

- *City of* -
BRANSON WEST
M I S S O U R I

Standard Specifications for Public Improvements

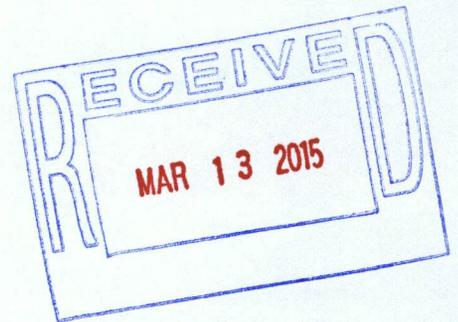
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**CITY OF
BRANSON WEST, MISSOURI**

**STANDARD SPECIFICATIONS
FOR
PUBLIC IMPROVEMENTS**

February 1999
Revised December 2004
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AM
Prepared by
ALLGEIER, MARTIN & ASSOCIATES, INC.
Consulting Engineers
Joplin, Missouri

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DIVISION 100
CONSTRUCTION MATERIALS AND METHODS
FOR
SANITARY SEWER SYSTEMS

SANITARY SEWER SYSTEMS100

101 MATERIALS

101-1 Gravity Sewer Pipe shall be PVC or Closed Profile PVC pipe conforming to the following specifications.

101.1.1 PVC pipe shall be solid wall meeting the requirements of ASTM D3034, latest revision, with a minimum diameter of 8" and wall thickness SDR35 for sizes 8" thorough 15" being buried less than 12 feet and SDR26 for pipe buried 12 feet or greater; and meeting ASTM F-679 for 18" and larger. Pipe shall be extruded with one end to serve as a spigot end and the other as a bell end, with a gasket groove molded inside for retention of a rubber gasket used in making the joint. Standard laying lengths shall be 12.5' or 20'. All 4" and 6" PVC service lateral pipe, fittings, and associated cleanouts shall be Schedule 40 PVC meeting all applicable testing and ASTM standards, latest revision, for Schedule 40 PVC pipe.

101.1.1.1 Drop Impact Test: Pipe shall withstand, without failure at 73°F, an impact of a falling missile (20 pounds Tup A) at the following levels, in accordance with ASTM D2444 latest revision:

<u>Nom. Size (")</u>	<u>Ft.-Lbs.</u>
4	150
6	210
8	210
10 or Larger	220

101.1.1.2 Pipe Stiffness: Minimum pipe stiffness (F/delta-y) at 5% deflection shall be 46 PSI for all sizes when tested in accordance with ASTM D2412, latest revision.

101.1.1.3 Flattening: There shall be no evidence of splitting, cracking, or breaking when a specimen of pipe, six-inches long, is flattened between parallel plates in a suitable press until the distance between the plates is forty percent of the outside diameter of the pipe. The rate of loading shall be uniform and such that the compression is completed within two to five minutes.

101.1.2 Closed Profile PVC Gravity Sewer Pipe: Closed profile gravity sewer PVC pipe shall meet the requirements of ASTM F1803, latest revision. The pipe shall be manufactured with an integral bell and elastomeric seal joint conforming to ASTM D-3212. Gaskets shall be factory installed and chemically bonded to the bell end of the pipe. Gasket material shall conform to the requirements of ASTM F-477. The pipe and fittings shall be made from polyvinyl chloride compounds, which comply with the requirements for a minimum cell classification of 12364 as defined by ASTM D-1784. Shall be used when specified by the City and only for pipes 24" in diameter and larger.

101.1.2.1 Drop Impact Test: Pipe shall withstand, without failure at 73°F, an impact of a falling missile (30 pounds Tup B, flat plate holder B) to a level of 220 ft-lbs, in accordance with ASTM D2444, latest revision.

101.1.2.2 Pipe Stiffness: Minimum pipe stiffness (F/delta-y) at 5% deflection shall be 46 PSI for all sizes when tested in accordance with ASTM D2412, latest revision.

101.1.2.3 Flattening: There shall be no evidence of splitting, cracking, or breaking when a specimen of pipe, six-inches long, is flattened between parallel plates in a suitable press until the distance between the plates is forty percent of the outside diameter of the pipe. The rate of loading shall be uniform and such that the compression is completed within two to five minutes.

101.1.2.4 Fusion Quality: There shall be no sign of flaking or disintegration when immersed in anhydrous acetone for 20 minutes as described in ASTM D2152.

101.1.2.5 Air Tightness: Each length of pipe shall pass a factory 3.5 psi air test as described in ASTM F1803.

101-2 Pressure Sewer Pipe: Pipe for pressure sewers shall be either PVC or ductile iron.

101.2.1 PVC pipe for pressure sewer lines shall be solid wall meeting the requirements of ASTM D2241, latest revision, with minimum wall thickness SDR 21 (Class 200). Thicker wall pipe may be required for certain pressure applications, as determined by the City. Pipe shall have an integral bell with a locked-in, solid cross section elastomeric gasket that meets the requirements of ASTM F477, latest revision. Provisions must be made for contraction and expansion at each rubber ring bell and spigot joint. Pipe shall be made from clean, virgin, NSF approved PVC material conforming to ASTM D1784, latest revision.

101.2.1.1 SDR 21 pipe shall be suitable for use at maximum hydrostatic pressures of 200 PSI at 73°F.

101.2.1.2 Physical and Chemical Tests: Pipe shall meet the following physical and chemical test requirements. All physical and chemical tests shall be conducted at 73°F ± 3.6°F.

<u>Test</u>	<u>ASTM Ref.</u>	<u>Requirements</u>
Quick Burst Test	D1599	630 PSI applied in 60 to 70 sec.
Sustained Pressure Test	D1598	1000 hrs. @ 420 PSI
Acetone Immersion Test	D2152	No visible spalling or cracking after 20 minutes
Vise Test	--	No splitting or shattering when compressed 60% in 2 to 5 minutes

101.2.2 Ductile iron pipe for pressure sewer lines 3-inch through 12-inch size shall be pressure class 350 and shall conform to the latest revision of ANSI A21.51 - (AWWA C151) Standard for Ductile Iron Pipe Centrifugally Cast in Metal Molds or Sand Lined Molds, for Water or Other Liquids. The pipe shall be standard asphaltic varnish coated on the outside. Pipe shall be cement mortar lined in conformance with ANSI A21.4-90 - (AWWA C104) unless specified otherwise.

101.2.2.1 Joints for ductile iron pipe that is to be buried shall be a push-on type. The push-on type joints consisting of a single neoprene gasket, which are acceptable, are "Tyton" as manufactured and licensed by the U.S. Pipe and Foundry Company; "Fastite" as manufactured and licensed by the American Cast Iron Pipe Company; and "Bell-Tite" as manufactured and licensed by James B. Clow and Son,

Inc. All required joint material, including the neoprene gasket and the lubricant, shall be furnished with the pipe.

101-3 Pressure Sewer Fittings: Fittings for pressure sewer lines larger than four (4) inches in diameter shall be mechanical or push-on joint of either gray iron or ductile iron, and shall conform to the requirements of ANSI/AWWA C110/A21.10 or C153/A21.53, latest revisions. All fittings shall be coated and lined in the same manner as the pipe. All mechanical fittings shall be pressure class 350 ductile iron. Fittings shall be standard asphaltic varnish coated on the outside. Fittings shall be cement mortar lined in conformance with ANSI A21.4-80 (AWWA C104). Mechanical joint and push-on joint gaskets shall meet all applicable requirements of ANSI 21.11 (AWWA C111), latest revision.

101.3.1 Fittings for pressure sewer lines four (4) inches in diameter and smaller shall be of the same material as that of pipe.

101-4 Precast Manholes and Manhole Drops:

101.4.1 Materials:

101.4.1.1 Portland Cement: Shall conform to ASTM C150, latest revision, Type I, II, or V.

101.4.1.2 Concrete Reinforcement: Shall be reinforcing bars conforming to ASTM 615, Grade 60.

101.4.1.3 Aggregate: Shall conform to ASTM C33, latest revision, for coarse and fine aggregate.

101.4.1.4 Mortar: Shall conform to ASTM C270, latest revision, Type M.

101.4.1.5 Water: Mixing water shall be clean and potable.

101.4.1.6 Dampproofing: Shall conform to Koppers Specifications for Coal Tar Bitumastic Super Service Black or an approved alternate.

101.4.1.7 Joint Sealant: Shall meet AASHTO Specification M-198, and shall be suitable for application in vertical and horizontal joints. Sealant shall be as manufactured by Hamilton-Kent, Ram-Nek, or approved equal. In cases where water infiltration might be an issue, additional measure shall be taken to seal around the manhole casting. Specified manhole castings shall include a Uni-band, as manufactured by Infi-Shield, or approved equal.

101.4.1.8 Manhole Pipe Connectors: Shall be a resilient connector designed to make a watertight seal between the precast manhole and sewer pipe, conforming to the requirements of ASTM C923, latest revision. Connectors shall be A-LOK, as manufactured by A-LOK Products, Inc. or approved equal.

101.4.1.9 Grout: Grout shall be a pre-mixed, packaged, non-ferrous, aggregate non-shrink grout. Grout shall be SEALTIGHT 588 Grout, as produced by W.R.Meadows, or approved equal.

101.4.1.10 Manhole Castings: Unless noted otherwise, all castings shall be made of clean, even grain, tough gray cast iron. The casting shall be smooth, true to pattern, and free from projections, sand holes, warp, and other defects that would

interfere with the use of, or impair the serviceability of the casting. All castings shall be well cleaned before enamel coating is applied. The iron used for these castings shall conform to ASTM A48, latest revision, for Class 30 gray iron. The "B" test bar (1.2" diameter by 21" long) shall be used to prove the quality of iron used. Manhole frames and covers shall be designed for heavy duty service. Cover shall be solid with two (2) pick holes and the total weight of the unit shall be 400 pounds minimum. A minimum access diameter of 24" shall be provided.

101.4.1.11 Manhole Steps: Manhole steps shall be copolymer polypropylene plastic steps with ½-inch grade 60 steel reinforcement as manufactured by M.A. Industries, Inc., Model PSI-PF, or polyethylene steps with ¾-inch O.D. 6351-T6 aluminum tubing as manufactured by MSU Mississauga Ltd., Model 360, or approved equal.

101.4.1.12 Manhole Drops:

A drop pipe should be provided for a sewer entering a manhole at an elevation of 24" or more above the manhole invert.

(a) Type A Drop: Shall be constructed of SDR-35 PVC pipe and shall be utilized for all drops of two feet minimum up to eight feet maximum.

(b) Type B Drop: Shall be constructed of ductile iron pipe and shall be utilized for all depths greater than eight feet.

101.4.2 Fabrication and Construction Requirements:

101.4.2.1 Fabrication and Manufacturing: Precast reinforced concrete manholes shall be manufactured to requirements of ASTM C478 and ASTM C497, latest revision and shall be of the type, size, and configuration shown on the drawings. Manhole tops shall be of the eccentric type. The minimum allowable wall thickness shall be determined by the manhole depth as below:

<u>Depth</u>	<u>Minimum Wall Thickness</u>
0 to 16 feet	1/12 of internal diameter
16 feet or greater	1/12 of internal diameter + 1"

Minimum internal diameter of any manhole section shall be 4 feet. Dampproofing shall be factory applied on all interior and exterior surfaces except to the interior surface of the bottom section. Dampproofing shall be field applied to the interior surface of the bottom section after base and fillet have been placed. Dampproofing system shall be Koppers Coal Tar Bitumastic Super Service Black or an approved alternate, applied to manufacturer's specifications. Two coats, each of minimum 14 mils dry thickness, shall be applied. A 75-volt maximum wet sponge detector shall be employed to check for holidays in the dried finish film.

101.4.2.2 Construction:

(a) Joints in the precast concrete manhole shall be set in a double ring of pre-molded mastic material or rubber gasket to produce an absolutely watertight joint under full hydrostatic head conditions.

(b) Bases shall be either 6" thick precast flat bases, with inverts

constructed in the field, or shall be a precast bottom with precast integral bottom, or shall be cast-in-place with precast units set into a reinforced concrete base constructed of 3,500 min. psi concrete, 4-inch max. slump, and #4 rebars at 12-inch on center each way. Bottom section shall be set into the base a minimum of 12 inches. Base shall extend not less than 6 inches from outside manhole wall.

(c) Precast riser sections shall be set plumb and oriented with manhole steps and access opening to match the detailed drawings designations.

(d) Inlet and outlet pipes shall extend through the walls of the structures a sufficient distance beyond the outside surface to allow for connections, and shall extend six inches beyond the inside surface of the wall. The new manhole shall be cleaned of silt, debris, or other foreign matter prior to acceptance.

(e) Openings in manhole sections for inlet and outlet pipes shall be formed at the factory, and shall utilize cast-in-place manhole pipe connector gaskets.

(f) Invert channels shall be smooth and semi-circular in shape conforming to the inside of the adjacent pipe line sections with change in flow direction made by a smooth curve of as large a radius as the manhole size will permit, and changes in the size and grade of the channels being made gradually and evenly. Manhole floor shall rise a minimum of 1 inch per foot from side of channel to wall.

(g) All lifting holes shall be thoroughly wetted and completely filled with non-shrinking grout to form a watertight seal.

(h) All castings, frames, and covers shall be set true to line and to correct elevation upon a mastic gasket. Frames and covers shall have true common bearing surfaces, such that the covers will seat firmly without rocking or shifting.

(i) Manholes shall not leak more than 1.14 gallons per day per vertical foot of manhole under a full hydrostatic head.

(j) The drop pipe in manhole drops shall be constructed using standard pipe sections and fittings so as to enter at the bottom of the manhole and also continue the incoming line in a straight line to enter the manhole at a higher elevation, all as shown on the detailed drawings.

(k) All manholes which are subject to standing water over the top of the lid shall have a gasketed, bolt-down lid.

101.4.3 Inspection and Rejection: The quality of materials, the process of manufacture, and the finished manhole sections shall be subject to inspection and approval by the City. Manhole sections shall be subject to rejection for failure to conform to any of the specified requirements. In addition, individual sections may be rejected because of any of the following:

101.4.3.1 Fractures or cracks passing through the wall;

101.4.3.2 Defects that indicate imperfect proportioning, mixing, and molding.

101.4.3.3 Surface defects indicating honeycombed or open texture;

101.4.3.4 Damaged or cracked ends where such damage would prevent making a satisfactory joint;

101.4.3.5 Any continuous crack having a surface width of 0.01 inch or more and extending for a length of 4 inches or more.

101-5 Pipe Bedding Material:

101.5.1 Granular Stone:

101.5.1.1 Granular stone pipe bedding material shall be crushed limestone consisting of aggregate particles meeting the requirements of ASTM C-33, latest revision, gradation 67, 1-inch to No. 8 size as follows:

<u>Sieve Size</u>	<u>Percent Passing</u>
1"	100
3/4"	90-100
3/8"	20-55
No. 4	0-10
No. 8	0-5

101-6 Steel Casing Pipe: Steel pipe for casing at highway and railroad crossings shall conform to AWWA C200-91.

101.6.1 Minimum wall thickness shall be in accordance with the following table:

<u>Diameter of Casing - Inches</u>	<u>Nominal Wall Thickness - Inches</u>	
	<u>Under Railroads</u>	<u>All Other Uses</u>
16	0.312	0.188
18	0.312	0.250
20	0.375	0.250
22	0.375	0.250
24	0.406	0.281
26	0.438	0.281
28	0.469	0.312
30	0.469	0.312
32	0.500	0.312
34	0.500	0.312
36	0.500	0.344

101.6.2 Steel shall be Grade B under railroads, and Grade A on all other uses.

101.6.3 Steel pipe shall have welded joints in accordance with AWWA C206.

101-7 Pumping Station Material and Equipment: Material and equipment for sewage pumping station will be reviewed and approved on a case-by-case basis due to the frequency of industry standards changing. It is recommended that the design engineer contact the City prior to submitting plans and specifications, to request a list of approved equipment manufacturers. Chain link fencing with grounding and 4" of crushed stone surfacing over the entire lift station site shall be required for all newly constructed lift stations. All areas receiving crushed stone surfacing shall receive a sterilant over the entire site. The sterilant shall be Monsanto Roundup or an approved equal, and shall be applied according to manufacturer's instructions.

101.7.1 Chain Link Fences and Gates:

101.7.1.1 Material and Coating: Posts, gate frames, braces, rails, stretcher bars, and truss rods shall be of steel reinforcing wires shall be of high carbon steel; and gate hinges, post caps, barbed wire and supporting arms, stretcher bar bands, and other parts shall be of steel, malleable iron, ductile iron or equal except that ties and clips may be of aluminum. All steel and iron parts shall be zinc coated after fabrication, using zinc grade "E" in accordance with Federal Specification QQ-Z-351. The weight of the zinc coating per square foot of actual surface area shall average not less than 1.2 ounces and no individual specimen shall show less than 1.0 ounces. The SS-40 pipe shall have a zinc coating of 0.9 ounces of zinc per square foot with a Chromate conversion coating and then a thermoplastic acrylic coating of not less than 0.3 mils dry film thickness. The SS-40 shall also have a zinc rich interior coating of not less than 0.3 mils dry film thickness.

(a) Lift station perimeter fencing shall consist of galvanized steel chain link fence with a fabric height of six (6) feet and an overall height of seven (7) feet from the bottom of the fabric to the top barbed wire. Fence shall have a top rail, bottom tension wire, and three strands of barbed wire mounted on 45 degree extension arms. Posts shall be set in concrete. Fence fabric shall be 11 gauge zinc-coated steel.

101.7.1.2 Gates: Gates shall be swing, complete with latches, stops, keepers, and hinges with provision for three strands of barbed wire above the fabric.

(a) Gate Frames: Constructed of tubular members (round or square) welded at all corners or assembled with fittings. On steel, welds shall be painted with aluminum base or zinc base paint. Where corner fittings are used, gates shall have truss rods of 3/8-inch nominal diameter to prevent sag or twist. Gate leafs shall have vertical intermediate bracing as required, spaced so that no members are more than eight feet apart. End members of the gate frames shall be extended one foot above the top horizontal member to which three strands of barbed wire, uniformly spaced, shall be attached by use of bands, clips, or hook bolts. Gate filler shall be of the same fabric as specified for fence and shall be attached securely to gate frame at intervals of 15 inches.

(b) Hinges: Adequate strength for gate, and with large bearing surfaces for clamping in position. The hinges shall not twist or turn under the action of the gate. The gates shall be capable of being opened and closed easily by one person.

(c) Latches, Stops and Keepers: Provided for all gates. Latches shall have a plunger-bar arranged to engage the center stop, except that for single gates of openings less than 10 feet wide, a forked latch may be provided. Latches shall be arranged for locking. Center stops shall consist of a device arranged to be set in concrete and to engage a plunger bar of the latch of double gates. No stop is required for single gates. Keepers shall consist of a mechanical device for securing the free end of the gate when in the full open position.

101.7.1.3 Posts: Shall be of the lengths specified and shall be tubular, except that line posts may be H-beam.

(a) Post Braces: Provided for each gate corner, pull, and end post,

and shall consist of a round tubular brace extending to each adjacent line post at approximately mid height of the fabric, and a truss consisting of a rod not less than 3/8-inch in nominal diameter from the line post back to the gate, corner, pull, or end post, with a turnbuckle or other equivalent provision for adjustment.

(b) Post Tops: Combination tops with barbed-wire supporting arms. The post tops shall fit over the outside of posts and shall exclude moisture from tubular posts.

101.7.1.4 Barbed Wire Supporting Arms: Shall be at an angle of approximately 45 degrees, and shall be fitted with clips or other means for attaching three strands of barbed wire. With 15-inch arms the top wire shall be approximately 12 inches horizontally from the fence line and the other wires spaced uniformly between the top of the fence fabric and the outside strand. Barbed wire arm shall be of sufficient strength to withstand a weight of 200 pounds applied at the outer strand of barbed wire.

