the CONTRACTOR must submit to the ENGINEER a work plan detailing the procedure and schedule to be used to execute the project. The work plan should include a description of all equipment to be used, down-hole tools, a list of personnel and their qualification and experience (including backup personnel in the event that an individual is unavailable), list of subcontractors, a schedule of work activity, a safety plan (including MSDS of any potentially hazardous substances to be used), an environmental protection plan and contingency plans for possible problems. Work plan should be comprehensive, realistic and based on actual working conditions for this particular project. Plan should document the thoughtful planning required to successfully complete the project.
3. Bore plan: Prior to beginning work, the contractor must submit to the engineer a to-

scale shop drawing of the pilot bore plan with Vertical scale 1" = 2' and Horizontal scale 1" = 20'. The plan shall show finished grade, deflection and radiuses of the pilot bore, and all existing utilities with minimum vertical and horizontal clearances. The proposed clearance shall exceed the guidance system accuracy tolerance by a minimum of 100%.

4. Material: Specifications on material to be used shall be submitted to ENGINEER. Material shall include the pipe, fittings and any other item which is to be an installed component of the project.
5. Equipment: Submit specifications on directional drilling equipment to be used to ensure that the equipment will be adequate to complete the project. Equipment shall include but not be limited to: drilling rig, mud system, mud motors (if applicable), downhole tools, guidance system, rig safety systems. Calibration records for guidance equipment shall be included. Specifications for any drilling fluid additives that CONTRACTOR intends to use or might use shall be submitted.

QUALITY ASSURANCE

- A. All directional drilling operations shall be done by a qualified directional drilling CONTRACTOR with at least (3) years' experience involving work of a similar nature to the work required of this project.
- B. Notify ENGINEER and OWNER a minimum of three (3) days in advance of the start of work.
- C. All work shall be performed in the presence of the OWNER or ENGINEER.

PART 2 PRODUCTS

POLYVINYL CHLORIDE (PVC) PIPE

- A. The pipe material to be used shall meet AWWA C900 standards for Polyvinyl Chloride pressure pipe and fittings with a dimension ratio DR18 or DR14. All other pipe shall have the written approval of the ENGINEER and meet all submittal review as an optional approved product. The pipe shall be designated as Certa-Lok C900/RJ as manufactured by CertainTeed Corporation.
- B. The pipe shall be joined using separate PVC coupling with beveled edges, built-in sealing gaskets and restraining grooves. The restraining splines shall be square or rectangular, and made from Nylon.
- C. Exposed splines shall be cut flush to coupling to reduce soil drag.
- D. Couplings shall be beveled on leading edges to minimize soil friction.
- E. CONTRACTOR shall adhere to the pipe manufacturer's most current calculations regarding tensile load limitations for trenchless application. This calculation shall be

part of the required submittal. (See chart next page)

Size	SDR	Class	Pipe O.D.	Coupling O.D.	Maximum Pull-In Force Tightest Bending	Maximum Pull-In Force Straight Pull (No Bending)
4"	18	150psi	4.800"	5.964"	6,700 lbs.	8,200 lbs.
6"	18	150psi	6.900"	8.366"	9,000 lbs.	12,800 lbs.
8"	18	150psi	9.050"	10.947"	18,000 lbs.	25,200 lbs.
10"	18	150psi	11.100"	13.361"	25,600 lbs.	35,200 lbs.
12"	18	150psi	13.200"	15.836"	26,440 lbs.	41,100 lbs.
4"	14	200psi	4.800"	5.964"	8,000 lbs.	10,300 lbs.
6"	14	200psi	6.900"	8.366"	9,300 lbs.	14,700 lbs.
8"	14	200psi	9.050"	10.947"	18,900 lbs.	28,800 lbs.
10"	14	200psi	11.100"	13.361"	24,900 lbs.	38,300 lbs.
12"	14	200psi	13.200"	15.836"	28,300 lbs.	48,300 lbs.

- F. CONTRACTOR shall adhere to the pipe manufacturer's most current recommendations regarding radius of curvature for Certa-Lok C900/RJ pipe used for trenchless application. This calculation of each bore shall be part of the required submittal prior to work.

Pipe Diameter	Min. Radius of Curvature *	Offset per 20' Length	Deflection per 20'
4"	100'	24"	11.5 Degrees
6"	150'	16"	7.6 Degrees
8"	200'	12"	5.7 Degrees
10"	250'	10"	4.6 Degrees
12"	300'	8"	3.8 Degrees

* Non-Tapped Pipe

DIRECTIONAL DRILLING EQUIPMENT REQUIREMENTS

- A. General: The directional drilling equipment shall consist of a directional drilling rig of sufficient capacity to perform the bore and pull back the pipe, a drilling fluid mixing, delivery and recovery system of sufficient capacity to successfully complete the installation, a drilling fluid recycling system to remove solids from the drilling fluid so that the fluid can be reused (if required), a magnetic guidance system or walk-over system to accurately guide boring operations, a vacuum truck of sufficient capacity to handle the drilling fluid volume, and trained and competent personnel to operate the system. All equipment shall be in good, safe condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of this project.
- B. Drilling Rig: The directional drilling machine shall consist of a hydraulically powered system to rotate and push hollow drilling pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head. The machine shall

be anchored to the ground to withstand the pulling, pushing and rotating pressure required to complete the installation. The hydraulic power system shall be self-contained with sufficient pressure and volume to power drilling operations. Hydraulic system shall be free of leaks. Rig shall have a system to monitor and record maximum pull-back pressure during pull-back operations. There shall be a system to detect electrical current from the drill string and an audible alarm which automatically sounds when an electrical current is detected.

- C. Drill Head: The drill head shall be steerable by changing its rotation, and shall provide necessary cutting surfaces and drilling fluid jets.
- D. Mud Motors (if required): Mud motors shall be of adequate power to turn the required drilling tools.
- E. Drill Pipe: Shall be constructed of high quality 4130 seamless tubing, grade D or better, with threaded box and pins. Tools joints should be hardened to 32-36 RC.

GUIDANCE SYSTEM

- A. General: An electronic walkover tracking system or a Magnetic Guidance System (MGS) probe or proven gyroscopic probe and interface shall be used to provide a continuous and accurate determination of the location of the drill head during the drilling operation. The guidance shall be capable of tracking at all depths up to fifty feet and in any soil condition, including hard rock. It shall enable the driller to guide the drill head by providing immediate information on the tool face, azimuth (horizontal direction), and inclination (vertical direction). The guidance system shall be accurate and calibrated to manufacturer's specifications of the vertical depth of the borehole at sensing position at depths up to fifty feet and accurate to 2-feet horizontally.
- B. Components: The CONTRACTOR shall supply all components and materials to install, operate, and maintain the guidance system.
- C. The guidance system shall be of a proven type, and shall be set up and operated by personnel trained and experienced with the system. The operator shall be aware of any geo-magnetic anomalies and shall consider such influences in the operation of the guidance system.

DRILLING FLUID (MUD) SYSTEM

- A. Mixing System: A self-contained, closed, drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid composed of bentonite clay, potable water, and appropriate additives. Mixing system shall be able to molecularly shear individual bentonite particles from the dry powder to avoid clumping and ensure thorough mixing. The drilling fluid reservoir tank shall be minimum of 1,000 gallons. Mixing system shall continually agitate the drilling fluid during drilling operations.
- B. Drilling Fluids: Drilling fluid shall be composed of clean water and bentonite clay. Water shall be from an authorized source with a pH of 8.5 – 10. Water of a lower pH or with

excessive calcium shall be treated with the appropriate amount of sodium carbonate or equal. No additional material may be used in drilling fluid without prior approval from ENGINEER. The bentonite mixture used shall have the minimum viscosities as measured by a March funnel:

Rocky Clay	- 60	seconds
Hard Clay	- 40	seconds
Soft Clay	- 45	seconds
Sandy Clay	- 90	seconds
Stable Sand	- 80	seconds
Loose Sand	- 110	seconds
Wet Sand	- 110	seconds

These viscosities may be varied to best fit the soil conditions encountered, or as determined by the operator.

- C. **Delivery System:** The mud pumping system shall have a minimum capacity of 35-500 GPM and the capability of delivering the drilling fluid at a constant minimum pressure of 1200 psi. The delivery system shall have filters in-line to prevent solids from being pumped into drill pipe. Used drilling fluid and drilling fluid spilled during operations shall be contained and conveyed to the drilling fluid recycling system or shall be removed by vacuum trucks or other methods acceptable to ENGINEER. A berm, minimum of 12- inches high, shall be maintained around drill rigs drilling fluid mixing system, entry and exit pits and drilling fluid recycling system to prevent spills into the surrounding environment. Pumps and or vacuum truck(s) of sufficient size shall be in place to convey drilling fluid from containment areas to storage and recycling facilities for disposal.

OTHER EQUIPMENT

- A. **Pipe Rollers:** If required, pipe rollers shall be used for pipe assembly during final product pull back.
- B. **Restrictions:** Other devices or utility placement systems for providing horizontal thrust other than those previously defined in the preceding sections shall not be used unless approved by the ENGINEER prior to commencement of the work. Consideration for approval will be made on an individual basis for each specified location. The proposed device or system shall maintain line and grade within the tolerances prescribed by the particular conditions of the project.

PERSONNEL REQUIREMENTS

- A. All personnel shall be fully trained in their respective duties as part of the directional drilling crew and in safety. Each person must have at least two years directional drilling experience.
- B. A competent and experienced supervisor representing the CONTRACTOR and Drilling Subcontractor shall be present at all times during the actual drilling operations.

A responsible representative who is thoroughly familiar with the equipment and type of work to be performed must be in direct charge and control of the operation at all times. In all cases, the supervisor must be continually present at the job site during the actual Directional Bore operation. The CONTRACTOR and Subcontractor shall have a sufficient number of competent workers on the job at all times to insure the Directional Bore is made in a timely and satisfactory manner.

- C. Personnel who are unqualified, incompetent or otherwise not suitable for the performance of this project shall be removed from the job site and replaced with a suitable person.
- D. A professional land surveyor registered in the State of Wisconsin may be required for Certified as-builts as per specifications.

PART 3 EXECUTION

GENERAL REQUIREMENTS

- A. The ENGINEER must be notified 3 days in advance of starting work. The Directional Bore shall not begin until the ENGINEER is present at the job site and agrees that proper preparations for the operation have been made. The ENGINEER'S approval for beginning the installation shall in no way relieve the CONTRACTOR of the ultimate responsibility for the satisfactory completion of the work as authorized under the Contract. It shall be the responsibility of ENGINEER to provide inspection personnel at such time as appropriate without causing undue hardship by reason of delay to the CONTRACTOR.
- B. All work under this specification affecting the City of Manitowoc property, right-of-way or facilities shall be carried out to the full satisfaction of the City's authorized representative. The CONTRACTOR shall fully inform himself of all requirements of the City as pertains to specific project and shall conduct all work accordingly.
- C. All equipment used by the CONTRACTOR on Owner's property and right-of-ways may be inspected by the OWNER or the Owner's Representatives and shall not be used if considered unsatisfactory by OWNER or Owner's Representatives.
- D. The Contractor shall be fully responsible for all damages arising from their failure to comply with the regulations and the requirements of these Specifications.

DIRECTIONAL DRILLING OPERATION

- A. The CONTRACTOR shall provide all material, equipment, and facilities required for directional drilling. Proper alignment and elevation of the bore hole shall be consistently maintained throughout the directional drilling operation. The method used to complete the directional drill shall conform to the requirements of all applicable permits. Copies of all permits will be supplied to the CONTRACTOR by the OWNER.
- B. The entire drill path shall be accurately surveyed with entry and exit stakes placed in the appropriate locations within the areas indicated on drawings. If CONTRACTOR is using a magnetic guidance system, drill path will be surveyed for any surface geo-magnetic variations or anomalies.
- C. CONTRACTOR shall place silt fence between all drilling operations and any drainage, well-fields, wetland, waterway or other area designated for such protection necessary by documents, state, federal and local regulations. Additional environmental protection necessary to contain any hydraulic or drilling fluid spills shall be put in place, including berms, liners, turbidity curtains and other measures. CONTRACTOR shall adhere to all applicable environmental regulations. Fuel may not be stored in bulk containers within 200 feet of any water body or wetland.
- D. Readings shall be recorded after advancement of each successive drill pipe (no more than 10') and the readings plotted on a scaled drawing of 1" = 2', both vertical and horizontal. Access to all recorded readings and plan and profile information shall be made available to the ENGINEER, or their representative, at all times. At no time shall the deflection radius of the drill pipe exceed the deflection limits of the carrier pipe as specified herein.
- E. A complete list of all drilling fluid additives and mixtures to be used in the directional operation will be submitted to the ENGINEER, along with their respective Material Safety Data Sheets. All drilling fluids and lose cuttings shall be contained in pits or holding tanks for recycling or disposal, no fluids shall be allowed to enter any unapproved areas or natural waterways. Upon completion of the directional drill project, the drilling mud and cuttings shall be disposed of by the CONTRACTOR at an approved dump site.
- F. The pilot hole shall be drilled on bore path with no deviations greater than 5% of depth over a length of 100-feet. In the event that pilot does deviate from the bore path more than 5-feet of depth in 100-feet, CONTRACTOR will notify ENGINEER and ENGINEER may require CONTRACTOR to pull-back and re-drill from the location along bore path before the deviation. In the event that a drilling fluid fracture, inadvertent returns or returns loss occurs during pilot hole drilling operations, CONTRACTOR shall cease drilling, wait at least 30 minutes, inject a quantity of drilling fluid with a viscosity exceeding 120 seconds as measured by a March funnel and wait another 30 minutes. If mud fracture or returns loss continues,

CONTRACTOR will discuss additional options with the engineer and work will then proceed accordingly.

