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WATER PROTECTION PROGRAM

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SANITARY SEWER COLLECTION SYSTEM SPECIFICATIONS

Department of
Natural Resources

JUL 30 2015

APPROVED

**PUBLIC WATER SUPPLY DISTRICT NO. 2
OF ST. CHARLES COUNTY, MISSOURI**

**100 WATER DRIVE
O'FALLON, MISSOURI 63368**

Revised June 2015

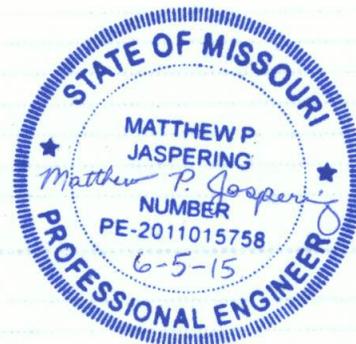


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DEFINITIONS

- ContractorPerson or Firm responsible for the construction of Improvements
- DesignPlans sealed by Engineer and approved for construction by District and MoDNR
- Developer.....Individual(s) or organization(s) proposing Improvements
- District.....Public Water Supply District No. 2 of St. Charles County, Missouri
- District EngineerAppointed representative of District
- EngineerPerson or Firm preparing Design
- ImprovementsLift Stations, extensions, relocations, upgrades, or any physical modification of or addition to an existing sanitary sewer collection system and any related appurtenances.
- MoDNR.....Missouri Department of Natural Resources

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Article I. GENERAL REQUIREMENTS

The following requirements apply to all Articles of these specifications. Additional requirements may be necessary for each individual section and are noted within the general requirements. Additional requirements may be set forth by the District Engineer.

Design, installation, and maintenance of Improvements shall be in accordance with the latest version of the District's "Guidelines for Water Distribution System and Sanitary Sewer Collection System Improvements".

All Improvements shall be designed in accordance with MoDNR under Title 10 CSR 20.8-120 and 130, these specifications and any other applicable federal, state, and local requirements.

In cases where project specific specifications are approved by the District Engineer the project specifications shall govern.

Failure to comply with these specifications, the "Guidelines for Water Distribution System and Sanitary Sewer Collection System Improvements", or any other applicable documents may result in rejection of the Improvements by the District.

Section 1.01 Standards and Conformance

Materials

Where references are made to standards such as AWWA, ANSI, ASTM, etc., it shall be understood that such references are made to the latest revisions of such standards. All materials used at any location in the Sewer System shall meet the requirements as set forth under this specification. When requested by the District, Contractors shall furnish affidavits from their suppliers certifying that materials conform to stated standards before being incorporated in the work.

Where materials are specified by brand name and model, followed by the words "or approved equal", the information concerning an "approved equal" product must be submitted to the District and a written statement of approval by the District or its assigned representative must be issued before such material may be used. In all cases, approval of such alternate products shall be at the sole discretion of the District or its assigned representative.

Installation

The work covered in this specification shall consist of furnishing all specified materials with all necessary equipment, machinery, tools, labor, and performing all work required to install and/or construct the sewer system Improvements with all directives or modifications and these specifications, all to be complete, in place, accepted, and ready for use.

Inspection, Tests, and Acceptance or Rejection of Defective Work

District staff or its representatives, independent testing laboratories, and governmental agencies with jurisdictional interests will have access to the Site and the Work for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for District's acceptance of materials or equipment to be incorporated in the work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the work. Specific testing requirements can be found in each Article of these specifications.

If any work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without concurrence of District staff or its representatives, Contractor shall, if requested by District staff, uncover such work for observation. Uncovering work shall be at Contractor's expense.

Promptly after receipt of written notice from the District or its representatives of defective work, Contractor shall correct all defective work, whether or not fabricated, installed, or completed, or, if the work has been rejected by the District, remove it from the Project and replace it with work that is not defective. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).

Field changes shall be made only with the specific permission of the District Engineer.

Section 1.02 Contractor Qualifications

To demonstrate Contractor's qualifications to perform the Work, within five (5) days of the District's request, the Contractor shall submit written evidence such as financial data, previous experience, present commitments, and three (3) projects performed within the past three (3) years, relating to construction of sanitary sewer collection system Improvements of a similar diameter, material, and scope, with project references and contacts.

Section 1.03 Site Work and Preparation

Prior to starting the Improvements as required, the Contractor shall notify the District a minimum of one (1) week prior to the start of construction. After doing so, the Contractor shall clear the route of all trees, shrubs, and other objects or materials which may directly interfere with the construction. All trees, shrubs, bushes, etc., which will not interfere with the construction shall be protected from damage.

Work preparations shall include having all necessary materials and equipment at the site in working condition, and an adequate labor force at the site and completely instructed and prepared to perform the work to completion. The Contractor shall notify all utility companies or organizations of work and shall request field markings of their respective facility locations prior to starting any work.

Contractor shall employ best management practices to mitigate changes in quality and quantity of runoff. Exposed areas shall not remain unprotected for more than seven (7) days.

Section 1.04 Drainage

The Contractor shall control the grading in the vicinity of the pipe trenches so that the surface of the ground will be properly sloped to prevent water from running into the excavated areas, where possible. Any water or other liquid wastes which accumulate in the excavated areas shall be promptly removed.

Section 1.05 Obstructions of Sewer Main

Where improvements, such as but not limited to retaining walls, tie-backs, and storm sewers greater than 24", are to be built over the sewer main, the main shall be placed in casing pipe as specified in Section 1.09. The determination of what will require the main to be placed in a casing pipe is at the discretion of the District Engineer.

Section 1.06 Separation of Water Main, Sewers, and Other Utilities

Sewers shall be laid at least 10 feet horizontally from any existing or proposed water main or appurtenance. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten foot separation, deviations may be made on a case by case basis, if supported by data from the Engineer and approved by the District Engineer and MoDNR. 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 elevation that the bottom of the water main is at least 18 inches above the top of the sewer.

Sewers crossing water mains 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.

Separation between sewers and all other utilities shall be a minimum of 2 feet horizontally and 18 inches vertically, or as required by the District Engineer.

If it is impractical to obtain proper horizontal and/or vertical separation with water mains as described above, the sewer must be constructed of slip-on or restrained pipe or continuously encased and be pressure tested to one hundred fifty pounds per square inch (150 psi) for a period of two (2) hours with no greater loss of pressure than two pounds per square inch (2 psi).

