

# Specifications For Water Main Construction



Public Water Supply District #9

Boone County, Missouri

April 2014

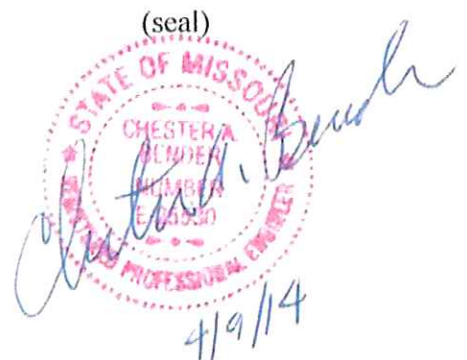
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**SPECIFICATIONS FOR WATER MAIN CONSTRUCTION**  
PUBLIC WATER SUPPLY DISTRICT #9  
BOONE COUNTY, MISSOURI

## 1. Authority

THESE SPECIFICATIONS ARE DRAWN AND APPROVED BY THE BOARD OF DIRECTOR'S OF PUBLIC WATER SUPPLY DISTRICT NO. 9 OF BOONE COUNTY, MISSOURI AND SHALL BE ENFORCED, AND NO PART THEREOF ALTERED WITHOUT APPROVAL OF SAID BOARD OR THEIR DULY APPOINTED REPRESENTATIVE.

## 2. Intents and Definitions

THE INTENT OF THESE SPECIFICATIONS IS TO SPECIFY THE TYPE AND QUALITY OF ALL WATER MAIN MATERIALS, THE METHOD AND PROCEDURE OF CONSTRUCTION, THE INSPECTIONS AND TESTING METHODS, AND THE TERMS OF ACCEPTANCE BY PUBLIC WATER SUPPLY DISTRICT NO. 9 OF ANY WATER MAIN WORK OR EXTENSION ON ANY MAIN OR MAINS, THAT ARE OR WILL BE AN ACTIVE PART OF THE WATER SYSTEM OF PUBLIC WATER SUPPLY DISTRICT NO. 9 OF BOONE COUNTY, MISSOURI.

### 2.1. Definitions:

- 2.1.1. **District:** Public Water Supply District No. 9 of Boone County, Missouri.
- 2.1.2. **Staff:** Employees of Public Water Supply District No. 9.
- 2.1.3. **Engineer:** Firm employed by the District for Engineering purposes.
- 2.1.4. **Inspector:** The technical inspector or inspectors authorized by the District, limited in each case to the particular duties entrusted to him or them.
- 2.1.5. **Contractor:** Any person or firm doing any type of work on a water main.
- 2.1.6. **Owner:** Any person owning rights to or sponsoring any work pertaining to water main work, such as a landowner or developer.
- 2.1.7. **AWWA:** American Water Works Association
- 2.1.8. **Or Equal:** Any part or fitting submitted to Public Water Supply District No. 9 for evaluation and determined by the District to be equal in quality and performance to any currently specified acceptable manufacturer and model.

## 3. Responsibilities of Contractor and Owner

- 3.1. The owner shall be responsible for the proper location and grade of the proposed extension and appurtenances based upon plans approved by the District. Property irons, or accurately placed laths, shall be provided at key lot corners, particularly at intersections and curves. The main shall not be located solely from street centerline markers. The street must be cut or filled to final subgrade prior to installation of the water main extension. Possible problems with sanitary sewers, manholes, storm sewers, and drop inlets must be marked and sizes and depths indicated. Failure to provide the above requirements will result in suspension of the work.
- 3.2. All waterlines and/or facilities shall be installed by the District or a District approved contractor, except if the Owner can satisfy the District that the Owners contractor is competent, qualified and creditworthy. The Owner shall employ skilled workmen under the supervision of a foreman, experienced in water main construction. The inspector may suspend work until, in his opinion, skilled personnel are provided.

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- 3.3. The **Owner** or **Developer** shall be responsible for any failure of the main extension that can be attributed to faulty workmanship or defective materials, and for maintenance of backfilled areas for one year after completion of the work. The completion date shall be established by the Board, based on the report of the inspector. The Owner or Developer shall be responsible for any cost incurred by the District for any work District crews must perform to water main or appurtenances during construction and for (2) full years after acceptance by the District of the completed work.
- 3.4. The Owner shall be responsible for providing necessary easements in the name of the District and, after completion of the work, for transferring ownership of the mains to the District. Failure to provide these documents will result in a refusal of the Water District to make service connections to the mains concerned.
- 3.5. The Owner shall have all previous work in District finished and completed to District's and land owners and any other utility or road entity's satisfaction. District reserves the right to refuse the work of any owner in which does not meet these criteria.
- 3.6. The Owner shall supply the District with a (2) year warranty on work and materials.
- 3.7. In Owner shall supply the District and/or inspector with a (24) hour phone number during construction for use in case of emergency. Owner shall make required repairs in a timely fashion not to exceed (24) hours after emergency occurs.
- 3.8. Prior to the start of work, District will establish the time and date and administer the pre-construction meeting which Owner, Contractor, Subcontractors, and the District staff will attend.
- 3.9. The Owner shall be required to call District staff before starting on the job. The Owner shall notify inspector by 8:15 a.m. if he or his contractor intends not to work on any given day.
- 3.10. The Owner will erect and maintain, as required by the conditions and progress of the work, all necessary safeguards for safety and protection. The contractor will notify owners of adjacent utilities when prosecution of the work may affect them. The Owner shall be responsible for requesting and coordinating all utility locations prior to excavation.

## **4. Material**

- 4.1. **Specifications:** All material shall meet the latest approved version of the referenced specifications.
- 4.2. **Pipe:** All pipe shall meet the latest approved version of one of the following specifications:
  - 4.2.1. **Ductile Iron:** AWWA C151, Class 52, push on joint, *mechanical joint or restraint joint* cement-mortar lined, bituminous coated.
  - 4.2.2. **PVC:** Integral Bell solid PVC piping shall conform to ASTM D-2241 Class 200 (SDR21) with a working pressure of 200 psi.
    1. The gasket shall meet the requirements of ASTM F-477.
    2. The joint shall comply with ASTM D-3139.
    3. Ultra Blue PVC pipe not accepted.
  - 4.2.3. **Restrained Joint PVC Pipe:** Shall conform to ASTM D-1784 Class 200 (SDR21) for (2) inch through (12) inch, with spline-type restrained joints. Pipe shall be "Yelomine" as manufactured by CertainTeed Corporation or approved equal.
  - 4.2.4. **C-900 PVC:** Whether Integral Bell or fusible, when approved on a case by case basis piping shall conform to the latest edition of the AWWA, ASTM, Plastic Pipe Institute

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(PPI), or UniBell Plastic Pipe Association standards or recommendations for C900 and C905 pipe.

### **4.3. Ductile Iron Fittings:**

- 4.3.1. Ductile iron compact fittings shall conform to AWWA C153, mechanical joint, cement-mortar lined, bituminous coated and all fittings to be 350 PSI.
- 4.3.2. All ductile iron fittings shall be US manufactured or pre-approved foreign on a case-by-case basis.

### **4.4. Valves:**

- 4.4.1. **Gate Valves:** NRS resilient wedge for buried service, conforming as a minimum to AWWA C509; 2" square operating nut; open left; MJ X MJ unless otherwise specified; wedge rubber shall be molded and bonded in place to the wedge and shall not be mechanically attached with screw, rivets, or similar fasteners; wedge shall seat so the seating is equally effective regardless of direction or pressure unbalanced across the wedge; waterway shall be full diameter, smooth and shall have no depressions or cavities in the seat area where foreign material can lodge and hinder closure or sealing, the valve body and bonnet shall be fusion bonded epoxy coated, inside and out. Valve shall be provided with stainless steel bonnet bolts and NSS Cor-ten, Cor-blue or approved equal "T" bolts for the MJ fittings. If valve is equipped with test plugs, plugs shall be stainless steel. Acceptable manufacturers for gate valves are American Flow Control Series 500, American Flow Control Series 2500, US Pipe metroseal 250, and Mueller Model A-2360 or approved equal. **(M & H and KENNEDY VALVES WILL NOT BE ACCEPTED.)**

- 1. **"T" bolts** used on valves with open notch boltholes must be anti-rotation with square shank.
- 2. **Valves** with a bury depth of 5' and greater will be required to have operating nut adapters to bring the operating nut to within 3' of the surface.

- 4.4.2. **Tapping Valves:** Same as Gate Valves above with MJ X Flange.

- 4.4.3. **Detector Check Valve Assemblies:** Shall for sizes (2) inch through (10) inch have flange fittings, furnished with stainless hex nuts and bolts, be constructed with stainless steel. Detector check assembly to be installed horizontally in a minimum of 30 x 42 inch pit with tamped crushed rock base (refer to section on meter settings for acceptable materials). Acceptable models of check valve assemblies are Watts Series SS07F, AMES Series1000 SS or approved equal. **(SEE DETAIL D-6)**

- 1. Check valve assembly to be equipped with a (3/4) inch bypass for metering, bypass meter shall be 5/8 x 3/4 inch to read in gallons, meter manufacturer and model to be Sensus SR11 Touch Read AMR or Schlumberger T-10 Proread ARB. Bypass to be equipped with a check valve with less differential opening pressure than main check. Shut off valve for bypass shall be curb stop style mounted horizontally.
- 2. A drawing of proposed assembly and pit configuration shall be submitted to the District for approval prior to installation.

- 4.4.4. **Tapping Sleeves:** Shall be Ford Style FTSS with stainless steel MJ Outlet and bolts or approved equal. For taps 2" in size that need to be made on 2" or 2 1/2" PVC pipe, tapping sleeve shall be Power Seal Model 3425AS or approved equal.

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4.4.5. **Valve Boxes:** All valve boxes must be constructed from (6) inch Class 200 PVC pipe with cast iron ring and lid embossed "WATER" on lid. Ring and lid must be Clay and Bailey Model 2194.

1. Valve box must be installed so that valve nut and gland is centered in box to prevent shifting against operating nut. **(SEE DETAIL D-1 and D-1A) If gland on valve is larger than the inside diameter of valve box a valve box adapter shall be used. For small valves cut valve box for support off of waterline. (SEE DETAIL D-3A)**
2. Valve box must be notched (12) inches from top end of box to allow access of trace wire.

4.5. **Fire Hydrants:**

4.5.1. Fire Hydrants shall be a traffic model with dry barrel and compression valve to open against water pressure. Nozzle threads to meet ASA specifications B26 for National American Standard Fire Hose coupling screw threads. Cap with conforming threads shall be supplied for each nozzle. Cap nuts shall have same dimensions identical to those of operating nut. Pentagonal operating nut dimensions (1 ½) inches from point to flat to open counter clockwise. Bonnet, body and caps shall be painted with silver-aluminum Tnemec "Poly-Ura-Prime 50-330", or approved equal, per paint manufacturer's specifications. Main valve to be faced with synthetic rubber. Main valve opening to be determined by style of hydrant. Hydrants shall have a coefficient of (9) nine or greater. Nozzles shall be (2 ½) inches and (4 ½) inches respective to style. Two-way nozzle hydrants shall have (2) (2 ½) inch nozzles, configured at a 45-degree angle on the barrel, with a (4 ½) inch valve opening with a (4) inch mechanical joint foot piece. Three-way nozzle hydrant shall have (2) (2 ½) inch nozzles and (1) (4 ½) inch steamer nozzle with a (5 ¼) inch valve opening with a (6) inch mechanical joint shoe. Bury to be (4) feet unless otherwise specified. All hydrant installations to have an isolation valve equal to shoe size of hydrant. **(FOR FIRE HYDRANT CONSTRUCTION SEE DETAIL D-3)**

4.5.2. Fire Hydrant style on job to be determined by District before bid.

4.5.3. Accepted brands of Fire Hydrants are Mueller Super Centurion and American Darling B-84-B & MK-73-1 where applicable. Any other hydrants may be considered in bid but manufacturer must supply seat wrench and any other tools required for maintenance of hydrant free of charge with acceptance of bid. The District reserves the right to refuse any brand or style.