- G. Upon completion of pilot hole phase of the operation, a complete set of “as-built” records shall be submitted in duplicate to the OWNER. These records shall include copies of the plan and profile drawing, as well as directional survey reports as recorded during the drilling operation.
- H. Upon approval of the pilot hole location, the hole opening or enlarging phase of the installation shall begin. The bore hole diameter shall be increased to accommodate the pullback operation of the required size of PVC pipe. The type of hole opener or back reamer to be utilized in this phase shall be determined by the types of subsurface soil conditions that have been encountered during the pilot hole drilling operation. The reamer type shall be at the CONTRACTOR’S discretion with the final hole opening being a maximum of 1.5 times larger than the outside diameter of the Certa-Lok C900 / Restrained Joint COUPLING to be installed in the bore hole.
- I. The open bore hole may be stabilized by means of bentonite drilling slurry pumped through the inside diameter of the drill rod and through openings in the reamer. The drilling slurry must be in a homogenous / flowable state serving as an agent to carry the loose cuttings to the surface through the annulus of the borehole. The volume of bentonite mud required for each pullback shall be calculated based on soil conditions, largest diameter of the pipe couplings, capacity of the bentonite mud pump, and the speed of pullback as recommended by the bentonite drilling fluid manufacture. The bentonite slurry is to be contained at the exit or entry side of the directional bore in pits or holding tanks. The slurry may be recycled at this time for reuse in the hole opening operation, or shall be hauled by the CONTRACTOR to an approved dumpsite for proper disposal.
- J. The PVC pipe shall be joined together according to manufacturer’s specifications. The gaskets and the ends of pipe must be inspected and cleaned with a wet cloth prior to each joint assembly so they are free of any dirt or sand. The ends of pipe must be free of any chips, scratches, or scrapes before pipe is assembled. A pulling eye will be attached to the Certa-Lok C900/RJ pulling head on the lead stick of pipe which in turn will be attached to a swivel on the end of the drill pipe. Tracer wire (#8) solid coated copper wire shall be attached to the pulling eye and the crown of PVC pipe with a minimum of two full wraps of duct tape around the pipe. This will allow for a straight, smooth pull of the product pipe as it enters and passes through the borehole toward the drill rig and original entrance hole of the directional bore. The product pipe will be elevated to the approximate angle of entry and supported by means of a sideboom with roller arm, or similar equipment, to allow for the “free stress” situation as the pipe is pulled into the exit hole toward the drill rig. The product pullback phase of the directional operation shall be carried out in a continuous manner until the pipe reaches the original entry side of the bore.

PIPE HANDLING

- A. Care shall be taken during transportation of the pipe such that it will not be cut, kinked or otherwise damaged.
- B. Ropes, fabrics or rubber protected slings and straps shall be used when handling pipes. Chains, cables or hooks inserted into the pipe ends shall not be used. Two slings spread apart shall be used for lifting each length of pipe. Pipe or fittings shall not be dropped into rocky or unprepared ground.
- C. Pipes shall be stored on level ground, preferably turf or sand, free of sharp objects which could damage the pipe. Stacking of the Certa-Lok C900 / RJ pipe shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature conditions. Where necessary due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitably and of such width as not to allow deformation of the pipe at the point of contact with the sleeper or between supports.
- D. The handling of the joint pipeline shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. Slings for handling the pipeline shall not be positioned at pipe joints. Sections of the pipes with deep cuts and gouges shall be removed and the ends of the pipeline rejoined.

TESTING PIPE

- A. Cleaning and flushing are to be done by the CONTRACTOR in accordance with the requirements of the contract.
- B. Directional drilling pipe shall be tested by CONTRACTOR after pullback. The average pressure shall be maintained at 150 psi for two hours. The test pump and water supply shall be arranged to allow accurate measurements of the water required to maintain the test pressure. Any material showing seepage or the slightest leakage shall be replaced as directed by the OWNER at no additional expense to the OWNER.
- C. The manufacturer's recommendations on bend radius and tensile strength shall be observed.
- D. Pipeline shall be tested end to end.
- E. All service lines on the new main shall also be tested along with the new (size of pipe) main.

SITE RESTORATION

- A. Following drilling operations, CONTRACTOR will de-mobilize equipment and restore the work site to the original conditions or better. All

excavations will be backfilled and compacted according to the specifications.

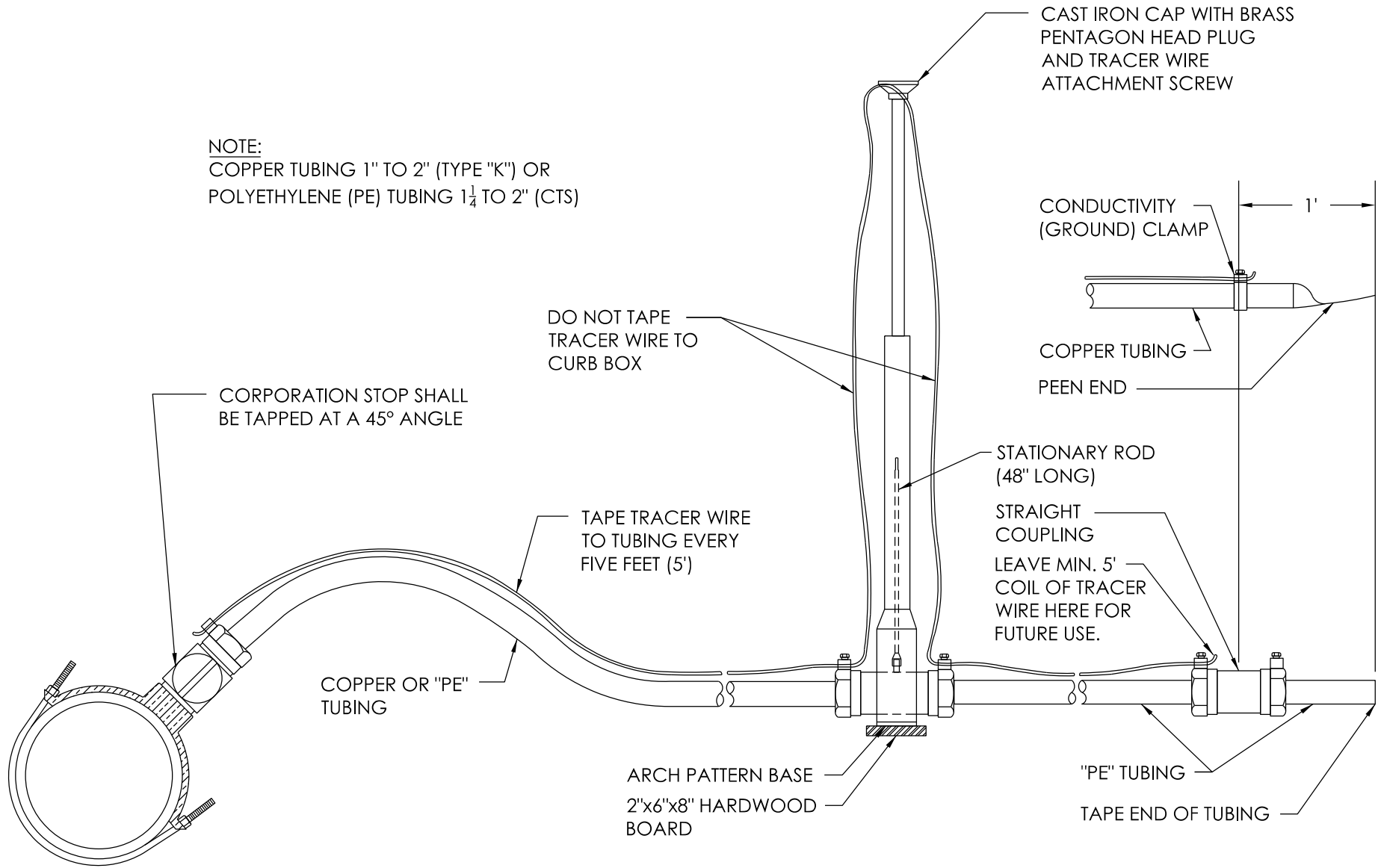
- B. Surface restoration shall be completed in accordance with the requirements of the contract, to a condition as good as or better than existed prior construction.

RECORD KEEPING AND AS-BUILTS

- A. CONTRACTOR shall maintain a daily project log of drilling operations and a guidance system log with a copy given to the ENGINEER at completion of project.
- B. The MGS data shall be recorded during the actual crossing operation. The CONTRACTOR shall furnish "as-built" plan and profile drawing based on these recordings showing the actual location horizontally and vertically of the installation, and all utility facilities found during the installation. The MGS data shall be certified accurate by the CONTRACTOR to the capability of the MGS System.
- C. "As-built" drawings shall be completed and certified by the Contractor in a form as approved by MPU.

END OF SECTION

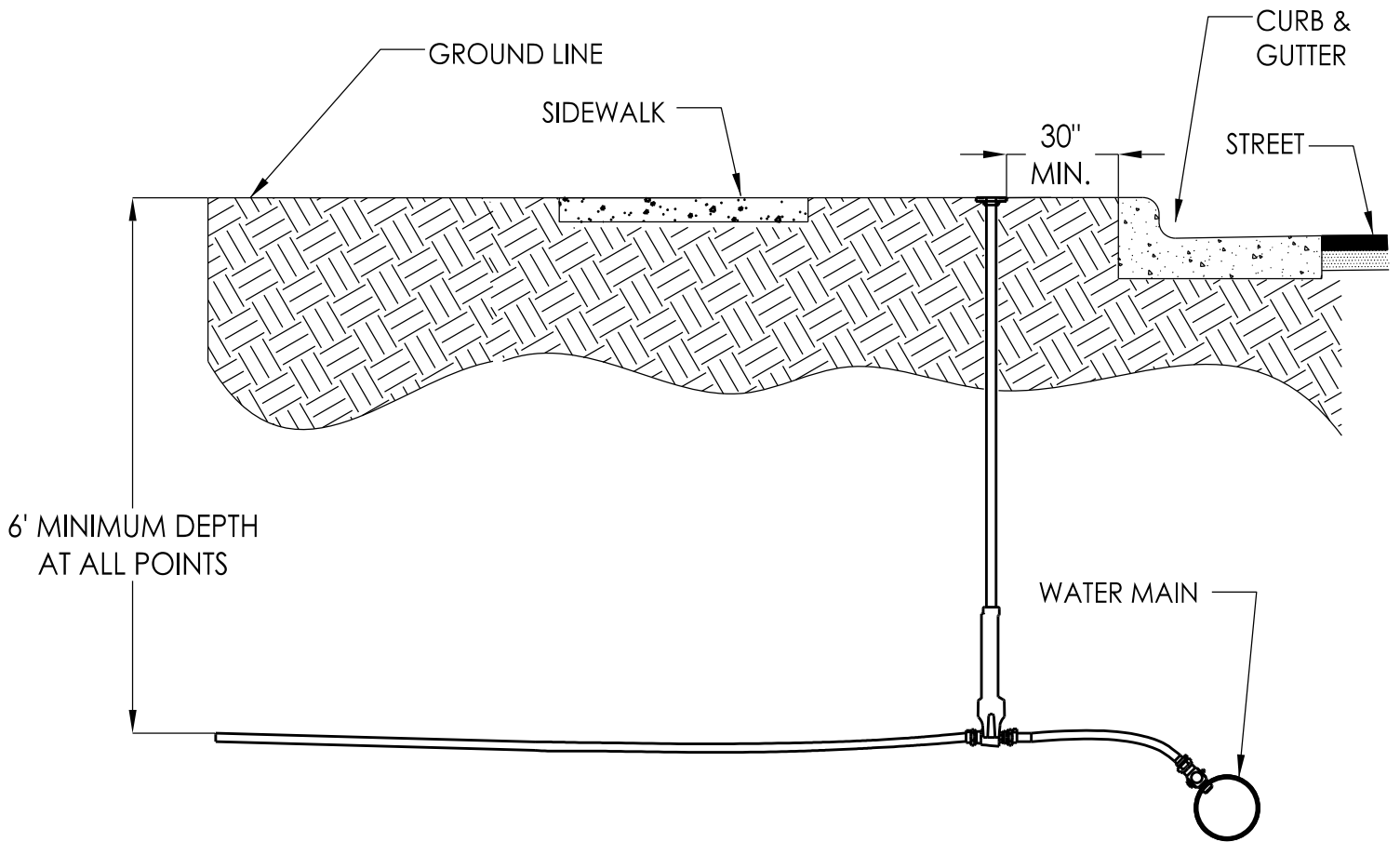
NOTE:
 COPPER TUBING 1" TO 2" (TYPE "K") OR
 POLYETHYLENE (PE) TUBING 1¼ TO 2" (CTS)