All water crossings shall be arranged so that sewer joints will be equidistant and as far as possible from water main joints. Where a water main crosses under a sewer, adequate structural support shall be provided for the sewer to maintain line and grade.

Section 1.07 Quality and Handling of Materials

All materials used for each Improvements project shall be new. Damaged or unsound pipe, fittings, and accessories of whatever nature shall be rejected and removed from the site immediately.

All pipe and other accessories, shall be unloaded, stored, re-handled, and installed by methods in such a manner as to insure their final location in a sound and undamaged condition, conforming in all respects to specified requirements. Under no circumstances shall pipe or other accessories be dropped to the ground or otherwise subjected to possible damage from impact or shock. Such materials shall be loaded by lifting with machine, hoist, or by skidding. Pipe handled on skid ways shall not be skidded or rolled against other pipe.

Under all circumstances, all materials for use shall be handled in a workman-like manner using the necessary manpower and equipment to perform the task in accordance with the manufacturer's recommendations.

Proper equipment, tools, facilities, and methods satisfactory to the District, shall be provided and used by the Contractor for the safe handling of all materials. Under no circumstances shall any materials be dropped or dumped into the trench.

All open ends of pipe, fittings, etc., shall be carefully sealed with appropriately sized mechanical joint plugs or caps at the end of each day's work to prevent entrance of animals, water, and other foreign matter. Mechanical joint plugs or caps and the appropriate gasket and gland packs shall be utilized for sealing.

Section 1.08 Work Adjacent to and/or Crossing Rights-of-Way

All work to be performed within the road right-of-way limits shall be performed in strict accordance with the road authority's requirements. The Contractor shall obtain the necessary permits for all work prior to starting any construction. All permits must be displayed as required with two (2) copies provided to the District.

The Contractor shall comply with all standards of the latest version of the Manual on Uniform Traffic Control Devices as published by the Federal Highway Administration and any additional requirements set forth by the road authority.

The crossings shall be machine bored with simultaneous installation of the encasement. Encasement will be required for all gravity systems. Encasement will only be required for force mains if required by the governing roadway authority or District Engineer. All joints of the encasement tube shall be welded as specified and the encasement tube shall extend to the required dimensions.

Following completion of the machine bored crossing, the ends of the pipe casings shall be sealed and all bore pit or other required excavation shall be suitably backfilled to grade.

Section 1.09 Casing Pipes

Materials

Where sewer pipes cross road right-of-way, or where required by the roadway authority or District Engineer, all pipes shall be installed in casing pipes, which shall be steel pipe with a minimum wall thickness of ¼", unpainted or coated, and shall have a minimum diameter as shown below. All sewers in casing pipes shall be restrained joint pipe and the ends of casing pipes shall be sealed with preformed seals and/or other material approved by the District Engineer.

Casing pipes shall be sized and have wall thicknesses as shown in the table below.

<u>DI Carrier Pipe</u>	<u>Welded Steel Casing Pipe</u>	<u>Casing Pipe Thickness</u>
6"	16"	0.25"
8"	20"	0.25"
12"	24"	0.375"
16"	30"	0.375"
20"	30"	0.375"
24"	36"	0.375"
30"	42"	0.375"
36"	54"	0.5"
42"	60"	0.5"

Wherever sewers are installed in casing pipes, the pipe shall be supported with "RACI" type casing spacers or approved equal.

Installation

The spacers shall be carefully installed on the carrier pipe before it is installed in the casing pipe at 8' intervals, or 3 spacers per 20' length of pipe (See Detail H).

Section 1.10 Creek Crossings

Where sewer mains cross creeks, all piping shall be restrained joint ductile iron piping with a minimum of 42 inches of cover. If the grades are such that the cover is less than 42 inches, the carrier pipe shall be in a casing pipe as specified in Section 1.09. All manholes shall be located so they do not interfere with the free discharge of flood flows of a stream.

Any required U.S. Army Corps of Engineers permits must be acquired by the Developer with two (2) copies provided to the District. All requirements of such permits must be met by the Contractor.

Aerial crossings are typically not allowed, but may be considered and reviewed on a case by case basis. If approved by the District Engineer, aerial crossings shall meet the minimum requirements of Missouri Department of Natural Resources regulations [10 CSR 20-8.120(9)].

Best management practices shall be utilized to limit silt from entering into streams. Exposed areas shall not remain unprotected for more than seven (7) days.

Section 1.11 Staking

Staking shall be completed before the start of and during construction. Staking shall be provided by the Developer's Engineer or Land Surveyor and shall be completed by or directly supervised by a Professional Land Surveyor licensed in the state of Missouri. All staking and survey shall be performed using US State Plane 1983, zone Missouri East 2401, datum NAD83, with altitude measured from mean sea level and units of feet.

The adjacent property lines, easement lines or road right of way lines shall be staked with laths clearly marked at a maximum spacing of 100 feet. The witness laths for the sewer stakes shall have the station and the cut clearly marked on them. Stakes shall consist of 2" x 2" hubs with 1" x 2" witness laths.

For specific requirements for staking of gravity mains and force mains see Section 2.08 and Section 3.08 of these specifications, respectively.

Section 1.12 Granular Material

Where required per these Specifications, Granular Material shall be 3/4" minus crushed limestone and screenings and shall be compacted to 95% per Standard Proctor Test Method (ASTM D698). The Contractor shall provide at the Contractor's cost independent third party compaction testing by a testing firm agreeable to the District.

Section 1.13 Trench Excavation and Backfilling

Trenches for sewers and force mains shall have a minimum width of 18" or the pipe O.D. plus 12 inches (whichever is greater), and a maximum width of the pipe O.D. plus 24 inches.

For PVC pipe, the trench depth shall be excavated 6" deeper than the proposed bottom of the pipe to allow for 6" of Granular Material bedding. The PVC pipe shall also have the Granular Material placed to a level 6" above the top of the pipe with care taken to fill all void spaces beneath the pipe. The Granular Material shall be placed as shown on Detail A of these specifications. Bedding materials for PVC pipe shall conform to ASTM D2321.

Bedding for composite pipe shall be the same as PVC pipe, except as described in ASTM D2680.