4.6. **Locator Wire:** Locator wire shall be THHN-12 gauge solid blue wire. All connections or splices shall be fastened by using a 3M DBY Direct Bury Splice Kit or with copper or bronze split bolts and taped with "3M SUPER 33+" and sealed with 3M electrical coating (SCOTCHKOTE). **(SEE DETAIL D-2 and D-2A)**

4.7. **Meter Settings:**

4.7.1. **Meter Relocation:** All materials for relocation of meters must meet specifications of the District. If any meters need to be replaced District will supply all new water meters and all old meters shall be returned to District. District crew will perform all new installations.

4.7.2. **Service Line Material:** Service line shall be Type K copper and shall conform to ASTM B88. Road crossings shall be sleeved or encased from ditch to ditch with 2" CL200 PVC pipe or polyethylene plastic pipe. **(SEE DETAIL D-5A)** Any 2" service lines on road crossings shall be 2" SDR 21 Yelomine PVC restraint joint pipe or 2" type "K" soft copper but must be encased in 4" PVC pipe. Service line material shall be

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type "K" soft copper on short meter setting and must be copper on all roads with 1" services. **(SEE DETAIL D-5B)** Minimum length of 2" copper roll is 60' and 1" roll is 100'. No service line splices in road right of way from toe of slope to toe of slope allowed. **Note: All connections must be compression type, no flair connections allowed.**

- 4.7.3. **Corporation Stops:** Corporation stops shall be Ford style F1100 male iron pipe thread X compression joint fittings.
- 4.7.4. **Saddles:** Shall be Ford style S71 for PVC pipe and S91 for Ductile and AC pipe. All saddles shall be brass with iron pipe thread.
- 4.7.5. **Meter Setters:** Shall be Ford style. For 5/8 x 3/4 VBHC72-15W-41-33. For a short set VBHC72-15W-11-33. For a road crossing 1" VBHC74-15W-41-44. For 2" VBH77-18B x 17 with female iron thread inlet and outlet. **Note: All setters must have brace eyelets and be braced with SCH 80 PVC pipe.**
- 4.7.6. **Meter Pits:** Shall be constructed from corrugated-wall PVC piping with smooth interior wall. Pit size (18x30) for 5/8 x 3/4 setters, (24x30) for 1" setters, and (30x30) for 2" setters. If corrugated-wall pits are unavailable in 24 & 30 diameters then C-900 PVC pipe may be used if cut in a neat manner with accurate dimensions in accordance to setter size.
- 4.7.7. **Lids and Rings:** Shall be cast iron, Vestal, C&B 2210 or Ford C-32 LL T 18" ring and 12" lid with pick hole cast for "AMR". All meter pits larger than 18" shall have cast iron adapter ring to fit 18" ring.

METER RING SIZING

Pit Size	Ring Size
18"	18" x 12"
24"	30" x 18"
30"	36" x 18"

(FOR A TYPICAL METER SETTING SEE DETAIL D-4)

- 4.7.8. **Concrete:** All concrete work shall meet ASTM. Standards C150 (type 1) C260 and C233. Concrete shall be Class A, (6) bag mix, (5) inch slump, (3,000) psi minimum compressive strength in 28 days.
- 4.7.9. **Anchors, Insert, Reinforcements:** All thread rod shall be stainless steel (5/8 or 3/4) inches. Nuts shall be stainless steel hex head heavy-duty type, (5/8 or 3/4) inches. Ductile iron mechanical joint "anchor" or "swivel" couplings shall be allowed on mechanical joint valves and fittings. Ductile iron "Foster Adaptor" fittings will be allowed on mechanical fittings on a case-by-case basis.
- 4.7.10. **Casing Pipe:** All road crossings and/or waterway crossings shall be encased in pipe conforming to the following schedule:

MINIMUM CASING AND SPACER REQUIREMENTS  
(all measurements in inches)

Nominal Pipe Size	Casing Size	Casing Material	Casing Wall Thickness	Maximum Spacing Between Adjacent Skids *
1	2	PVC	CL 200	N/A
2	4	PVC	CL 200	N/A
4	12	Steel	0.188	7'
6	12	Steel	0.188	7'
8	16	Steel	0.188	5'
10	20	Steel	0.250	5'
12	20	Steel	0.250	5'
16	24	Steel	0.250	5'

\* Measurement from centerline to centerline of skid.

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1. All pipe shall conform to all applicable requirements of AWWA C200 and AWWA M11 and the Missouri Highway and Transportation Department 7CSR 10-3.010, and if fabricated shall be constructed of A36 steel with a minimum yield point of 36 ksi. It may be shipped in random lengths between 18 and 22 feet and shall have one end cut square and one end beveled. All casing pipe to be joined with 360 degrees weld.
2. **Casing Spacers:** Casing spacers shall be used with all casing 12" and larger in diameter. Shall be Cascade Stainless Steel; APS Model CI; or RACI Polyethylene Spacers; or approved equal.
3. **Spacing Between Spacers:** Casing spacers shall be installed per approved manufacturer's printed recommendations, or at spacing shown in table above, whichever provides greater support. Casing spacers are required at each end of casing. Spacers shall have runners attached to the shell and be designed to provide a minimum of 0.75 inches clearance between the carrier pipe's greatest outside diameter and the casing pipe's inside diameter. **(SEE DETAIL D-6A)**
4. **End Seal:** End seals shall be provided on all casing pipe, as shown on **DETAIL D-6A.**
5. **Carrier Pipe:** PVC carrier pipe on all waterway crossings encased (60) feet in length or greater and on all State and Federal highway crossings shall be Class 200 PVC Yelomine, or approved equal. Ductile iron carrier pipe shall be restraint joint.

## 5. Material Handling

- 5.1. **PVC Pipe:** Shall be handled according to guidelines set out in AWWA M23. The pipe shall not be handled with individual chains or single cables, even if padded. They shall not be dropped to the ground or into the trench and shall not be dropped or rolled against other objects on the ground.
  - 5.1.1. Gaskets shall be protected from excessive exposure to direct sunlight, ozone, oil, and grease. If stored for extended periods (60 days+) the pipe shall be protected from sunlight. The pipe shall be stored so as not to become deformed or bent.
  - 5.1.2. **Pipe Cutting:** Pipe cutting for any reason shall be done in a neat workmanlike manner, by methods that will not damage pipe. The outside edge must be beveled and smooth to prevent gasket damage. Flanged pipe shall not be threaded or flanged in the field.
- 5.2. **Ductile Iron Pipe and Accessories:** The handling of pipe, fittings, valves, hydrants, and accessories shall conform as a minimum to the standards set out in AWWA C600. They shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped or rolled against pipe, fittings or other objects.

## 6. Location

- 6.1. **Alignment and Grade:**
  - 6.1.1. The water mains shall be laid, and valves, hydrants, and fittings shall be placed in accordance with the plans. Written approval by the District is required for any variations from the plans. Variations must be approved prior to construction.

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- 6.1.2. All pipe shall have a minimum of (42) inches of cover over the top of the pipe unless otherwise approved by the District. All pipe shall have a maximum of (60) inches of cover with final grade over the top of the pipe unless otherwise approved by the District.
- 6.2. **Dead Ends:** The dead end of a main shall have a fire hydrant, flushing hydrant, or approved flushing assembly for flushing purposes. Flushing assemblies shall be a minimum (2) inch for (2) inch through (8) inch mains, a minimum (6) for (10) inch and (12) inch mains. **(SEE DETAIL 3-A)**
- 6.3. **Water Mains Near Sewers:**
- 6.3.1. **Parallel Installation:** Water mains shall be installed at least (10) feet horizontally from any existing or proposed sewer line, force main or manhole. The distance shall be measured edge to edge. In cases where it is not practical to maintain a (10) foot separation, the District may allow deviation on a case-by-case basis. Such deviation may allow installation of the water main closer to a sewer, provided that the water main is installed in a separate trench or on an undisturbed earth shelf located on one side of the sewer and on either case, at such an elevation that the bottom of the water main is at least (18) inches above the top of the sewer. In areas where the recommended separations cannot be obtained, either the waterline or sewer line shall be constructed of mechanical joint pipe or cased in a continuous casing. Where separations cannot be obtained where there are sanitary sewer force mains, the waterline or sewer line shall be cased in continuous casing.
- 6.3.2. **Crossings:** Water mains crossing sewers shall be installed to provide a minimum vertical clear distance of (18) inches between the outside of the water main and the outside of the sewer. This shall be the case where the water main is either above or below the sewer. At crossings, the full length of water pipe shall be located so both joints will be as far from the sewer as possible but in no case less than (10) feet. Special structural support for the water and sewer pipes may be required. In areas where the recommended separations cannot be obtained either the waterline or sewer line shall be constructed of mechanical joint pipe or cased in a continuous casing that extends no less than (10) feet on both sides of the crossing.
- 6.3.3. **Sewer Manholes:** No waterline shall be located closer than (10) feet to any part of a sanitary or combined sewer manhole. Where the separation cannot be obtained, the waterline shall be constructed of mechanical or manufactured restrained joint pipe, fusion welded pipe, or cased in a continuous casing. Casing pipe must be a material that is approved for use as a water main. The full length of water pipe shall be located so both joints will be as far from the manhole as possible, but in no case less than (10) feet or centered on a (20) foot pipe. No water pipe shall pass through or come into contact with any part of a sanitary or combined sewer manhole.
- 6.3.4. **Disposal Facilities:** No waterline shall be located closer than (25) feet to any on-site wastewater disposal facility, agricultural waste disposal facility, or landfill.
- 6.3.5. **Unusual Conditions:** Where conditions prevent the minimum separation as set forth above from being maintained the Missouri Department of Natural Resources shall be consulted as to the precautions to be taken to protect the public water supply.

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## **7. Surface Water Crossings**

7.1. **Above-Water Crossings:** Water mains installed above all waterways shall be adequately supported and anchored, protected from damage and freezing and accessible for repair or replacement.

7.2. **Underwater Crossings:**

7.2.1. **Flowing Streams:** A minimum cover of (4) feet shall be provided over the pipe. When crossing watercourses greater than (15) in width, the following shall be provided:

1. The pipe shall be of special construction, having flexible watertight joints. Ductile iron ball-joint river pipe shall be used for open cut crossings. Mechanical, Restraint joint or fusion welded pipe shall be used for bored crossings.
2. Adequate support and anchorage shall be provided on both sides of the stream.
3. Valves shall be provided at both ends of water crossings so that the section can be isolated for testing or repair; the valves shall be easily accessible and should not be subject to flooding.
4. The valve closest to the supply source shall be in an accessible location and installed in a vault, manhole or meter pit sized to allow the installation of leak detection equipment. Permanent taps shall be provided on each side of one of the isolation valves to allow insertion of a small meter to determine leakage and for sampling purposes.
5. The stream crossing pipe or casing shall extend at least (15) feet beyond the upper edge of the stream channel on each side of the stream.

7.2.1. **Intermittent Flowing Streams:**

1. Restraint joint pipe shall be used for all stream crossings;
2. The pipe shall extend at least (15) feet beyond the upper edge of the stream channel on each side of the stream.

## **8. Excavation and Preparation of the Trench**

8.1. **Size and Alignment:** Backhoe excavated trenches shall be dug such that the pipe can be laid to the proper grade and alignment as shown on the approved plans. Width of the trench shall be so as to have a minimum width of (12) inches greater than the outside diameter of the pipe. Bell holes shall be provided at each joint to permit proper jointing and ensure the pipe is supported evenly along the entire length of the barrel. This is especially important for PVC pipe. Hand excavation shall be employed in trenching when deemed necessary by the District. Exceptions to trench width and construction requirements may be granted in writing by the District for use of chain trenchers for a specific project or site.