DCN # 2020-02

NO	DATE	DESCRIPTION	BY	TITLE:	DATE: 3-22-2012
1	1/20	UPDATED STATIONARY ROD LENGTH	RAO	WATER SERVICE LATERALS	DRAWN: CMJ
					CHK'D: RM
					SCALE: NTS
					DEPT: WD
					TYPE: WORK ORDER
					SHEET NUMBER: WD-6A-S



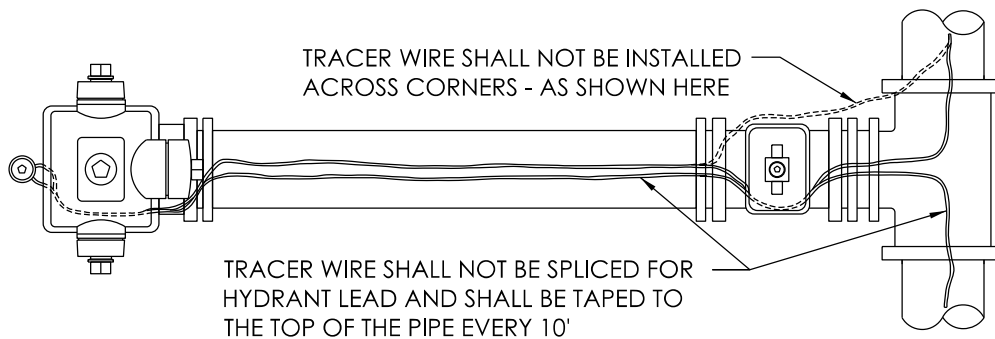


NOTES:

1. IF CURB BOX MUST BE INSTALLED IN DRIVEWAY OR SIDEWALK, A CURB BOX RECEPTACLE MUST BE USED WHEN PLACING CONCRETE.
2. CORPORATION STOP, CURB STOP, CURB BOX , AND RECEPTACLE (IF NEEDED) TO BE SUPPLIED BY WATER DEPARTMENT.
3. COPPER SERVICES ARE TO BE WRAPPED IN POLYETHYLENE FROM THE WATER MAIN TO THE CURB STOP IF POSSIBLE.
4. ENTIRE SERVICE INSTALLED AND MAINTAINED BY PROPERTY OWNER

DCN #2020-2

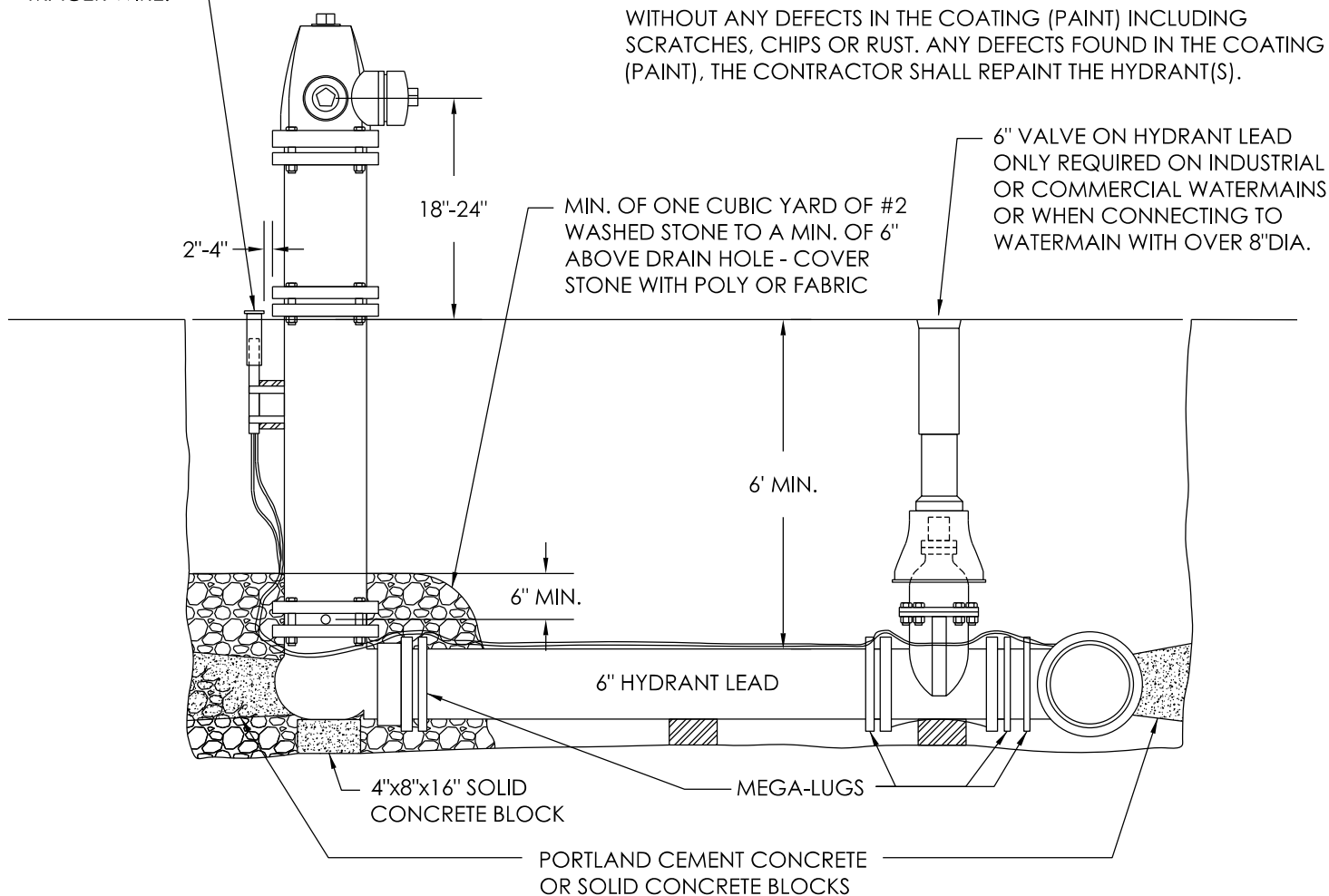
NO.	DATE	BY	REVISION		
1	1-15-20	RAO	UPDATED CURB STOP LOCATION	 MANITOWOC PUBLIC UTILITIES MANITOWOC, WISCONSIN	DATE: 10/19/2013
					DRAWN BY: KJM
					CHECKED BY: XX
					SCALE: NTS
					DEPARTMENT: WD
					TYPE: NA
				TITLE: PROFILE - TYPICAL WATER SERVICE INSTALLATION	DRAWING # WD-6-S



TRACER WIRE ACCESS BOX TO BE FLUSH WITH BREAK FLANGE, 2" TO 4" FROM SIDE OF BREAK FLANGE AND SHALL NOT BE TAPED TO HYDRANT 2" PVC CONDUIT, A MIN. OF 3' LONG, CAN BE TAPED TO HYDRANT BARREL WITH 2x4 SPACERS. PROVIDE A MIN. 18" OF EXTRA TRACER WIRE.

NOTES:

1. ALL PUSH-ON JOINTS IN HYDRANT LEAD MUST BE RESTRAINED.
2. ANCHOR TEE, VALVE, HYDRANT LEAD AND HYDRANT BARREL SHALL BE WRAPPED IN POLYETHYLENE WRAP - DO NOT COVER DRAIN HOLE - IF APPURTENANCES ARE NOT WRAPPED IN A TUBE, A DOUBLE WRAP OF FLAT SHEET OR SPLIT TUBE MUST BE USED.
3. THE CONTRACTOR IS RESPONSIBLE FOR INSTALLING THE HYDRANT WITHOUT ANY DEFECTS IN THE COATING (PAINT) INCLUDING SCRATCHES, CHIPS OR RUST. ANY DEFECTS FOUND IN THE COATING (PAINT), THE CONTRACTOR SHALL REPAINT THE HYDRANT(S).

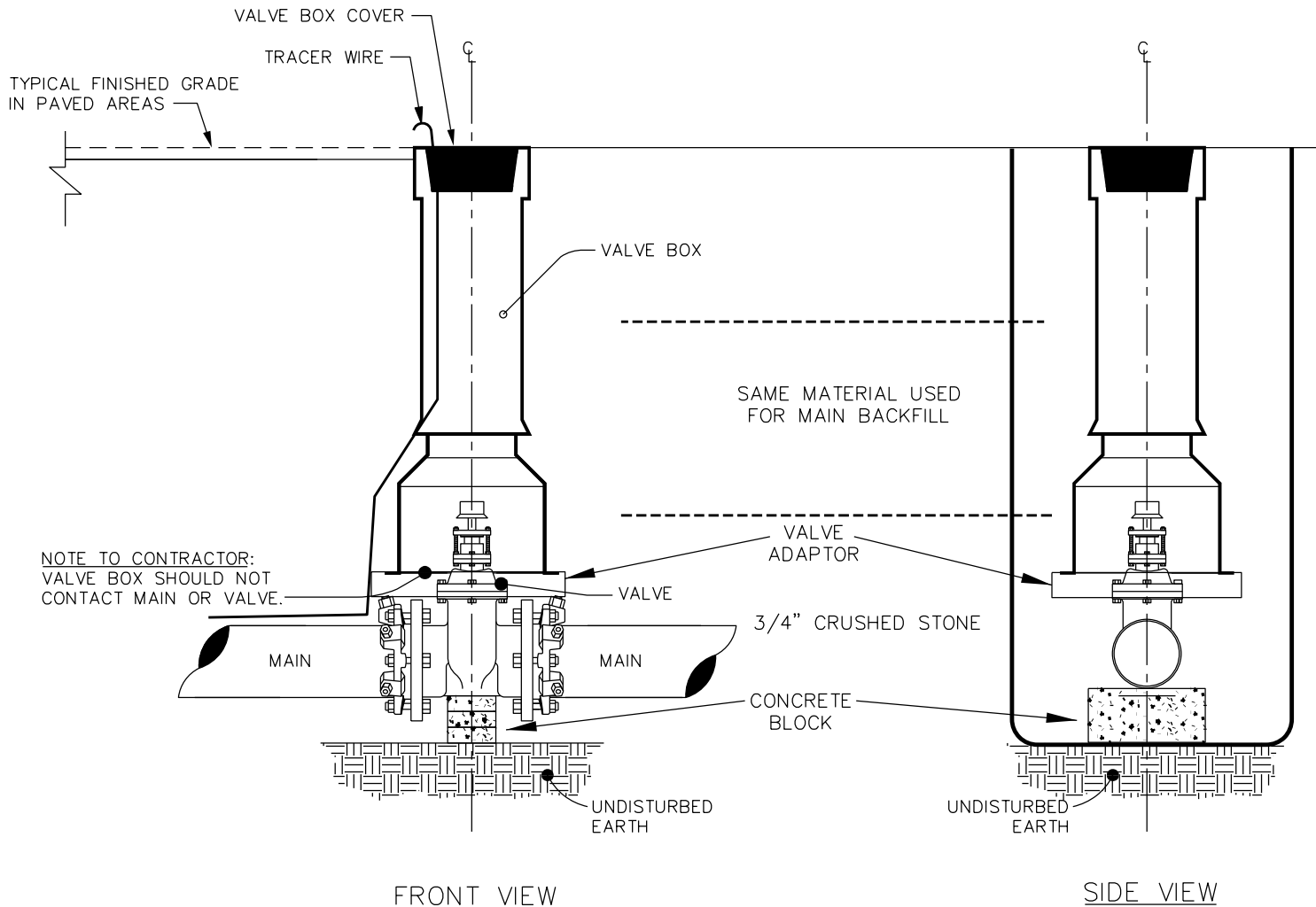


DCN #2020-02

NO	DATE	DESC	BY	TITLE:	DATE: 5-6-2013
1	1/20	ADDED NOTE TO LEAD VALVE	RAO	STANDARD HYDRANT INSTALLATION	DRAWN: CMJ
					CHK'D: RM
					SCALE: NTS
					DEPT: WD
					TYPE: WORK ORDER
					SHEET NUMBER:
					WD-7-S



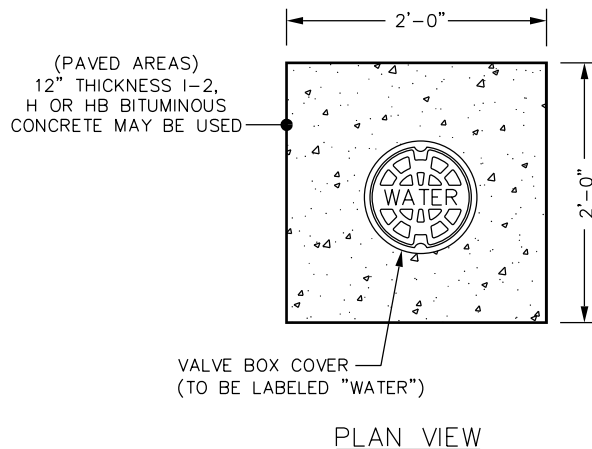
MANITOWOC PUBLIC UTILITIES
MANITOWOC, WISCONSIN



NOTE TO CONTRACTOR:
VALVE BOX SHOULD NOT
CONTACT MAIN OR VALVE.