101.7.1.5 Top Rails: Shall be round (tubular), shall be in lengths not less than 18 feet, and shall be fitted with couplings for connecting the lengths into a continuous run. The couplings shall be not less than six inches long, with 0.070 minimum wall thickness, and shall allow for expansion and contraction of the rail. Open seam outside sleeves shall be permitted only with a minimum wall thickness of 0.100 inches. Suitable ties or clips shall be provided in sufficient number for attaching the fabric securely to the top rail at intervals not exceeding two feet. Means shall be provided for attaching the top rail to each gate, corner, pull, and end post.

101.7.1.6 Stretcher Bars: Shall not be less than 3/16 by 3/4-inch nor less than two inches shorter than the full height of the fabric with which they are to be used. The stretcher bars shall be arranged for attaching the fabric to all terminal posts by threading through the fabric, by bands, or by other positive mechanical means. One stretcher bar shall be provided for each gate and end post, and two for each corner and pull post.

101.7.1.7 Ties, Clips, Bands: Ties or clips of adequate strength shall be provided in sufficient number for attaching the fabric to all line posts at intervals not exceeding 15 inches. Bands or clips of adequate strength shall be provided in sufficient number for attaching the fabric and stretcher bars to all terminal posts at intervals not exceeding 15 inches. Tension bands and brace bands shall be formed from flat or beveled steel and shall have a minimum thickness of 0.155-0.005 after galvanizing with a minimum width of 7/8 of an inch 0.015.

101.7.1.8 Barbed Wire: Barbed wire shall consist of two strands of 12-1/2 gauge wire with 14 gauge 4 point barbs spaced approximately 5 inches apart. All wire shall be zinc coated with a minimum coating of 0.80 ounces per square foot of surface area on 12-1/2 gauge wire and 0.60 ounces per square foot of surface area on 14 gauge wire.

101.7.1.9 Posts, gate frames, rails, and braces shall conform to the dimensions and weights as follows:

<u>Use & Section</u>	<u>Outside Diameter Or Dimensions Nominal</u>	<u>Weight Per Foot Nominal</u>
End, corner and pull posts (tubular) for fabric heights: 6 feet and less: Round Sch-40	2.375	3.65
Square	2.00	3.60
Gate posts for nominal width of gate, single, or one leaf of double: 6 feet and less: Round Sch-40	2.875	5.79
Square	2.50	5.70
Gate width 13 feet and less: Round Sch-40	4.00	9.10
Square	3.00	9.10
Gates: exterior frames for fabric heights: 6 feet and less, and gate leaves 8 feet and less: Round Sch-40	1.660	2.27
Square	1.50	1.90
Gate leaves over 8 feet width: Round Sch-40	1.90	2.72
Square	2.00	2.10
Internal gate bracing: Round Sch-40	1.660	2.27
Square	1.50	1.90
Rails and post braces (tubular): Round Sch-40	1.660	2.27
Intermediate posts for fabric heights: 6 feet and less: Tubular (round) Sch-40	1.90	2.72
H-Section	1.875x1.625x.113	2.70

102 INSTALLATION PROCEDURES

102-1 Trenching, Bedding, Backfilling, and Compacting:

102.1.1 Materials:

102.1.1.1 Earth Backfill: Earth backfill shall be earth previously excavated from the trench, free from perishable matter, frozen soil, stone over four (4) inches in its largest dimension, and other matter liable to become unstable when saturated with water and compacted.

102.1.1.2 Select Backfill: Where previously excavated earth is determined to be unsuitable for backfill, suitable material from an approved source shall be obtained.

102.1.2 Construction:

102.1.2.1 Trench Excavation (Gravity Sewer Lines):

(a) All trench excavation shall be made with a sufficient working space to permit the placement, inspection, and completion of all work contemplated in the contract. Excavated material that is unsuitable for backfill, and all boulders exposed by trenching shall be removed from the work area. Trenches shall be excavated in accordance with the standard detail for trench width relative to trench depth.

(b) Trenches shall be excavated to six inches below established flow lines to provide clearance for the pipe bell and not less than four inches of granular stone bedding material. Should the trench be excavated more than six inches below the flowline, only granular stone bedding material shall be used to establish flow line grade.

(c) Trench excavation shall, in all cases, be continuous from the ground surface to the established trench depth. Materials excavated shall be stockpiled at the sides of the trench and within established area limits so as to minimize inconvenience to the public, and damage to vegetation and structures in the area.

(d) When unstable ground is encountered, the trenching shall be carried out utilizing trench shoring, bracing, and shields to prevent cave-ins.

(e) Trench width from six inches below the bottom of the pipe to six inches above the pipe joint shall be held to 24" minimum, or 1.4 times the pipe O.D., plus 12 inches, whichever is greater. Trench width above these levels may be wider to accommodate shoring, bracing, and shields, but shall be kept within practical limits.

102.1.3 Trench Excavation (Pressure Sewer Lines):

102.1.3.1 Trench Depth: Trenches shall be cut as deep as necessary on either side of natural depressions, ditches, waterways, etc. to provide for not less than 42 inches of cover over the top of the pipe. Depth of cover shall be measured from the outside top of the pipe vertically to the original ground surface or pavement surface. Mounding over the trench to attain the specified cover shall not be permitted. Trenches shall be cut so as to prevent high spots that could lead to "air binding" of

the line. Trenches shall be excavated to four (4) inches below the bottom of the pipe to provide clearance for not less than four (4) inches of pipe bedding material. The maximum degree of deflection, either vertical or horizontal, shall not cause a pipe joint's annular clearance in the bell to be less than one-fourth (1/4) inch at its closest point. In case the trench be excavated at any place more than four (4) inches below grade, it shall be filled to the design grade with approved bedding material. Trench excavation shall, in all cases, be continuous from the ground surface to the established trench depth. Gutters and ditches shall be kept clear, or other satisfactory provisions shall be made to facilitate drainage. Ground adjacent to trench shall be graded so as to prevent water from flowing into the trench. Provisions shall be made for the continuous flow of all waterways, ditches, drains, or sewers encountered during construction. All ditches and waterways shall be restored to their original conditions as soon as possible.

102.1.3.2 Trench Width: The width of the trench, as dug, from the trench bottom to the top of the pipe, shall not exceed the outside diameter of the pipe bell or socket plus 12 inches, or 24 inches, whichever is greater. Trench width above the top of the pipe shall be as required by field conditions to prevent sliding and caving of the excavation.

102.1.4 Sheeting, Shoring, or Bracing: Sheeting, shoring, or bracing shall be placed wherever necessary for the proper preserving of any excavation, embankment, or structure. Where the ground is of such a character or other conditions are such as to render it necessary, the sheeting shall be closely driven and to such depth below the lowest point of the final excavation as may be required. Shore up, protect, and insure from injury all buildings, retaining walls, piers and footings, storm sewers, sanitary sewers, gas lines, water lines, fences, curbs, trees, or other property liable to be injured during the process of the work. Sheeting, shoring, and bracing shall be provided, installed, and maintained to protect the excavation and insure open trench operations.

102.1.5 Placement of Bedding Material: Granular Stone Pipe Bedding: Granular stone shall be placed in the trench and shaped so as to provide uniform support for the bottom quadrant of the pipe barrel. The bedding shall be not less than four (4) inches in thickness. Following placement of the pipe, the trench shall be filled with granular stone bedding material to a minimum compacted depth of six (6) inches above the pipe barrel.

102.1.6 Backfilling: Material used for backfilling of trenches shall be free from perishable matter and from other material liable to become unstable when saturated with water after having been compacted. No frozen material shall be used in backfill. Care shall be taken to prevent damage to the pipe and structures. Special precautions shall be taken in backfilling over pipes. No backfill shall be placed over any portion of pipes and/or joints not inspected by the City or the City Engineer. The bedding material shall be brought to a depth of at least six inches over the top of the pipe bell, with this material carefully deposited in uniform layers not exceeding six inches in depth, and each layer carefully and solidly tamped with mechanical tampers in such a manner as to avoid damage to pipe or disturbing completed work. Unless noted otherwise on the drawings, backfilling for the remainder of the trench shall be previously excavated gravel, sand, or earth, and shall contain no stone over four inches in its largest dimensions. Stones smaller than that size may be used in proportion not exceeding one part of stone and three parts of earth in any place. This backfilling shall be deposited and spread in layers and solidly tamped. Except as specified for roadway crossings, trench backfill shall be compacted to 85 percent

of the maximum density at optimum moisture. As the trenches are backfilled, remove all surplus material and regrade the surface, leaving it in good order. The trenches shall be filled to the ground surface elevation which previously existed.

102.1.7 New Manhole Over an Existing Line: Manholes to be located over an existing sewer line will be built so that all of the manhole inverts will be smooth and continuous after the sewer tile is broken open.

102.1.8 Connections to Existing Manholes: Existing manholes used for connecting new sewer lines to the existing sewerage system will have the invert chipped out and grouted back with non-shrink grout as required to facilitate the uninterrupted sewage flow from the new connection.

102-2 Installation:

102.2.1 Pipe Installation:

102.2.1.1 General: Only workers competent at laying pipe shall be employed on this phase of the work, and complete suitable equipment necessary for the execution of same is required. Any incompetency observed must be removed, and where improper equipment or lack of same appears to be impairing the quality or speed of the work, such adjustment in same shall be made.

102.2.1.2 Handling of Materials: The pipe, fittings and valves shall be placed in the trench with care. Under no circumstances shall pipe or other materials be dropped or dumped into the trench. If plastic pipe is used, the pipe shall be snaked into the trench, either employing the natural snaking tendency of some plastic pipe or the pipe shall be laid from one side to the other on alternate lengths.

102.2.1.3 Pipe Cleaning During Laying Operations: The pipe, if furnished from the factory with dust covers over the ends, shall be examined carefully during laying operations to insure that such covers are not lost inside the pipe. At the termination of pipe laying, the open end of the pipeline shall be closed off by a suitable cover until laying operations are resumed. No pipe shall be placed in the trench unless it is intended to make the joint to the pipeline at that time.

102.2.1.4 Inspection of Materials During Construction: Any materials not meeting the specifications, or obviously faulty material, shall be rejected and removed from the job site.

102.2.1.5 Joining Pipe: In joining sections of pipe, the installer shall use good working practices. All pipe ends shall be cleaned thoroughly inside and out before application of lubricant. The recommendations of the manufacturer of the pipe shall be followed closely in joining this type of pipe. Care shall be taken in lowering pipe into the trench in order that a tensile stress is not created that would cause partial or complete separation of the joints. Concrete thrust blocks shall be installed on pressure sewer line construction at all bends, tees, crosses, and reducers.

102.2.1.6 Breaks in Pipe and Joints: Breaks in the pipe or joints shall be repaired.

102.2.1.7 Bedding of Plastic Pipe: The Contractor shall bed the pipe in accordance with the requirements of Section 102-1 - TRENCHING, BEDDING, BACKFILLING, AND COMPACTING.

102.2.1.8 Avoidance of Unnecessary Bends: Excessive bends in the alignment of pressure sewer lines will not be permitted. Where obviously required, sweep ells shall be used in making connections between two sections having differing alignment. Standard 90E elbows are not to be used, except in confined locations.

102.2.1.9 All gravity sewers shall have a uniform slope between manholes, straight alignment between manholes for lines of 24" in diameter or less, and shall be checked for alignment with a laser beam or lamping.

102.2.2 Anchorage of Pressure Sewer Line Bends, Tees, and Plugs: On all pipe lines four inches (4") in diameter and larger, all tees, plugs, caps, and bends exceeding 22-1/2± degrees shall be restrained. Mechanical joint restraints, such as a retainer gland, restraint harness, etc. shall be used. Concrete thrust blocks will not be allowed.

102.2.3 Separation of Sewer and Water Lines:

102.2.3.1 Horizontal Separation: When sanitary sewers are to be laid parallel to existing potable water lines, it will be necessary to maintain at least ten feet horizontal separation between the sewer and water lines. The distance shall be measured between outside edge of lines. In cases where it is not practical to maintain this specified separation, the City may allow installation of a sewer line closer to a water line, provided that the water main is located in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer.

102.2.3.2 Vertical Separation (Crossings): Sewer lines crossing water mains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer. This separation shall be provided whether the water main is above or below the sewer. The crossing shall be constructed such that the sewer joints will be equidistant and as far as possible from the water main joints. Where a water main crosses under a sewer, adequate structural support shall be provided for the sewer to prevent damage to the water main.

102.2.3.3 Special Conditions: When it is impossible to obtain the horizontal and vertical separations specified herein, either the sewer or water line shall be designed and constructed equal to water pipe or may be continuously encased or enclosed in a watertight carrier pipe or concrete. In each case the carrier pipe or encasement shall extend ten feet (10') on both sides of the crossing, measured perpendicular to the water main. The carrier pipe shall be materials approved by the City for use. The sewer pipe shall be pressure tested in accordance with paragraph 3.6 of Section 102-3 of this specification.

102.2.4 Stream Crossings:

102.2.4.1 Location of Sewer in Streams: The top of all sewers entering or crossing streams shall be at a sufficient depth below the natural bottom of the stream bed to protect the sewer line. In general, one foot (1') of cover is required where the sewer is located in rock and three feet (3') of cover is required in other material in major streams more than three feet (3') of cover may be required. In paved stream channels, the top of the sewer line should be placed below the bottom of the channel pavement.

102.2.4.2 Construction and Materials: Sewers entering or crossing streams shall be constructed of ductile iron pipe with mechanical joints or concrete encased; otherwise, they shall be constructed so they will remain watertight and free from changes in alignment or grade. Material used to backfill the trench shall be stone, coarse aggregate, washed gravel, or other materials which will not readily erode, cause siltation, damage pipe during placement, or corrode the pipe. Construction methods that will minimize siltation and erosion shall be employed. Such methods shall provide adequate control of siltation and erosion by limiting unnecessary excavation, disturbing or uprooting trees and vegetation, dumping of soil or debris, or pumping silt-laden water into the stream. Exposed areas shall not remain unprotected for more than seven (7) days.

102-3 Testing: 102.2.5 Aerial Crossings: Aerial crossing of sewers shall be avoided, but if approved, shall be in accordance with Section 10 CSR 20-8.120(9) of the Design Guide.

102.3.1 Gravity Sewer Testing:

102.3.1.1 General: All completed gravity sewers shall require pneumatic or hydrostatic testing for the purpose of locating potential infiltration and/or exfiltration within the system. Sewer service lateral lines shall be excluded from testing requirements.

102.3.1.2 Pneumatic Testing Procedure: Performance of low pressure air testing on all sections of completed sewer 8-inch through and including 24-inch diameters, shall be conducted in the presence of the City or City Engineer. It will be the responsibility of the Contractor to furnish and operate equipment capable of making the required tests. Pneumatic plugs shall be utilized to isolate sewer sections for testing. Plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected. Pneumatic plugs shall resist internal test pressure without requiring external bracing or blocking. All air used shall pass through a single control panel and three individual hoses shall be used for connections from the control panel to: 1) pneumatic plugs for inflation; 2) sealed line for introducing the low pressure air; and 3) to the sealed line for continually monitoring the air pressure rise in the sealed line. Equipment shall be Cherne Air-Loc equipment or approved equal. Testing methods and air leakage rates shall conform to ASTM F1417, latest revision, as a minimum. Otherwise, the following procedures shall be followed:

102.3.1.3 Pipe Above Groundwater Table: All pneumatic plugs shall be seal-tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 25 psig. The sealed pipe shall be pressurized to 5 psig. The plugs shall hold against this pressure without bracing and without movement of the plugs of the pipe. After a manhole to manhole reach of pipe has been backfilled and cleaned and the pneumatic plugs are checked by the above procedure, the plugs shall be placed in the line at each manhole and inflated to 25 psig. Low pressure air shall be introduced into this sealed line until the internal air pressure reaches 4 psig greater than the average back pressure of any groundwater that may be over the pipe. At least two minutes shall be allowed for the air pressure to stabilize. After the stabilization period (3.5 psig minimum pressure in the pipe), the air hose from the control panel to the air supply shall be disconnected. The portion of line being tested shall be termed "Acceptable" if the time required in

minutes for the pressure to decrease from 3.5 to 2.5 psig shall not be less than the time shown for the given diameters in the following table:

Pipe Diameter In Inches	Minimum Time (min., sec.)	Max. Length (ft.) for Min. Time	Time (sec.) for Longer Length (L)
4	3:46	597	0.380 L
6	5:40	398	0.854 L
8	7:34	298	1.520 L
10	9:26	239	2.374 L
12	11:20	199	3.418 L
15	14:10	159	5.342 L
18	17:00	133	7.692 L
21	19:50	114	10.470 L
24	22:40	99	13.674 L
27	25:30	88	17.306 L
30	28:20	80	21.366 L
33	31:10	72	25.852 L
36	34:00	66	30.768 L

102.3.1.4 Pipe Below Groundwater Table: In areas where groundwater is known to exist, install a one-half inch diameter capped pipe nipple, approximately 10" long, through the manhole wall on top of one of the sewer lines entering the manhole. This shall be done at the time the sewer line is installed. Immediately prior to the performance of the test, the groundwater shall be determined by removing the pipe cap, blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic tube to the nipple. The hose shall be held vertically and a measurement of the height in feet of water over the invert of the pipe shall be taken after the water has stopped rising in this plastic tube. The height in feet shall be divided by 2.3 to establish the pounds of pressure that will be added to all readings. (For example, if the height of water is 11-1/2 feet, then the added pressure will be 5 psig. This increases the 3.5 psig to 8.5 psig, and the 2.5 psig to 7.5 psig. The allowable drop of one pound and the timing remain the same.)

102.3.2 Testing of Manholes:

102.3.2.1 Vacuum Testing: Vacuum infiltration/exfiltration tests of all manholes shall be done in the presence of the City, to demonstrate that the manholes are free of leaks. And exfiltration or infiltration test shall be performed with a minimum positive head of two feet.

(a) The vacuum "test head" assembly shall be placed inside the frame of the manhole cover, in order to include in the test the seal between the frame and the manhole cone section, slab, or adjusting rings.

(b) Plugs shall be placed at least eight inches inside all pipes entering the manhole. Location of plugs shall be such that when inflated, they are past the gasket seal or joint of the manhole and sewer pipe. All plugs shall be braced sufficiently to prevent the plug or pipe from becoming dislodged and drawn into the manhole.

(c) A vacuum of at least 10½ inches mercury shall be drawn on the manhole. The valve on the vacuum line to the manhole shall be closed, and the vacuum line disconnected. The vacuum within the manhole shall then be adjusted

to 10 inches to mercury by opening the vacuum line valve.

(d) A liquid-filled pressure gauge having a face of 3½ inches and reading from zero to 30 inches of mercury shall be utilized.

(e) The time for the vacuum reading to drop from 10 inches of mercury to 9 inches of mercury must be equal to or less than the following values in order for the manhole to be considered as passing the vacuum test.

<u>Manhole Depth</u>	<u>Time (minutes)</u>
10 feet or less	2.0
10.1 feet to 15 feet	2.5
15.1 feet to 25 feet	3.0

(f) If vacuum drops less than one inch mercury within the test time, the manhole is considered acceptable and passes the test. If manhole fails and leaks, the contractor shall make the needed repairs and test again until satisfactory results are obtained. Test may be done before backfilling, but shall be repeated after backfill.

(g) All safety procedures, placing of plugs, and bracing, labor, and other work required for testing will be the responsibility of the contractor.

102.3.3 Infiltration/Exfiltration Allowance: Infiltration or exfiltration for sewers shall not exceed 100 gallons per inch of pipe diameter per mile per day for any section of sewer (gal/in of pipe diameter/mi/day) for any section between manholes of the system. Infiltration or exfiltration for manholes shall not exceed 1.14 gallons per day per vertical foot of manhole.

102.3.4 Infiltration/Exfiltration Elimination: The Contractor shall locate all sources of infiltration and exfiltration in the sewer lines, manholes, and appurtenances, and shall correct deficiencies and eliminate infiltration/exfiltration sources in a manner approved by the City Engineer. All sections of sewer line, manholes, and appurtenances shall be re-tested after corrections are finalized.