For ductile iron pipe, if the trench bottom is stable and suitable earth, the pipe may be placed on the earth trench bottom. If the trench bottom contains stones larger than 2" in any length or solid rock, the trench shall be excavated 6" deeper than the

proposed pipe bottom and 6" of Granular Material bedding shall be placed before the pipe is laid. The ductile iron pipe shall then have compacted backfill of clean earth or Granular Material placed to a level 6" above the top of the pipe.

If the trench bottom contains frozen material, excessive moisture, debris or other deleterious material, the trench shall be excavated 6" or more deeper than the proposed pipe bottom and backfilled to the desired grade with Granular Material. For all pipe, bell holes in the trench bottom shall be provided to allow full contact of the pipe with the trench bottom.

Backfill for all pipes under roadways or parking lots shall consist of Granular Material carefully placed to avoid future settlement from 6" above the top of the pipe to the finished grade or as specified by the governing road authority.

In other areas, the backfill may be soil meeting ASTM D2487 soil classification groups GW, GP, GM, SW, SP, SM, GC, SC, ML, MH, CL, and CH free of large stones, debris, waste, frozen materials, vegetation and other deleterious matter.

The liquid limit and plasticity index shall not exceed 45 and 25, respectively, for the silt and clay materials.

Backfill of all pipe shall be well compacted by mechanical means. Any completed areas that show settlement shall be promptly re-backfilled with compacted clean earth, as specified above, or compacted Granular Material as required for the initial backfill.

Section 1.14 Pipe Installation

Laying of the pipe shall commence immediately after the excavation is started, and the Contractor shall use every possible means to keep the completed pipe installation closely behind the trenching. The District may stop the trenching if it appears that the trench is open too far in advance of the pipe laying operation. The Contractor may lay pipe in the best manner adapted to securing speed and good results. The Contractor shall have the necessary equipment and tools available for making the joints for the specific materials being used.

Generally the maximum slope of sewers shall not be greater than 10%, but if a steeper slope is needed, concrete anchors shall be utilized to prevent the pipe from moving down the slope. Concrete anchors shall be constructed as cross blocks as shown in Detail J of the District's Sanitary Specifications. Concrete anchors shall be spaced as follows:

<u>Grade</u>	<u>Anchor Spacing</u>
10%-35%	≤36ft
35%-50%	≤24ft
≥50%	≤16ft

Sewers shall not be closer to any building than a 1:1 ratio for depths less than 5 feet and 1:1.5 for depths from 5 to 10 feet. The deflections of sewers at any manhole shall not exceed 90 degrees.

Section 1.15 Buried Below Tape

Materials

Warning tape shall be installed with all sewers. The materials to be installed for this purpose shall consist of three (3) inch wide tape made of bonded layer plastic with a metallic foil core. Tape splices shall be knotted to prevent tensile pressure on the splice.

The metallic tape shall be colored green and shall bear an imprint identifying the line below, such as; "Caution Sewer Main Buried Below".

Installation

The Contractor shall furnish all materials. The three (3) inch wide tape shall be installed 18" above the sewer main locations as the trench backfill progresses. The tape material shall be installed in accordance with the manufacturer's recommendations. The tape is to be placed in a manner such that trench backfill settlement will not place an excessive tensile stress on the material.

Section 1.16 Site Cleanup and Restoration

After work is completed, the site of all Improvements shall be cleared of all construction material and other debris. The entire work area shall be left in an orderly condition, acceptable to the District.

Grading shall provide proper drainage and all installation sites shall be left in a neat, clean and acceptable condition. All walkways, driveways, roads, streets, etc. shall be cleaned and replaced to their original condition.

For all Improvements in easements the site shall be restored to a condition equal to or better than it's condition before the work was started.

All Best Management Practices shall be according to the appropriate local, state, or federal authorities' requirements.

Section 1.17 As-Built Drawings

As work progresses, the Contractor shall note all lengths of pipe installed, flow lines at all manholes, locations of all manholes, air relief valve vaults, and service connections and record all dimensions necessary to locate all sewer system facilities.

At the completion of the project, and prior to acceptance by the District, the Contractor shall furnish the copy of plans where all "as-built" dimensions and notes are endorsed. The plans must be clean and legible with regard to all notes made thereon.

Electronic copies of the as-builts shall be provided to the District in both .PDF and AutoCAD formats. The coordinate system to be utilized shall be US State Plane

1983, zone Missouri East 2401, datum NAD83, with altitude measured from mean sea level and units of feet.

See Section 2.10 and Section 5.02 of these specifications for additional requirements for gravity sewer and lift station as-builts, respectively.

Additional requirements for the number of copies and format required can be found in the latest version of the District's "Guidelines for Water Distribution System and Sanitary Sewer Collection System Improvements".

Section 1.18 Final Inspection

After all work and testing is complete a final inspection shall be made by a District representative and all manholes, valves, and cleanouts shall be plumb and be to proper grade and all cleanup work must be satisfactorily completed. The work shall be accepted only after completion of the final inspection. Any defects found in the final inspection shall be promptly corrected by the Contractor.

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Article II. GRAVITY SEWER

Section 2.01 Pipe and Fittings

Materials – General

Pipe for gravity collection systems shall be PVC pipe with a standard dimension ratio (SDR) of 26 for sewers less than 20 feet deep, and for sewers from 20 feet to 30 feet deep the pipe shall be SDR 21 PVC pipe unless directed otherwise by the District Engineer. Sewers deeper than 30 feet will not be allowed except where specifically authorized by the District.

Materials – PVC Pipe

PVC pipe and fittings shall conform to ASTM D3034 "Standard Specification for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings". The pipe shall be furnished in 20' laying lengths. The pipe shall be made and jointed with integral bell and spigot rubber gasketed joints. Each integral bell joint shall consist of a formed bell complete with a single rubber gasket. Gaskets shall conform to ASTM F477 and meet ASTM D3212 Specifications. The pipe shall be made of PVC having a cell classification as defined in ASTM D1784 for 12454 B or 12454 C cell classifications.

Restrained joint PVC pipe, couplings, and fittings utilizing precision-machined grooves and meeting the requirements of this section may be approved by the District Engineer on a case by case basis.

Materials – Ductile Iron Pipe

Ductile iron pipe shall only be used in special circumstances and as directed by the District Engineer. Ductile iron pipe and fittings shall conform to ASTM A746 and be seal coated with a protective coating. Protective coatings shall be Tnemec Series 431 Perma-Shield or approved equal. The joints of pipe shall be push on joints with rubber gaskets conforming to AWWA C-110. In general, ductile iron pipe shall be pressure class 250.