NOTES:

1. ALL VALVES TO BE MECHANICAL JOINT FITTINGS.
2. IF PIPE IS PVC, VALVE MUST BE BLOCKED AS SHOWN ON TYPICAL CONCRETE THRUST BLOCK DRAWING
3. IF IN ROADWAY, TOP TWO FEET OF BACKFILL MUST BE COMPACTED BREAKER RUN MATERIAL WITH NO GREATER THAN 25% FINES
4. TRACER WIRE SHALL BE INSTALLED ON THE OUTSIDE OF THE BOTTOM SECTION AND INSIDE THE TOP SECTION OF THE VALVE BOX



DCN #2020-2

NO.	DATE	BY	REVISION
1	1/16/20	RAO	CONVERTED TO CAD & ADDED TRACER WIRE

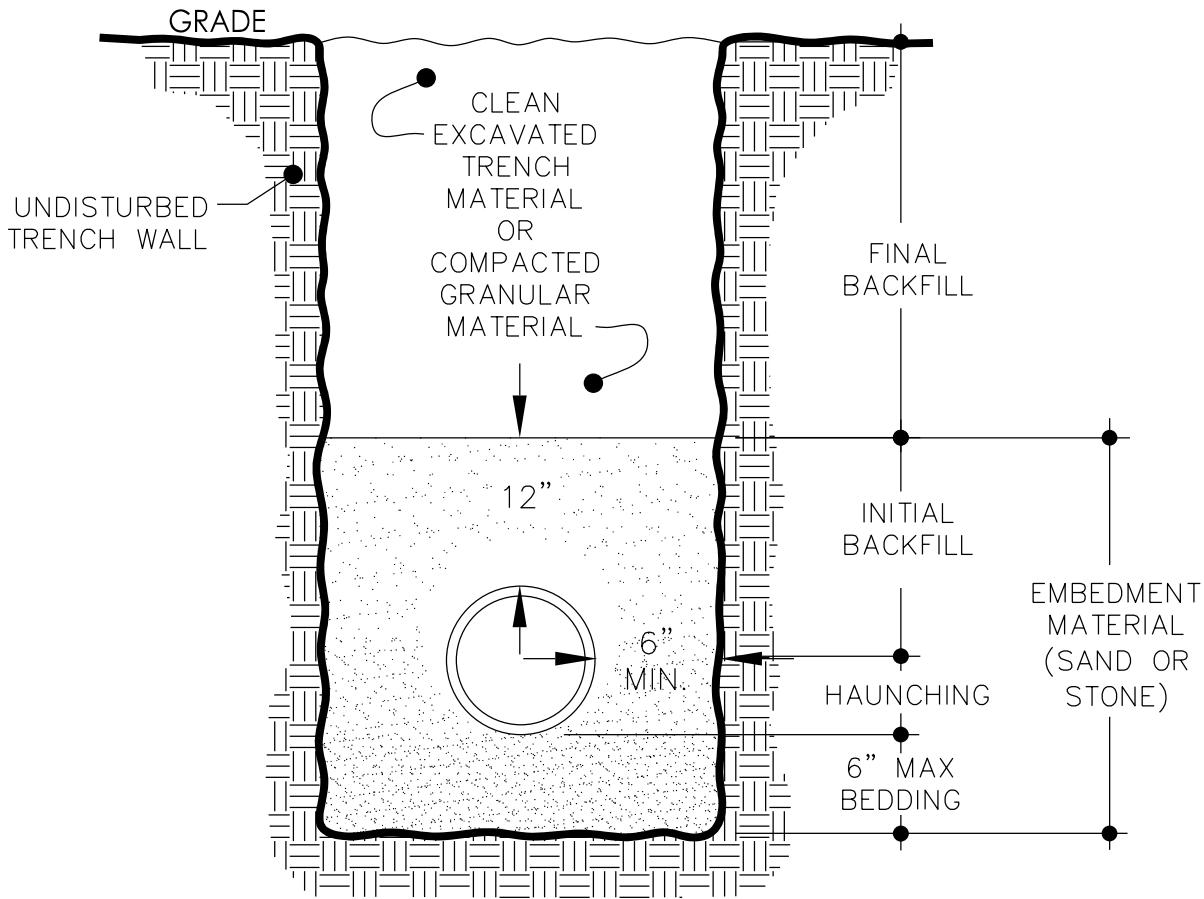


**MANITOWOC PUBLIC UTILITIES
MANITOWOC, WISCONSIN**

TITLE:

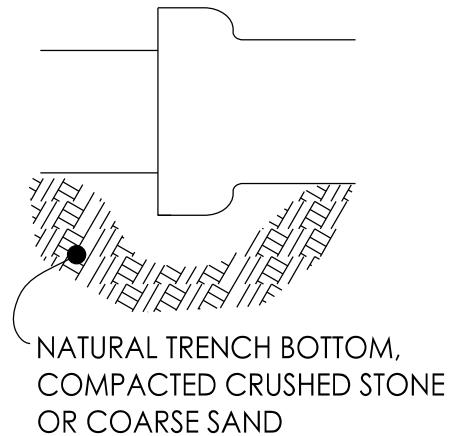
**TYPICAL INST. OF RESILIENT
WEDGE OR GATE VALVE**

DATE:	03/28/2019
DRAWN BY:	RAO
CHECKED BY:	RM
SCALE:	NTS
DEPARTMENT:	WD
TYPE:	NA
DRAWING #	WD-8-S



NOTES:

1. IF TRENCH BOTTOM IS ROCKY OR FROZEN, PLACE A 6" LAYER OF SAND OR STONE ALONG BOTTOM FOR BEDDING
2. HAUNCHING MATERIAL SHALL BE WELL COMPACTED SAND OR STONE TO A DEPTH OF ONE HALF THE PIPE DIA.
3. INITIAL BACKFILL SHALL BE WELL COMPACTED SAND OR STONE TO A DEPTH OF 12" ABOVE THE PIPE.
4. FINAL BACKFILL MAY BE MACHINE PLACED WITH NO LARGE STONES, FROZEN MATERIALS OR DEBRIS.



DCN #2020-2

NO.	DATE	BY	REVISION
1	1/16/20	RAO	CONVERTED TO CAD

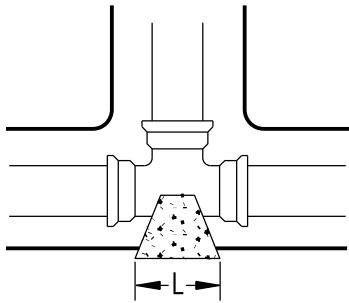


**MANITOWOC PUBLIC UTILITIES
MANITOWOC, WISCONSIN**

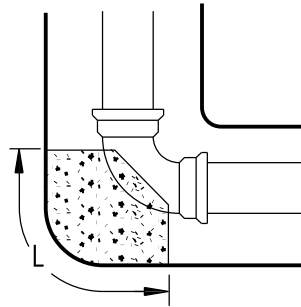
TITLE:

**TYPICAL INSTALLATION
OF PVC PIPE**

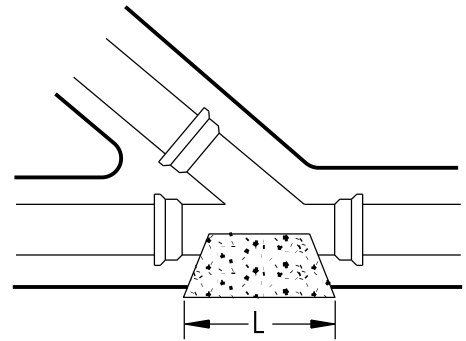
DATE:	03/28/2019
DRAWN BY:	RAO
CHECKED BY:	RM
SCALE:	NTS
DEPARTMENT:	WD
TYPE:	NA
DRAWING #	WD-9-S



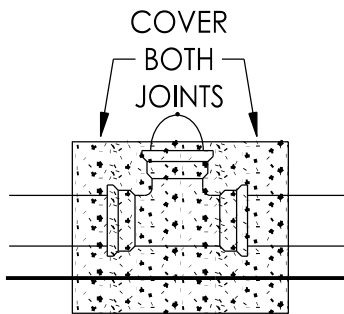
TEE



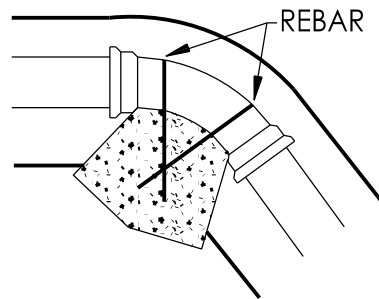
HORIZONTAL BEND



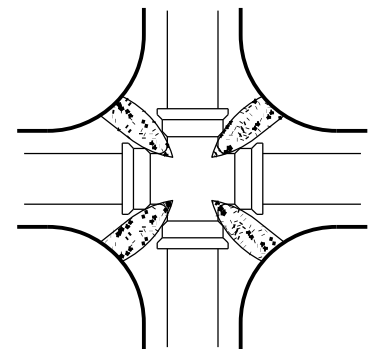
WYE



VALVE TIE-DOWN



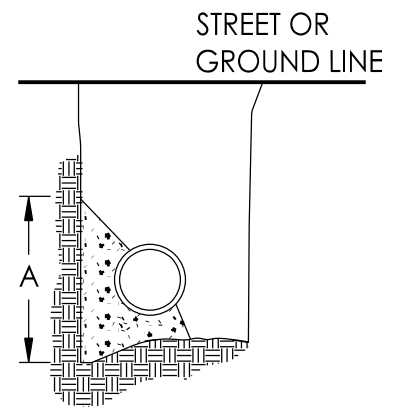
VERTICAL BEND



CROSS

NOTES:

1. THRUST BLOCK SHALL BE PLACED AGAINST FITTING IN A MANNER THAT INSURES NUTS AND BOLTS CAN BE REMOVED.
2. DIMENSIONS (L) AGAINST UNDISTURBED SOIL IS TO BE DETERMINED BY MPU.
3. UPON APPROVAL BY MPU, TIE RODS MAY BE USED IN PLACE OF CONCRETE FOR DUCTILE IRON PIPE.
4. STEEL REINFORCEMENT BARS TO BE SIZED BY MPU.
5. IF UNDISTURBED SOIL IS NOT AVAILABLE, A LARGER MASS OF CONCRETE SHALL BE USED. JOINTS CAN BE COMPLETELY COVERED TO TIE PIPE AND FITTINGS TOGETHER.
6. ALL MECHANICAL JOINTS SHALL BE RESTRAINED USING A RESTRAINING GLAND
7. ALSO REFER TO WD-18-S