102.3.5 Deflection Test: The rules of the Department of Natural Resources, State of Missouri, 10 CSR 20-8.120 (H)5, state that a deflection test shall be performed on all flexible pipe not less than thirty days after the placement of final backfill. The deflection test shall consist of hand-pulling a rigid ball or mandrel through the installed pipe in the presence of the City Engineer. The rigid ball or mandrel shall have a diameter equal to 95 percent of the inside diameter of the pipe. If the rigid ball or mandrel fails to pull through the pipe, the section being tested fails the test and will be replaced.

102.3.6 Pressure Sewer Testing:

102.3.6.1 All piping that is to convey liquid under pressure shall be hydrostatically tested in conformance with Section 4 of ANSI/AWWA C600, latest revision. Testing shall include both a "pressure test" of at least two hours duration for the purpose of blowing defective joints, and a "leakage test" to determine actual loss of water from the system. The use of compressed air for testing pipe shall not be permitted. During the pressure test, the piping shall be subjected to a hydrostatic pressure equal to 150 percent of the maximum operating pressure in the system, or

75 psi, whichever is greater.

102.3.6.2 Adequately plug and brace, as necessary, the ends of the pressure sewer, whether they be at the lift station or at the discharge manhole, to allow for the hydrostatic testing.

102-4 Roadway Surface Replacement:

102.4.1 All roadway surfaces removed during sewer line construction shall be replaced with a minimum of 6 inches of concrete. Asphalt repairs will only be allowed when the City receives a written request and the City gives written approval. The Contractor shall be responsible for determining the nature and thickness of all pavement and surfacings to be cut and replaced, including any base courses. Concrete pavement, asphaltic pavement, macadam pavements, crushed stone, and any type of roadway surface, whether public or private, which is cut or damaged during construction of the project shall be replaced so as to conform to the lines and grades of the original roadway surface, and shall be of a quality, thickness, and appearance equal to or better than that of the roadway as it existed prior to construction.

102.4.2 Existing paving shall be cut vertically and horizontally to straight lines. The trench shall be backfilled full depth with granular stone material compacted to 95 percent of maximum density, to an elevation level with the existing riding surface of the roadway. This level shall be maintained by the Contractor until all secondary settling has occurred. Any crushed stone required to maintain the trenches in a suitable condition for traffic during this period shall be furnished at the Contractor's expense. When the trench has been properly backfilled and has settled sufficiently to permit final repairs, roadway surfacing shall be applied according to this specification. At the time of final repairs, the Contractor shall remove sufficient material to allow placement of roadway surfacing to the thicknesses specified above.

102.4.2.1 Granular stone backfill shall meet the gradation requirements specified in Paragraph 101.5 of this Division.

102.4.3 Crushed Stone: Trenching along or across unpaved roadways, including county roads, and city streets, as well as dirt, or gravel shoulders of paved streets, roads, or highways, shall be backfilled with granular stone material in compliance with these specifications. The trench shall be backfilled to a level with the existing riding surface of the roadway. When the trench has been properly backfilled and has settled sufficiently to permit final repairs, the backfill shall be removed as necessary for crushed stone surfacing. The crushed stone surfacing shall be as set forth in Section 501-4 of these specifications, and shall be rolled and thoroughly compacted in layers to a minimum finished thickness of 6 inches.

102.4.4 Concrete, Asphaltic Concrete, and Chip and Seal: Pavement surfaces, including private drives, shall be replaced with concrete surfacing equal to the thickness of existing pavement, plus a minimum of 2 inches. Concrete shall have a minimum 28-day compressive strength of 3500 psi. Total thickness of concrete shall be a minimum of 6 inches.

102-5 Clean-up:

102.5.1 After completion of any portion of work, the construction area shall be cleaned of all surplus material, earth, rubbish, etc. and left in as near the original state as possible. All ditches and drainage shall be restored to their original condition.

- 102.5.2 All grassed areas shall be seeded, fertilized, and mulched as required to restore the area to a condition equal to that which existed prior to construction.

102-6 Highway, Railroad, and Stream Crossings:

- 102.6.1 Where designated on the approved design drawings, underground highway and railroad crossings shall be installed. Such installations shall be accomplished by tunneling, boring, or jacking methods. Each method shall provide for removal of earth and rock encountered during installation of the carrier and casing pipes. Where jacking or tunneling are utilized, the annular space between the casing and earth shall be pressure grouted with neat cement grout.
- 102.6.2 Highway crossings shall be made in strict compliance with Missouri Department of Transportation requirements. No highway crossings shall be installed without the Contractor first obtaining all necessary permits from the Missouri Department of Transportation.
- 102.6.3 Railroad crossings shall be made in strict compliance with railroad company requirements. No railroad crossings shall be made without the Contractor first obtaining all necessary permits from the railroad company.
- 102.6.4 Installation of stream crossings shall be as shown on the standard details. Where trenching is utilized to install stream crossings, backfilled stream banks shall be protected from erosion by placement of stone riprap. Stream crossings shall be in accordance with Section 102-2 of this specification.
- 102.6.5 The Contractor shall insure that traffic interruptions are minimized during the underground excavation operations. After the operation is completed, the Contractor shall slide the sewer pipe in place. The pipe shall be supported by PSI Ranger II non-metallic casing spacers, as manufactured by Pipeline Seal and Insulator, Inc. or an approved equal. Casing spacers shall be spaced a maximum of eight (8) feet apart along the length of the carrier pipe with one casing spacer within two (2) feet of each side of a pipe joint. Wood skids are not an acceptable method of supporting the carrier pipe. Once the carrier pipe has been fixed, the annular space at each end of the casing pipe shall be sealed by installing 1/8" thick synthetic rubber end seal, PSI Model "C", as manufactured by Pipeline Seal and Insulator, Inc., or an approved equal.
- 102.6.6 The Contractor shall take precautions to insure that the sewer pipe is on line and grade following the installation operation.

102-7 Pumping Station Chain Link Fences and Gates

- 102.7.1 Line posts for pumping station fence shall be spaced at intervals not to exceed 10 feet average when measured from center to center between terminal posts. In general in determining the post spacing, measurement will be made parallel to the slope of the natural ground, and all posts shall be placed in a vertical position. All posts shall be set in holes of diameter and depth as follows:

<u>Type of Post</u>	<u>Fabric Height</u>	<u>Hole Dia. At Top</u>	<u>Hole Depth</u>	<u>Post Embedment</u>
Line	6'-12'	9"	38"	36"
Terminal	6'-12'	12"	38"	36"

102.7.2 After the post has been set and plumbed, the hole shall be filled with fill concrete. The exposed surface of the concrete shall be crowned to shed water.

102.7.3 Where solid rock is encountered without an overburden of soil, line posts shall be set a minimum depth of 12 inches, and end, corner, gate and pull posts a minimum of 18 inches into the solid rock. The hole shall have a minimum width one inch greater than the largest dimension of the post section to be set.

102.7.4 After the post is set and plumbed, the hole shall be filled with grout consisting of one part Portland cement and three parts clean, well graded sand. Other grouting materials may be used if approved by the City in writing in advance. The grout shall be thoroughly worked into the hole so as to leave no voids. The grout shall be crowned to carry water from the post.

102.7.5 Where solid rock is covered by an overburden of soil or loose rock, the posts shall be set to the full depth unless the penetration into solid rock reaches the minimum depths specified above, in which case, the depth of penetration may be terminated. Concrete footings shall be constructed from the solid rock to the top of the ground. Grouting will be required on the portion of the post in solid rock.

102.7.6 End, corner, gate and pull posts shall be braced to the nearest post with a horizontal galvanized pipe brace used as a compression member, and a galvanized 3/8-inch steel truck rod and trust tightener used as a tension member. All members in direction of fence line of 30 degrees or more shall be considered as corners. Pull posts shall be used at all abrupt changes in grade.

102.7.7 Barbed wire support arms shall be placed on the side of the fence as designated by the Owner or his representative.

102.7.8 The fabric shall be stretched taut approximately two (2) inches above the ground, and securely fastened to the posts. The fabric shall be cut and each span shall be attached independently at all terminal posts. Fastening to terminal posts shall be with stretcher bars and fabric bands spaced at 15-inch intervals maximum. Fastening to line post shall be with tie wire, metal bands, or other approved methods, attached at maximum 15-inch intervals. The top edge of the fabric shall be fastened to the top rail with wire ties at intervals not exceeding 24 inches. The bottom edge of fabric shall be fastened to the bottom tension wire with wire ties at intervals not exceeding two feet.

102.7.9 Rolls of wire fabric shall be joined by weaving a single strand into the ends of the rolls to form a continuous mesh.

DIVISION 200
CONSTRUCTION MATERIALS AND METHODS
FOR
POTABLE WATER SYSTEM

POTABLE WATER SYSTEMS 200

201 MATERIALS

201-1 Water Distribution Line shall be PVC or ductile iron pipe meeting the following specifications:
All pipes, fittings, and appurtenances shall contain less than 0.25 percent lead calculated by weighted average.

201.1.1 PVC pipe shall be solid wall meeting the requirements of ASTM D2241, latest revision, with minimum wall thickness SDR 21 (Class 200) or thicker wall, as called for on the drawings. All pipe must bear the National Sanitation Foundation seal for potable water pipe. Pipe shall have an integral bell with a locked-in, solid cross section elastomeric gasket that meets the requirements of ASTM F477, latest revision. Provisions must be made for contraction and expansion at each rubber ring bell and spigot joint. Pipe shall be made from clean, virgin, NSF approved PVC material conforming to ASTM D1784, latest revision.

201.1.1.1 SDR 21 PVC pipe shall be suitable for use at maximum hydrostatic pressures of 200 PSI at 73°F.

201.1.1.2 Physical and Chemical Tests: Pipe shall meet the following physical and chemical test requirements. All physical and chemical tests shall be conducted at 73°F ±3.6°F.

<u>Test</u>	<u>ASTM Ref.</u>	<u>Requirements</u>
Quick Burst Test	D1599	630 PSI applied in 60 to 70 sec.
Sustained Pressure Test	D1598	1000 hrs. @ 420 PSI
Acetone Immersion Test	D2152	No visible spalling or cracking after 20 minutes
Vise Test	--	No splitting or shattering when compressed 60% in 2 to 5 minutes

201.1.2 Ductile iron pipe for 3-inch through 12-inch size shall be pressure class 350 and shall conform to the latest revision of ANSI A21.51 - (AWWA C151) Standard for Ductile Iron Pipe Centrifugally Cast in Metal Molds or Sand Lined Molds, for Water or Other Liquids. The pipe shall be standard asphaltic varnish coated on the outside. Pipe shall be cement mortar lined in conformance with ANSI A21.4-90 (AWWA C104) unless specified otherwise.

201.1.2.1 Joints for ductile iron pipe that is to be buried shall be push-on type consisting of a single neoprene gasket which are acceptable are "Tyton" as manufactured and licensed by the U.S. Pipe and Foundry Company' "Fastite" as manufactured and licensed by the American Cast Iron Pipe Company; and "Bell-Tite" as manufactured and licensed by James B. Clow and Son, Inc. All required joint materials including the neoprene gasket and the lubricant shall be furnished with the pipe.

201.1.3 Water Line Fittings: Fittings to be used with water distribution lines larger than 4 inches in diameter shall have the same pressure rating as the pipe used and be either gray iron or ductile iron, and shall conform to the requirements of ANSI/AWWA C110/A21.10 or C153/A21.53, latest revisions. All mechanical joint fittings shall be pressure class 350 ductile iron. Fittings shall be standard asphaltic varnish coated on the outside. Fittings shall be cement mortar lined in conformance with ANSI A21.4

(AWWA C104), latest revision. Fittings shall be mechanical joint or push-on joint and shall meet all applicable requirements of ANSI 21.11 (AWWA C111), latest revision.

201.1.3.1 Fittings for water distribution lines four (4) inches in diameter and smaller shall be of the same material and pressure rating as that of the pipe.

201-2 Water Service Line & Appurtenances: Water service line shall be solvent weld PVC pipe or polyethylene tubing meeting the following specifications:

201.2.1 PVC pipe for water service lines shall be solvent weld PVC pressure pipe, Schedule 80, meeting the requirements of ASTM D1785, latest revision. All pipe shall bear the National Sanitation Foundation seal for potable water pipe. Pipe shall be made from clean, virgin, NSF approved material conforming to ASTM D1784, latest revision. All connections shall be joined by primer and PVC solvent cement conforming to ASTM D2564, latest revision.

201.2.2 Polyethylene Service Line: Shall be polyethylene tubing, minimum 1" diameter, PE2406, Class 160, IDR 7, conforming to AWWA C901, latest revision.

201.2.3 Service Saddles: Shall be a full circle brass saddle suitable for installation on PVC or DIP pipe. The outlet shall be 1" minimum.

201.2.4 Corporation stops shall be designed and manufactured to conform to AWWA Standard C800-84, and shall be designed to withstand working pressures up to 250 PSI.

201.2.4.1 Inlet Threads: Shall be AWWA Standard thread.

201.2.4.2 Outlet Threads: Shall be suitable for water service line subject to approval of the City Engineer.

201.2.5 Water Service Meters and Appurtenances:

201.2.5.1 Water Meters: Shall be purchased from the City. Each new service connection shall be individually metered.

201.2.5.2 Coppersettors: Shall be provided for each water service meter. Coppersettors shall have a brace eye for installation of a cross-brace. Coppersettors shall have inlet and outlet compatible for the size and type of water service line. An inverted key valve with padlock wings shall be provided at the meter inlet, and a dual angle check valve shall be provided at the meter outlet. In lieu of coppersettors, the City may approve the use of a fabricated setter of equal performance.

201.2.5.3 Meter Pits and Covers: Meter pits shall be ribbed and of Type 1, Grade 2 PVC conforming to ASTM D1784, latest revision, reinforced concrete pipe, or PVC Schedule 35. Pit shall be minimum 18" diameter by 24" deep. Flat meter pit covers of cast iron and of the size required to fit the meter pits shall be provided. Covers shall be stamped "Water Meter".

201-3 Valves and Hydrants:

201.3.1 Gate Valve and Box:

201.3.1.1 All gate valves shall be iron body, with mechanical joint restraints, non-rising stem with O-ring gaskets. The valves shall be equipped with a two-inch square operating nut.

201.3.1.2 Gate valves shall conform to AWWA C500 (Metal Seated Gate Valves)

or AWWA C509 (Resilient Seated Gate Valves), latest revisions for design working water pressures of 200 psig for valves 12 inches NPS in diameter or smaller, and 150 psig for valves with diameter 14 inches NPS and larger.

201.3.1.3 Valve Boxes: Valve boxes shall be required for all buried valves, and shall be cast iron. The valve box shall have a round top with open base. A top cover will be provided, marked "water". The valve box shall be of the two-piece screw type with top piece capable of adjustment to final grade.

201.3.2 Fire Hydrants and Appurtenances:

201.3.2.1 Materials:

201.3.2.1.1 Gate Valve and Box: Shall be located adjacent to each fire hydrant for isolation of the hydrant for repairs. Gate valves and boxes shall be as specified in Section 3.1 - GATE VALVE AND BOX.

201.3.2.1.2 Fire Hydrants: Shall meet or exceed requirements set forth in AWWA Standard C502, latest revision. Hydrants shall be dry barrel traffic model with break flange construction. Outlets shall be three-way and as required for the Fire Department's pumper and/or hose sizes and threads. Operating nut shall also be of the type in use by the City. Contractor shall be solely responsible for insuring compatibility of City's equipment and hydrants. Inlet shall be mechanical joint type and main valve size shall be 5/4 inch. Acceptable manufacturer is Mueller.

201.3.2.2 Testing: All fire hydrants shall be flow tested to verify the maximum flow that each fire hydrant can produce with dropping the system pressures below 20 psig. If a throttling mechanism is used, it shall then be set at the maximum flow that will not drop system pressures below 20 psig. The bonnet and nozzle caps of each hydrant should be painted the appropriate color to indicate the hydrants flow class in accordance with local fire authority requirements, based on the results of the flow test.

201-4 Pipe Bedding Material:

201.4.1 Granular Stone: Granular stone pipe bedding material shall be crushed limestone consisting of aggregate particles meeting the requirements of ASTM C-33, latest revision. Embedment material diameter shall be no greater than 1/2-inch for 4-inch diameter pipe, 3/4-inch for 6 and 8-inch diameter pipe, and 1-inch for pipe 10-inches or greater in diameter, 1-inch to No.16 gradation as follows:

Sieve Size	Percent Passing		
	≤4-inch Dia. Pipe	6 thru 8-inch Dia. Pipe	≥10-inch Dia. Pipe
1"			100
3/4"		100	90 - 100
1/2"	100		
3/8"	85 - 100		20 - 55
No. 4	10 - 30	0 - 15	0 - 10
No. 8	0 - 10	0 - 5	0 - 5
No. 16	0 - 5		

201.4.2 Sand: All sand used for bedding shall be clean, graded from fine to coarse, not lumpy or frozen, and free from slag, cinders, ashes, rubbish, or other material that, in the opinion of the Engineer, is objectionable or deleterious. It should not contain a total of more than 10 percent by weight, of loam and clay, and all material must be capable of being passed through a 3/4-inch sieve. Not more than five percent shall remain on a No. 4 sieve.

201-5 Steel Casing Pipe:

Steel pipe for casing at highway and railroad crossings shall conform to AWWA C200 or AWWA C209, latest revision.

201-6 Tracer wire:

201.6.1 All non-metal pipes shall be installed with tracer wire to facilitate future location of pipe. However, tracer wire is not a substitute for accurate as-built plans, GIS mapping, or individual fixture record on each extension or modification of a system.

201.6.2 Tracer wire shall be designed to withstand buried use, expected soil conditions, and provide water proof connection at each splice. All tracer wire for new installation shall be tested before acceptance. Detectable warning tape is not a substitute for tracer wire.

202 INSTALLATION PROCEDURES

202-1 Trenching, Bedding, Backfilling, and Compacting

202.1.1 Trench Excavation:

202.1.1.1 Trench Depth: Trenches shall be cut as deep as necessary on either side of natural depressions, ditches, waterways, etc. to provide for not less than 42 inches of cover over the top of the pipe. Depth of cover shall be measured from the outside top of the pipe vertically to the original ground surface or pavement surface. Mounding over the trench to attain the specified cover shall not be permitted. Trenches shall be cut so as to prevent high spots that could lead to "air binding" of the water line. Trenches shall be excavated to four (4) inches below the bottom of the pipe to provide clearance for not less than four (4) inches of pipe bedding material. Rocks and hard objects larger than one (1) inch in diameter found in the trench shall be removed for a depth of six (6) inches below the bottom of the pipe. The maximum degree of deflection, either vertical or horizontal, shall not cause a pipe joint's annular clearance in the bell to be less than one-fourth (1/4) inch at its closest point. In the case the trench is excavated at any place more than four (4) inches below grade, it shall be filled to the design grade with approved bedding material. Trench excavation shall, in all cases, be continuous from the ground surface to the established trench depth. Gutters and ditches shall be kept clear, or other satisfactory provisions shall be made to facilitate drainage. Ground adjacent to trench shall be graded so as to prevent water from flowing into the trench. Provisions shall be made for the continuous flow of all waterways, ditches, drains, or sewers encountered during construction. All ditches and waterways shall be restored to their original conditions as soon as possible.

202.1.1.2 Trench Width: The width of the trench, as dug, from the trench bottom to the top of the pipe, shall not exceed the outside diameter of the pipe bell or socket plus 12 inches, or 24 inches, whichever is greater. Trench width above the top of the pipe shall be as required by field conditions to prevent sliding and caving of the excavation.

202.1.2 Sheeting, Shoring, or Bracing: Sheeting, shoring, or bracing shall be placed wherever necessary for the proper preserving of any excavation, embankment, or structure. Where the ground is of such a character or other conditions are such as to render it necessary, the sheeting shall be closely driven and to such depth below the lowest point of the final excavation as may be required. Shore up, protect, and insure from injury all buildings, retaining walls, piers and footings, storm sewers, sanitary sewers, gas lines, water lines, fences, curbs, trees, or other property liable to be injured during the process of the work. Sheeting, shoring, and bracing shall be provided, installed, and maintained to protect the excavation and insure open trench operations.