Fittings shall have mechanical joints conforming to AWWA C-110 and be seal coated with the same protective coating as pipe specified above.

All ductile iron pipe and fittings shall have polywrap in accordance with AWWA C-105 and be installed per AWWA C-600.

For all carrier pipe placed in casing pipe under roads or highways, where used for creek or ditch crossings or at any location requiring vertical fittings, the pipe shall be mechanically restrained ductile iron, pressure class 350.

Installation

All pipe spigot ends shall be visibly marked to fully "make-up" the joint. With the exception of field cut pipe, all "make-up" marks shall be placed on the pipe at the factory. Field cut pipe shall be marked for full joint depth prior to insertion.

Gravity sewer pipe 24" or less in diameter shall be laid manhole to manhole, straight to line and grade, carefully controlled by means of the stakes provided (as specified in Section 2.08) and a laser or other manner approved by the District.

Curvilinear alignment of sewers larger than 24" may be considered by the District Engineer on a case-by-case basis, provided compression joints are specified and ASTM or specific pipe manufacturers' maximum allowable pipe joint deflection limits are not exceeded. Curvilinear sewers shall be limited to simple curves which start and end at manholes. When curvilinear sewers are proposed, minimum slopes shall be increased to provide a minimum velocity of two feet per second (2 feet/second) when flowing full.

Section 2.02 Manholes

Materials

All manholes shall be concentric manholes constructed of reinforced concrete sections in accordance with ASTM C478 and ASTM C497 and as shown on Detail B of these specifications.

Calcium aluminate cement shall be used for all manholes and the concrete shall have a minimum 28 day compressive strength of 4,000 PSI. Manholes shall have a minimum inside diameter of 48" and have pre-cast manhole bases. Manhole invert channels shall be formed with 4,000 PSI concrete.

Manhole steps shall have a minimum width of 14 inches and be steel reinforced corrosion resistant polypropylene plastic.

Installation

All manholes shall be installed as shown in the details of these specifications and at the locations and to the grades shown on the plans. The maximum spacing between manholes shall be 500 feet and, where possible, manholes shall be located on side property lines.

After the bottom section of each manhole has been installed, the invert shall be shaped with smooth curves of as large a radius as the size of manhole and pipes permit. The floor of all manholes shall be smooth and slope to the channels therein. A bench shall be provided on each side of any manhole channel when the pipe diameter(s) are less than the manhole diameter. The bench should be sloped no less than one-half inch per foot (0.5 in/ft). No pipe shall discharge onto the surface of the bench.

After the manhole has been fully installed, all lifting holes shall be filled with non-shrink grout and the outside of the manhole shall be sealed as called for in Section 2.03. Care shall be taken to ensure that the flow line grade and finished grades are accurately established as shown on the plans.

Backfilling of the manholes shall be done carefully to ensure that no movement of the manhole occurs. Compaction shall be performed around manholes to 95% per Standard Proctor Test (ASTM D698).

All elevation differences of two (2') feet or more where the pipe enters the manhole shall require an outside drop manhole (See Detail C).

Manhole steps shall be firmly embedded in the manhole walls. Steps shall extend 4.5" from the wall and be aligned so they are not directly over any pipes. Steps shall be spaced at 16" and not more than 24" from the finished grade and the bottom of the manhole.

Section 2.03 Manhole Liners and Seals

Materials

Manhole lift holes, grade adjustment rings, precast section joints, and any additional areas potentially subject to infiltration shall be sealed watertight.

Manhole sections shall be jointed with flexible butyl rubber mastic or bitumen mastic in compliance with ASTM C990. The minimum width of sealant strips shall be 1 inch.

Manholes shall be sealed on the outside with a two-part urethane modified asphalt applied to provide a dry film thickness of 20 mils. All exterior joints shall be sealed with a pressure sensitive sealing tape conforming to ASTM C877. The tape shall be Boa Tape as manufactured by Pipeline Seal & Insulator, Inc. or approved equal.

All pipe openings through manhole walls shall be sealed with a resilient connector in accordance with ASTM C923. The connector shall provide a flexible and watertight seal between the pipe and manhole opening.

Where a force main discharges into a manhole, the interior of that manhole and the next two manholes downstream shall be sealed with an epoxy liner. Manholes further upstream or downstream may require an epoxy liner at the discretion of the District Engineer. The epoxy liner shall be made up of at least 90% solids by volume.

Installation

Two solid strips of mastic, as described above, shall be used between manhole sections with joints at 180 degrees apart.

Installation of exterior joint seals, resilient connectors, and epoxy liners shall be per the manufacturer's instructions.

Section 2.04 Manhole Frames and Covers

Materials

Manhole frames and covers shall be gray iron conforming to ASTM A48. The surfaces shall be machined to provide even seating and shall be coated with coal tar pitch varnish. The minimum clear opening in manhole access openings shall be 27".

All manhole covers shall be solid gasketed covers with a pick hole for opening. The cover shall utilize a ball and socket hinge for ease of opening and be lockable. The cover shall include a "Hold-Open" arm and have the ability to be completely removed for

replacement and safe access. Manhole covers where traffic loads are possible shall have a minimum weight of 145 pounds. Where there is no possibility of traffic load, manhole covers shall have a weight of not less than 85 pounds.

All manholes on sanitary sewers that are located in paved areas, 100-year flood limits, storm water overflow paths, or in other areas determined to be subject to flooding shall be provided with watertight manhole covers.

Manhole frames shall be 7" in height and have a sealant material, as described in Section 2.03, between the frame and cone section or adjustment rings. Manhole frames for all manholes shall weigh a minimum of 230 pounds.

Installation

Prior to placing the manhole frame and cover, any debris shall be cleaned from the cone section and frame. The manhole frames and covers shall sit flush with grade and shall conform to any slope of the ground or pavement.

Section 2.05 Adjustment Rings and Chimney Seals

Materials

Grade adjustment rings shall be reinforced concrete only and have dimensions of 26.5" opening, 8" width, and a minimum height of 2".

If grade rings are used a chimney seal shall be used to provide a watertight seal from the frame to the cone section. The seal shall be a pressure sensitive tape conforming to ASTM C877. The tape shall be Boa Tape as manufactured by Pipeline Seal and Insulator, Inc. or approved equal.