8.2. **Boring:** All road bores to conform to Missouri Highway and Transportation Department specifications.

8.3. **Tunneling:** Tunneling may be permitted or required at the discretion of the District.

8.4. **Bracing and Shoring:** It is the responsibility of the Owner to maintain all work in compliance with current Occupational Safety and Health Act (OSHA) standards

8.5. **Open Trench and Excavations:** At no time shall there be more than (300) feet of trench opened in advance of the pipe laying operations and this length of open trench may be shortened by order of the District. During the time any excavation is left open, the Owner

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shall provide all required safety barriers and fencing. When unattended, the area shall be surrounded with poly fencing. Taping off the excavated area is not considered sufficient.

**8.6. Rock Excavations:**

8.6.1. **Definition:** Rock excavation shall include any excavation consisting of one-third cubic yard or more of rock in any one line segment. If rock is encountered, notify the District before proceeding.

8.6.2. **Trench Width and Depth:** Any trench of rock excavation shall be at least (24) inches wider than the outside of the pipe and eight (8) inches deeper than the average depth of the trench as required by existing topography or these specifications. In the event of any required undercut, the trench subgrade shall be restored to proper grade by filling and compacting, with an approved material, so as to insure a uniform bed along the full length of the pipe barrel. Approved materials are clean, finely divided soil, sand, and crushed stone aggregate (95% passing a (1/2) inch screen but not more than (10%) passing a #200 screen).

**9. Pipe Laying**

9.1. **Laying:** All pipe, fittings, valves, and hydrants shall be carefully lowered into the trench by means of a rope or mechanical equipment. Under no conditions may they be dropped or thrown. Ends of all pipes must be thoroughly cleaned.

9.1.1. After placing a length of pipe in the trench, the spigot end shall be centered in the bell; the pipe forced home and brought to the proper grade and alignment. The pipe shall be secured in place with proper backfill material tamped around and over it except at the bells. Bells shall be in the direction of the laying operations.

9.1.2. Precautions shall be taken to protect the interior of pipe, fittings, and valves against contamination in accordance with the latest version of AWWA 651. All openings in the pipeline shall be closed with watertight plugs when pipe laying is stopped, at the close of the day's work or for other reasons, such as breaks or meal periods. Joints of all pipes in the trench shall be completed before work is stopped. If water accumulates in the trench, the plugs shall remain in place until the trench is dry.

9.1.3. All joint deflections must be within the pipe manufacturer's recommendations, which are hereby included in and made a part of these specifications.

9.1.4. PVC pipe may be deflected around curves so long as deflection is in the joint only. No strain shall be placed on the pipe for the purpose of deflection. Manufacturers may vary in the amount of deflection which can be obtained in the pipe joint and their specifications should be consulted. In the absence of manufacturers specifications use (1.5) degrees per (20) foot section in the following schedule:

ALLOWABLE PVC PIPE DEFLECTION FROM JOINT ONLY

Degree of Deflection in Joint	Offset per 20' Section (in inches)	Minimum Radius of Curvature
5	21	230 feet
3	12	380 feet
2	8	570 feet
1.5	6	760 feet

MAXIMUM DEFLECTIONS OF DUCTILE IRON PIPE  
PUSH-ON JOINT

Pipe Size	Deflection	Offset per	Minimum Radius
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	Degrees in Joint	(18') Section	Curvature
6" to 12"	5	19"	205 feet
16" to 24"	3	11"	304 feet

- 9.1.5. Blocking is not allowed. No pipe or fittings shall be laid in or under water.
- 9.2. **Jointing:** All joints must be as per the manufacturer's and AWWA specifications.
- 9.3. **Valves:** Valves shall be located as designated by the District at street, bridge, waterway crossings, dead ends, and at all fire hydrants.
- 9.3.1. All valves shall be protected by a valve box of six inches minimum diameter, the top of which shall be to the same grade as the existing terrain.
- 9.3.2. Valves and boxes are not to be placed in roadways or driveways. If unavoidable, they shall be set to grade and have a (6) foot by (6) foot concrete pad a minimum of (4) inches thick, poured and finished around and flush with the top of the box. If valve is located in a concrete roadway, the additional concrete pad may be omitted. **(SEE DETAIL D-1A)**
- 9.4. **Locator Wire:**
- 9.4.1. All water mains and services shall be installed with a locator wire attached. The wire shall be 12 gauge AWG-THHN solid copper, insulated, and used in minimum 2500-foot rolls. It shall be installed with no splices closer than 2000 feet except for crossings and service lines. All connections or splices shall be fastened by using a 3M DBY Direct Bury Splice Kit or with copper or bronze split bolts and taped with "3M SUPER 33+" and sealed with 3M electrical coating (SCOTCHKOTE). No bare wire shall be exposed. Branch connections shall be made without cutting the main wire.
- 9.4.2. All connecting and intersecting waterlines shall have the locator wire(s) connected together so that the waterlines can be located without repositioning the locate equipment. All 2-inch service crossings will have the locate wire attached to the valve box in addition to connecting the locate wire to all other locate wire(s) on the adjoining waterline(s).
- 9.4.3. The wire shall be securely attached to the pipe to retain its position during backfill. The wire shall be fastened to outside of all valve boxes and looped into each valve box through a hole just below the cap or lid with enough wire to extend 12" above final grade. **(SEE DETAIL D-2 AND D-2A)** The wire length between surface points shall not exceed 2000'.
- 9.4.4. After construction is complete and final grading is done, a continuity test shall be performed on the wire. Any breaks in the circuit must be repaired by the Owner, at Owner's expense, prior to acceptance of the water main by the District.

## 10. Anchorage

- 10.1. **Plugs, Caps, Bends, etc:** All plugs, caps, tees, end valves, fire hydrant valves, valve assemblies, and bends, unless otherwise indicated on approved plans, shall be anchored to prevent movement by providing suitable reaction backing in the form of concrete thrust blocks or approved manufactured restraints.
- 10.2. Tie rods shall be stainless steel and be installed in accordance with the following schedule:

MINIMUM NUMBER OF TIE RODS REQUIRED  
FOR A CLOSED VALVE OR DEAD END

**SPECIFICATIONS FOR WATER MAIN CONSTRUCTION**  
**PUBLIC WATER SUPPLY DISTRICT #9**  
**BOONE COUNTY, MISSOURI**

	5/8" RODS	3/4" RODS
2" to 2 1/2"	2	
3"	4	
4" to 6"		4
8" to 12"		6
16" to 24"		8

- 10.3. **Reaction Backing:** Concrete reaction backing shall be provided for all tees, elbows, dead ends and fire hydrants according to the table of square footages of bearing surface as shown on detail drawings **D-7A, D-7B, and D-7C**. Confirm unusual and site specific requirements with the District prior to construction.

**NOTE:** DO NOT cover bolts and nuts with concrete on mechanical or flange joints.

- 10.4. **Temporary Blocking:** Temporary blocking may be allowed using used grader blades driven into the soil behind valves, DIP caps or other metal fixtures. These may be encased in the permanent thrust blocking structure upon approval by the District. If so encased, temporary blocking must be trimmed so as not to protrude above the permanent blocking.

## 11. Backfilling

- 11.1. **Under the Pipe:** All backfill under the barrel of the pipe shall be free from debris, organic matter, stones larger than one inch in greatest dimension, and shall be tamped into place. Sand or crushed stone aggregate (95%) passing a (1/2) inch screen but not more than (10%) passing a #200 sieve are acceptable substitutes for soil.

- 11.2. **Adjacent to Top of Pipe:** The first two feet of backfill over the top of pipe shall be free of debris, organic material, and stones larger than one inch in greatest dimension, and shall be hand placed. Exception to hand backfill requirements may be granted by the District for use of chain trenchers with approved materials excavated from the trench.

11.2.1. **If Excavated Material is Not Suitable for Backfill:** The inspector may require imported material be used, including clean, finely divided soil or crushed stone aggregate (one inch and smaller). If the material in the banks of the trench is suitable, it may be used.

11.2.2. **On Completion of the Specified Hand Fill:** The balance of the trench shall be mechanically filled to at least three inches above the proposed finished grade of the surrounding terrain. Backfill shall be free of junk, debris, brush, roots thicker than two inches, and stones or rubble more than six inches in greatest dimension. Top six inches of backfill shall be topsoil corresponding to that underlying original sod.

### 11.3. Improved Areas:

11.3.1. Backfill of trenches through any improved area such as streets, or improved drives shall be of one-inch clean gravel or approved material of agency having jurisdiction. Restoration of improved areas shall be sufficient to return the area essentially to its previous condition and shall be to the satisfaction of the property owner or agency having jurisdiction and the District.

11.3.2. **Any Backfill in or Resurfacing of any Portion of an Existing Street:** Shall be treated in the manner as prescribed by the City of Columbia, Counties of Boone and Callaway, or the Missouri Highway and Transportation Department's Rules and Regulations or Ordinances, whichever is applicable.

- 11.4. **Maintenance of Backfilled Areas:** The Owner or Developer shall provide for the Contractor to maintain the backfilled areas to the grade of the surrounding terrain for a

**SPECIFICATIONS FOR WATER MAIN CONSTRUCTION**  
**PUBLIC WATER SUPPLY DISTRICT #9**  
**BOONE COUNTY, MISSOURI**

period of one year after completion of his respective project. Seeding or resodding shall be to the satisfaction of the District.

**11.5. Trees, Shrubs, Pastures and Lawns:**

- 11.5.1. The Contractor shall remove only those trees and shrubs which are so designated on the Plans or as field directed by the District, protecting all others from damage.
  - 11.5.2. All ground disturbed by construction shall be graded smooth then harrowed or disked before planting.
  - 11.5.3. Backfill placed in trenched through non-pavement areas shall be neatly formed above the trench.
  - 11.5.4. Fertilizer shall consist of 12-12-12 applied at a rate of 10 pounds per 1,000 square feet.
  - 11.5.5. Grass seed mixture for fields and lawns shall be consistent with existing grasses and shall be applied at a rate of 3 pounds per 1,000 square feet. Changes in seed variety and application rate shall be approved by the District.
  - 11.5.6. Mulch all seed areas with wheat straw.
- 11.6. **Fences:** All fences disturbed by construction shall be returned to a condition equal to, or better than the original condition immediately after construction is completed in the vicinity of the fence.
- 11.7. **Cleaning Up:** The Owner shall remove all excess materials or supplies and shall clean up the entire working area and dress the land so as to leave a neat, accessible work area. Any ditch, road, or street shoulder shall be restored to their original alignment and grade.

## **12. Disinfection**

- 12.1. **General:** All phases of disinfection and testing shall meet the latest revision of AWWA Standard C651 and applicable requirements of the Missouri Department of Natural Resources. All disinfection and chlorination will be done by the Owner under direct supervision and inspection of the District. Owner shall furnish and place disinfection media. The District shall assist in and coordinate the operation of the District's valves to flush or pig new water mains.
- 12.2. **Continuous Feed Method:** Water from approved potable source shall be made to flow at a constant, measured rate into newly constructed water main. Chlorine shall be injected at a rate to provide a 50 mg/L chlorine dosage. Chlorinated water shall be retained in the new water main for not less than 24 hours (48 hours preferred), during which time all valves and hydrants shall be operated to assure disinfection of appurtenances. The Owner shall provide all excavation, backfilling, equipment and material required to establish any source water taps for the chlorination of the new main.
- 12.3. **Granule Method:** This method of disinfection will be by utilizing calcium hypochlorite granules (65-70% available chlorine) in the mains as pipe is laid and only at the discretion of the District prior to construction.
- 12.3.1. The granules shall be added to each section of pipe as it is installed such that there will be a chlorine concentration of approximately 50 mg/L when the pipe is filled. Disinfecting material shall be placed in the manner and in amounts as specified by the District.