TYPICAL SECTION

DCN # 2020-2

NO.	DATE	BY	REVISION
1	1/20/20	RAO	CONVERTED TO CAD

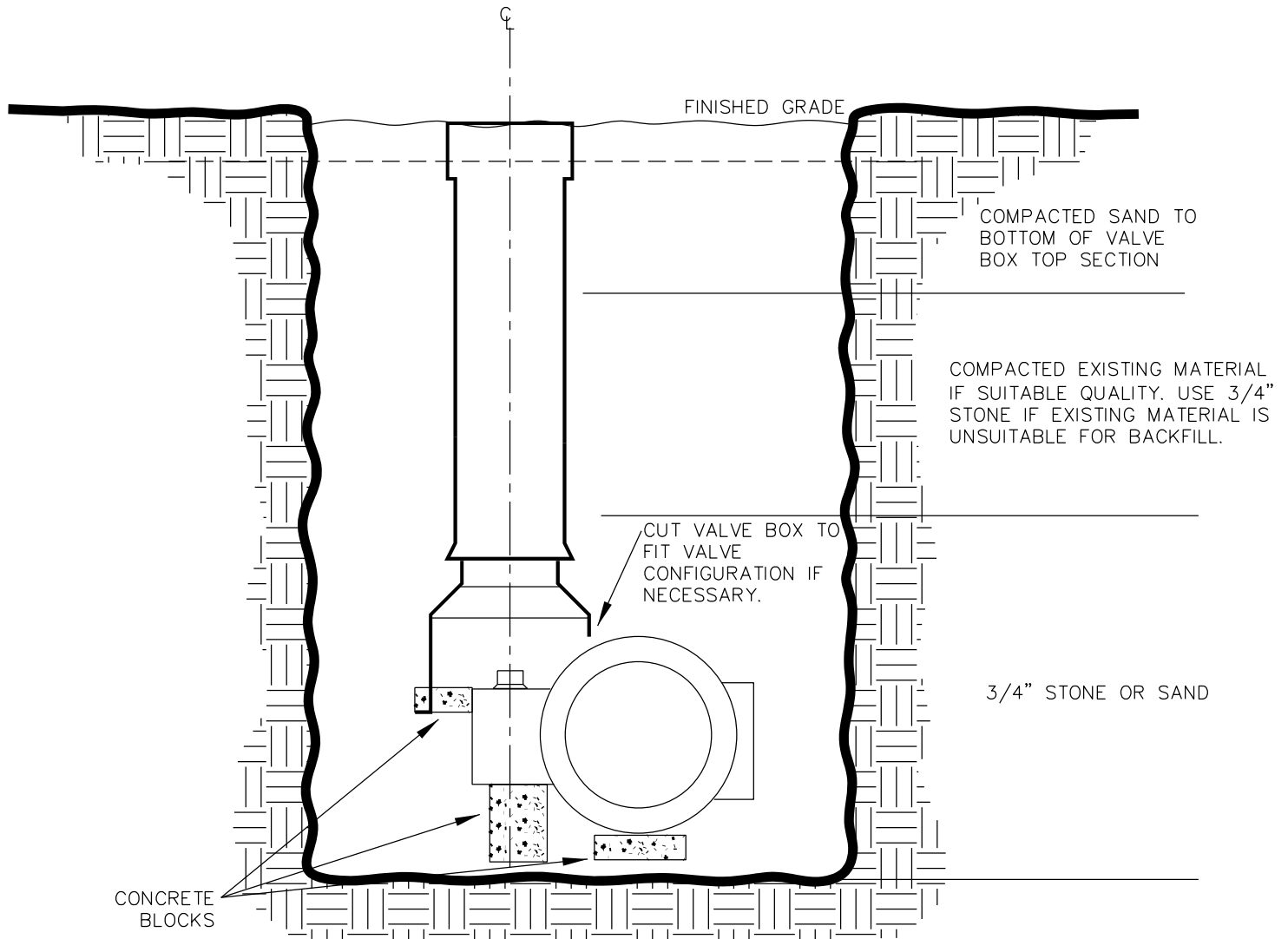


**MANITOWOC PUBLIC UTILITIES
MANITOWOC, WISCONSIN**

TITLE:

**TYPICAL CONCRETE
THRUST BLOCKS**

DATE:	03/28/2019
DRAWN BY:	RAO
CHECKED BY:	RM
SCALE:	NTS
DEPARTMENT:	WD
TYPE:	NA
DRAWING #	WD-10-S

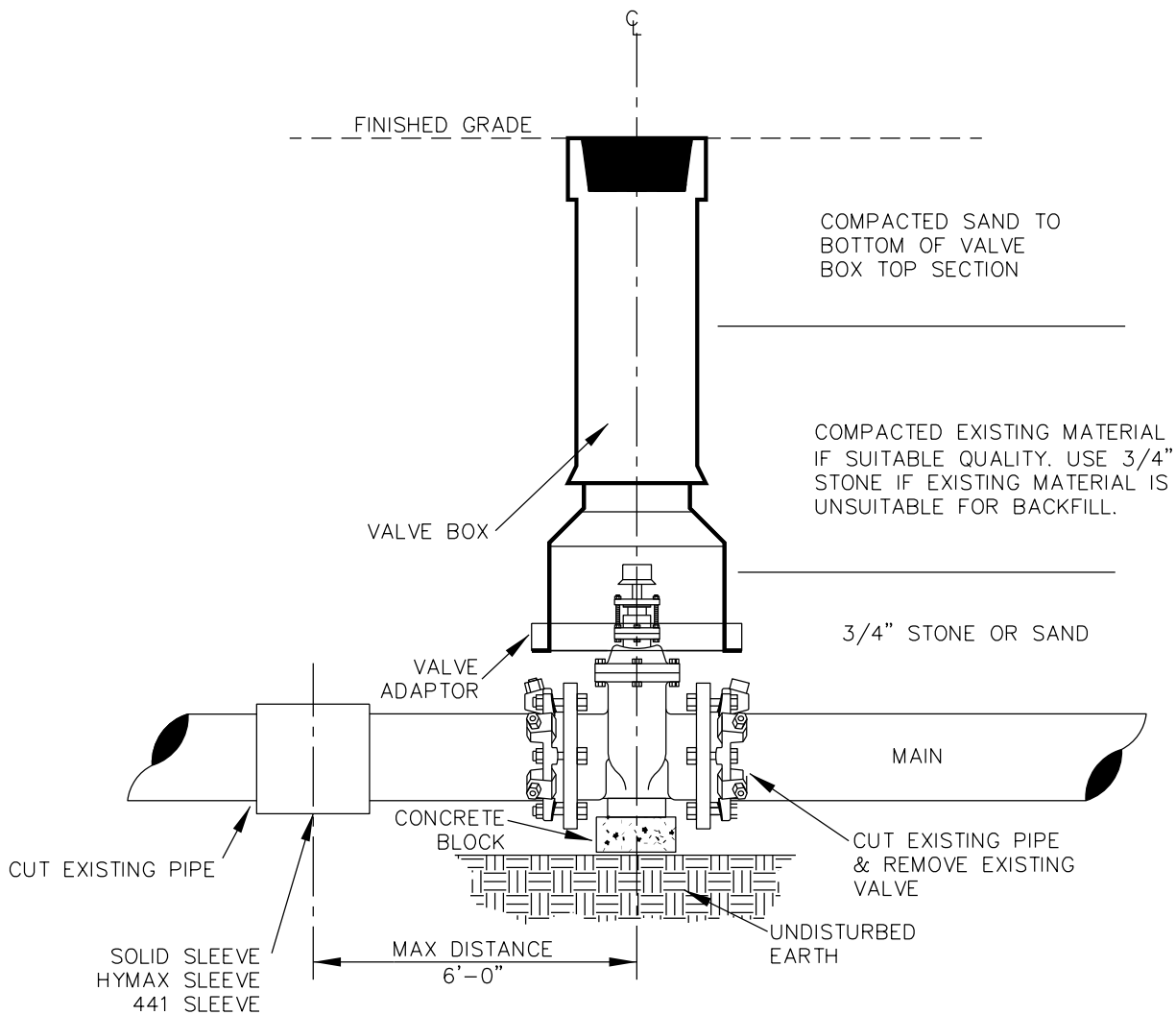


NOTES:

1. ALL BUTTERFLY VALVES TO BE MECHANICAL JOINT FITTINGS
2. ALL PIPE AND VALVE MATERIALS SUPPLIED BY MPU
3. A SLEEVE IS TO BE USED TO CLOSE PIPE WHEN A VALVE IS REPLACED
4. CONTRACTOR TO PROVIDE ALL BACKFILL MATERIALS
5. IF IN ROADWAY, TOP TWO (2) FEET OF BACKFILL MUST BE COMPACTED BREAKER RUN MATERIAL WITH NO GREATER THAN 25% FINES.
6. OPERATING NUT SHALL BE PLACED ON THE NORTH OR EAST SIDE OF WATERMAIN

DCN # 2020-2

NO.	DATE	BY	REVISION		
1	1/20/20	RAO	CONVERTED TO CAD	<p>MANITOWOC PUBLIC UTILITIES MANITOWOC, WISCONSIN</p> <p>TITLE: TYPICAL INSTALLATION OR REPLACEMENT OF BUTTERFLY VALVES</p>	DATE: 4/4/2019
					DRAWN BY: RAO
					CHECKED BY: RM
					SCALE: NTS
					DEPARTMENT: WD
					TYPE: NA
				DRAWING # WD-11-S	



- NOTES:
1. ALL PIPE AND VALVE MATERIALS SUPPLIED BY MPU
 2. IF EXISTING VALVE IS IN MANHOLE, REMOVE AND ELIMINATE THE MANHOLE
 3. CONTRACTOR TO PROVIDE ALL BACKFILL MATERIALS
 4. IF IN ROADWAY, TOP TWO(2) FEET OF BACKFILL MUST BE COMPACTED BREAKER RUN MATERIAL WITH NO GREATER THAN 25% FINES

DCN # 2020-2

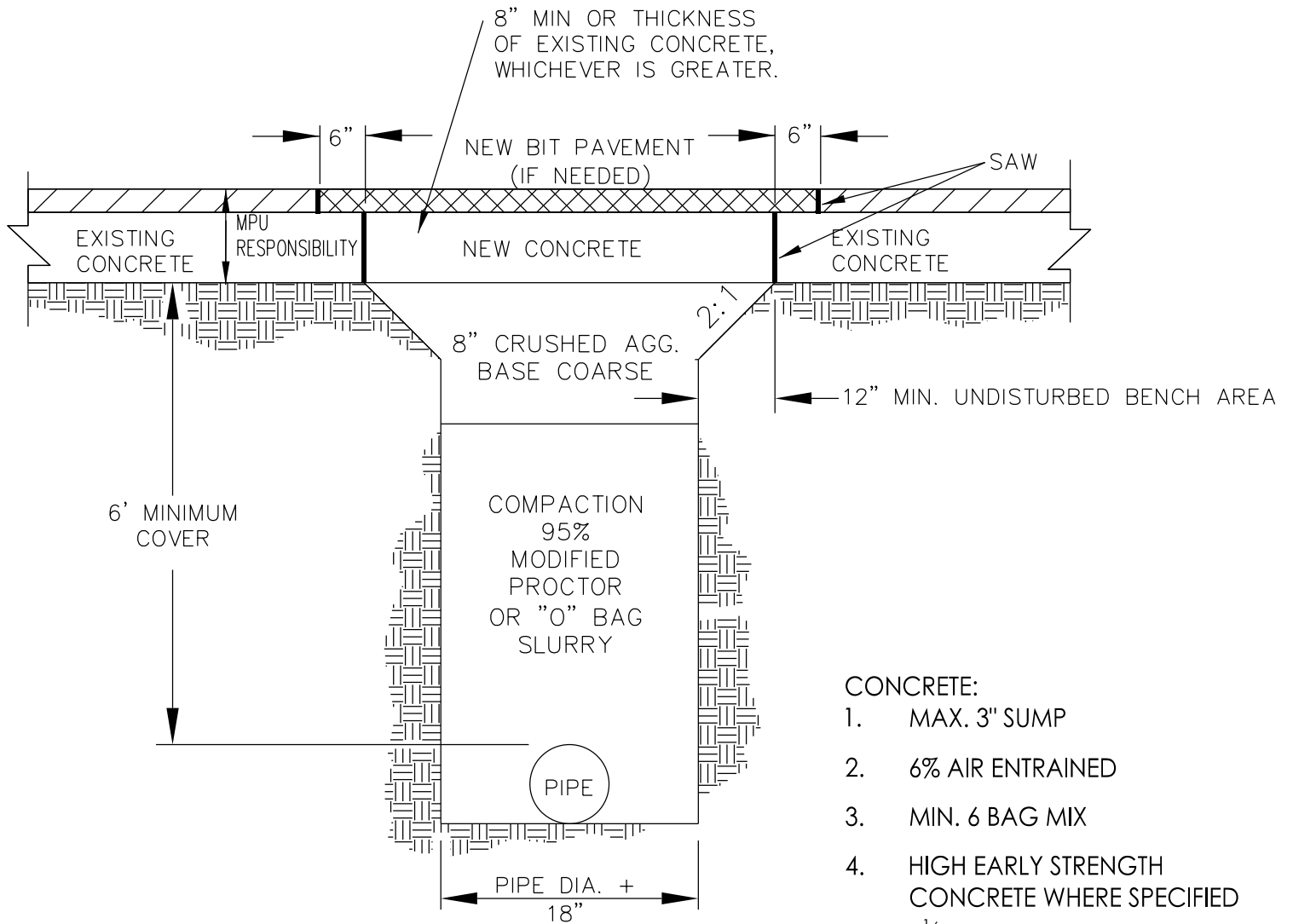
NO.	DATE	BY	REVISION
1	1/20/20	RAO	CONVERTED TO CAD