Installation

Between each grade ring that is used mastic shall be placed as described under Section 2.03. A maximum of 12" of grade adjustment rings will be allowed. If the grade adjustment is 6" or less no more than one grade ring shall be used. Cutting of grade rings is not permitted.

Chimney seals shall be installed per the manufacturer's instructions.

Section 2.06 Drop Manholes

When a pipe entering a manhole is over 2' above the pipe exiting the manhole an outside drop shall be installed (See Detail C). When using precast manholes, drop connections must not enter the manhole at a joint. Inside drops will only be allowed on a case by case basis as directed by the District Engineer.

Section 2.07 Gravity Service Connections

Gravity service connections shall be made in accordance with the District's sewer service connection policy as described in detail on the District's website at www.waterdistrict2.com.

Section 2.08 Staking

In addition to the General Requirements for Staking, stakes shall be placed for each manhole and for each proposed fitting for service wyes. Flow lines shall be indicated on the stakes.

Section 2.09 Testing

Testing shall occur no fewer than thirty (30) days after the final backfill has been in place to permit stabilization of the soil-pipe system.

Testing shall include:

- a. A mandrel test of all gravity sewers using a mandrel having nine (9) or more odd number of flutes or points with a diameter 95% of the inside pipe diameter. If the mandrel test fails on any section of pipe, that section of pipe shall be uncovered and replaced. No expansion devices will be allowed to "force" the pipe that is deformed back into round. Any string lines used in mandrel testing shall be removed after the testing is completed.
- b. An air pressure test of all gravity sewers performed to a pressure of 5 PSI with no observed drop in pressure during a test period of 5 minutes.
- c. A vacuum test, according to ASTM C1244, of all manholes for a period of one minute and the vacuum shall be 10 inches of mercury and may not drop below 9 inches of mercury at the end of the one minute test.

Section 2.10 As-Built Drawings

At the completion of the project, and prior to acceptance by the District, gravity systems shall be surveyed and as-built drawings shall be sealed by a Professional Land Surveyor registered in the state of Missouri. The as-builts shall include flow lines, pipe inverts, and manhole rim elevations.

Electronic copies of the as-builts shall be provided to the District in both .PDF and AutoCAD formats. The coordinate system to be utilized shall be US State Plane 1983, zone Missouri East 2401, datum NAD83, with altitude measured from mean sea level and units of feet.

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Article III. FORCE MAIN

Section 3.01 Pipe and Fittings

Materials – General

For 12” or smaller diameter sewer force mains PVC pipe shall be used. Ductile iron pipe and fittings may be required for sewer force mains with diameters 12” or larger at the discretion of the District Engineer.

Materials – PVC Pipe

PVC pipe shall be class 200, with a standard dimension ratio (SDR) of 21. Pipe for use under this heading shall be manufactured from clean, virgin, N.S.F. approved Type I, Grade I, 1120 P.V.C. conforming to A.S.T.M. specification D2241. The pipe shall be pressure rated for a hydrostatic working pressure of 200 PSI at 73.4 degrees F. The pipe shall also conform to the following:

- a. Hydrostatic Integrity: The pipe shall withstand without failure, a pressure of 420 PSI for at least 1,000 hours at 73.4 degrees F, in accordance with A.S.T.M. Specifications 1598. The pipe shall withstand without failure, a pressure of 630 PSI applied in 60 to 90 seconds.
- b. Vice Flattening Test: A 2 inch wide section of pipe shall be flattened in less than one minute, to 100% without showing evidence of shattering or splitting at 73.4 degrees F.
- c. Pipe Wall Thickness: Rigid plastic pipe shall be manufactured to provide a minimum pipe wall, and bell or coupling thickness in accordance with the following schedules:

Minimum Wall Thickness (Inches)

<u>I.D. Size (Inches)</u>	<u>Barrel</u>	<u>Bell</u>
2	0.113	0.146
4	0.214	0.258
6	0.316	0.376
8	0.410	0.481
10	0.511	0.607
12	0.606	0.735

- d. Concentricity: The outer diameter of the pipe shall be concentric within .003 of an inch.

All PVC pipe shall be joined by means of a rubber ring slip joint. Cement weld or glued joints will not be permitted. The slip joint shall be formed by a bell joint which shall be an integral and homogenous part of the pipe formed by extrusion, with a ring

groove for seating the rubber ring gasket. "Ultra Blue" or other PVC with any thickness less than stated above will not be allowed. Also, C-900 PVC pipe shall not be allowed.

Restrained joint PVC pipe, couplings, and fittings utilizing precision-machined grooves and meeting the requirements of this section may be approved by the District Engineer on a case by case basis.

Materials – Ductile Iron Pipe

Ductile iron pipe shall only be used in special circumstances and as directed by the District Engineer. Ductile iron pipe shall conform to ASTM A746 and be seal coated with a protective coating. Protective coatings shall be Tnemec Series 431 Perma-Shield or approved equal. The joints of pipe shall be push on joints with rubber gaskets conforming to AWWA C-111. In general, ductile iron pipe shall be pressure class 250.

All ductile iron pipe and fittings shall have polywrap in accordance with AWWA C-105 and be installed per AWWA C-600.

For all carrier pipe placed in casing pipe crossing road right-of-ways, where used for creek or ditch crossings or at any location requiring vertical fittings, the pipe shall be mechanically restrained ductile iron, pressure Class 350.

Design

Force mains should typically be designed so that the design average flow velocity is between 3 feet per second and 5 feet per second. Design average flow velocities as low as 2 feet per second or as high as 8 feet per second may be allowed at the discretion of the District Engineer.

Installation

Force mains shall be laid straight to line and grade with major deflections to be made by appropriate bends. The grades for force mains shall be established from the cuts shown on the stakes and shall be such that at least 42", but no more than 72" of cover is provided and provisions are made to clear other utilities or obstructions.

All pipe spigot ends shall be visibly marked to fully "make-up" the joint. With the exception of field cut pipe, all "make-up" marks shall be placed on the pipe at the factory. Field cut pipe shall be marked for full joint depth prior to insertion.