202.1.3 Placement of Bedding Material:

202.1.3.1 Granular Stone Pipe Bedding: Granular stone shall be placed in the trench and shaped so as to provide uniform support for the bottom quadrant of the pipe barrel. The bedding shall be not less than four (4) inches in thickness. Following placement of the pipe, the trench shall be filled with granular stone bedding material to a minimum compacted depth of six (6) inches above the pipe barrel.

202.1.3.2 Sand Pipe Bedding: Sand shall be shaped and placed similar to the granular stone specified above.

202.1.4 Backfilling:

202.1.4.1 Material used for backfilling of trenches shall be free from perishable matter and from other material liable to become unstable when saturated with water after having been compacted. No frozen material shall be used in backfill. Care shall be taken to prevent damage to the pipe and structures. Special precautions shall be taken in backfilling over pipes. No backfill shall be placed over any portion of pipes and/or joints not inspected by the City Engineer. The bedding material shall be brought to a depth of at least six inches over the top of the pipe bell, with this material carefully deposited in uniform layers not exceeding six inches in depth, and each layer carefully and solidly tamped with mechanical tampers in such a manner as to avoid damage to pipe or disturbing completed work. Unless noted otherwise on the drawings, backfilling for the remainder of the trench shall be previously excavated gravel, sand, or earth, and shall contain no stone over ten inches in its largest dimensions. Stones smaller than that size may be used in proportion not exceeding one part of stone and three parts of earth in any place. This backfilling shall be deposited and spread in layers and solidly tamped. Except as specified for roadway crossings, trench backfill shall be compacted to 80 percent of the maximum density at optimum moisture. As the trenches are backfilled, remove all surplus material and regrade the surface, leaving it in good order. The trenches shall be filled to the ground surface elevation which previously existed.

202-2 Installation:

202.2.2 Pipe Installation:

202.2.2.1 General: Only workers competent at laying pipe shall be employed on this phase of the work, and complete suitable equipment necessary for the execution of same is required. Any incompetency observed must be removed, and where improper equipment or lack of same appears to be impairing the quality or speed of the work, such adjustment in same shall be made.

202.2.2.2 The pipe, fittings and valves shall be placed in the trench with care. Under no circumstances shall pipe or other materials be dropped or dumped into the trench. If plastic pipe is used, the pipe shall be snaked into the trench, either employing the natural snaking tendency of some plastic pipe or the pipe shall be laid from one side to the other on alternate lengths.

202.2.2.3 Pipe Cleaning During Laying Operations: The pipe, if furnished from the factory with dust covers over the ends, shall be examined carefully during laying operations to insure that such covers are not lost inside the pipe. At the termination of pipe laying, the open end of the pipeline shall be closed off by a suitable cover until laying operations are resumed. No pipe shall be placed in the trench unless it is intended to make the joint to the pipeline at that time.

202.2.2.4 Inspection of Materials During Construction: Any materials not meeting the specifications, or obviously faulty material, shall be rejected and removed from the job site.

202.2.2.5 Joining Pipe: In joining sections of pipe, the installer shall use good working practices. All pipe ends shall be cleaned thoroughly inside and out before application of lubricant. The recommendations of the manufacturer of the pipe shall be followed closely in joining this type of pipe. Care shall be taken in lowering pipe into the trench in order that a tensile stress is not created that would cause partial or complete separation of the joints. Mechanical joint restraints, such as a retainer gland, restraint, harness, etc., shall be used to restrain bends, tees, crosses, reducers, and other fittings. Concrete thrust blocks shall not be used.

202.2.2.6 Breaks in Pipe and Joints: Breaks in the pipe or joints shall be repaired.

202.2.2.7 Bedding of Plastic Pipe: The Contractor shall bed the pipe in accordance with the requirements of Section 202-1 - TRENCHING, BACKFILLING, AND COMPACTING.

202.2.2.8 Allowance for Expansion: Expansion and contraction of PVC pipe is relatively great. Snake the pipe in the trench or allow in other ways for some expansion or contraction of the pipe.

202.2.2.9 Avoidance of Unnecessary Bends: Excessive bends in the alignment of the pipe will not be permitted. Where obviously required, sweep ells shall be used in making connections between two sections having differing alignment. Standard 90E elbows are not to be used, except in confined locations.

202.2.2.10 Water in Trench: Pipe shall not be laid in a trench containing standing water. A pump(s) and appliances of sufficient capacity shall be furnished and operated by the installer to prevent interference of water, ice, or snow with installation of the pipe. No structure or pipe shall be placed in water, and water shall not be allowed to run into or cover any concrete work or pipe, or into or through any pipe.

202.2.3 Anchorage of Bends, Tees, and Plugs: All tees, plugs, caps, and bends exceeding 22-1/2°± shall be restrained with mechanical joint restraints, such as a retainer gland, restraint harness, etc. Concrete thrust blocks shall not be used.

202.2.4 Water Mains Near Sewers: The requirements for parallel installation and crossings apply to water mains and any existing or proposed line carrying non-potable fluids such as, but not limited to, drains, storm sewers, sanitary sewers, combined sewers, sewer service connections, and process waste or product lines.

202.2.4.1 Horizontal Separation: Water mains shall be laid at least ten feet horizontally from any existing or proposed drain, sewer line, or lines carrying non-potable fluids. The distance shall be measured edge of pipe to edge of pipe. In cases where it is not practical to maintain a ten-foot separation, the department may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the water main closer to a sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer and in 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 the sewer line shall be constructed of mechanical joint pipe. Casing pipe must be a material that is approved for use.

202.2.4.2 Vertical Separation: Water mains crossing sewers, storm drains, sanitary sewers, or any non-potable line shall be laid 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 ten 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 the sewer line shall be constructed of mechanical joint pipe that extends no less than ten feet on both sides of the crossing. Casing pipe must be a material that is approved for use.

202.2.4.3 Unusual Conditions: Where it is necessary for the water main to pass under a sewer line, the water main must be laid with ductile iron pipe, or shall be PVC piping with a steel casing, both of which must extend on each side of the crossing until the normal distance from the water main to the sewer is at least ten feet. In making such crossings, a full length of pipe must be centered over or under the sewer to be crossed so that the joints will be equally distant from the sewer and as remote therefrom as possible, but in no case, less than ten (10) feet. The sewer line must also be constructed of ductile iron pipe with mechanical, compression, or leaded joints until the normal distance from the sewer to the water main is at least ten feet. Where a water main must cross under a sanitary sewer, a vertical separation of at least 18 inches between the bottom of the sewer line and the top of the water main must be maintained with adequate support for the larger size sewer lines to prevent them from settling or their breaking the water main. Where these conditions cannot be met, the Missouri Department of Natural Resources shall be consulted as to the precautions to be taken to protect the public water supply.

202.2.4.4 No water line shall be located closer than ten (10) feet to any part of a sanitary or combined sewer manhole.

202.2.4.5 Force Mains: There shall be at least ten foot horizontal separation between water mains, sanitary sewer force mains and other force mains carrying non-potable fluids, and they shall be in separate trenches. In areas where these separations cannot be obtained, either the water line or the sewer line shall be cased in a continuous casing.

202.2.4.6 Disposal Facilities: No water line shall be located closer than 25 feet to any on-site wastewater disposal facility, agricultural waste disposal facility, or landfill.

202.2.5 Water Mains Near Other Utilities: Water mains shall be located at least 10 feet horizontally from any existing or proposed oil and gas lines, and buried electric lines. In cases where the specified separation of 10 feet cannot practically be maintained, the City may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the water line closer to existing or proposed utilities, provided that the water line is in a separate trench. Under no circumstances, however, shall a water line be installed closer than 12 inches to other existing or proposed utilities.

202-3 Testing, Flushing, and Disinfecting:

202.3.1 Testing: Installed water lines shall be hydrostatically tested. The test shall be conducted with all meter settings in place and the angle valve closed. Prior to conducting the test, the water line and fittings shall be backfilled. All air shall be expelled from the pipeline prior to the test by use of air release valves, hydrants, or taps. Taps shall be plugged after testing is completed. The test procedure shall be in accordance with the latest edition of AWWA standards and as specified below:

202.3.1.1 Test pressure shall not be less than 1.25 times the stated anticipated maximum sustained working pressure of the pipeline measured at the highest elevation along the test section and not less than 1.50 times the stated sustained working pressure at the lowest elevation of the test section. The duration of the hydrostatic test shall be 2 hours.

202.3.1.2 The pipeline shall be pressurized using a hand or motor-operated pump equipped with a shut-off valve, pressure relief valve, and a gauge located to read the line pressure when the pump valve is closed.

202.3.1.3 At the end of the 2-hour test period, water shall be pumped into the system to bring the pipeline back up to the test pressure. The volume of water required shall be measured with an approved meter or by pumping from a calibrated vessel. The pipe or installation shall not be accepted unless or until the leakage test is conducted. Leakage shall be defined as the quantity of water that must be supplied into the new laid pipe, or any valved section thereof, to maintain pressure within 5 psi ± of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.

202.3.1.4 The pipe installation will be accepted if the leakage is less than or equal to that determined by the following formula:

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

In which L is the allowable leakage in gallons per hour; S is the length of pipeline tested in feet; D is the nominal diameter of the pipe in inches; and P is the average test pressure during the leakage test, in pounds per square inch gauge. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gal/hr/in. of nominal valve size shall be allowed.

202.3.1.5 Any test section not meeting the requirements of this specification shall be repaired and retested until the test requirements are satisfied. Defective pipe, valves, fittings, hydrants, or other appurtenances shall be removed and replaced.

202.3.1.6 The pressure test shall be performed in the presence of the City Engineer or his representative. A written report shall be made by the installer during the test showing the test section, test pressure, test results, and other pertinent data.

202.3.2 Flushing and Disinfecting: The completed water distribution system shall be flushed and disinfected in accordance with AWWA C651, latest revision. The "Continuous-Feed Method" shall be utilized. This method is summarized below:

202.3.2.1 Calcium hypochlorite granules shall be placed in pipe sections during construction. Granules shall be placed at upstream end of the first section of pipe, at the upstream end of each branch main, and at 500 foot intervals. Calcium hypochlorite granules shall not be placed within solvent weld PVC pipe or in screwed joint steel pipe. The following table shows the amount of granules needed based on pipe diameter.

<u>Pipe Dia., in.</u>	<u>Calcium Hypochlorite Granules, oz.</u>
4	1.7
6	3.8
8	6.7
10	10.5
12	15.1
14 and larger	$D^2 \times 15.1$

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

202.3.2.2 Prior to disinfection, the completed water line shall be filled and flushed. All air shall be expelled from the pipeline as described in paragraph 3.1 of this specification. The flushing velocity shall not be less than 2.5 feet per second (fps). The following table shows the approximate rates of flow required to produce a velocity of 2.5 fps in pipes of various diameters:

<u>Pipe Dia., In.</u>	<u>Approx. Flow Req'd. To Produce 2.5 fps, GPM</u>
1	10
2	30
3	65
4	105
6	230
8	390
10	620
12	890

202.3.2.3 Potable water from an approved source shall be introduced into the water line at a constant, measured rate. At a point no more than 10 feet downstream from the beginning of the new water line, water entering the line shall receive a dose of one percent chlorine/water solution, fed at a rate such that the water shall have not less than 25 mg/l free chlorine. Measure the chlorine concentration at regular intervals using appropriate chlorine test kits. The following table shows the gallons of one percent chlorine/water solution required per 100 feet of pipe to produce a 25 mg/l concentration in the pipeline:

<u>Pipe Dia., In.</u>	<u>Gallons of 1% Solution Req'd. Per 100 Ft. of Pipe</u>
101
205
311
418
638
865
10	1.02
12	1.47

202.3.2.4 Approximately one pound of liquid chlorine (100% available chlorine) is required for 12 gallons of water to produce a one percent solution. Approximately one pound of calcium hypochlorite (HTH) is required per 8 gallons of water to produce a one percent solution.

202.3.2.5 The chlorinated water shall be allowed to stand in the new water line for at least 24 hours, during which time all valves and hydrants shall be operated. At the end of the 24-hour period, water in all portions of the line shall have a residual of not less than 10 mg/l free chlorine. If a concentration less than 10 mg/l is found after the

24-hour period, the entire disinfection procedure shall be repeated by the Contractor at his expense.

202.3.2.6 Upon satisfactory completion of the disinfection procedure, the heavily chlorinated water shall be flushed from the system until the chlorine concentration throughout the entire system is no higher than one 1 mg/l or the chlorine concentration of the water source. Prolonged chlorinated exposure to the pipe shall be avoided in order to prevent damage to the pipe lining or corrosion damage to the pipe. The environment to which the heavily chlorinated water is to be discharged shall be inspected. If the chlorinated discharge will cause damage to the environment, a neutralizing chemical shall be applied to the water to be wasted to thoroughly neutralize the residual chlorine. Where necessary, federal, state, or local regulatory agencies should be contacted to determine special provisions for the disposal of heavily chlorinated water.

202.3.2.7 After final flushing and filling of the system and prior to placing the system in service, the installer shall arrange with the Missouri Department of Natural Resources for collecting samples for required tests. If bacteriological test results are unsatisfactory, the entire disinfection procedure shall be repeated by the Contractor at his expense. The installer shall be available to assist the Missouri Department of Natural Resources in collecting samples if required.

202-4 Roadway Surface Replacement:

202.4.1 All roadway surfaces removed during water line construction shall be replaced with a minimum of six inches of concrete. Asphalt repairs will only be allowed when the City receives a written request and the City gives written approval. The Contractor shall be responsible for determining the nature and thickness of all pavement and surfacings to be cut and replaced, including any base courses. Concrete pavement, asphaltic pavement, macadam pavements, crushed stone, and any type of roadway surface, whether public or private, which is cut or damaged during construction of the project shall be replaced so as to conform to the lines and grades of the original roadway surface, and shall be of a quality, thickness, and appearance equal to or better than that of the roadway as it existed prior to construction.

202.4.2 Existing paving shall be cut vertically and horizontally to straight lines. The trench shall be backfilled with granular stone material compacted to 95 percent of maximum density, to an elevation level with the existing riding surface of the roadway. This level shall be maintained by the Contractor until all secondary settling has occurred. Any crushed stone required to maintain the trenches in a suitable condition for traffic during this period shall be furnished at the Contractor's expense. When the trench has been properly backfilled and has settled sufficiently to permit final repairs, roadway surfacing shall be applied according to this specification. At the time of final repairs, the Contractor shall remove sufficient material to allow placement of roadway surfacing to the thicknesses specified below.

202.4.2.1 Granular stone backfill shall meet the gradation requirements specified in Paragraph 201-4 of this Division.

202.4.3 Crushed Stone: Trenching along or across unpaved roadways, including county roads, and city streets, as well as dirt, or gravel shoulders of paved streets, roads, or highways, shall be backfilled in compliance with these specifications. The trench shall be backfilled to a level with the existing riding surface of the roadway. When the trench has been properly backfilled and has settled sufficiently to permit final repairs, the backfill shall be removed as necessary for crushed stone surfacing. The crushed stone surfacing shall be as set forth in Section 501-4 of these specifications and shall be rolled and thoroughly compacted in layers to a minimum finished thickness of 6 inches.

202.4.4 Concrete, Asphaltic Concrete, and Chip and Seal: Pavement surfaces, including private drives, shall be replaced with concrete surfacing equal to the thickness of existing pavement, plus a minimum of 2 inches. Concrete shall have a minimum 28-day compressive strength of 3500 psi. Total thickness of concrete shall be a minimum of six inches.

202-5 Clean-up:

202.5.1 After completion of any portion of work, the construction area shall be cleaned of all surplus material, earth, rubbish, etc. and left in as near the original state as possible. All ditches and drainage shall be restored to their original condition.

202.5.2 All grassed areas shall be seeded, fertilized, and mulched as required to restore the areas to a condition equal to that which existed prior to construction.

202-6 Highway and Railroad Crossings: Where designated on the approved design drawings, underground highway and railroad crossings shall be installed. Such installations shall be accomplished by tunneling, boring, or jacking methods. Each method shall provide for removal of earth and rock encountered during installation of the carrier and casing pipes. Where jacking or tunneling are utilized, the annular space between the casing and earth shall be pressure grouted with neat cement grout.

202.6.1 Highway crossings shall be made in strict compliance with Missouri Department of Transportation requirements. No highway crossings shall be installed without the Contractor first obtaining all necessary permits from the Missouri Department of Transportation.

202.6.2 Railroad crossings shall be made in strict compliance with railroad company requirements. No railroad crossings shall be made without the Contractor first obtaining all necessary permits from the railroad company.

202.6.3 The Contractor shall insure that traffic interruptions are minimized during the underground excavation operations. After the operation is completed, the Contractor shall slide the water pipe in place. The pipe shall be supported by PSI Ranger II non-metallic casing spacers, as manufactured by Pipeline Seal and Insulator, Inc. or an approved equal. Casing spacers shall be spaced a maximum of eight (8) feet apart along the length of the carrier pipe with one casing spacer within two (2) feet of each side of a pipe joint. Wood skids are not an acceptable method of supporting the carrier pipe. Once the carrier pipe has been fixed, the annular space at each end of the casing pipe shall be sealed by installing 1/8" thick synthetic rubber end seal, PSI Model "C", as manufactured by Pipeline Seal and Insulator, Inc., or an approved equal.

202-7 Stream Crossings: Where designated on the approved design drawings, underground stream crossings shall be installed. Installation shall be by trenching or longitudinal boring methods.

202.7.1 Carrier pipe shall be of restrained joint SDR21 PVC pipe, Yellowmine with Certa-Lok joints, as manufactured by Certainteed Corporation.

202.7.2 Casing pipe shall be SDR 21 PVC pipe as specified in Section 201-1 of this division.

202.7.3 Installation of stream crossings shall be as shown on the standard details providing a minimum cover of four feet. Where trenching is utilized to install stream crossings, backfilled stream banks shall be protected from erosion by placement of stone riprap.

202.7.4 After the trenching or boring operation is completed, the Contractor shall slide the water pipe in place. The pipe shall be supported by PSI Ranger II non-metallic casing spacers,

as manufactured by Pipeline Seal and Insulator, Inc. or an approved equal. Casing spacers shall be spaced a maximum of eight (8) feet apart along the length of the carrier pipe with one casing spacer within two (2) feet of each side of a pipe joint. Wood skids are not an acceptable method of supporting the carrier pipe. Once the carrier pipe has been fixed, the annular space at each end of the casing pipe shall be sealed by installing 1/8" thick synthetic rubber end seal, PSI Model "C", as manufactured by Pipeline Seal and Insulator, Inc., or an approved equal.

202.7.5 If the stream has permanent flow and the crossing width is greater than 15 feet, the crossing shall be constructed in accordance with the provisions set forth in Section 8.7.2 of the Design Guide for Community Water Systems, published by the Missouri Department of Natural Resources, reproduced as follows:

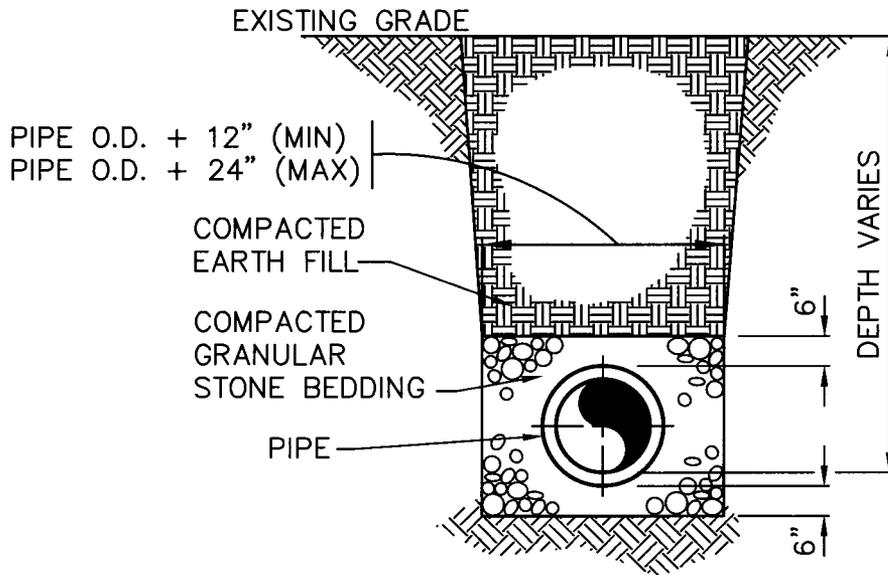
202.7.5.1 The pipe shall be of special construction, having flexible watertight joints. Steel or ductile iron ball-joint river pipe shall be used for open cut crossings. Restrained joint pipe may be used for open cut crossings, provided it is encased in a welded steel casing. Restrained joint or fusion weld pipe shall be used for bored crossings. Adequate support and anchorage shall be provided on both sides of the stream.