**MANITOWOC PUBLIC UTILITIES
MANITOWOC, WISCONSIN**

TITLE:
**TYPICAL GATE
VALVE REPLACEMENT**

DATE:	4/4/2019
DRAWN BY:	RAO
CHECKED BY:	RM
SCALE:	NTS
DEPARTMENT:	WD
TYPE:	NA
DRAWING #	WD-12-S



NOTE:
 1. RESTORATION MUST CONFORM TO CITY PERMIT REGULATIONS AND SPECIFICATIONS

MINIMUM UTILITY TRENCH RESTORATION
 FOR
 CONCRETE AND RESURFACED CONCRETE OR BRICK PAVEMENTS

DCN # 2020-2

NO.	DATE	BY	REVISION
1	1/20/20	RAO	CONVERTED TO CAD



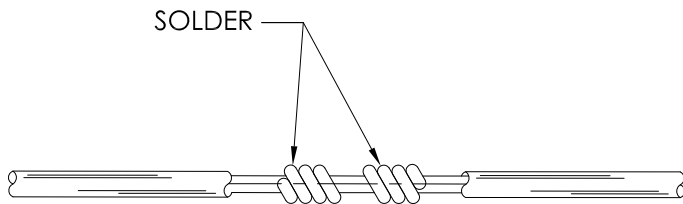
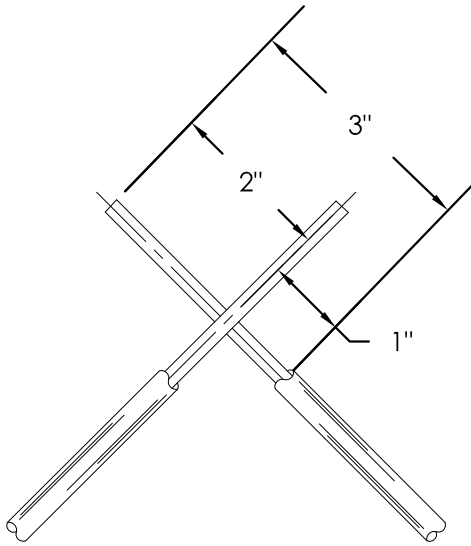
**MANITOWOC PUBLIC UTILITIES
 MANITOWOC, WISCONSIN**

TITLE:

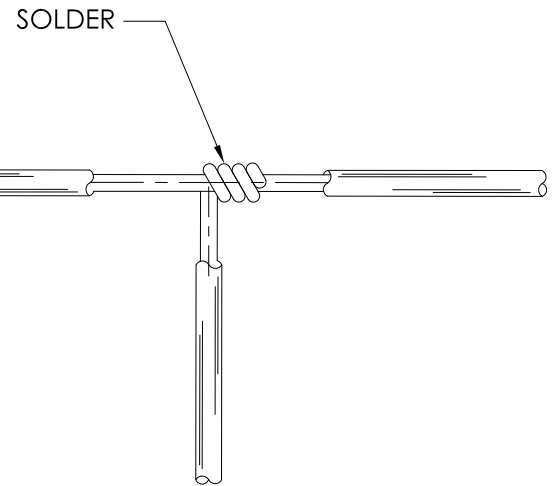
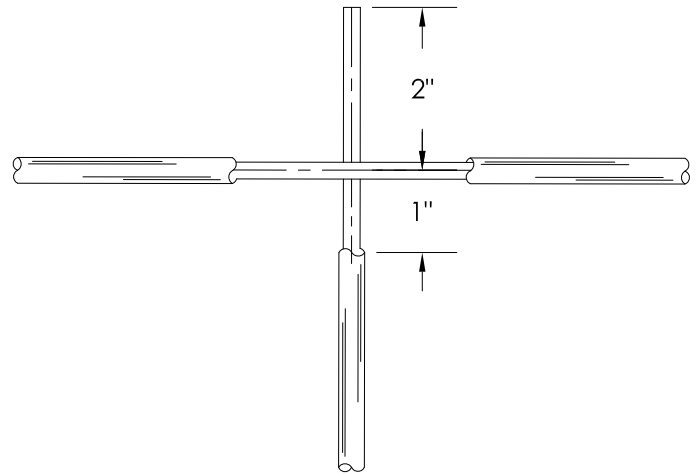
TRENCH RESTORATION

DATE:	04/04/2019
DRAWN BY:	RAO
CHECKED BY:	RM
SCALE:	NTS
DEPARTMENT:	WD
TYPE:	NA
DRAWING #	WD-13-S

IN-LINE CONNECTION



BRANCH CONNECTION



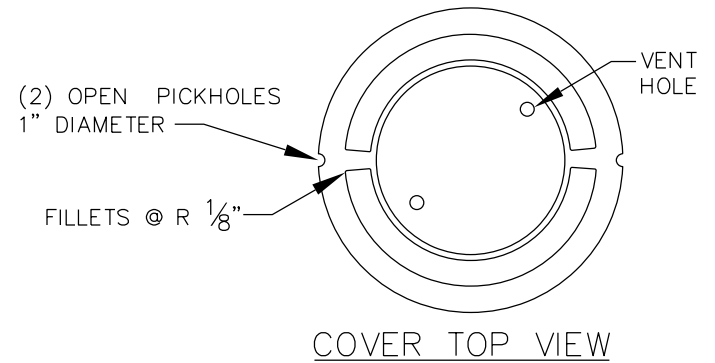
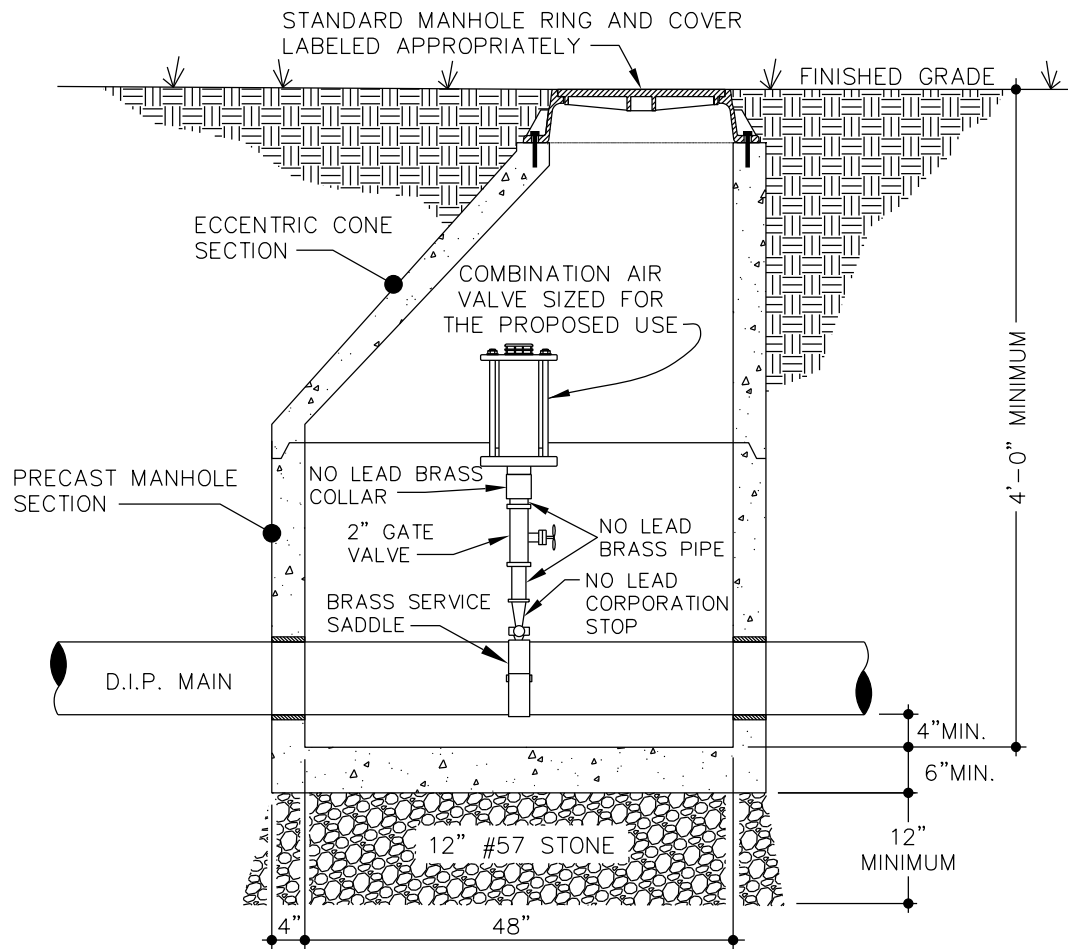
NOTES:

1. STRIP THE INSULATION FROM THE WIRE AS SHOWN IN THE DRAWING, BUT DO NOT CUT THE COPPER WIRE.
2. LOOP THE WIRE ENDS A MINIMUM OF FOUR (4) TIMES FOR EACH WIRE OF THE CONNECTION.
3. USING A PROPANE TORCH, APPLY THE FLAME DIRECTLY TO THE JOINT (LOOPS) TO BE SOLDERED.
4. APPLY 62SN OR EQUIVALENT ROSIN CORE SOLDER TO THE SPLICE. SOLDER SHOULD FLOW INTO THE JOINT.
5. SOLDERING PASTE MUST BE APPLIED TO THE LOOPS BEFORE HEAT IS APPLIED IF ROSIN CORE SOLDER IS NOT USED.
6. COVER ALL BARE COPPER WIRE WITH A WATERPROOF WRAP THAT IS APPROVED FOR UNDERGROUND CONNECTIONS. THE WRAP MUST EXTEND A MINIMUM OF TWO INCHES (2") BEYOND THE END OF THE STRIPPED WIRE.

NO	DATE	DESC	BY	TITLE:	DATE: 2-15-2012
				TRACER WIRE SPLICE CONNECTION DETAIL	DRAWN: CMJ
					CHK'D: RM
					SCALE: NTS
					DEPT: WD
					TYPE: WORK ORDER
					SHEET NUMBER:
					WD-15-S



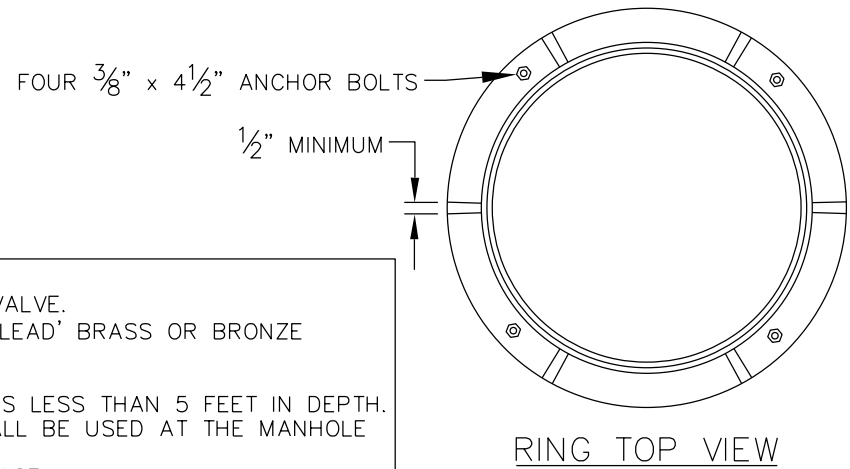
MANITOWOC PUBLIC UTILITIES
MANITOWOC, WISCONSIN



RING & COVER SPECIFICATIONS:

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

MINIMUM WEIGHTS	
RING	180
COVER	120
TOTAL	300

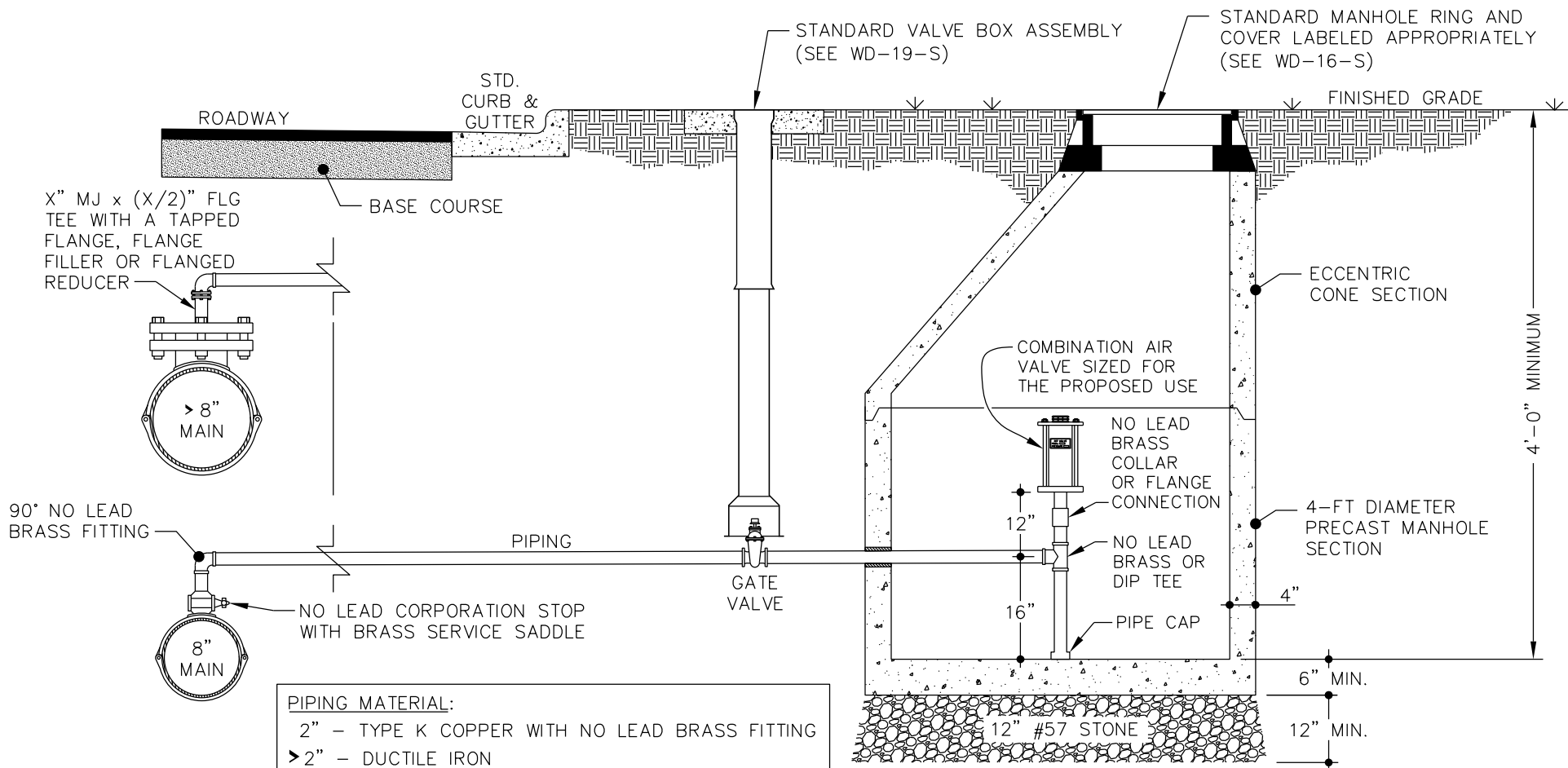


- NOTES:**
1. TAP SIZE AND ISOLATION VALVE TO BE SAME SIZE AS AIR VALVE.
 2. ALL PIPING AND FITTINGS, IN THE MANHOLE, SHALL BE 'NO LEAD' BRASS OR BRONZE UNLESS NOTED.
 3. ARV MANHOLE SHALL BE PROVIDED WITHOUT STEPS.
 4. CONCENTRIC CONES MAY BE USED FOR AIR VALVE MANHOLES LESS THAN 5 FEET IN DEPTH.
 5. RESILIENT CONNECTORS OR BOOTS MEETING ASTM C923 SHALL BE USED AT THE MANHOLE AND PIPE INTERFACE.
 6. MANHOLES DEEPER THAN 12 FEET REQUIRE AN EXTENDED BASE.

DCN # 2020-2

NO	DATE	DESCRIPTION	BY	TITLE:	DATE: 01-13-2020
				STANDARD COMBINATION AIR VALVE	DRAWN: RAO
					CHK'D: RM
					SCALE: NTS
					DEPT: WD
					TYPE: WORK ORDER
					SHEET NUMBER:
					WD-16-S





PIPING MATERIAL:
 2" - TYPE K COPPER WITH NO LEAD BRASS FITTING
 >2" - DUCTILE IRON

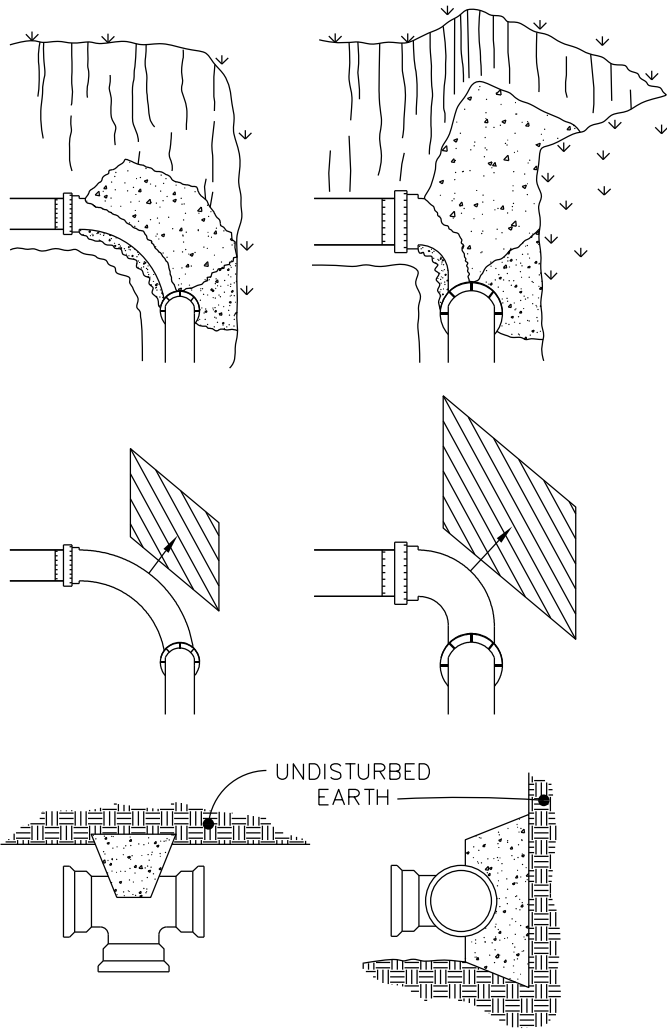
- NOTES:**
1. ALL BRASS PIPING AND FITTINGS SHALL BE 'NO LEAD' BRASS.
 2. 'NO LEAD' CORPORATION STOP SHALL BE LOCATED IN THE TOP OF MAIN.
 3. PIPING AND GATE VALVE SIZE SHALL MATCH ARV, SIZED BY THE ENGINEER.
 4. ARV MANHOLE SHALL BE PROVIDED WITHOUT STEPS.
 5. RESILIENT CONNECTORS OR BOOTS MEETING ASTM C923 SHALL BE USED AT THE MANHOLE AND PIPE INTERFACE.
 6. MANHOLES DEEPER THAN 12 FEET REQUIRE AN EXTENDED BASE.

DCN # 2020-2

NO	DATE	DESCRIPTION	BY	TITLE:	DATE:
				STANDARD COMBINATION AIR VALVE MANHOLE OFFSET FROM MAIN	01-13-2020
					DRAWN: RAO
					CHK'D: RM
					SCALE: NTS
					DEPT: WD
					TYPE: WORK ORDER
					SHEET NUMBER:
					WD-17-S



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 MANITOWOC, WISCONSIN




MINIMUM CONCRETE BLOCKING (C.Y.) *					
NOMINAL PIPE DIAMETER INCHES	TEES & DEAD ENDS	90° BEND	45° BEND	22½° BEND	11¼° BEND
4	1/3	1/3	1/3	1/3	1/3
6	1/3	1/3	1/3	1/3	1/3
8	1/3	1/2	1/3	1/3	1/3
10	2/3	3/4	1/2	1/3	1/3
12	3/4	1.0	2/3	1/3	1/3
14	1.0	1 1/2	3/4	1/2	1/3
16	1 1/3	2.0	1.0	1/2	1/3
18	1 2/3	2 1/3	1 1/3	2/3	
20	2.0	3.0	1 2/3	3/4	
24	3.0	4 1/3	2 1/3	1 1/3	

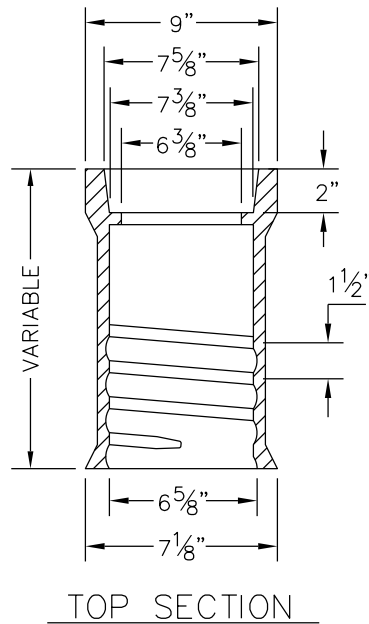
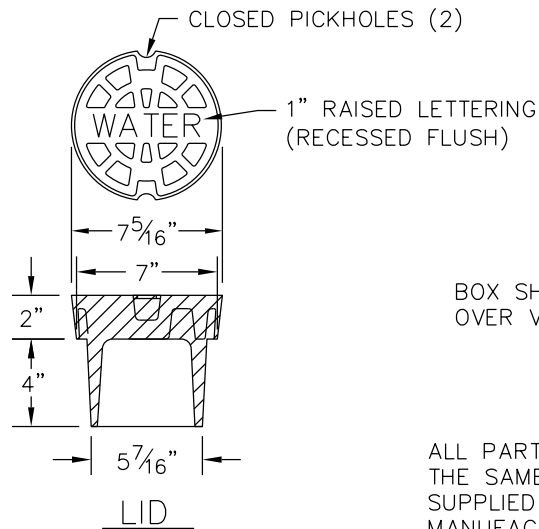
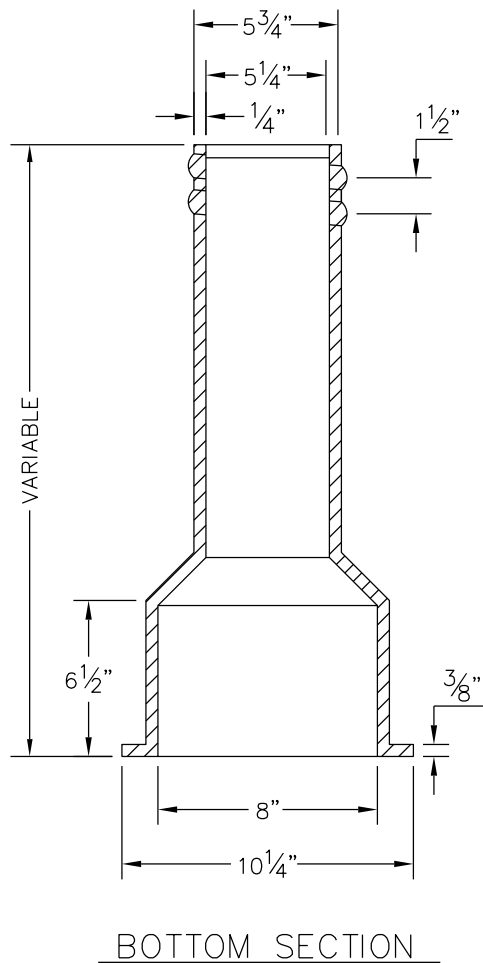
NOTES:

1. FITTING SHALL BE WRAPPED WITH A MINIMUM 4 MIL PLASTIC.
2. NO CONCRETE SHALL COVER BOLTS OR GLANDS.
3. FOR ADDITIONAL DETAILS, REFER TO WD-10-M

* CONCRETE SHALL BE 3,000 P.S.I. MIX.

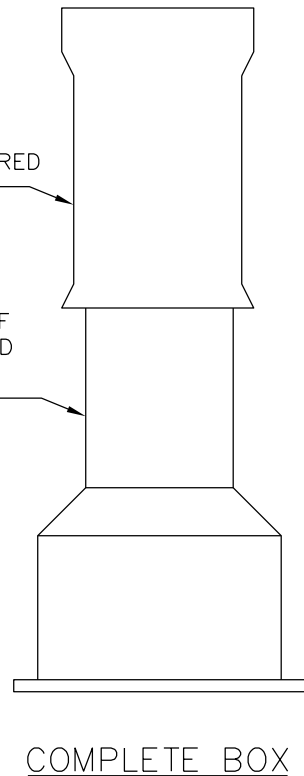
DCN # 2020-2

NO	DATE	DESCRIPTION	BY	TITLE:	DATE: 01-13-2020
				STANDARD THRUST BLOCKING	DRAWN: RAO
					CHK'D: RM
				 MANITOWOC PUBLIC UTILITIES MANITOWOC, WISCONSIN	SCALE: NTS
					DEPT: WD
					TYPE: WORK ORDER
					SHEET NUMBER: WD-18-S