**SPECIFICATIONS FOR WATER MAIN CONSTRUCTION**  
**PUBLIC WATER SUPPLY DISTRICT #9**  
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12.3.2. The granules shall not be allowed to remain in the pipe for an extended period. If the pipe will not be slowly filled, tested, flushed and put in service within two weeks, disinfection shall be done using the continuous feed method.

12.4. **Flushing:** Each section of line shall be flushed by opening the fire, or flush, hydrant at the end of that line section and opening or closing valves as needed. The flushing velocity shall not be less than 2.5 feet per second. Flush until water runs clear for 3 to 4 minutes minimum (test in a clear glass).

Unless otherwise specified, all water mains shall be cleaned by hydraulic "pigging" methods using polyurethane foam pigs to remove objectionable debris from the inside surface of the pipe. The Owner shall install a new, line sized, pig in the first section of the new piping at the point nearest to the flush water source. Use a new pig each pass until clean.

Pigs shall be manufactured of the highest quality two and five pound per cubic foot density open cell polyurethane foam and coated with the polyurethane coatings, when applicable and approved for use in potable water supply. Pigs shall be able to travel through multidimensional lines having as much as 65 percent reductions in diameter and have the resilience to return to original diameter.

Any excavation, backfilling, equipment and materials required to launch or extricate pigs, or repair of the water main, shall be the responsibility of the Owner. Temporary pig launch or retrieval (flush) assemblies shall be removed, or may be left in place at the discretion of the District. All work and repairs shall be in a manner satisfactory to the District. Excavations and work shall be in such a manner as to prevent the backflow of nonpotable water into the water main.

12.5. **Acceptance:** following disinfection and flushing, District personnel shall collect at least two bacteriological samples. Water from the new main will be flushed by District personnel. Should any section of main fail the required test for disinfection, then further disinfection will be required by using the injection method at the Owner's expense. Only upon safe bacteriological samples notification will the new main be considered acceptable and placed into operation by the District.

## **13. Testing**

### **13.1. Hydrostatic Pressure Testing:**

13.1.1. The Owner shall provide all equipment, material and personnel necessary for the pressure test. The test shall be made by the Owner.

13.1.2. The District's Inspector shall witness the test.

13.1.3. **Procedure:** After the pipe has been laid and backfilled, all newly laid pipe or any valved section thereof shall be subject to a hydrostatic pressure of 150 - 200 psi (approximately 150% maximum operating pressure, measured at the lowest elevation), applied by means of a pump connected to the pipe in a manner satisfactory to the District, for a period of two hour and until completion of inspection. Air or air water methods of applying pressure are prohibited.

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

**SPECIFICATIONS FOR WATER MAIN CONSTRUCTION**  
**PUBLIC WATER SUPPLY DISTRICT #9**  
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corporation cocks shall be removed and plugged, or left in place at the discretion of the District.

2. The procedure shall be as follows: fill system slowly; expel air at the high points and apply pressure; examine line and appurtenances for leaks and movement. Any defects in piping, valves, fittings, or hydrants must be immediately corrected by the Owner and successive pressure tests shall be run until satisfactory to the District.

13.1.4. Hydrostatic pressure test may be waived by the District at their discretion.

13.1.5. **Connections to Existing Mains:** Solely at the discretion and permission of the District, competent party or parties other than District forces may be allowed to make taps or connections to an existing main. District personnel must be present at time of tap or connection. Owner shall give the District no less than (48) hour's notice of work to be done.

13.1.6. **Operation of Existing Pressurized Valves:** All valves under pressure in the mains supplied by the Water Supply District shall be operated only by employees of the District except in cases of extreme emergency.

13.2. **Leakage Test:** After satisfactory completion of the aforesaid pressure test, a leakage test shall be run. The following procedure shall be used: fill main as in pressure test; expel all air; apply pressure as in pressure test; supply makeup water from a measurable source; determine quantity of water required to maintain test pressure; repair defects and repeat test until acceptable. Leakage test shall be maintained for a period of at least two (2) hours under a minimum pressure of 150 psi. All lines shall meet the AWWA C-600 leakage standards as shown on the following chart.

13.2.1. **Leakage defined.** Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi (35 Mpa or 0.35 bar) of the specified test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by a drop in pressure in a test section over a period of time.

ALLOWABLE LEAKAGE FOR DUCTILE IRON AND PVC PIPE  
 Allowable Leakage per 1000 feet - Gallons per Hour

Average Test Pressure PSI	4"	6"	8"	10"	12"	16"	20"	24"
100	0.30	0.45	0.60	0.75	0.90	1.20	1.50	1.80
125	0.34	0.50	0.67	0.84	1.01	1.34	1.68	2.01
150	0.37	0.55	0.74	0.92	1.10	1.47	1.84	2.21
175	0.40	0.59	0.80	0.99	1.19	1.59	1.98	2.38
200	0.43	0.64	0.85	1.06	1.28	1.70	2.12	2.55
225	0.45	0.68	0.90	1.13	1.35	1.80	2.25	2.70

13.2.2. When hydrants are in the test section, the test shall be made with isolation valves open and hydrant main valves closed.

13.2.3. Acceptance of installation. Acceptance shall be determined on the basis of allowable leakage. If any test of laid pipe discloses leakage greater than that specified the owner shall, at his own expense, locate and make approved repairs as necessary until the leakage is within the specified allowance.

13.2.4. All visible leaks are to be repaired, regardless of the amount of leakage.

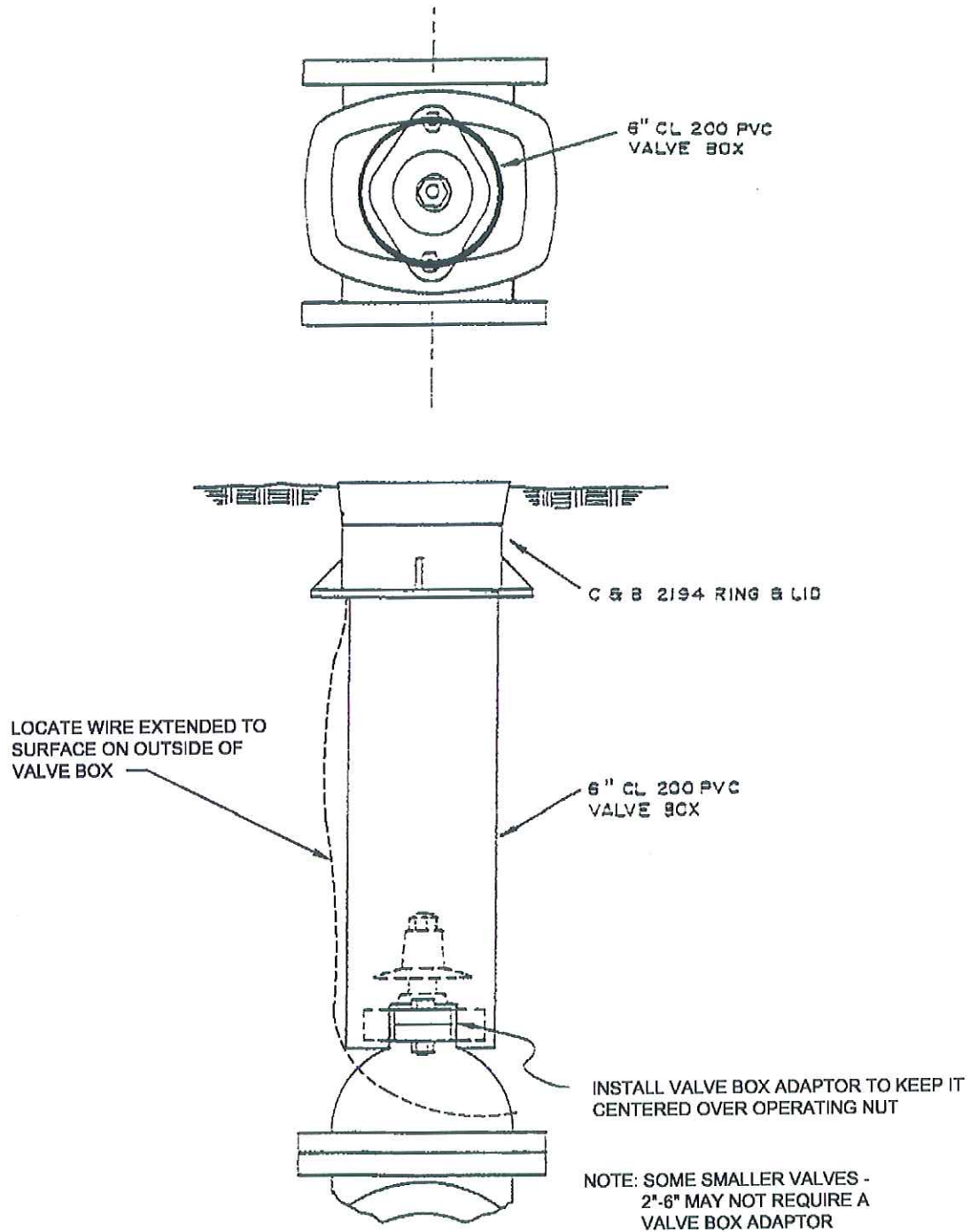
13.3. **Continuity Test for Locator Wire:** Locator wire installed with water line shall be tested for continuity by the District, or its representative, before acceptance will be made of the water line.

**SPECIFICATIONS FOR WATER MAIN CONSTRUCTION**  
**PUBLIC WATER SUPPLY DISTRICT #9**  
**BOONE COUNTY, MISSOURI**

- 13.4. **Final Tests:** After final test procedures and main is connected to the existing system, it shall be subjected to normal working pressure. If at any time within two years of final inspection, any trouble or failure in the respective line or lines occurs that can be directly attributed to faulty workmanship or defective materials, it shall be the Owner or Developer's financial responsibility to repair.

## **14. Inspection**

- 14.1. **Agreement:** It shall be agreed to by all parties that District staff shall have full authority of inspection at all times during the progress of any water main work. The inspector shall have full authority to inspect the materials and the work performed.
- 14.1.1. Any intimidation or attempted intimidation of the inspector by the Owner or one of his employees shall be sufficient reason, if the inspector so desires, for suspension of work.
- 14.1.2. Such inspections shall not relieve the Owner from any obligation to perform his work in accordance with these specifications or any approved plans, and work not so constructed shall be removed and made good by the Owner at his expense, whenever ordered by the inspector without reference to any previous oversight or error in inspection.
- 14.1.3. No work shall be done between (7:00) p.m. and (7:00) a.m. nor on Saturdays, Sundays, or legal holidays without permission of the District staff. However, emergency work may be done without prior permission. Emergency work consists of District customers without water or severe leak. District must be contacted during emergency at (573) 474-9522 or inspector assigned to that projects direct contact number.