202.7.5.2 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; and the valve closest to the supply source shall be in an accessible location.

202.7.5.3 Permanent taps shall be provided on each side of the valve within the manhole to allow insertion of a small meter to determine leakage and for sampling purposes.

202.7.5.4 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.

202.7.6 If the stream is an intermittent flowing stream, restrained joint pipe shall be used, extending at least 15 feet beyond the upper edge of the stream channel on each side of the stream.



SEWER LINE TRENCH & BEDDING DETAIL

N.T.S.

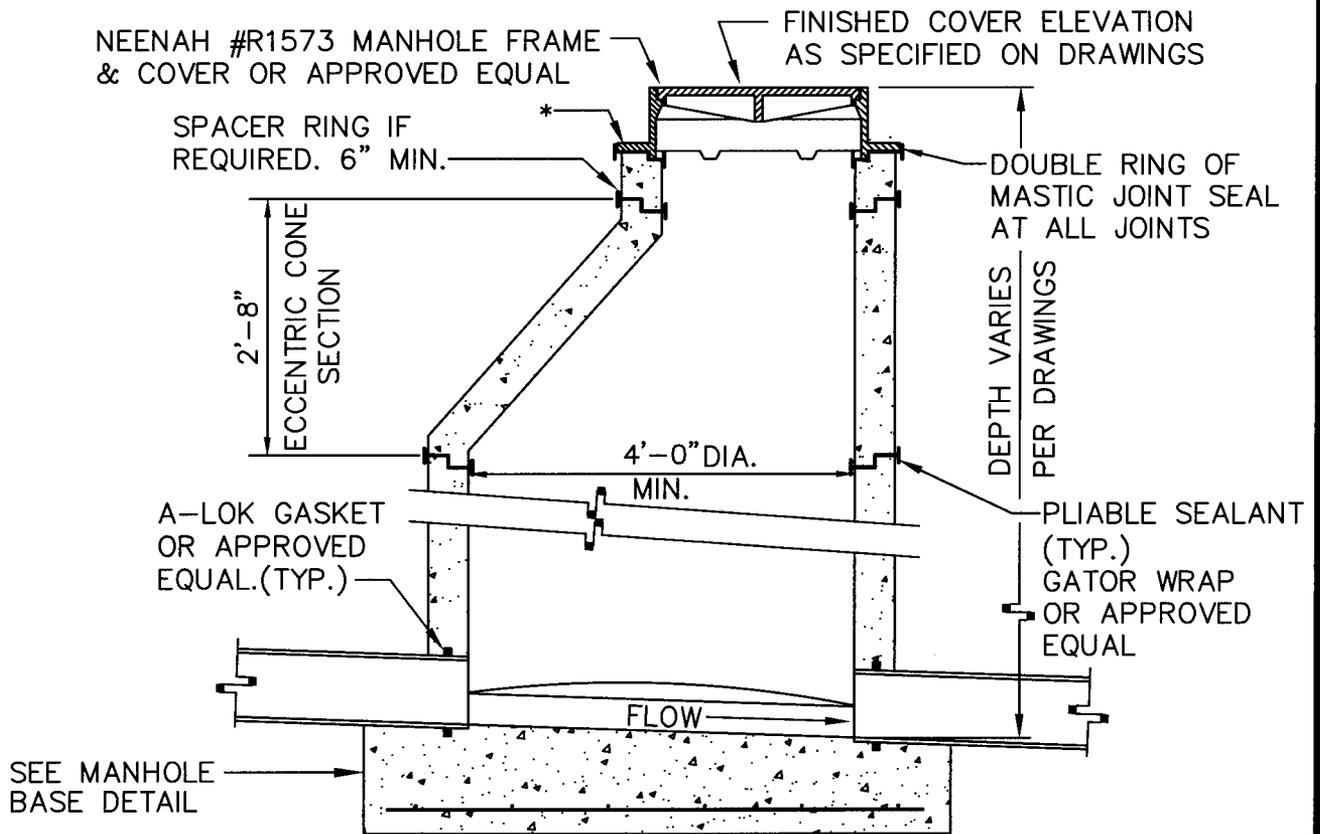
* NOTE: TRENCH SHALL BE BACKFILLED FULL DEPTH WITH COMPACTED GRANULAR STONE BEDDING AT ALL ROADWAY CROSSINGS.

CITY OF CARL JUNCTION, MISSOURI



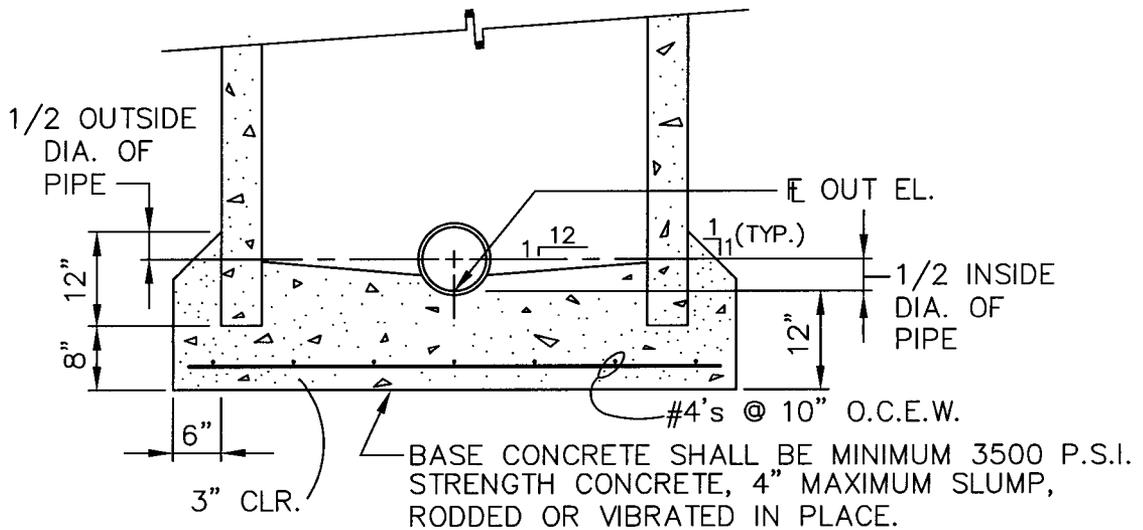
ALLGEIER, MARTIN & ASSOCIATES, INC.

CONSULTING ENGINEERS & SURVEYORS
JOPLIN, MISSOURI



TYPICAL PRECAST MANHOLE DETAIL

N.T.S.



MANHOLE BASE DETAIL

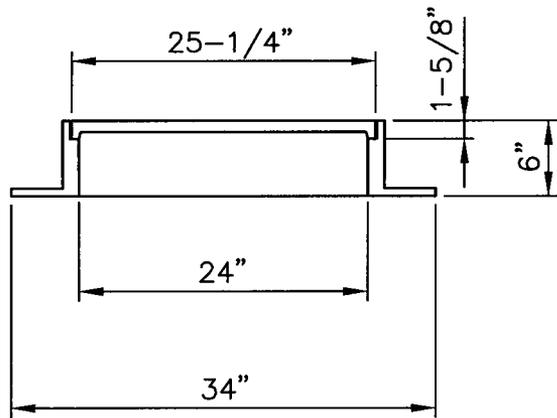
N.T.S.

* IN LOW LYING AREAS WHERE GROUND WATER IS AN ISSUE & TO PREVENT INFILTRATION A UNI-BAND OR APPROVED EQUAL SHALL BE USED

CITY OF CARL JUNCTION, MISSOURI



ALLGEIER, MARTIN & ASSOCIATES, INC.
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STD. FRAME & COVER,
NEENAH R-1573
OR APPROVED EQUAL

TOTAL WEIGHT OF FRAME
& COVER, 400 LBS. (MIN.)

MANHOLE FRAME & COVER DETAIL

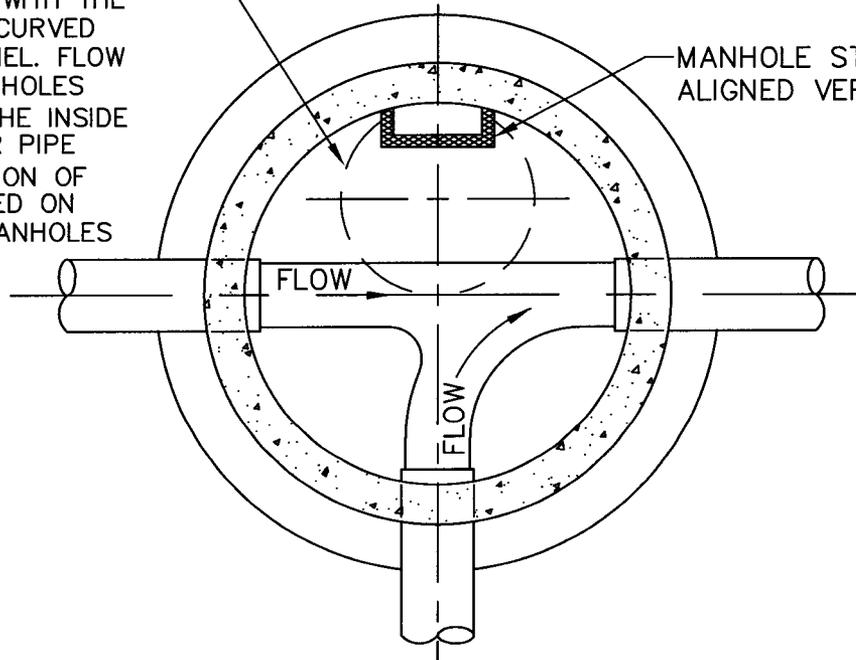
NOTES:

N.T.S.

INVERTS COMING IN AT ELEVATION HIGHER THAN THE OUTLET INVERT SHALL BE FILLETED TO A UNIFORM SLOPE BETWEEN INLET AND OUTLET INVERTS. INVERTS COMING INTO THE MANHOLE AT AN ANGLE WITH THE OUTLET PIPE SHALL BE CURVED INTO THE OUTLET CHANNEL. FLOW CHANNEL THRU ALL MANHOLES SHALL CONFORM TO 1/2 THE INSIDE DIAMETER OF THE SEWER PIPE CROSS SECTION. 1/2 SECTION OF SEWER PIPE MAY BE USED ON STRAIGHT RUNS THRU MANHOLES FOR FLOW CHANNEL.

MANHOLE FRAME & COVER SHALL BE LOCATED 90° FROM OUTLET SEWER CENTERLINE ON ALL MANHOLES

MANHOLE STEPS ALIGNED VERTICALLY



PLAN - TYPICAL ALL MANHOLES

N.T.S.

CITY OF CARL JUNCTION, MISSOURI

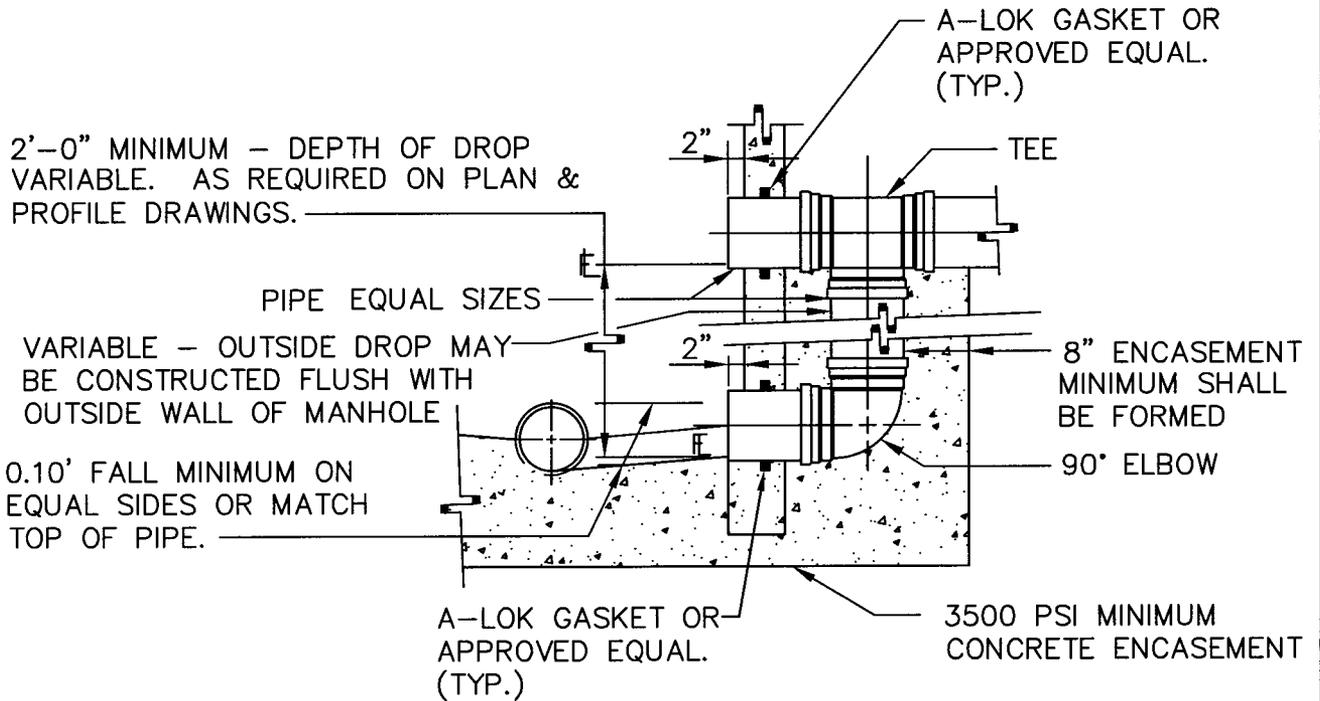


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JOPLIN, MISSOURI

DROP MANHOLE NOTE:

TYPE 'A' DROP - 2' MIN. TO 8' MAX.
PIPE - SDR 35 P.V.C.

TYPE 'B' DROP - OVER 8'
PIPE - CLASS 50 DUCTILE IRON



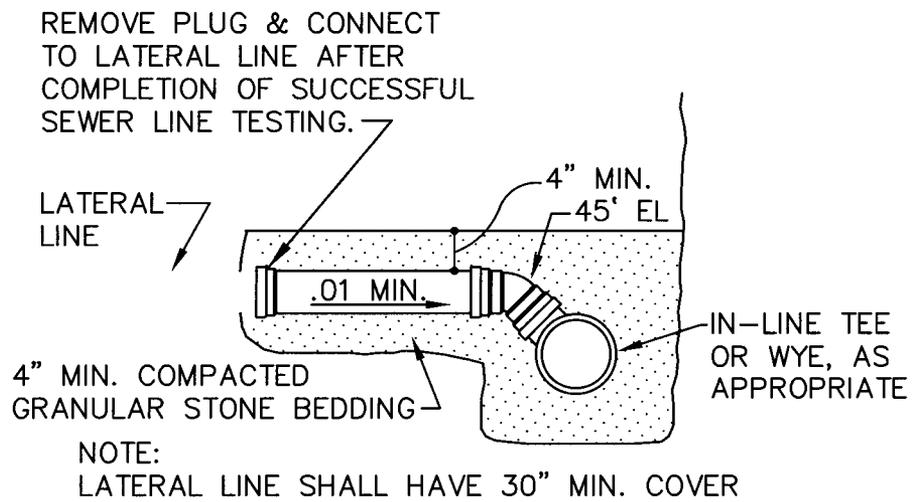
DROP MANHOLE DETAIL

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SERVICE LATERAL DETAIL

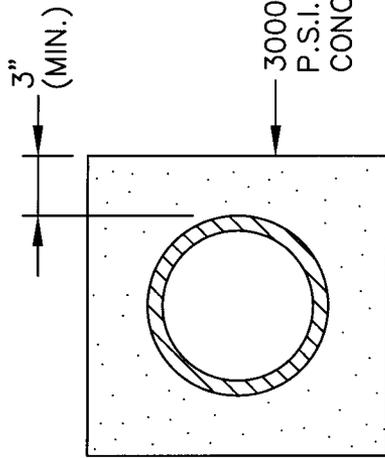
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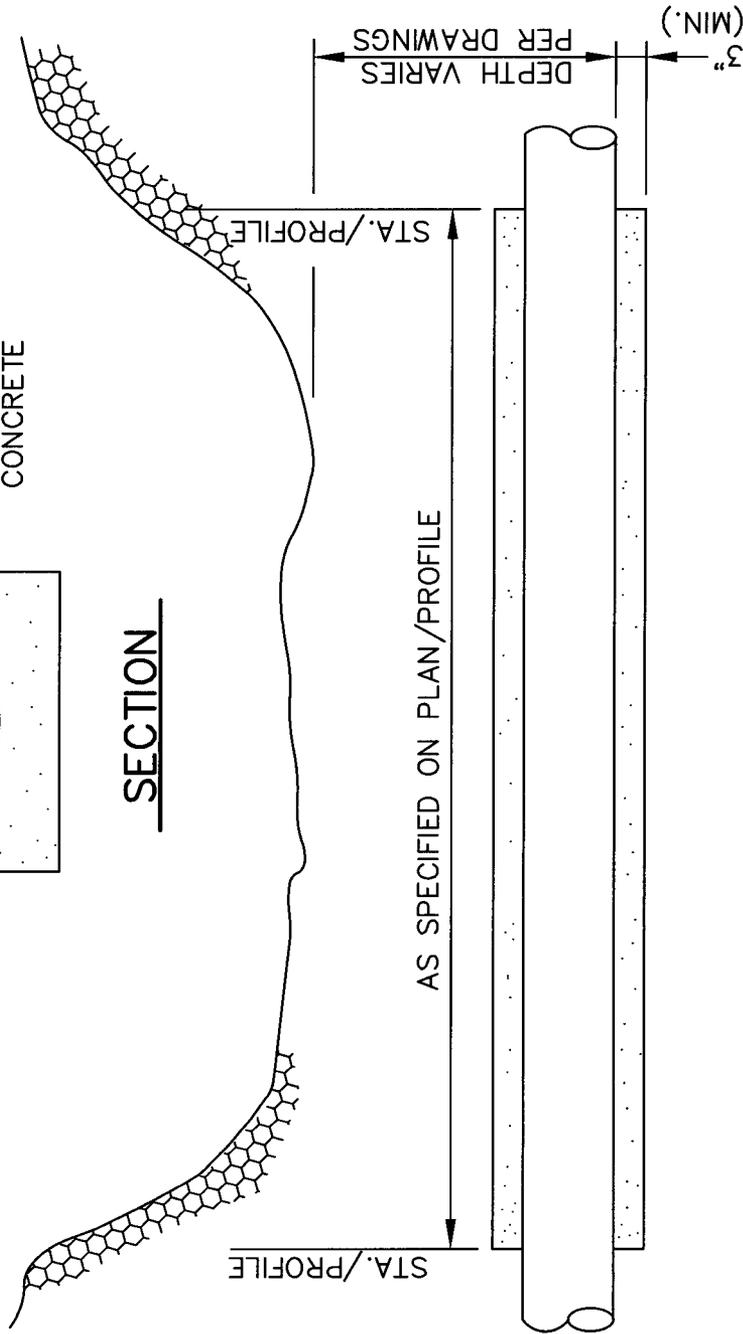
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STONE RIP RAP SHALL BE PLACED WHERE STREAM CROSSINGS ARE INSTALLED BY TRENCHING. RIP RAP SHALL BE PLACED SO AS TO PROVIDE A TOTAL BLANKET THICKNESS OF 12" MIN., 16" MAX. RIP RAP SHALL BE PLACED FULL HEIGHT OF BANK, WITH A TOTAL WIDTH ALONG THE BANK OF 10 FT. CENTERED ON THE WATER LINE.