Cutting of pipe for closure pieces with installation of valves or fittings, or for any other reason, shall be done in a neat and workman-like manner without damage to the pipe or linings. The cutting operation shall leave a smooth cut end at right angles to the longitudinal axis of the pipe. The exterior surface of the cut end shall be beveled, and the interior surface shall be reamed or filed free of all rough edges and protrusions. All pipe cutting shall be done by saw or mechanical pipe cutters of an approved type.

Upon completion of the cutting and trimming operation, the pipe end or ends shall be marked for "make-up" depth. Prior to insertion, the pipe shall be thoroughly cleaned of all foreign materials, including filing and cutting debris.

Section 3.02 Fittings and Fitting Restraint

For restraint of unbalanced thrust for fittings larger than 12", either conventional thrust blocking or mechanical restraints may be used.

Ductile iron pipe restraints for fittings may be designed using restrained joints in the pipe and fittings. However if such restraints are provided, calculations signed and sealed by a Missouri Registered Professional Engineer shall be provided.

Concrete for thrust blocking shall be ready mix concrete, composed of Portland cement, sand and gravel with not more than six (6) gallons of water per sack of cement. The concrete shall be a 5-1/2 sack mix with 28 day minimum compressive strength of 3,000 PSI.

All fittings shall be ductile iron, Class 350, conforming to ASTM A746. The fittings shall have mechanical joints conforming to AWWA C-111 and be seal coated with a protective coating as specified for Ductile Iron Pipe in Section 2.01. If restraints are being used in a ductile iron restraint system, U.S. Pipe TR FLEX, American Flex Ring, or Griffin Snap-Lock restrained joint pipe and fittings or approved equal shall be allowed. Megalug type joint restraints shall only be allowed with mechanical joint fittings.

Installation

All horizontal fittings 12" and smaller shall be thrust blocked with poured concrete as shown in Detail E of these specifications. Thrust blocking for fittings larger than 12" shall be designed and detailed by Engineer.

Forms shall be provided to avoid concrete encasement of any part of mechanical joints. All form material shall be removed from the trench prior to backfilling. Pre-cast concrete block supports shall be used for all fittings installed.

Section 3.03 Valves

Valves shall be mechanical joint plug valves with adjustable gear driven operators rated for buried service. Plug valves shall be of the non-lubricating, eccentric type and shall be designed for a working pressure of 150 psi. Valves shall provide tight shut-off at rated pressure. The valve shall have a round port design.

The valve body shall be ductile iron ASTM A-536, Grade 65-45-12 with welded in overlay of 95 percent nickel alloy content on all surfaces contacting the face of the plug. The valve shall be internally and externally coated with an epoxy coating.

The valve plug shall be ductile iron ASTM A-536, Grade 65-45-12 with Buna N resilient seating surface to mate with the body seat.

The plug valve shall be furnished with permanently lubricated sleeve type bearings conforming to AWWA C517. Bearings shall be of sintered oil impregnated type 316 stainless steel ASTM A-743 Grade CF-8M or bronze ASTM B-127.

Valve shaft seals shall be of the "U" cup type in accordance with AWWA C517. Seals shall be self-adjusting and re-packable without moving the bonnet from the valve.

Valves shall also include a cast iron valve box with the lid stamped "SEWER".

Section 3.04 Force Main Service Connections

Service connections to force mains shall be made in accordance with the District's sewer service connection policy as described in detail on the District's website at www.waterdistrict2.com.

Section 3.05 Air Release Valves

Materials

Air release valves shall have a reinforced nylon body with stainless steel inner working parts and be 2" A.R.I. "Saar" Short Version D-025 or approved equal. All air release valves shall be installed in a flat bottom 72" diameter manhole. The piping for the air release valve and all fittings including the saddle shall be stainless steel. Refer to Detail G for additional information.

Installation

Air relief valves shall be provided on force mains at all high points and as indicated on the plans. The valves shall be installed on the top of the pipe and shall have a 2" stainless steel globe valve between the force main and the air relief valve. The air relief valves shall be attached to the sides of the manhole with stainless steel straps attached to the sides of the manhole to prevent movement of the valve during operation.

Section 3.06 Cleanouts

Cleanouts shall be installed to provide a means for flushing force mains. Cleanouts shall be installed as shown on the plans, as approved by the District or as directed by the District Engineer. At a minimum cleanouts shall be installed at terminating ends of the force main, at points where there is a change in direction 45° or greater, or every 500 feet. Refer to Detail F for further requirements.

Terminal cleanouts shall be installed at all ends of public force mains. Terminal cleanouts shall be installed as shown on the plans, as approved by the District or as directed by the District Engineer. Refer to Detail K for further requirements.

Section 3.07 Tracer Wire

Materials

On all force mains there shall be installed a tracer wire which shall be a single insulated No. 12 copper wire, THNN or THWN, gasoline and oil resistant. The insulated wire shall be furnished in rolls of not less than 500 feet. Where splices are required, splices shall be made with 3M splice kits or approved equal.

Installation

The Contractor shall furnish all materials. The No. 12 insulated wire shall be placed along the top of the force main and taped in place with duct tape or electrical tape at a maximum of 6' intervals. Permanent access points shall be provided through manholes, valve boxes, clean outs or other approved means at the ends of the tracer wire.

For ductile iron pipe the locator wire shall be placed outside the polyethylene encasement. Caution must be exercised in the initial backfilling not to move or damage the locator wire.

The wire shall be brought up the outside of each access point from each direction and then both wires are to be threaded into the access point through the ½" diameter hole near the top in the initial installation.

The two wires shall be spliced inside the access point with a standard plastic or rubberized wire connector. After testing for continuity, the splices inside the box shall be made with a 3M splice kit or approved equal. Where splices become necessary outside of valve boxes, the splices shall be made initially with a 3M splice kit or approved equal.

All tracer wire shall be tested for continuity as called for in Section 3.09.

Section 3.08 Staking

Stakes shall be placed at intervals not to exceed 100 feet along the force main and at all fittings, cleanouts, and air release valves.

Section 3.09 Testing

Testing of force mains shall include:

- a. Force mains shall be pressure tested (at the highest point in the project) at a pressure of 150 PSI for a period of 2 hours with a maximum of not more than 2 PSI drop in pressure;
- b. The tracer wire on all force mains shall be tested by the Contractor for continuity in the presence of a District representative. If the test is satisfactory, all splices shall be made permanent by means of 3-M splice kits or approved equal. If the tests fail in a section, the Contractor shall find and repair any failure in the locator wires.