PUBLIC WATER SUPPLY DISTRICT #9

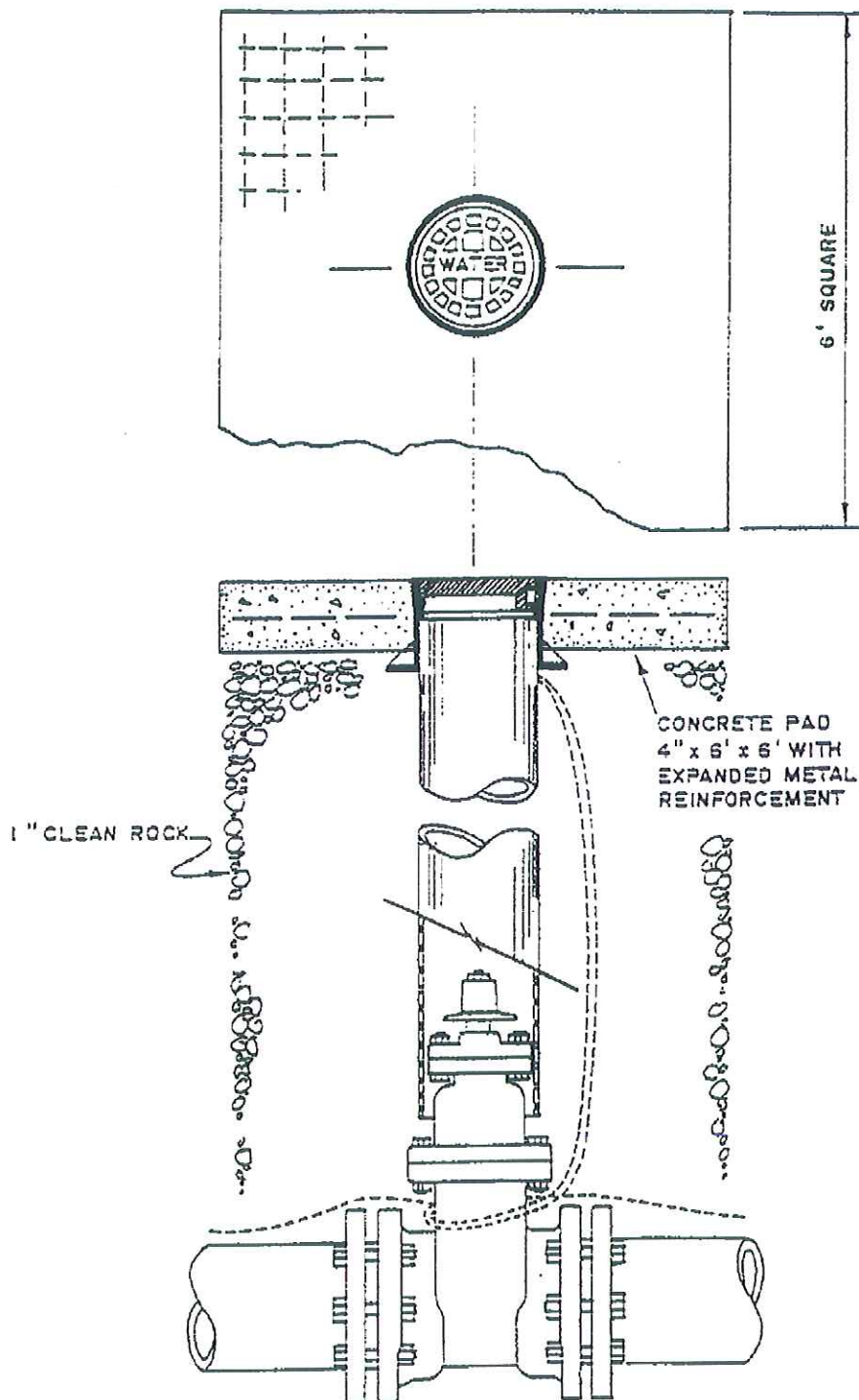
BOONE COUNTY, MISSOURI

# VALVE BOX DETAIL

DATE:  
MARCH, 2007

REVISED:

SHEET:  
D-1



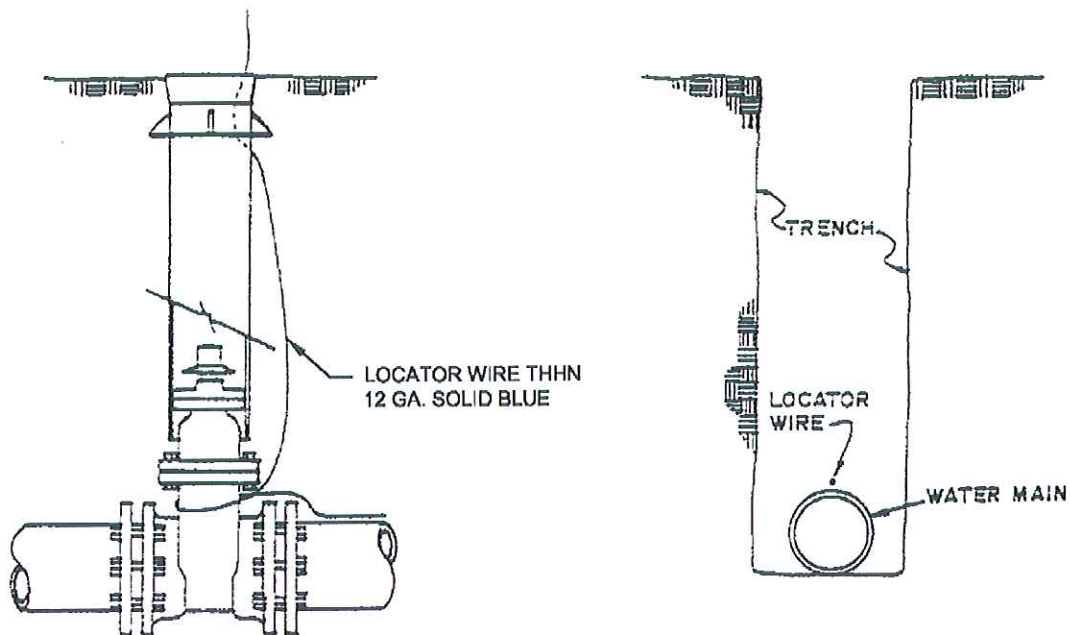
PUBLIC WATER SUPPLY DISTRICT #9  
BOONE COUNTY, MISSOURI

# VALVE BOX IN ROADWAY

DATE:  
MARCH, 2007

REVISED:

SHEET:  
D-1A



1. LOCATOR WIRE TO BE TAPED ALONG THE TOP OF THE PIPE. APPLY 3 PIECES OF DUCT TAPE PER 20 FT. JOINT.
2. AT VALVES, WRAP WIRE AROUND VALVE BODY AND BRING UP ON OUTSIDE OF VALVE BOX. CUT A GROOVE 8" FROM TOP OF PIPE DOWNWARD TO BRING WIRE INTO BOX JUST BELOW RING & LID. LEAVE WIRE LONG ENOUGH TO PULL 1 OR 2 FT. OUT OF BOX.

PUBLIC WATER SUPPLY DISTRICT #9

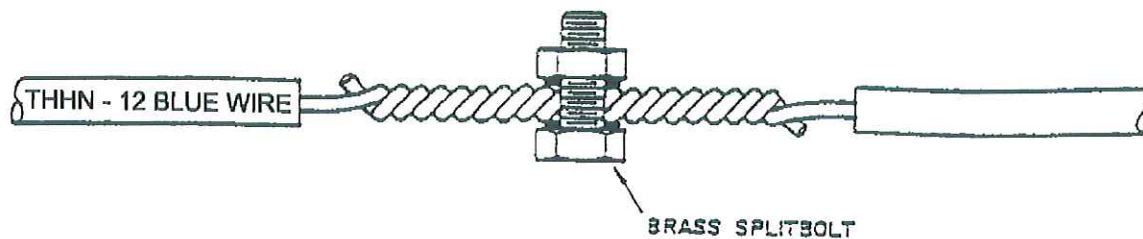
BOONE COUNTY, MISSOURI

LOCATOR WIRE

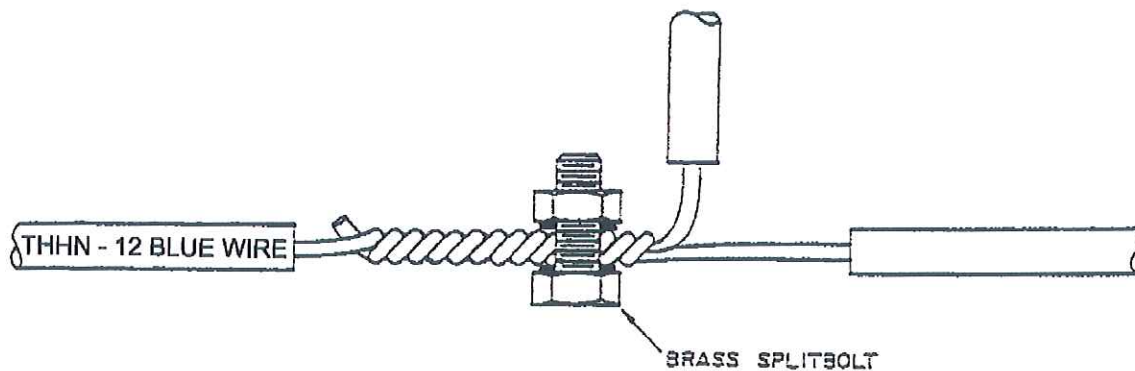
DATE:  
MARCH, 2007

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SHEET:  
D-2



LINE SPLICE



TEE INTERSECTION

NOTE: AT TEE INTERSECTION, REMOVE INSULATION ONLY.  
DO NOT CUT MAIN LOCATOR WIRE.

WIRE TO BE 12 GAUGE SOLID COPPER WITH THHN BLUE INSULATION.

SPLICE OR CONNECTION TO BE DOUBLE WRAP TAPED WITH  $\frac{1}{2}$  OVERLAP  
 PER ROUND. APPLY SCOTCHKOTE TO SEAL THE TAPED CONNECTION.

PUBLIC WATER SUPPLY DISTRICT #9

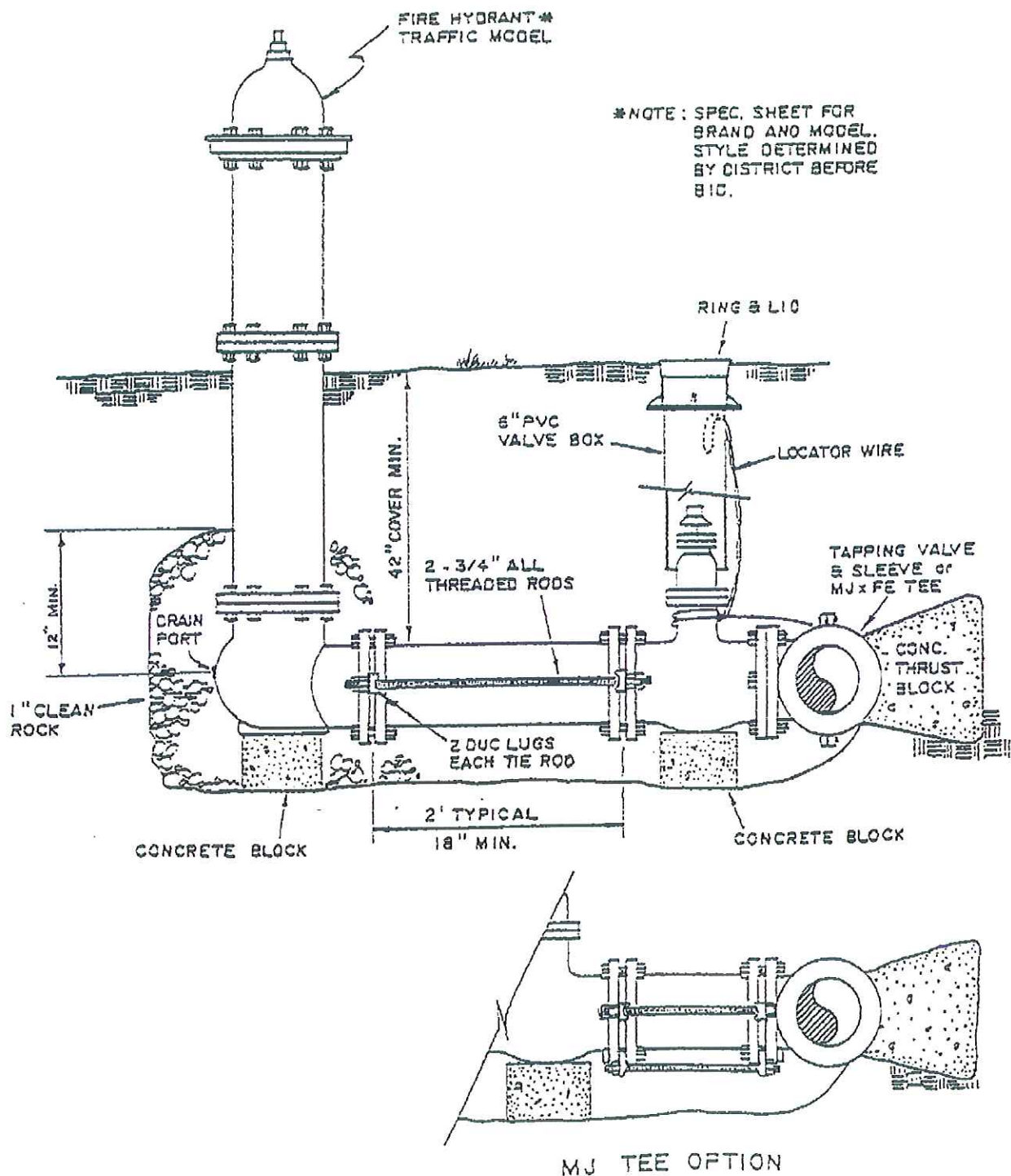
BOONE COUNTY, MISSOURI

TEE INTERSECTION AND LINE SPLICE

DATE:  
MARCH, 2007

REVISED:

SHEET:  
D-2A



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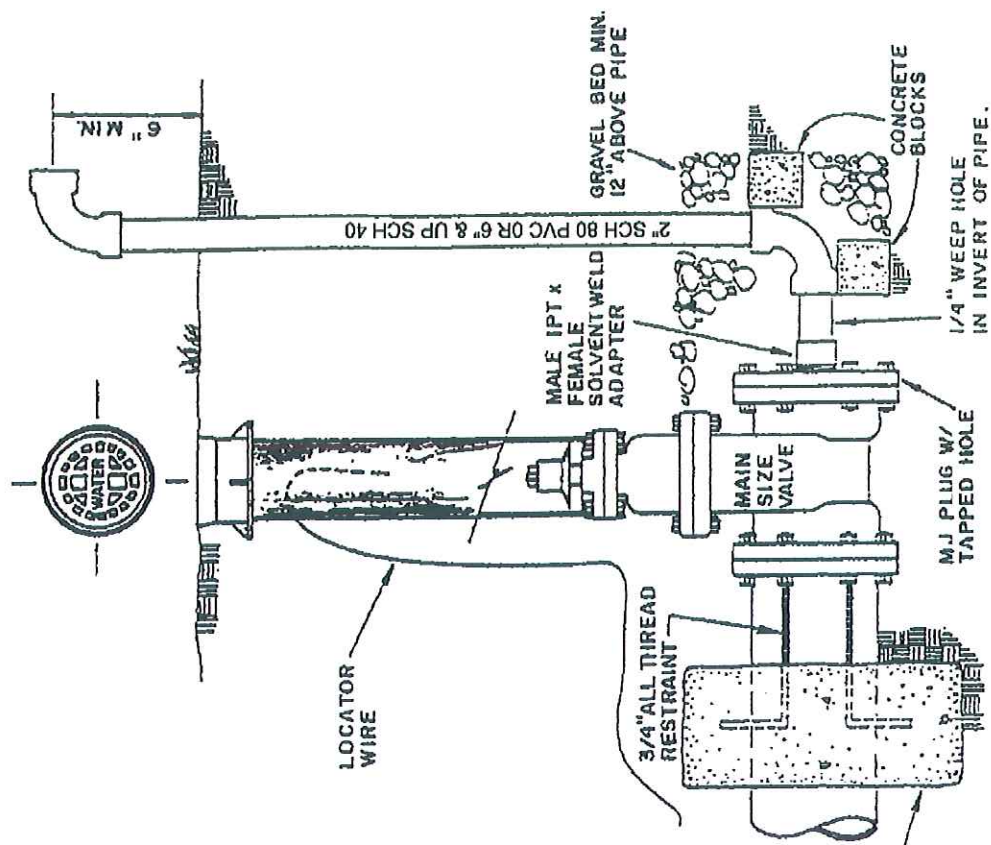
BOONE COUNTY, MISSOURI

FIRE HYDRANT DETAIL

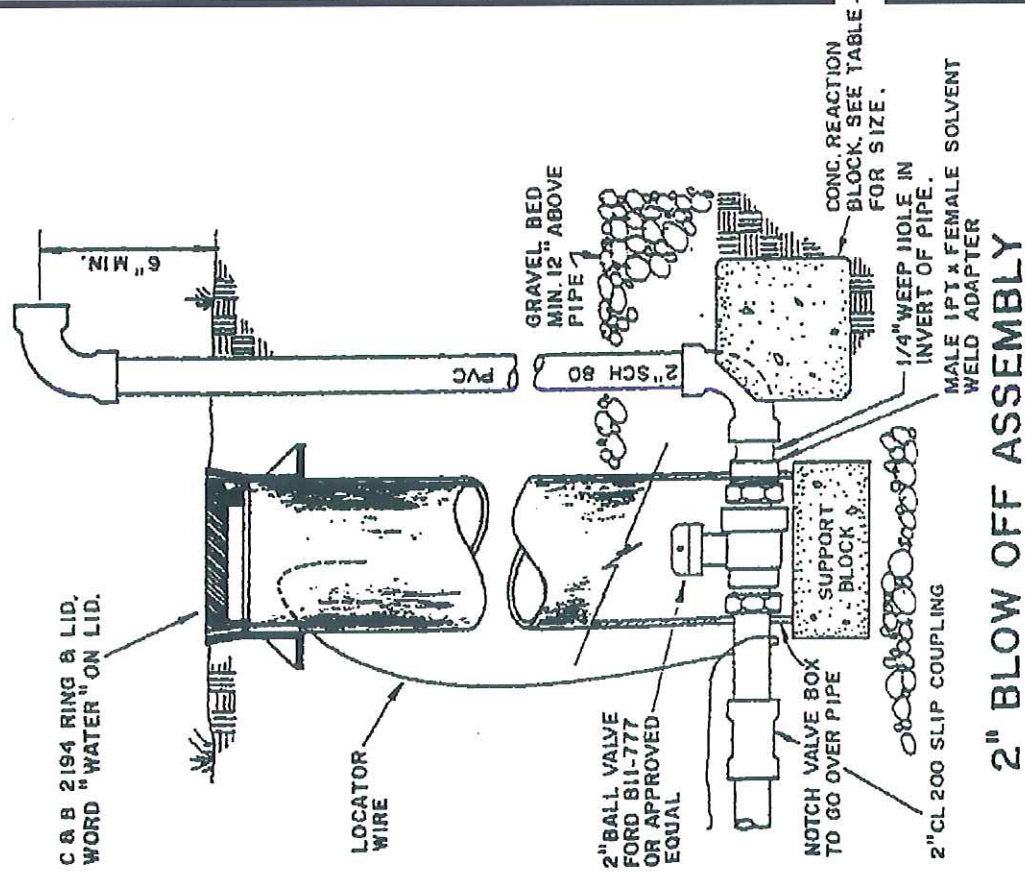
DATE:  
MARCH, 2007

REVISED:

SHEET:  
D-3



## DEAD END LINE BLOW OFF ASSEMBLY



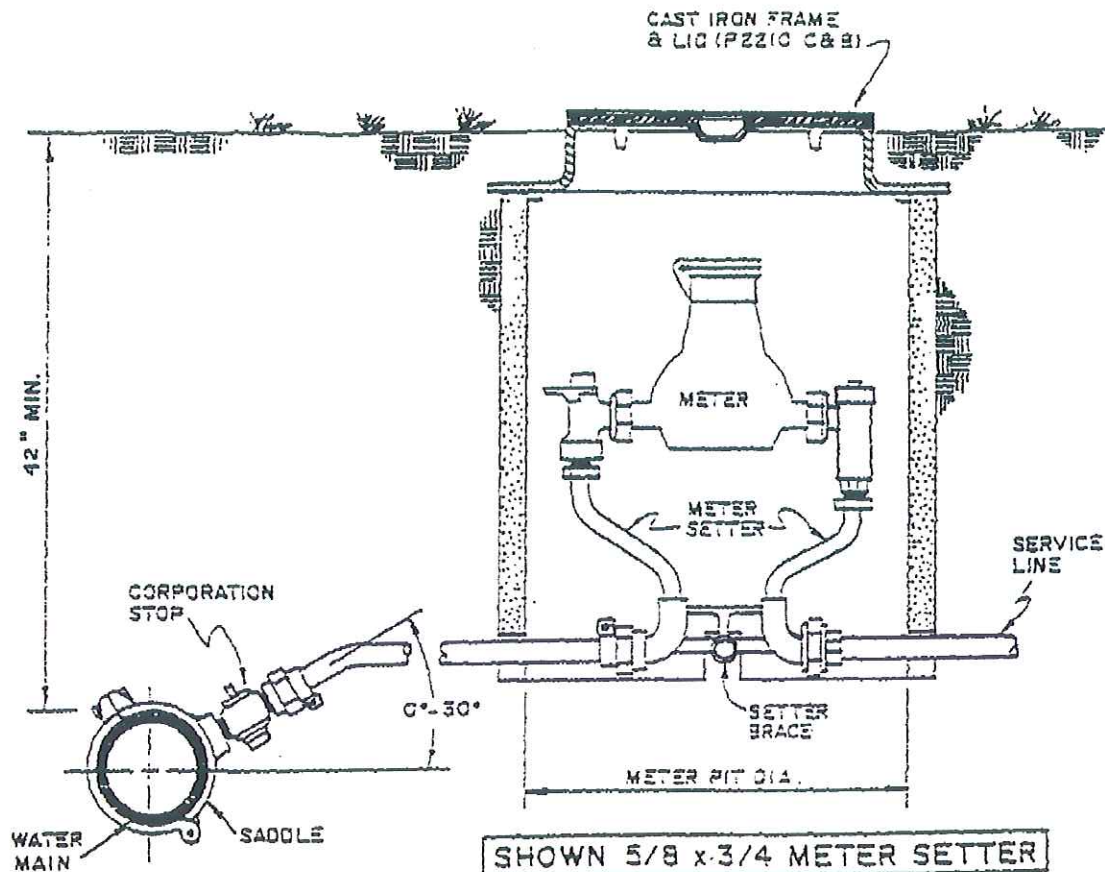
## PUBLIC WATER SUPPLY DISTRICT #9

BOONE COUNTY, MISSOURI

## BLOW OFF DETAILS

DATE:	REVISD:	SHEET:
MARCH, 2007		D-3A

Meter Size	Meter Pit Dia. X Height	Meter Setter
5/8 x 3/4	18" x 30"	VBHC72-15W-11-33
1"	24" x 30"	VBHC74-15W-11-44
2"	30" x 30"	VBH77-18B x 17



1. 5/8 x 3/4 meter copper setter shall be Ford VBHC72-15W-11-33 with inlet ball valve and padlock wing, cartridge dual check valve, 3/4" dual purpose union swivel inlet and outlet connections, and brace eye for 1/2" x 24" Schedule 80 PVC setter brace.
2. Service Line: Type "K" copper.
3. Ford Brass Saddle: S71 for PVC and S91 for DIP or AC pipe.
4. Ford Corporation Stop: F1100-G, IPT x pack joint w/ gripper.
5. Tracer Wire: 12 ga. Solid copper - blue THHN insulation.

Note: Cut a square notch on each side of the meter pit for insertion of 1/2" Sch. 80 PVC pipe to keep setter centered in pit. Notch only 1" deep.