PIPE MAYBE ENCASED IN CONCRETE OR DUCTILE IRON PIPE AS STATED IN THESE SPECIFICATIONS.

SECTION



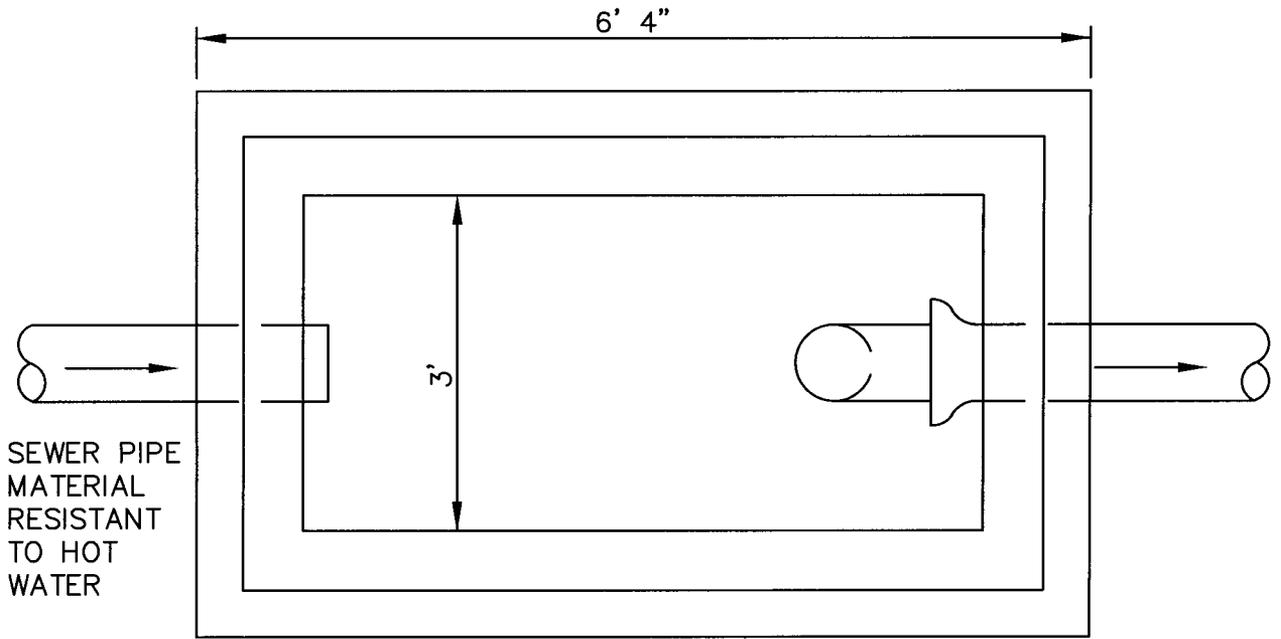
STREAM CROSSING DETAIL – SANITARY SEWER

N.T.S.

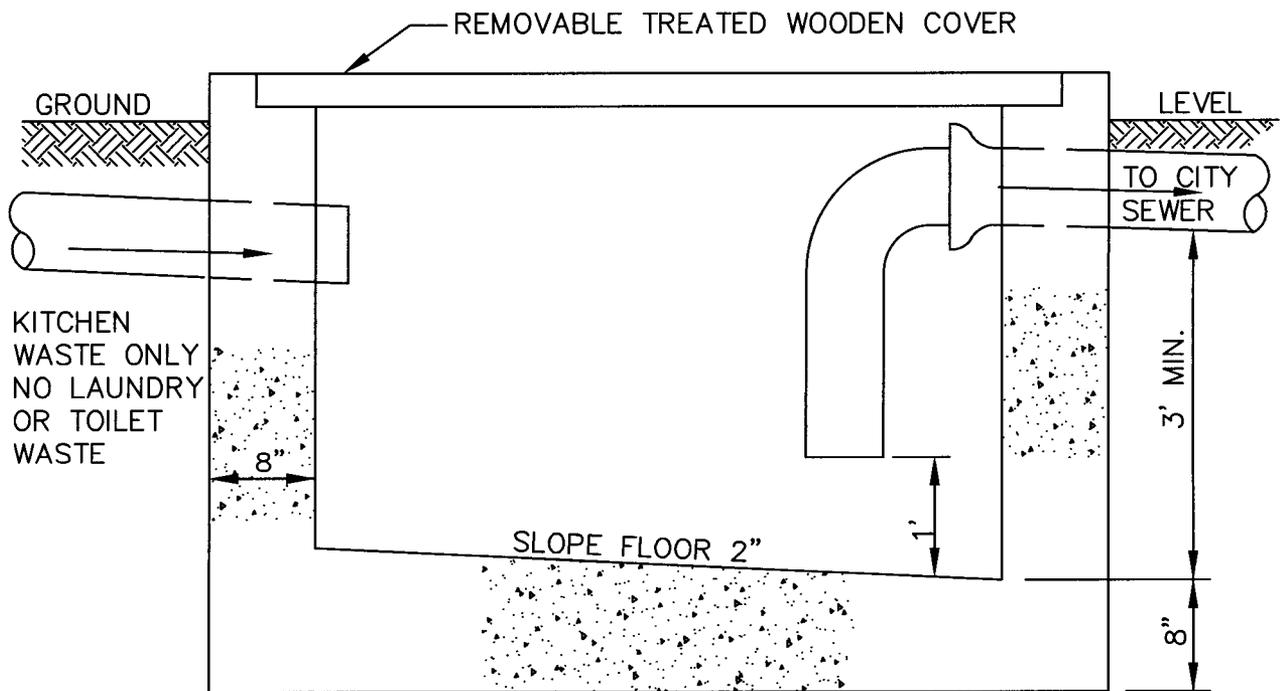
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PLAN

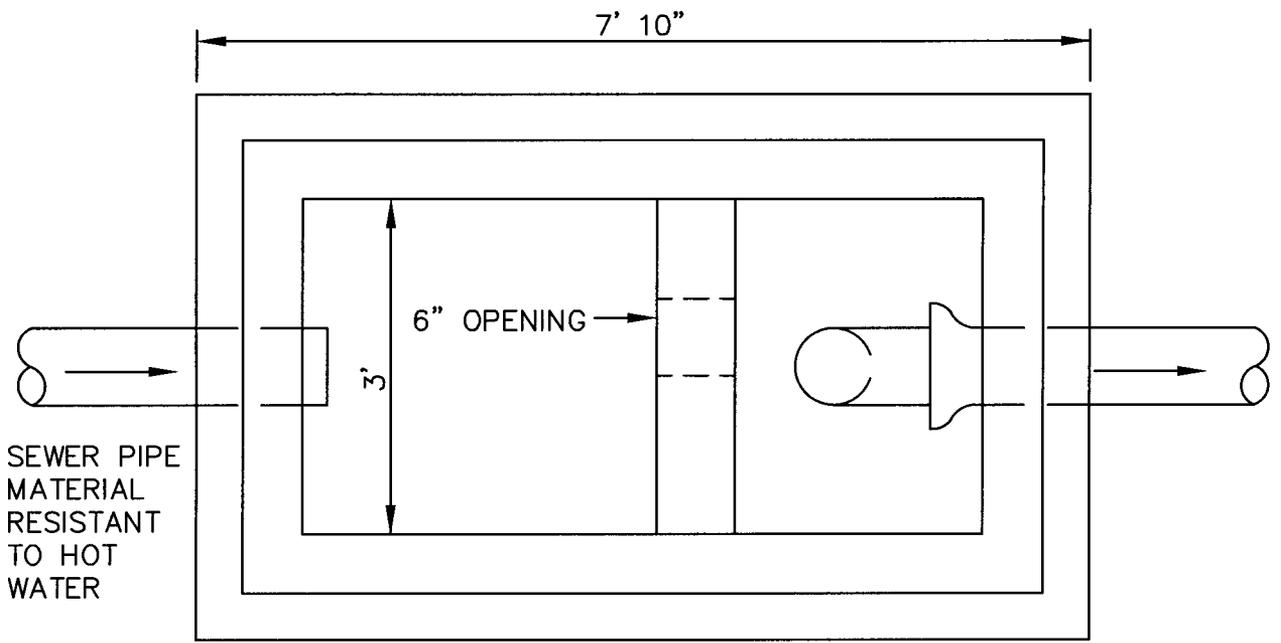


SECTION
OUTDOOR GREASE TRAP

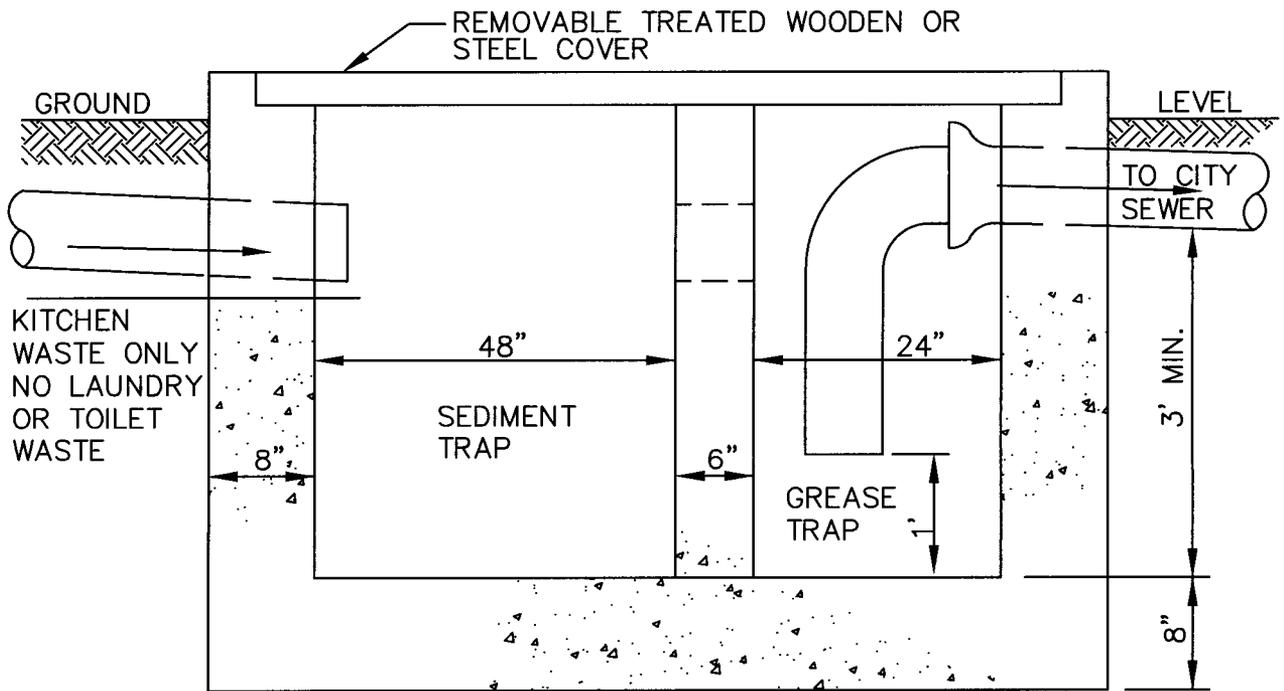
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PLAN

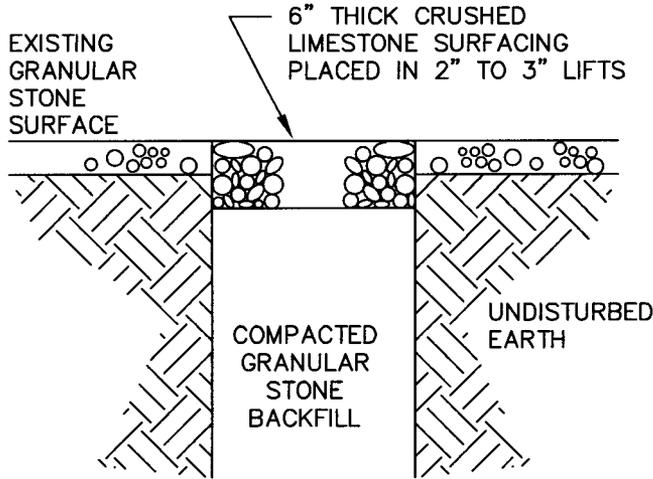


SECTION
OUTDOOR SEDIMENT GREASE TRAP

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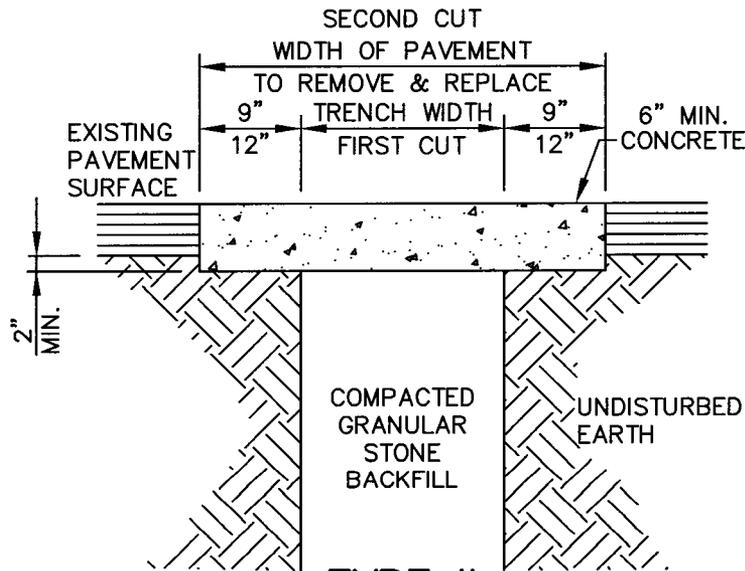
TYPE I
CRUSHED STONE SURFACING

NOTES:

PAVEMENT SHALL BE REMOVED AT THE TRENCH WIDTH AFTER THE FIRST CUT WITHOUT DAMAGE TO ADJACENT PAVEMENT.

AFTER TRENCH IS PROPERLY BACKFILLED, PAVEMENT SHALL BE CUT AND REMOVED AN ADDITIONAL 9" TO 12" ON EACH SIDE OF THE FIRST SAW CUT, AS SHOWN. THE SECOND CUT SHALL BE SAWN TO FULL DEPTH OF THE EXISTING SURFACE.

ALL EXISTING PAVEMENT SHALL BE REPLACED WITH A MINIMUM OF 6" OF CONCRETE. SPECIAL REQUEST FOR USE OF ASPHALT SHALL BE SUBMITTED IN WRITING TO THE CITY. IF APPROVED THE CITY SHALL ISSUE A WRITTEN APPROVAL.



TYPE II
CONCRETE SURFACING

SEWER & WATER STREET CROSSING DETAIL

N.T.S.

CITY OF CARL JUNCTION, MISSOURI



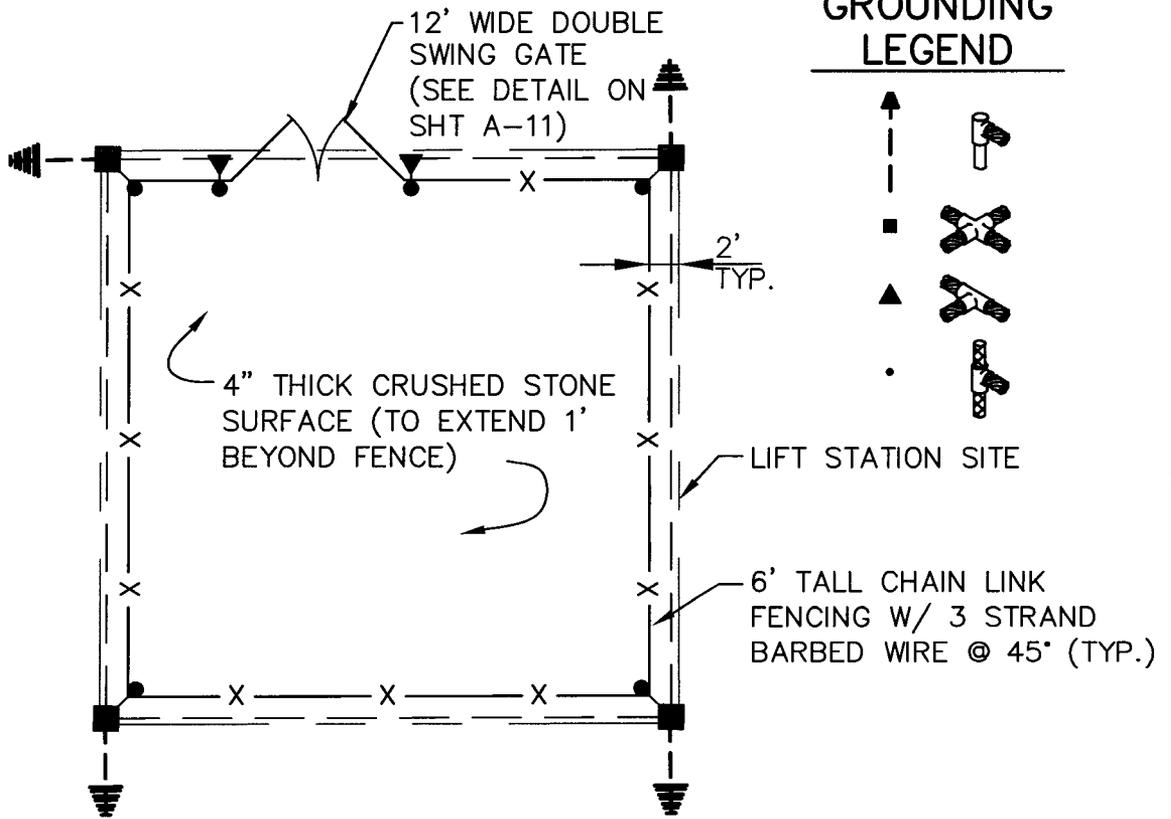
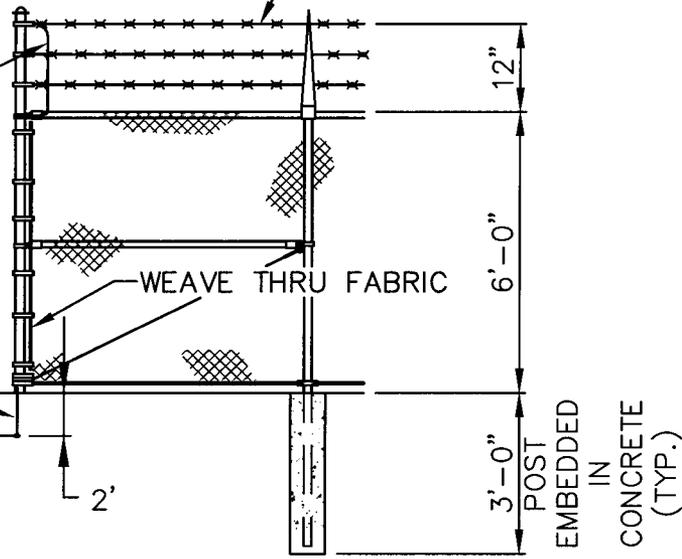
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#6 SOLID COPPER
GROUND CLAMPED TO THE
ROD AND TO THE
FENCE IN SUCH A MANNER
THAT EACH ELEMENT OF
THE FENCE IS GROUNDED