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Article IV. LIFT STATIONS

Section 4.01 General

Materials

Lift stations shall consist of a wet well, submersible pumps, dry valve vault, control panel and other related accessories. The lift stations shall conform to MoDNR Design Guide per 10 CSR 20.8.130. Design calculations of maximum flow shall be submitted with detailed specifications and flows shall be determined in accordance with the requirements of MoDNR Design Guide per 10 CSR 10.8.110. All lift stations shall contain at least two (2) pumps, each with 100% design capacity.

Installation

The work covered by this Article of the specifications, shall consist of furnishing all specified materials with all necessary equipment, machinery, tools, and labor, and performing all work required to install and/or construct the sewer lift stations with all directives or modifications and these specifications, all to be; complete, in place, accepted, and ready for use. Failure to comply with these specifications will result in the rejection of the work by the District. All work shall be in accordance with MoDNR Rules under Title 10 CSR 20.8-120 and 130.

Section 4.02 Wet Well

Materials

The wet well shall consist of a circular basin, minimum 6 feet in diameter and minimum 10 feet in depth. The wet well shall be constructed of reinforced concrete and have walls designed to withstand the external earth loadings when the wet well is empty. The wet well shall have a reinforced concrete bottom and top with access hatch.

A 6" ductile iron suction pipe shall run inside the wet well for a bypass suction line. It shall extend above the wet well with a 90° fitting with a 6" stainless steel male cam and groove fitting. Stainless steel pipe supports shall be placed along the line.

The base of the wet well shall be grouted with non-shrink, non-metallic, non-corrosive cement based grout conforming to ASTM C1107.

All pipe openings through the wet well walls shall be sealed with a resilient connector in accordance with ASTM C923. The connector shall provide a flexible and watertight seal between the pipe and wall opening.

The wet well shall contain stainless steel guide rails for the installation and removal of the pumps.

The interior of the wet well shall be epoxy seal coated per the following:

- a. All voids shall be patched with TNEMEC Series 218 MortarClad or approved equal.

- b. The entire interior shall then be coated with TNEMEC Series 434 Permashield H2S or approved equal.
- c. The interior shall then receive a topcoat of TNEMEC Series 435 Perma Glaze or approved equal.

All exterior joints shall be sealed with a heat shrinkable joint wrap conforming to ANSI/AWWA C-216. The wrap shall be Riser-Wrap Water Infiltration Sealing System as manufactured by Pipeline Seal and Insulator, Inc. or approved equal. All sealed joints are to be inspected by District personnel prior to backfilling.

The pump bases shall be as specified by the pump manufacturer and have minimum 4" ductile iron (Class 350) discharge pipes, which run through the valve vault.

There shall be provided stainless steel lifting chains and floats for control of the pumps as called for in Article V and as recommended by the pump manufacturer. Floats shall be provided for the control of the pumps and alarms.

The wet well shall have a 3" minimum diameter Type 304 stainless steel air vent extending through the top slab with a 180 degree turn. All vents shall have a charcoal filter at the end of the vent pipe. The filter shall be such that the filter material may be replaced without replacing the vent filter piping.

There shall be a stainless steel or aluminum trash basket located at the inlet pipe with a stainless steel lifting chain to provide for periodic removal and cleaning.

Access to the wet well shall be through an aluminum hatch, rated for a 300 pound load, Halliday R2R or approved equal. The hatch shall be complete with hinges and flush locking mechanism, upper guide holder and level sensor cable holder. Doors shall open and automatically lock with stainless steel "hold open" arm with aluminum release handles.

Wet wells shall contain a form of fall protection around the access hatch meeting OSHA standards. Due to the varying conditions for the wet well and site layout fall protection will likely be unique to each individual lift station. Fall protection shall be proposed with each design and approval is at the discretion of the District Engineer.

Steps shall have a minimum width of 14 inches and be steel reinforced corrosion resistant polypropylene plastic.

Installation

The wet well shall be constructed as detailed on the plans, as approved by the District, and per these specifications. The base of the wet well shall be grouted on the inside at a 1:1 slope to prevent the accumulation of solids or as specified by the District.

All access frames and covers shall be properly set and installed as recommended by the manufacturer.

The bypass pump suction line shall be securely fastened with stainless steel pipe supports at a maximum of 10' on center. The line shall extend 2'-6" above the top of the wet well. See Detail I for more information.

The stainless steel guide rails shall be securely fastened at the top opening of the wet well, with a stainless steel bracket, to allow the pumps to accurately mate with the pump bases which shall be secured to the bottom with stainless steel bolts.

Floats shall be located such that they are not affected by incoming flow.

Vent filters shall be installed directly on the end of the vent pipe per the manufacturer's instructions.

The top elevation of the wet well shall be 12" higher than the surrounding ground and the grades around the wet well shall be such that all runoff will be diverted away from the top. The hatch frame and cover shall be flush with the top of the concrete.

Steps shall be embedded 4.5" from the wall of the wet well at 16" vertical spacing and shall be no more than 24" from the top and bottom of the wet well. Steps shall not be placed directly above any pipes.

The joint wrap and resilient connectors shall be installed per the manufacturer's recommendations.

Section 4.03 Pumps and Motors

Materials

The pump and motor units shall be the submersible type to deliver the design flow through minimum 4" discharge force mains. The pumps shall be capable of passing spheres of at least 3" in diameter and shall be driven by 3 phase, 460 volt, and 60 Hz. motors. The units shall be as manufactured by Flygt, Fairbanks Morse, and ABS or approved equal. Grinder pumps shall not be allowed.

Major pump components shall be gray cast iron, Class 30, with smooth surfaces devoid of blowholes or other irregularities. Thermal sensors shall be used to monitor stator temperatures and specialized relays/sensors shall be supplied to the control panel manufacturer prior to panel construction. Impellers shall be of gray cast iron, Class 30, dynamically balanced, single or double shrouded non clogging design, with stainless steels shafts, and be capable of handling solids, fibrous materials, heavy sludge, and be capable of passing a solid 3" diameter sphere.

Installation

The pump and motor units shall be carefully installed as recommended by the manufacturer and the seals between pumps and pump bases must mate as intended. The pump and motor units shall be properly wired and field checked to see that they can be easily removed and replaced by means of the lifting chains and do not bind on the guide rails. Actual pump tests may be required by placing water in the wet well and timing the withdrawal rates.