**PUBLIC WATER SUPPLY DISTRICT #9**

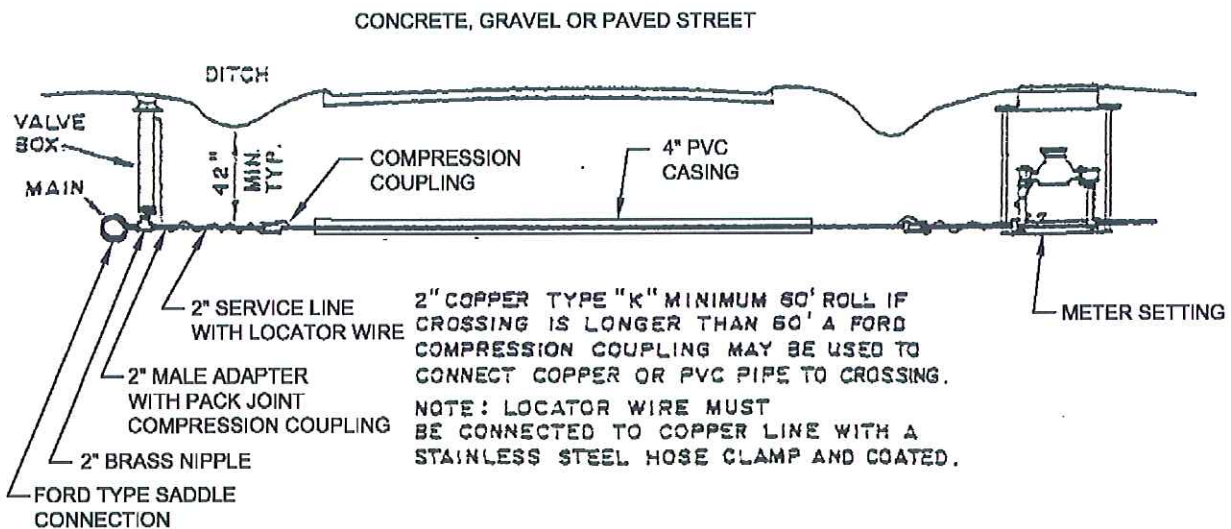
**BOONE COUNTY, MISSOURI**

**TYPICAL METER SETTING**

DATE:  
MARCH, 2007

REVISED:

SHEET:  
D-4



PUBLIC WATER SUPPLY DISTRICT #9

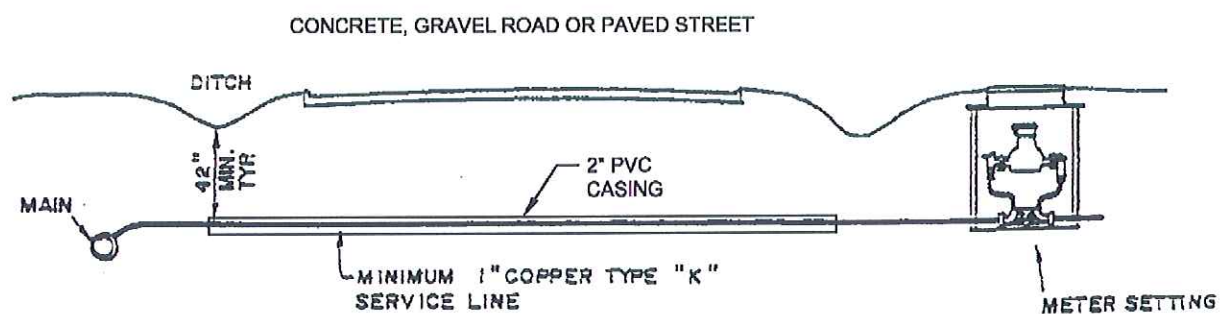
BOONE COUNTY, MISSOURI

2" METER - ROAD CROSSING

DATE:  
MARCH, 2007

REVISED:

SHEET:  
D-5A



PUBLIC WATER SUPPLY DISTRICT #9

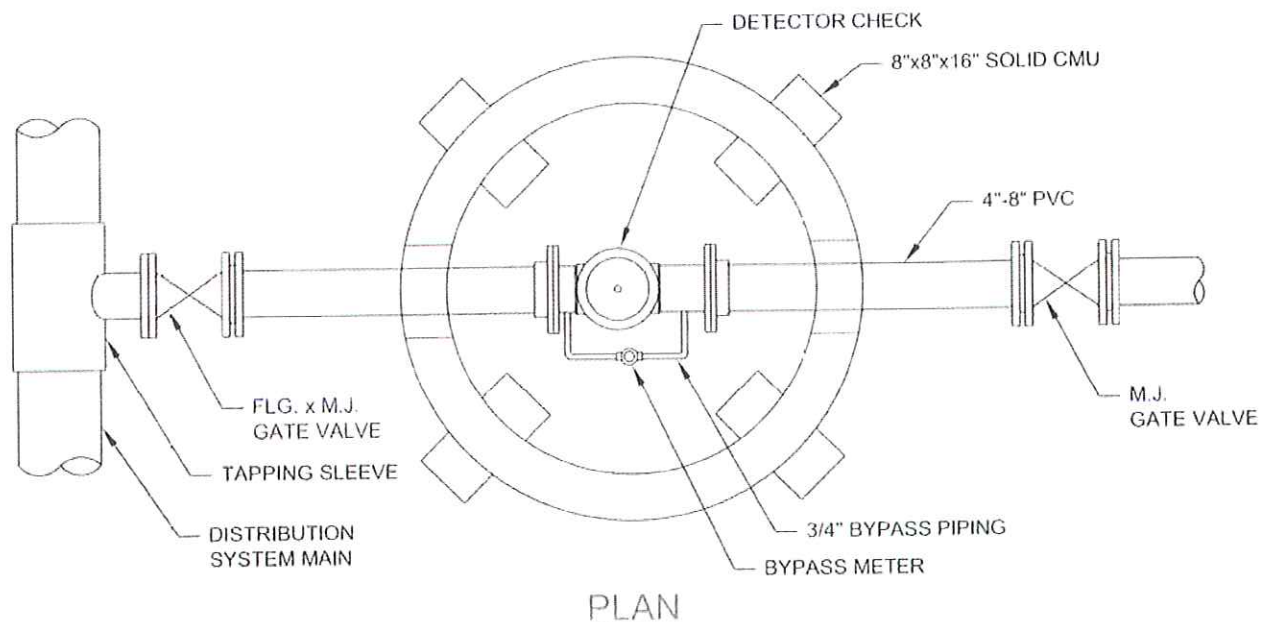
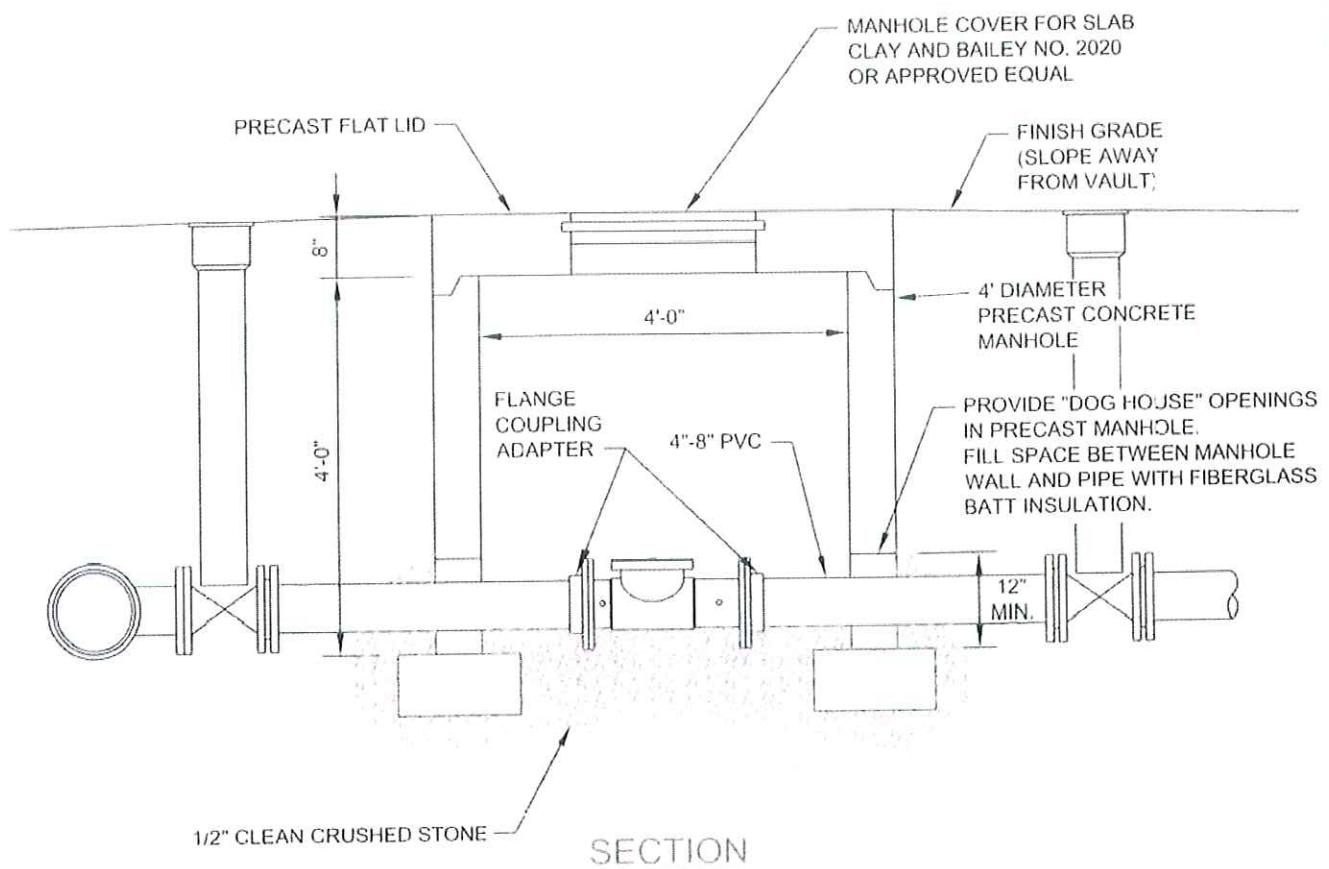
BOONE COUNTY, MISSOURI

1" AND 3/4" METER - ROAD CROSSING

DATE:  
MARCH, 2007

REVISED:

SHEET:  
D-5B



NOTES:

1. FOR USE IN ALL AREAS SUBJECT TO VEHICULAR TRAFFIC.
2. IN NON-TRAFFIC AREAS, A PLASTIC METER BOX WITH CAST IRON LID MAY BE SUBSTITUTED AS APPROVED BY THE DISTRICT.
3. ALL PRECAST CONCRETE SHALL CONFORM TO ASTM C478 AND C789.

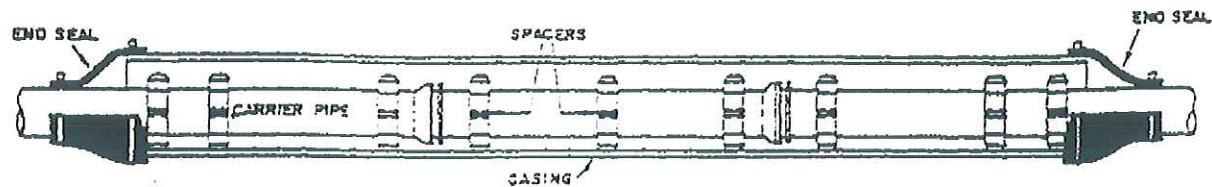
PUBLIC WATER SUPPLY DISTRICT #9

DETECTOR CHECK DETAIL

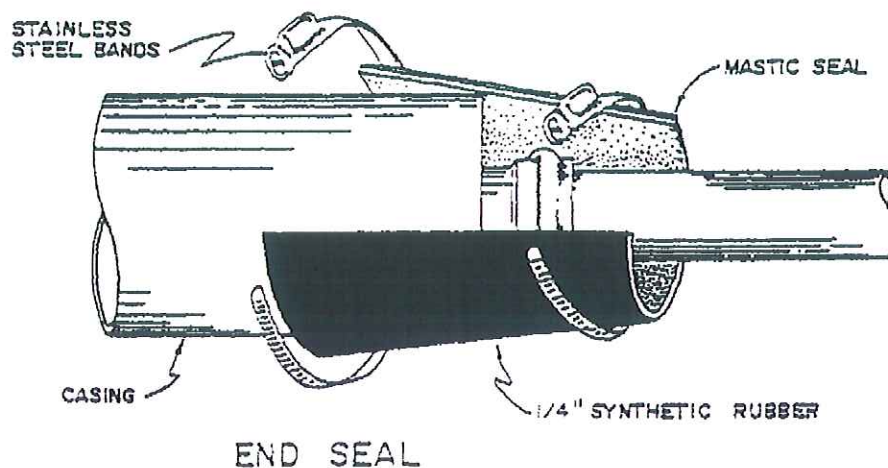
MARCH, 2007

APRIL, 2014

D-6



TYPICAL CASING SPACER CONFIGURATION  
AS SPECIFIED



Highway and railroad bore approval and permit shall be provided by the respective owner or agency of authority. Construction shall be in accordance with the respective rules and specifications of the respective owner or agency of authority: MHTD (7 CSR 10-3.1010) Location and Relocation of Utility Facilities on State Highways Appendix A; or AREA Specifications, Part 5B, Pipelines for Non-flammable Substances, Appendix B.