RISER CONTINUOUS ON
ONE SIDE OF CORNER

5/8" x 8'-0"
COPPER CLAD
GROUND ROD

3 STRANDS OF 4
POINT BARB WIRE
ON 45° OUT RIGGERS



**GROUNDING
LEGEND**



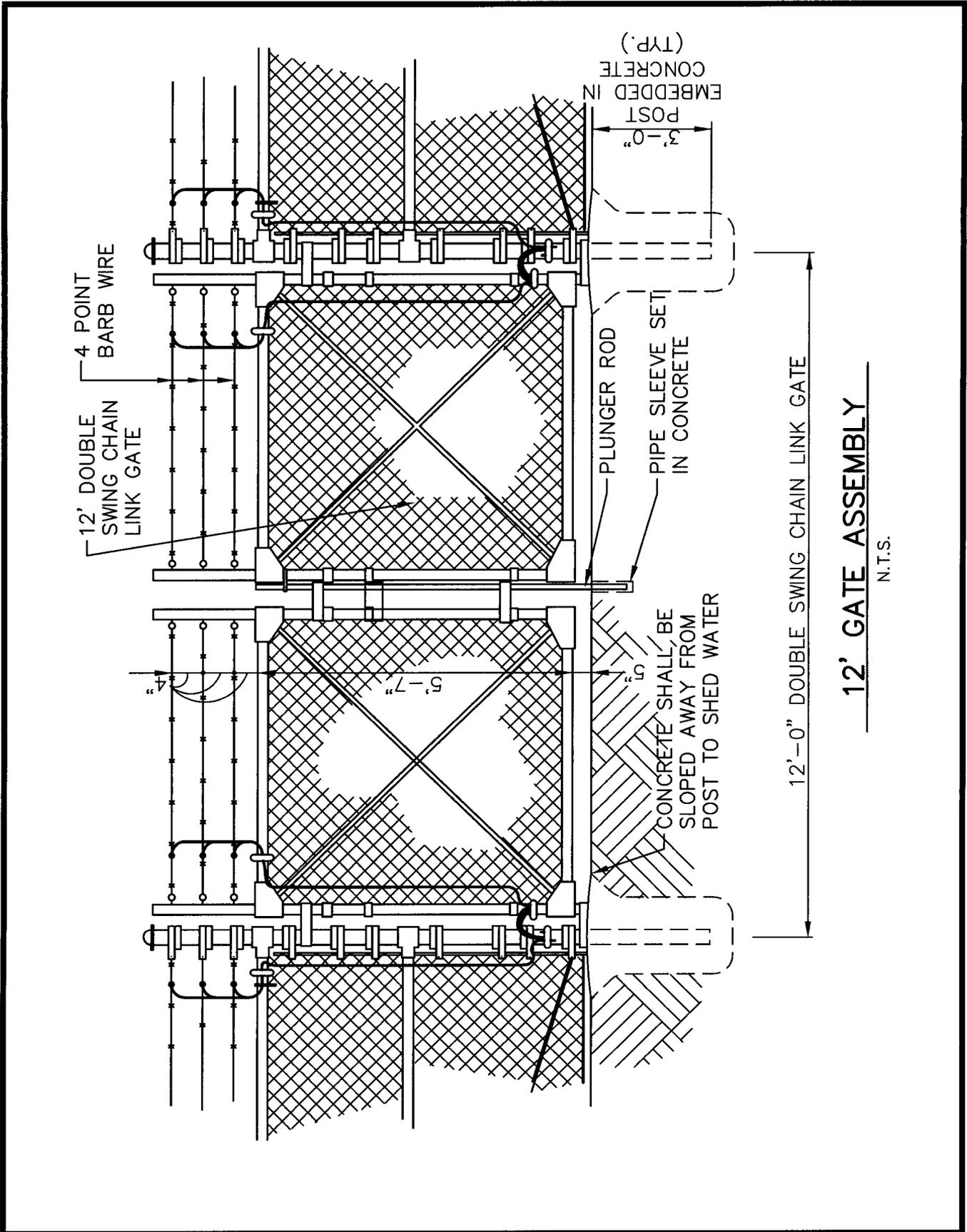
CHAIN LINK FENCE W/ GROUND DETAIL

N.T.S.

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12' GATE ASSEMBLY

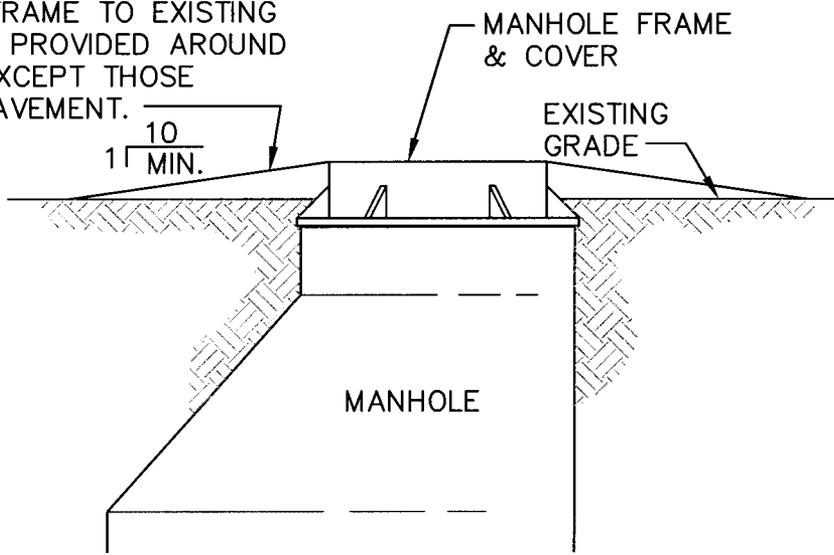
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NOTE: COMPACTED BACKFILL, SLOPED FROM MANHOLE FRAME TO EXISTING GRADE SHALL BE PROVIDED AROUND ALL MANHOLES EXCEPT THOSE WITHIN STREET PAVEMENT.



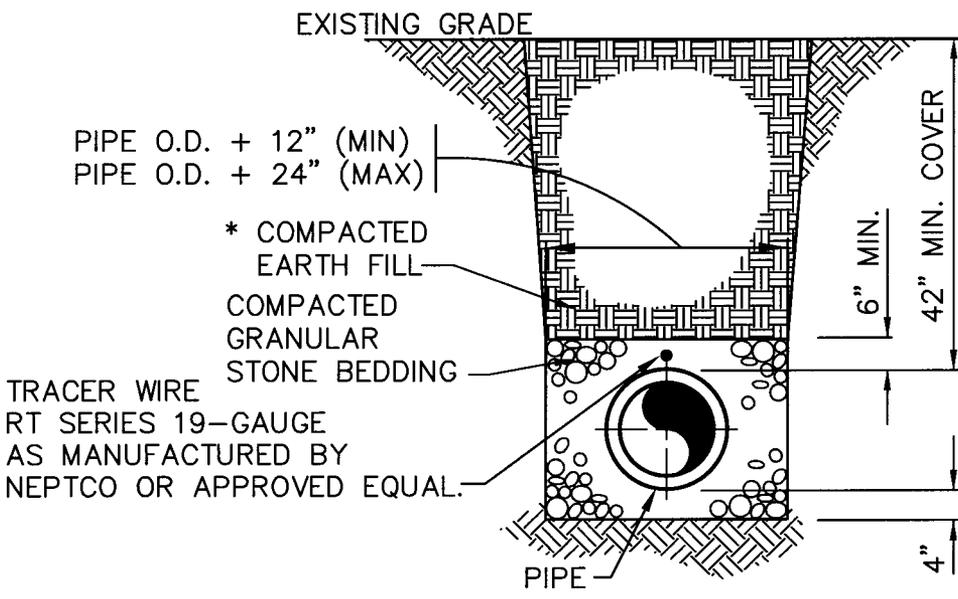
MANHOLE GRADING DETAIL

N.T.S.

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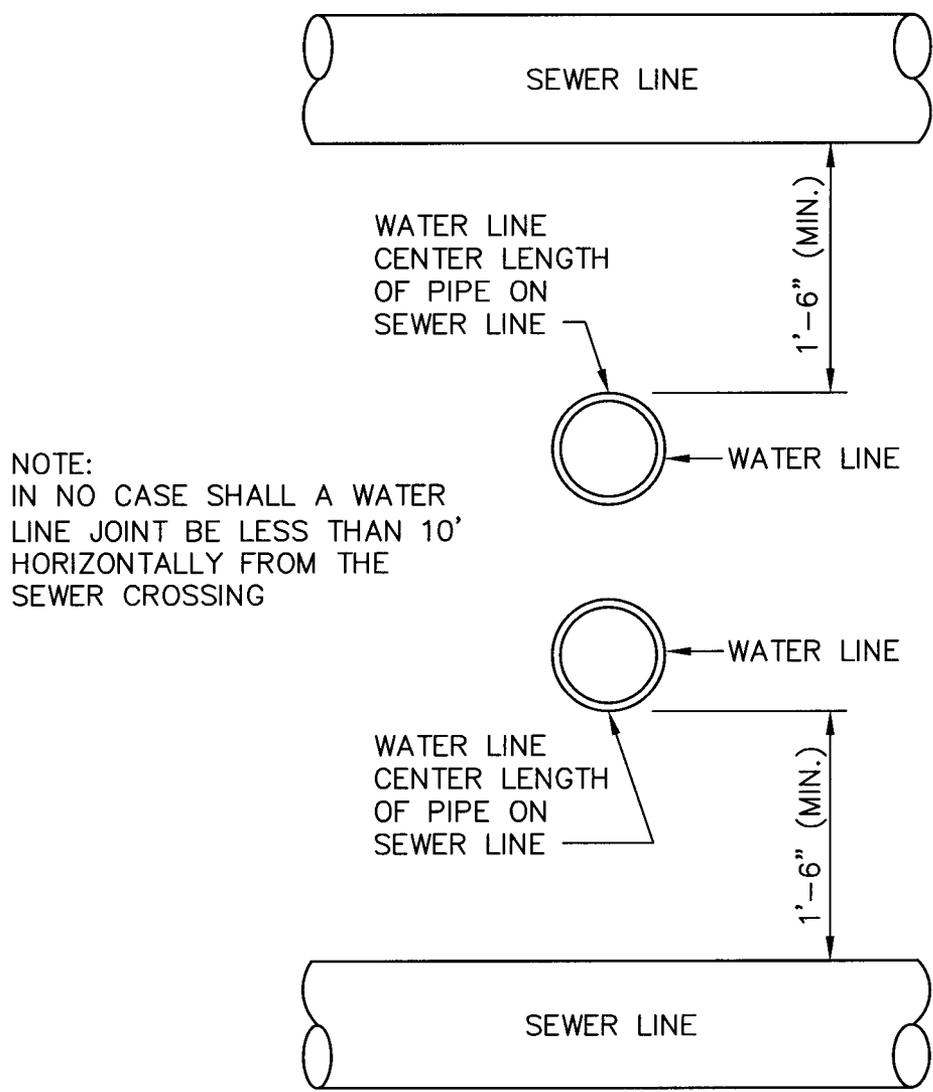
WATER LINE TRENCH & BEDDING DETAIL
N.T.S.

* NOTE: TRENCH SHALL BE BACKFILLED FULL DEPTH WITH COMPACTED GRANULAR STONE BEDDING AT ALL ROADWAY CROSSINGS.

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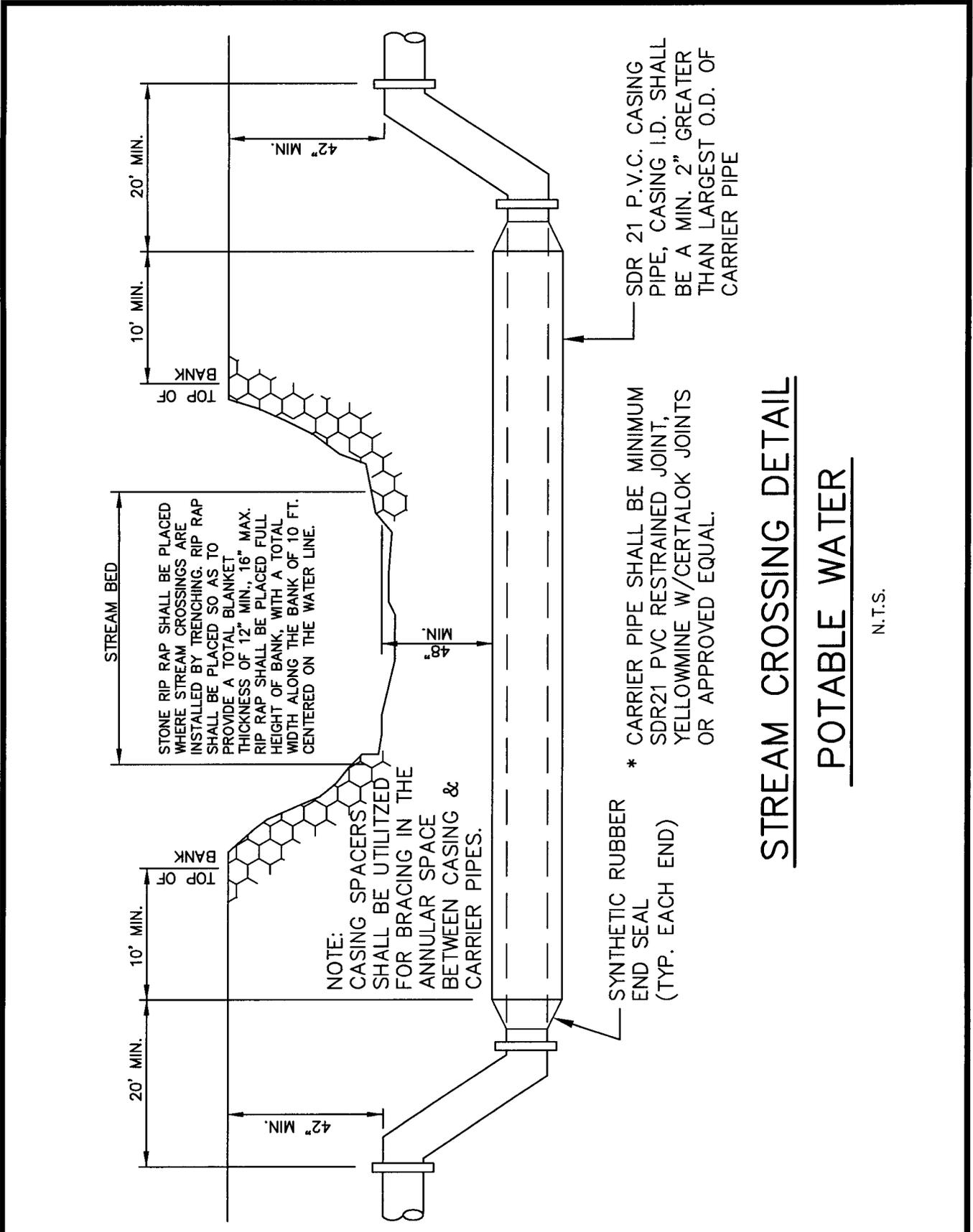
NOTE:
IN NO CASE SHALL A WATER
LINE JOINT BE LESS THAN 10'
HORIZONTALLY FROM THE
SEWER CROSSING

WATER LINE CROSSING DETAIL
N.T.S.

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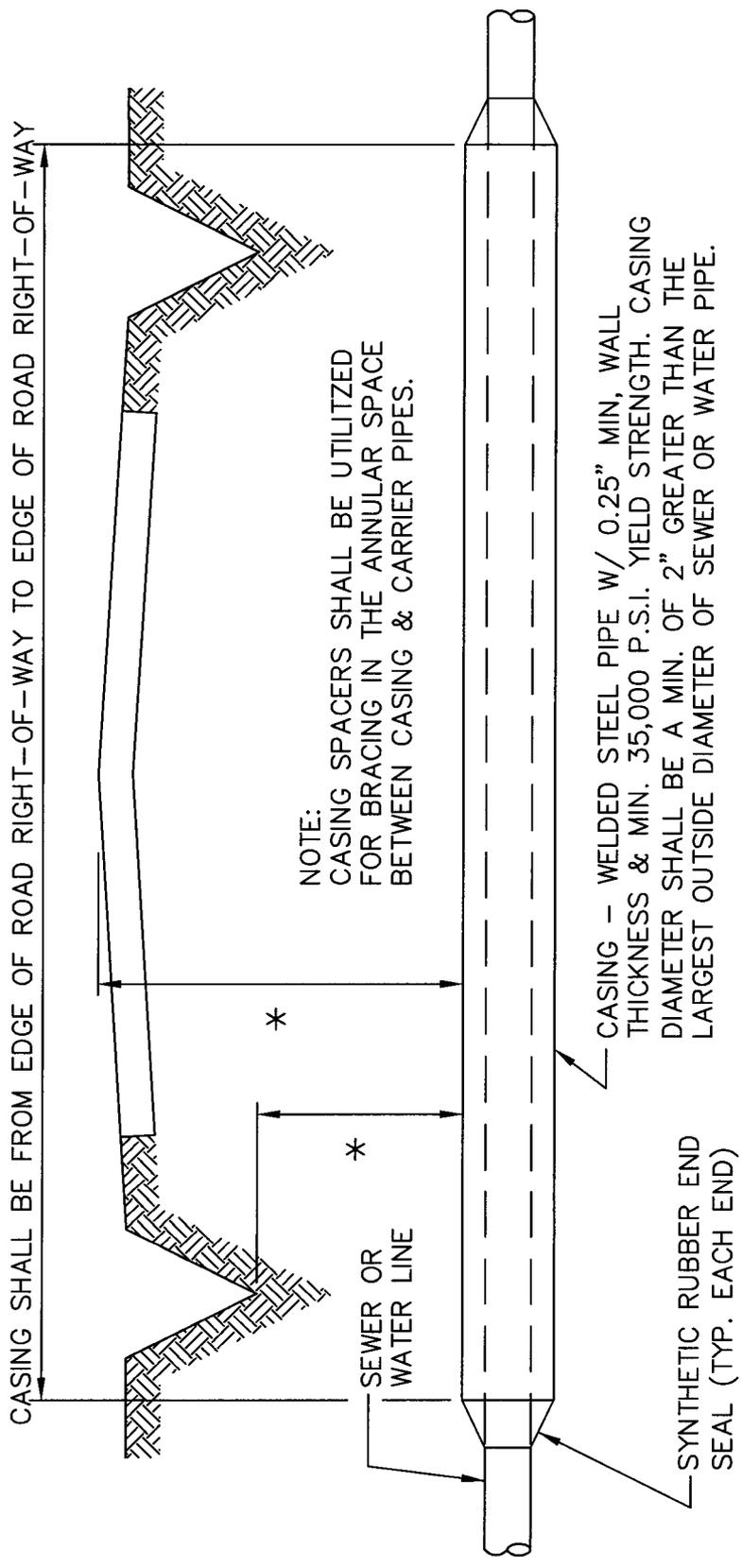
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STREAM CROSSING DETAIL
POTABLE WATER

N.T.S.



* - MIN. DEPTH OF COVER SHALL BE 5' BELOW CROWN GRADE OR 3' BELOW DITCH GRADE, WHICHEVER SHALL GOVERN.

HIGHWAY CROSSING DETAIL

N.T.S.