BOX SHALL BE CENTERED OVER VALVE

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

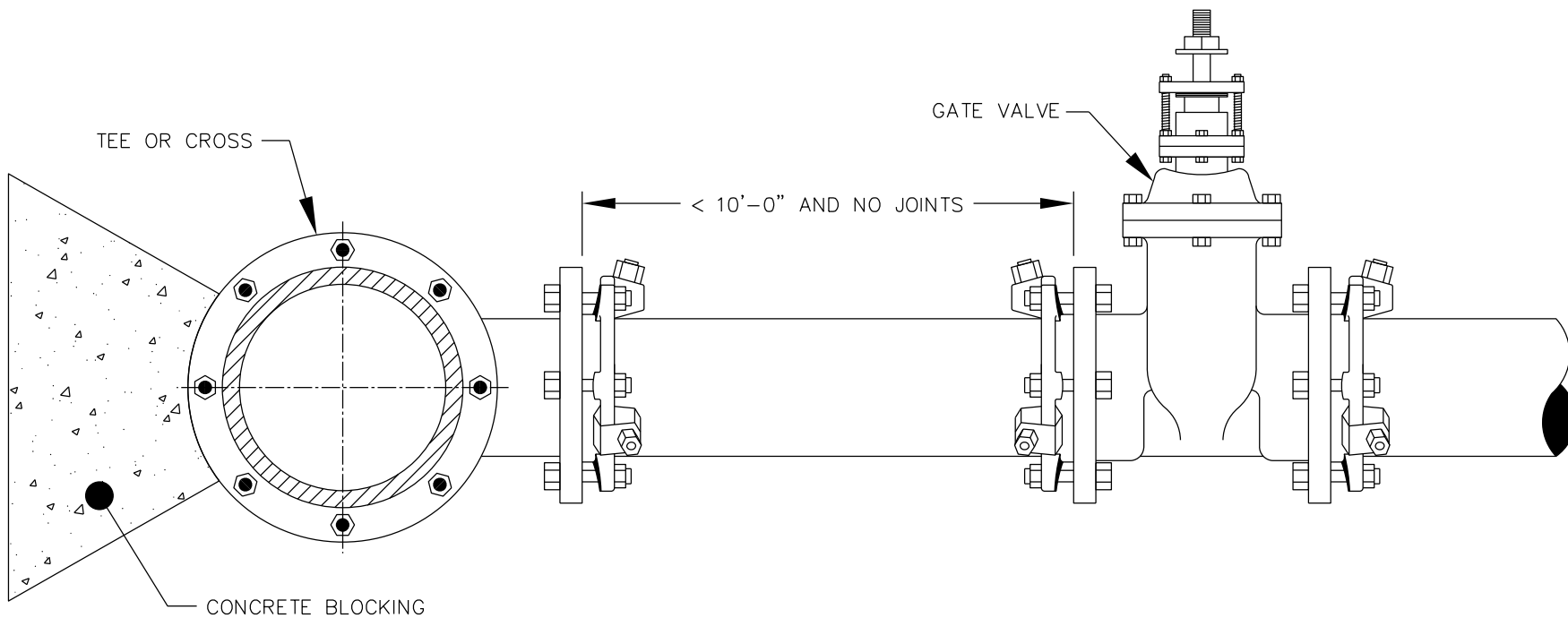


- NOTES:**
1. VALVE BOX COVER SHALL WEIGH A MINIMUM 24 lbs.
 2. ENTIRE VALVE BOX ASSEMBLY & COVER SHALL BE CAST FROM CLASS 35 GRAY IRON.
 3. ASSEMBLY SHALL BE DOMESTICALLY MADE AND MANUFACTURED IN THE U.S.A.

DCN # 2020-2

NO	DATE	DESCRIPTION	BY	TITLE:	DATE: 01-13-2020
				STANDARD VALVE BOX INSTALLATION	DRAWN: RAO
					CHK'D: RM
					SCALE: NTS
					DEPT: WD
					TYPE: WORK ORDER
					SHEET NUMBER: WD-19-S




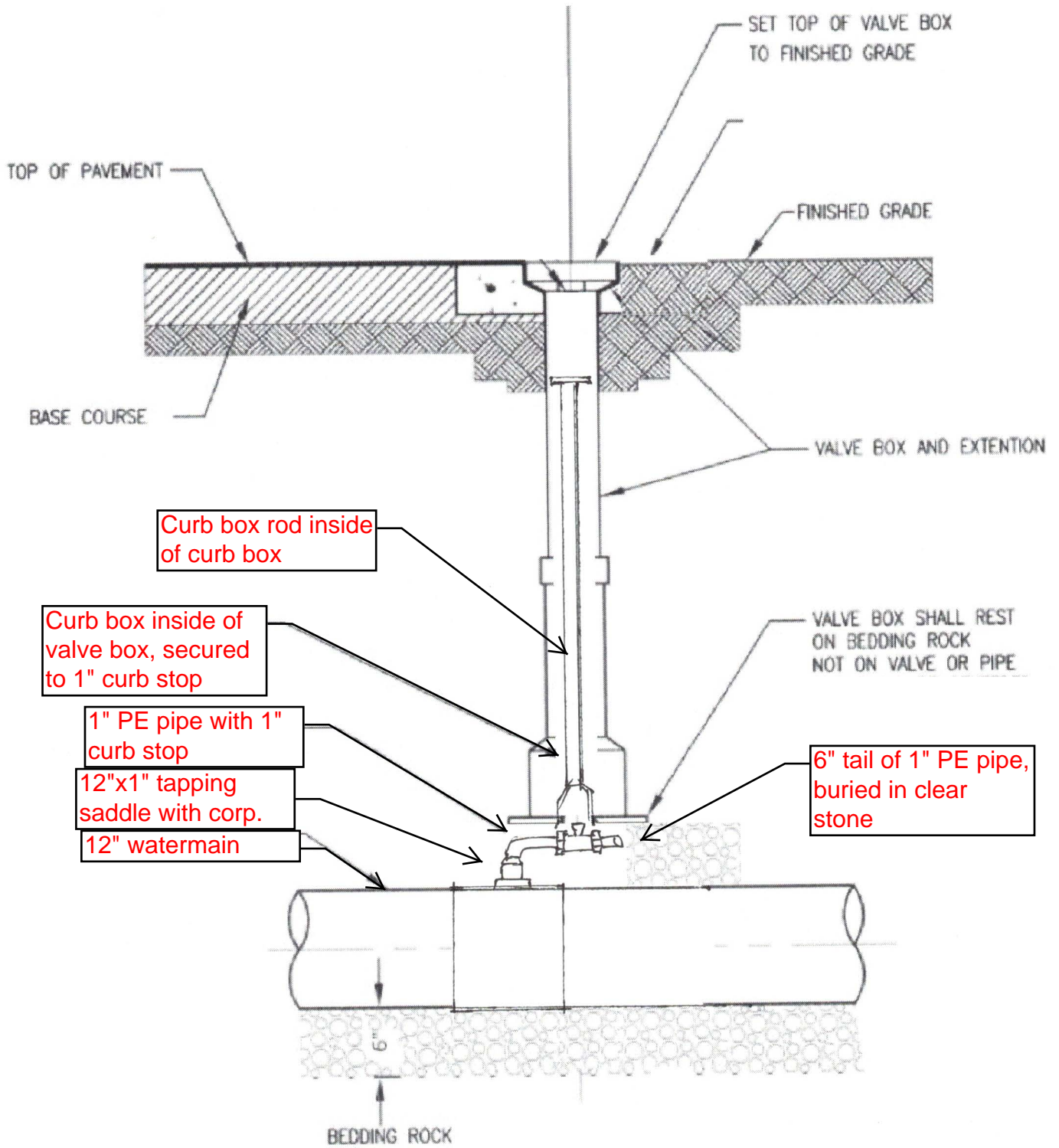


GENERAL NOTES:

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

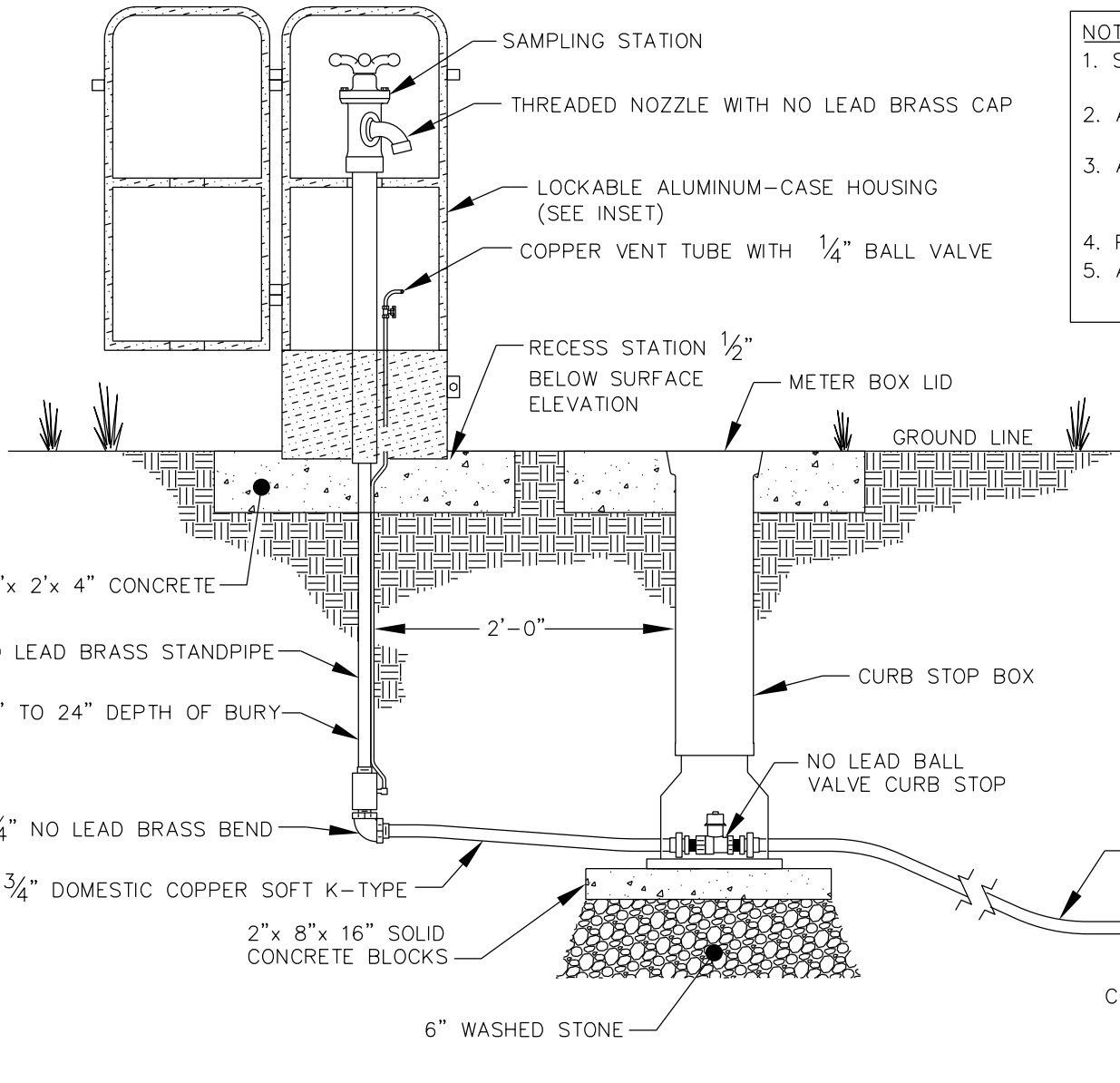
DCN # 2020-2

NO	DATE	DESCRIPTION	BY	TITLE:	DATE: 01-13-2020
				ALTERNATE VALVE	DRAWN: RAO
				RESTRAINT WITH WEDGE	CHK'D: RM
				ACTION RETAINER GLANDS	SCALE: NTS
				 MANITOWOC PUBLIC UTILITIES MANITOWOC, WISCONSIN	DEPT: WD
					TYPE: WORK ORDER
					SHEET NUMBER:
					WD-20-S

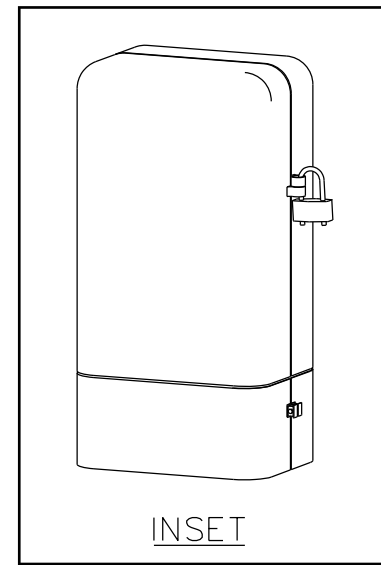


DETAIL MANUAL AIR RELEASE VALVE


NO SCALE



- NOTES:**
1. SAMPLING STATIONS SHALL BE 18"-24" BURY, WITH A 3/4" THREADED NOZZLE WITH 'NO LEAD' BRASS CAP.
 2. ALL STATIONS SHALL BE ENCLOSED IN A LOCKABLE, NON-REMOVABLE, ALUMINUM-CAST HOUSING.
 3. A COPPER VENT TUBE WILL ENABLE EACH STATION TO BE PUMPED FREE OF STANDING WATER TO PREVENT FREEZING AND TO MINIMIZE BACTERIA GROWTH.
 4. PADLOCK PROVIDED BY MANITOWOC PUBLIC UTILITIES.
 5. ALL BRASS COMPONENTS SHALL BE 'NO LEAD' BRASS MEETING UNS C89833 AS PER ASTM B584.



DCN # 2020-2

NO	DATE	DESCRIPTION	BY	TITLE:	DATE: 01-13-2020
				SAMPLING STATION  MANITOWOC PUBLIC UTILITIES MANITOWOC, WISCONSIN	DRAWN: RAO
					CHK'D: RM
					SCALE: NTS
					DEPT: WD
					TYPE: WORK ORDER
					SHEET NUMBER: WD-25-S