Carrier pipe shall be Class 200 PVC Yellowmine or approved equal, or as shown on approved plans. Casing spacers shall be RACI polyethylene casing spacers or approved equal and shall be spaced and installed per approved manufacturer's printed recommendations.

Tracer wire shall be laid along the center line of all water line construction.

PUBLIC WATER SUPPLY DISTRICT #9

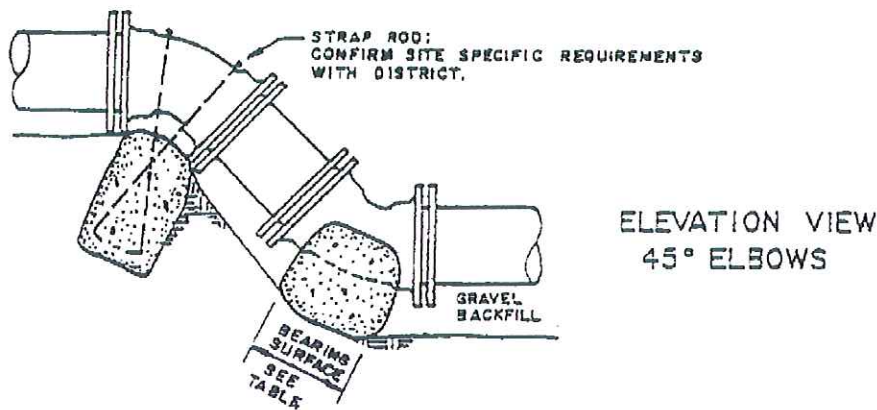
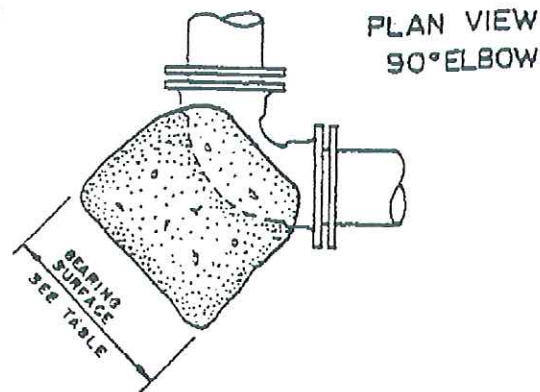
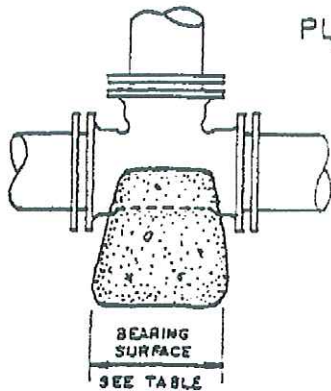
BOONE COUNTY, MISSOURI

BORE DETAIL

DATE:  
MARCH, 2007

REVISED:

SHEET:  
D-6A



BEARING AREA OF BLOCK IN SQUARE FEET					
Fitting Sizes	Valve, Tee, Deadend	90° Elbow	45° Elbow	22 1/2° Elbow	11 1/4° Elbow
2" - 3"	0.7	1.0	0.5	0.3	0.2
4"	1.3	1.8	1.0	0.5	0.3
6"	2.8	4.0	2.1	1.1	0.6
8"	5.0	7.1	3.8	2.0	1.0
10"	7.9	11.2	6.0	3.1	1.5
12"	11.3	16.0	8.6	4.4	2.2

Areas are based on an allowable soil bearing pressure of 2000 pounds per sq. ft. Pipe at 200psi. For other soil conditions multiply area in table by appropriate factor.

Soil Type	Bearing Pressure	Multiplier
Soft Clay	1,000	2.00
Sand or Medium Clay	2,000	1.00
Compacted Sand & Gravel	3,000	0.67
Sand/Gravel/Cemented w/Clay	4,000	0.50

Do not cover bolts or nuts on MJ flange fittings with concrete

PUBLIC WATER SUPPLY DISTRICT #9

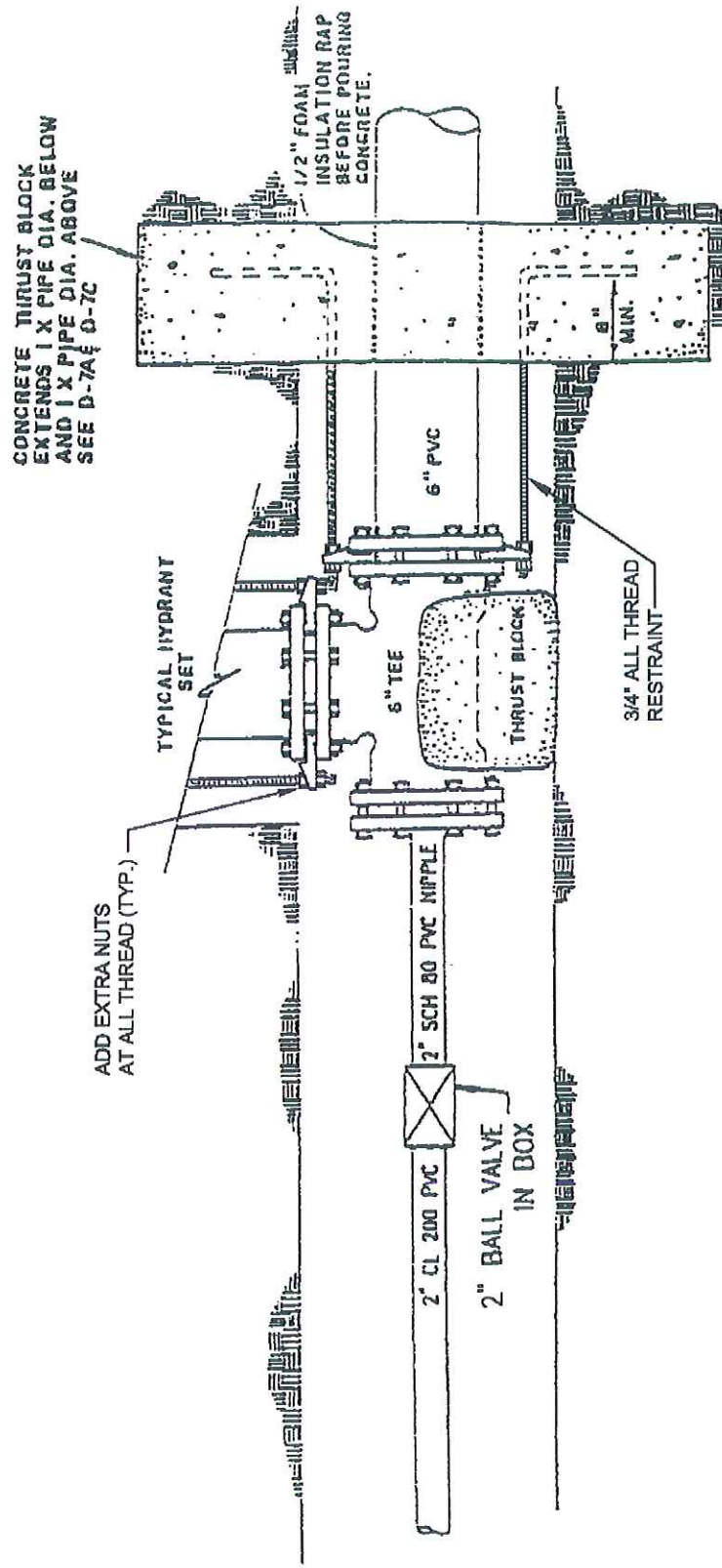
BOONE COUNTY, MISSOURI

CONCRETE THRUST BLOCKING

DATE:  
MARCH, 2007

REVISED:

SHEET:  
D-7A



# PUBLIC WATER SUPPLY DISTRICT #9

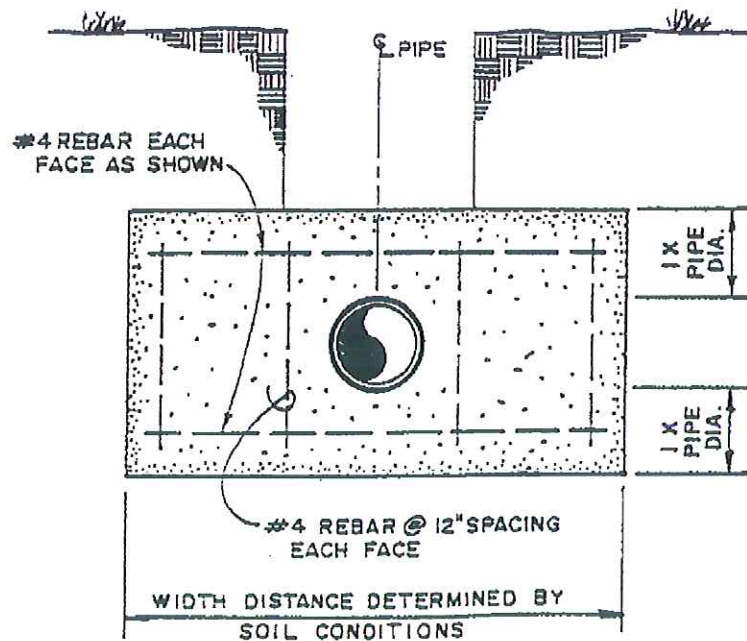
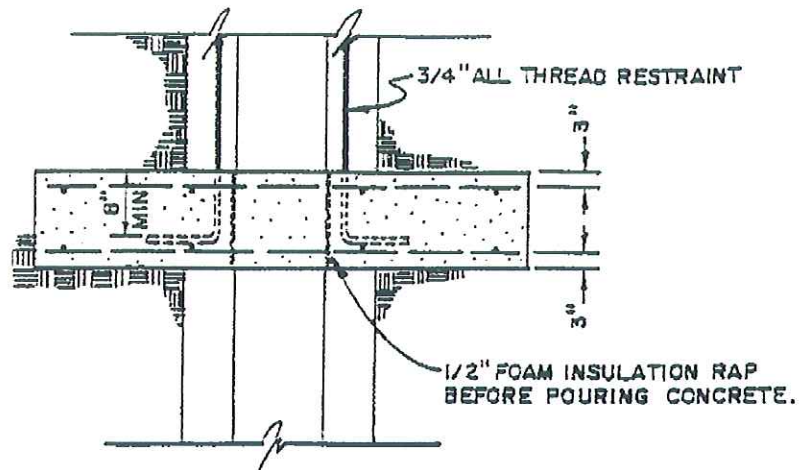
BOONE COUNTY, MISSOURI

## CUL-DE-SAC MAIN REDUCTION BEYOND LAST FIRE HYDRANT

DATE:  
MARCH, 2007

REVISED:

SHEET:  
D-7B



PUBLIC WATER SUPPLY DISTRICT #9

BOONE COUNTY, MISSOURI

THRUST WALL DETAIL

DATE:  
MARCH, 2007

REVISED:

SHEET:  
D-7C