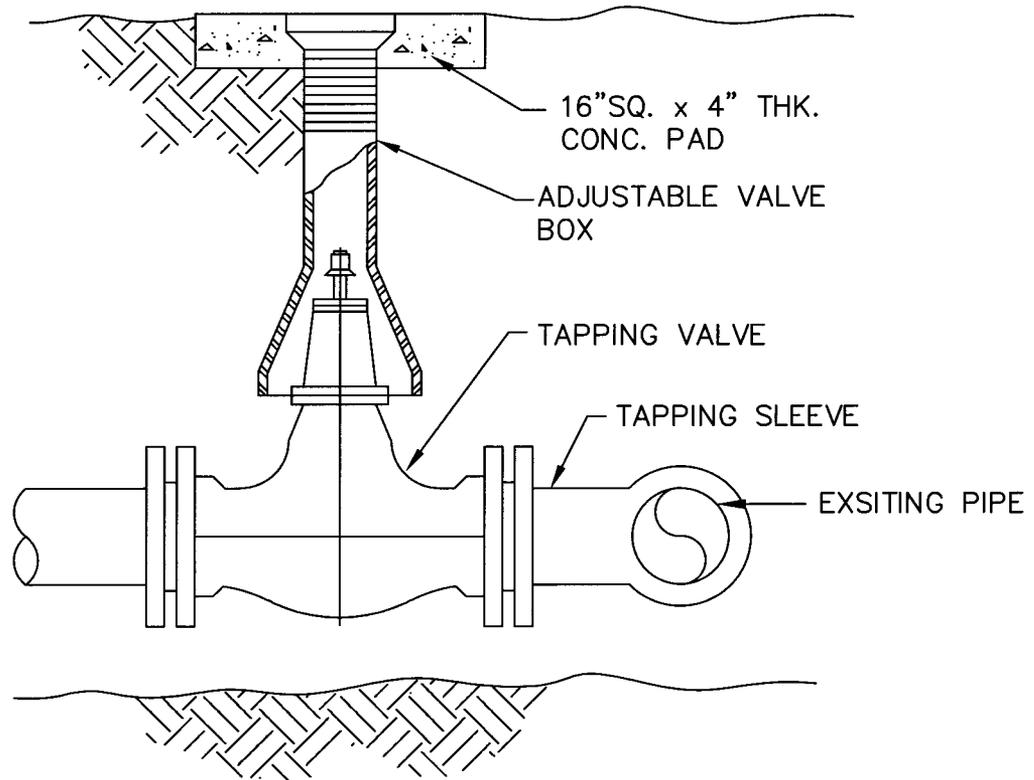
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NOTE:

CONTRACTOR SHALL FIELD VERIFY
TYPE & SIZE OF EXISTING PIPES
TO BE TAPPED

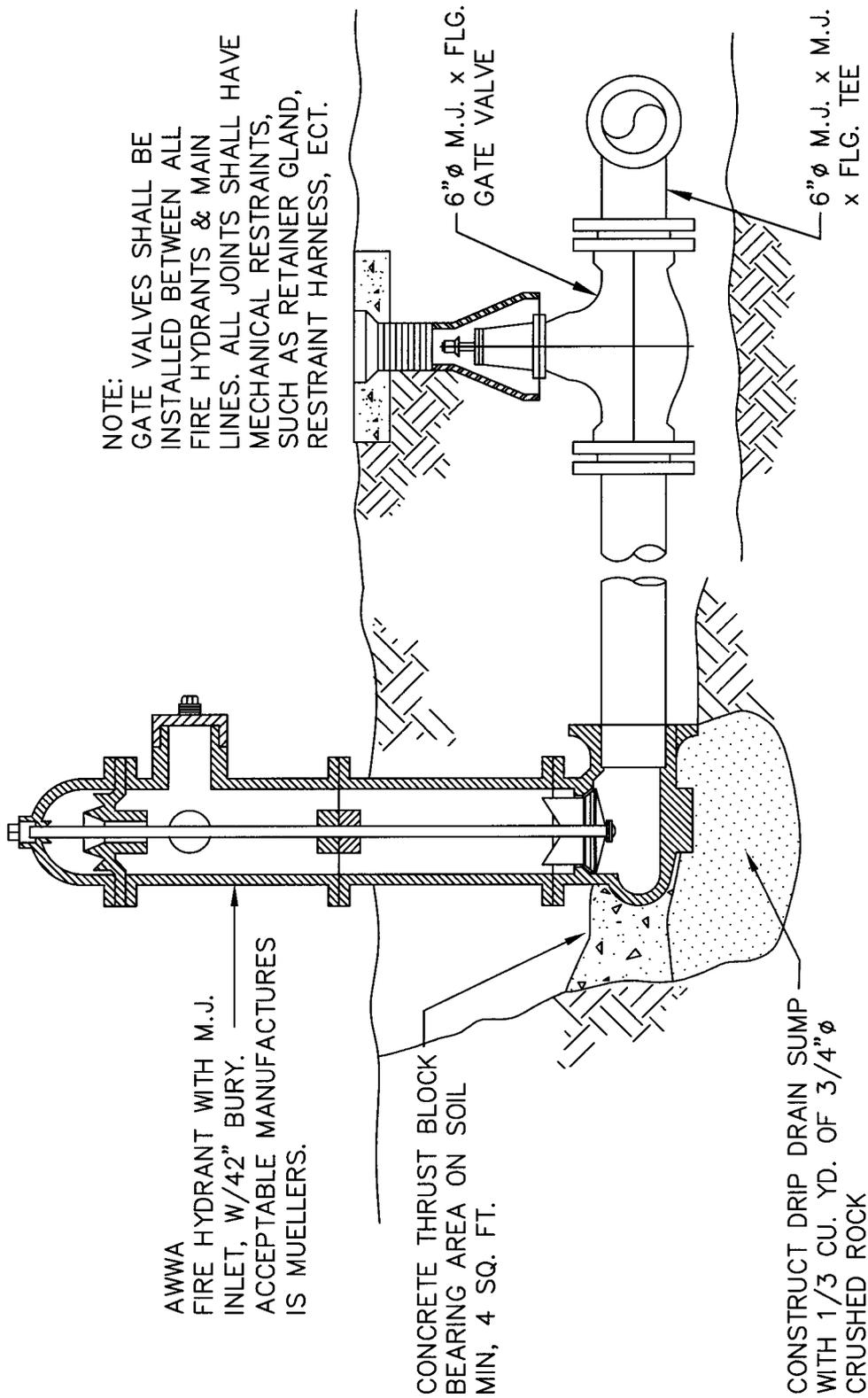


TAPPING VALVE & SLEEVE INSTALLATION

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FIRE HYDRANT INSTALLATION

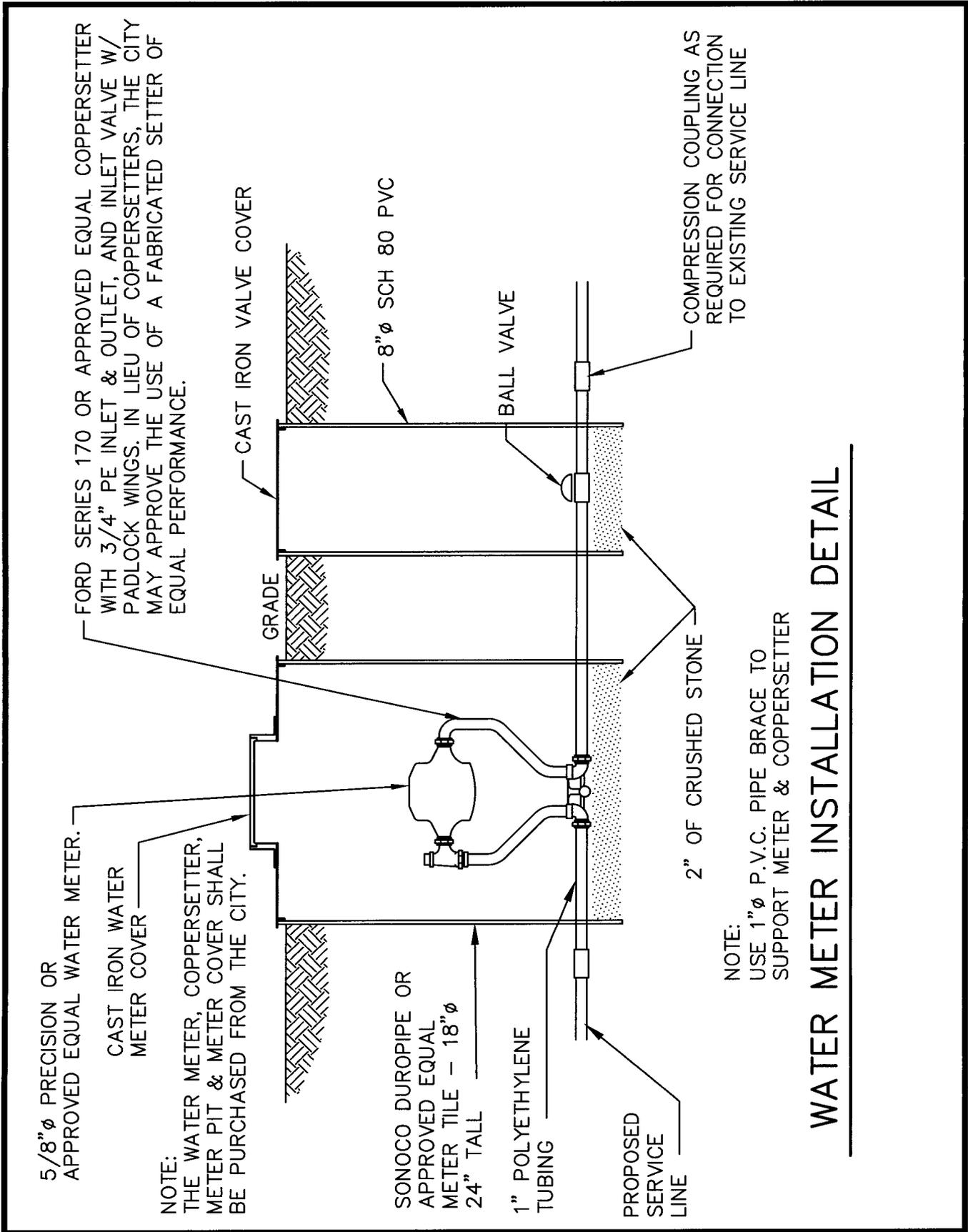
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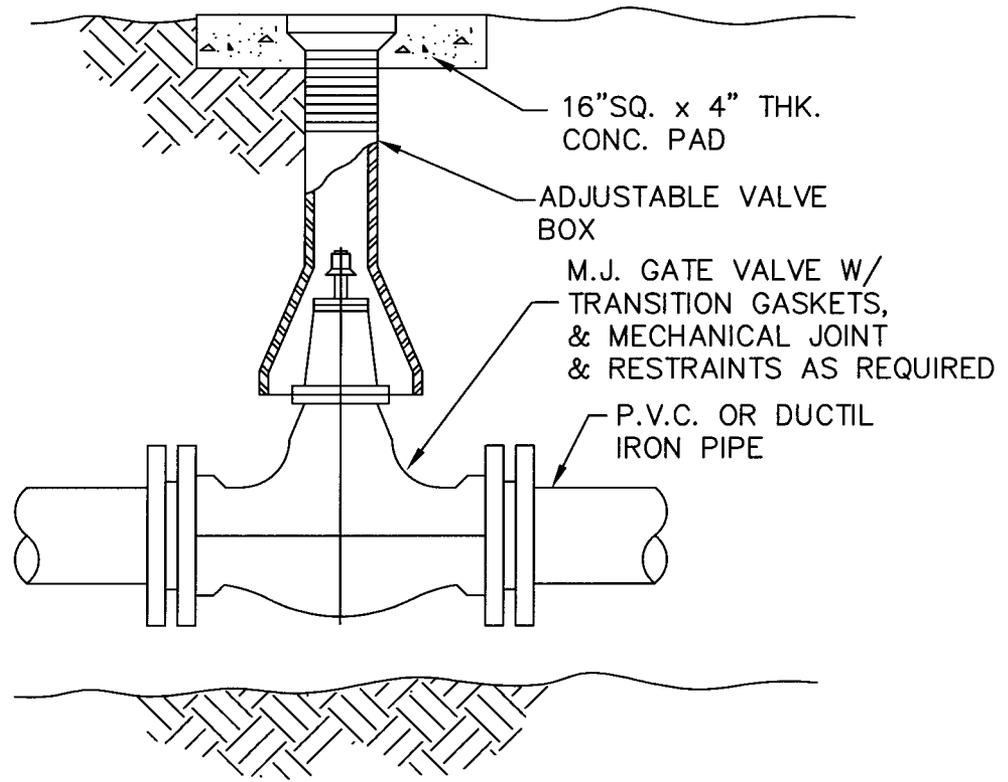
NOTE:
USE 1" ϕ P.V.C. PIPE BRACE TO SUPPORT METER & COPPERSETTER

WATER METER INSTALLATION DETAIL

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GATE VALVE INSTALLATION

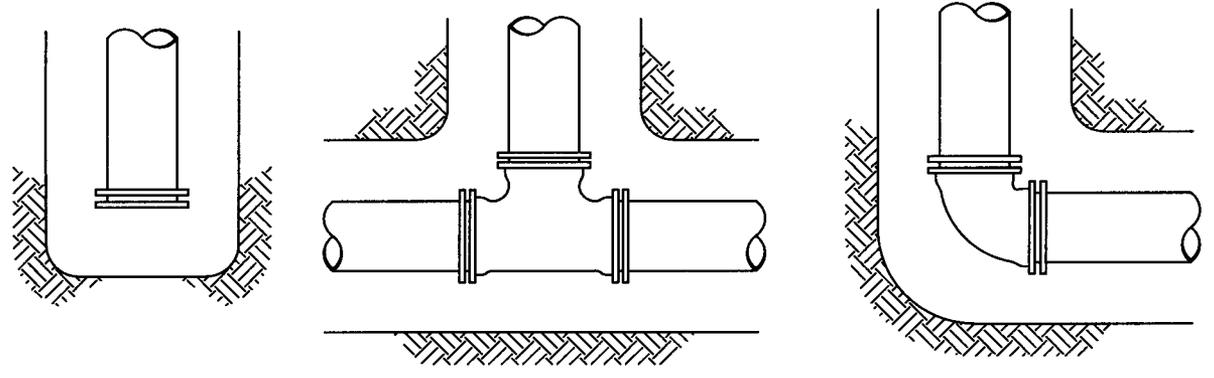
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NOTES:

MECHANICAL JOINT RESTRAINTS, SUCH AS A RETAINER GLAND, RESTRAINT HARNESS, ECT., MUST BE USED. CONCRETE THRUST BLOCKS SHALL NOT BE USED UNLESS APPROVED BY CITY IN WRITING.



THE LENGTH OF RESTRAINED PIPE JOINTS BEYOND THE FITTING SHALL BE AS REQUIRED BY THE JOINT RESTRAINT MANUFACTURER INSTALLATION INSTRUCTIONS AND IN ACCORDANCE WITH RECOGNIZED UNDERGROUND RESTRAINED JOINT PIPING SYSTEM EQUATIONS UTILIZING CONSERVATIVE SOIL PARAMETERS.

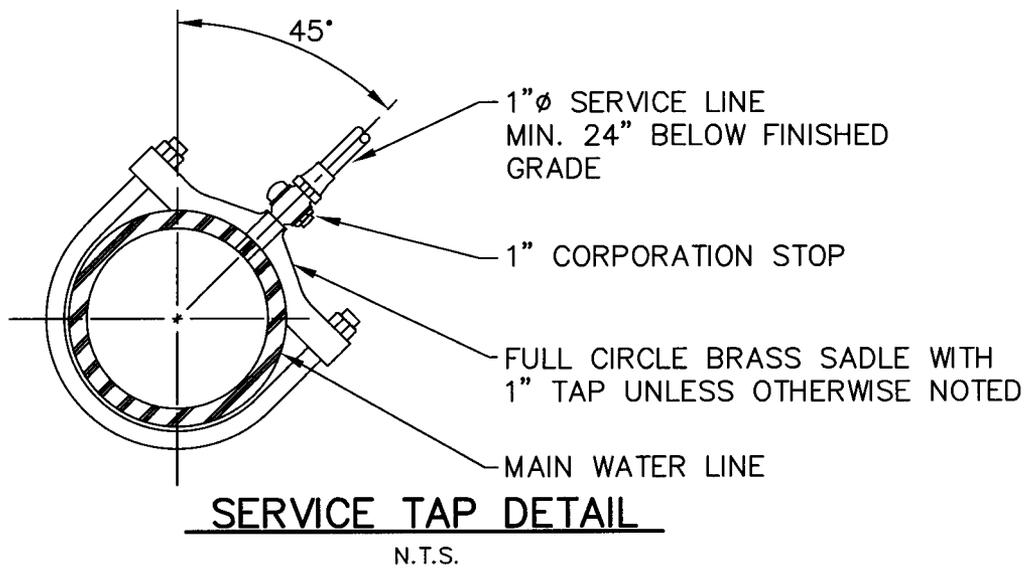
MECHANICAL JOINT RESTRAINTS

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CITY OF CARL JUNCTION, MISSOURI



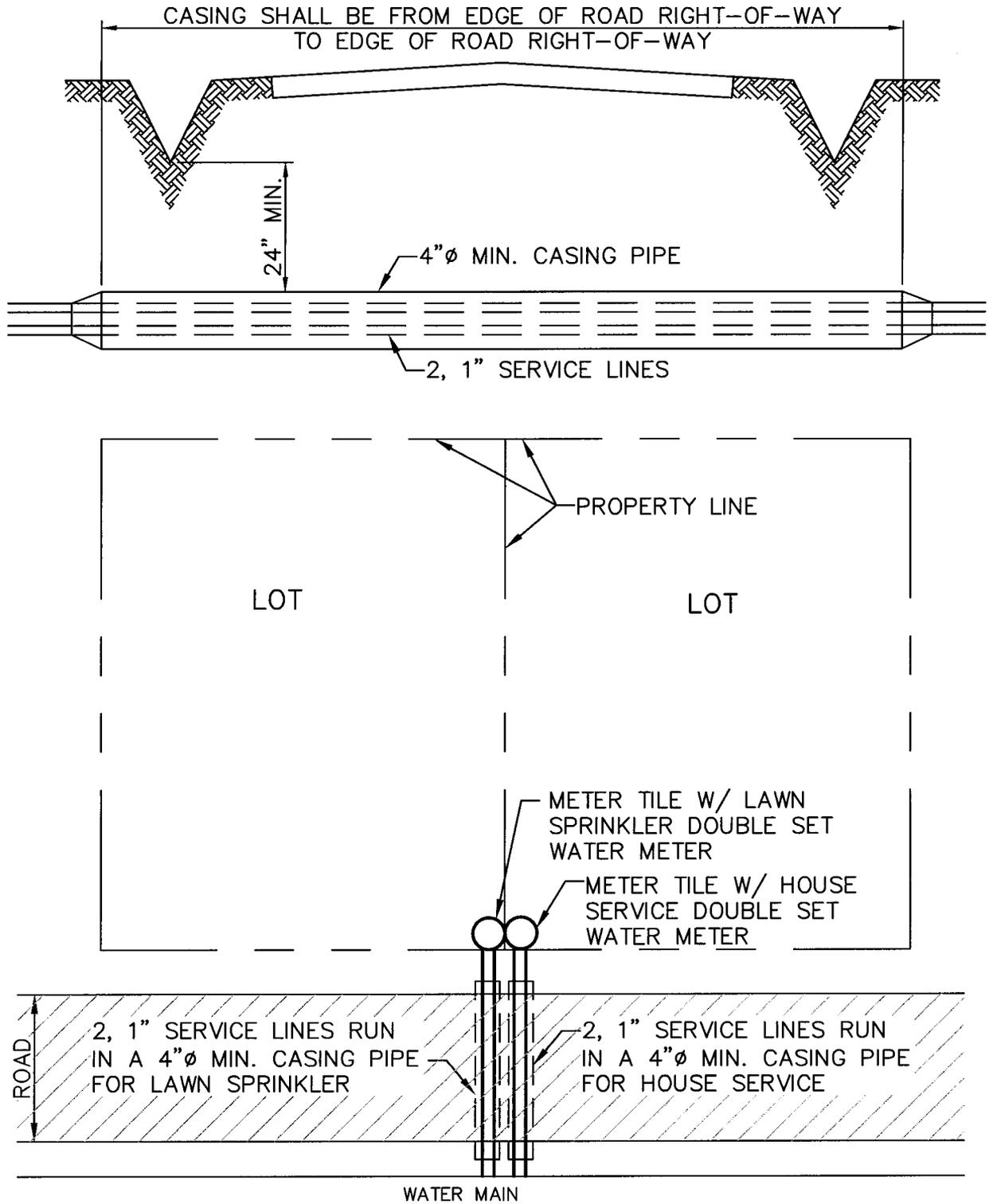
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DOUBLE SET METER & SERVICE LINE CROSSING ROADWAY

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ALLGEIER, MARTIN and ASSOCIATES, INC.
— Consulting Engineers —

Corporate Office
7231 East 24th Street
Joplin, MO 64804
417.680.7200



amce.com

Rolla Office
112 West 8th Street
Rolla, MO 65401
573.341.9487