The discharge connection elbows shall be permanently installed in the wet well and the pumps shall be automatically connected to the discharge connection when lowered into place and shall be easily removed for inspection or service by means of stainless steel lifting chains. There shall be no need for personnel to enter the wet well.

Section 4.04 Valve Vault

Materials

The valve vault for each lift station shall be pre-cast or cast in place reinforced concrete.

Access to the valve vault shall be through an aluminum hatch, rated for a 300 pound load, Halliday S2R or approved equal. The hatch shall be complete with hinges and flush locking mechanism, upper guide holder and level sensor cable holder. Doors shall open and automatically lock with stainless steel "hold open" arm with aluminum release handles.

Steps shall have a minimum width of 14 inches and be steel reinforced corrosion resistant polypropylene plastic.

The valve vault shall contain two 4" (min.) discharge lines from the pumps and each line shall have a horizontal swing check valve with an outside rotating arm indicator and a gate valve with a hand wheel operator.

The base of the valve vault shall be grouted with grout specified in Section 4.02.

All piping and all fittings shall be flanged ductile iron and all piping shall be properly supported. In one of the discharge lines there shall be a tee and valve and a male "cam lock" connection for emergency pumping to a tank truck. Immediately beyond the valve vault, there shall be one 90 degree bend to bring the piping to a tee and then to the force main with a plug valve, as specified in Section 3.03, immediately beyond the tee, with a valve box for operation from the ground surface. There shall be provided a minimum 2" schedule 40 PVC drain pipe from the valve vault to the wet well.

All pipe openings through the walls of the vault shall be sealed with a resilient connector in accordance with ASTM C923. The connector shall provide a flexible and watertight seal between the pipe and wall opening.

Installation

The valve vault shall be constructed as detailed on the plans, as approved by the District, and per these specifications. The floor of the valve vault shall be grouted to provide a slope of 1% to the drain line.

All resilient connector's shall be installed per the manufacturer's recommendations.

Section 4.05 Magnetic Flow Meter

Materials

A magnetic flow meter shall be supplied with a separate signal converter for all lift stations. Meter vaults shall be a meter pit or reinforced concrete vault as determined by the size of the meter required and as directed by the District.

The magnetic flow meter body shall be rated for direct bury, full submersion, and shall be flanged. The meter body shall be carbon steel with ANSI 150 pound flanges and

a corrosion coating rated for submerged conditions. The valve body liner shall be hard rubber and shall be rated for full vacuum service.

The electrodes shall be type-super smooth, polished with self-cleaning finish and non-stick shape. They shall be constructed of 316L stainless steel equivalent. The meter body shall include 316 stainless grounding rings. The cable connection ports shall be ¾" NPT male and rated for submersion.

The signal converter shall be installed in a separate enclosure. The converter shall have one digital output and shall have current output with HART communication.

Schedule 80 PVC conduits shall be used for all wiring from the meter vault to the signal converter enclosure.

Installation

Flow meters shall be supplied in a vault as specified above on the discharge line beyond the valve vault. All power and signal wiring shall be per manufacturer's requirements.

Section 4.06 Storage and Capacity

The station shall have additional storage capacity to handle flows during peak demand period, during a power failure or other malfunction, of two hours or more at the discretion of the District Engineer. This excess capacity may be in the wet well if possible, or may be an external concrete storage tank, designed to flow back into the wet well upon correction of the lift station malfunction or power failure and is at the discretion of the District Engineer. "In-line" storage within gravity sanitary collection mains will only be allowed at the discretion of the District Engineer.

In some circumstances on site generators or quick connects for portable generators, per District details, will be required at the discretion of the District Engineer.

Materials

All joints and pipe openings in the external concrete storage tanks shall be lined and sealed using approved liners and seals as stated in Section 2.03.

Installation

Storage structures shall be installed per the approved plans and specifications or as directed by the District Engineer. All seals and liners shall be installed per the manufacturer's recommendations.

Section 4.07 Piping and Valving

Materials

All piping in the wet well and the valve vault shall be ductile iron pipe, class 350 in accordance with AWWA C-151. Valving shall be as specified in Section 3.03 of these specifications. Provisions shall be made for the removal and replacement of all piping, valves and fittings.

All bolts used inside the wet well and valve vault shall be stainless steel.

The force mains between the wet well and valve vault shall be inside schedule 40 PVC casing pipes which shall be 4" larger in diameter than the force mains and which shall be properly sealed on each end. A resilient connector conforming to ASTM C923 shall be used between the wall opening and the casing pipe. Between the casing pipe and the carrier pipe shall be grouted with non-shrink, non-metallic, non-corrosive cement based grout conforming to ASTM C1107.

Installation

Piping shall be installed as shown on the plans, as approved by the District, and in accordance with Article III

Section 4.08 Pavement

Materials

Paving shall be provided for the access road and for all areas inside the fence and shall consist of a sub-base of 6" of Granular Material and the finished pavement shall be constructed with 4" of asphaltic concrete or 6" fiber mesh concrete.

Installation

Paving shall be to a smooth grade and sloped to provide proper drainage, especially away from the lift station facilities. The paved area shall be 10' in width and a paved turn around area shall be provided.

Section 4.09 Entrance Road Barriers

Materials

There shall be provided two 36" high barrier posts, vinyl clad schedule 40 steel pipe at the entrance road to the lift station and the posts shall be painted yellow. There shall also be provided a 5/16" diameter galvanized chain locked on one end and attached to the other, run between the posts. For safety purposes, a 4" x 12" reflective plate shall be attached to the chain at the center of the span.

Installation

The barriers shall be installed as shown on the plans as approved by the District.

Section 4.10 Fencing

Materials

Fencing around the lift station, including the wet well, valve vault and control panel, shall consist of a 6' high chain link fence with a barbed wire security top and a 12' wide entrance gate.

Wire fabric for the fence shall be a vinyl clad chain link fence fabric and wire shall be No. 11 gauge woven into a 2" mesh. The barbed wire top shall consist of three strands of No. 12-1/2 gauge line wires with No. 14 gauge barbs spaced at approximately

5" centers. Posts shall be vinyl clad schedule 40 pipe and post shall be equipped with suitable tops. All fencing must conform to local ordinances.

Posts shall be sized and set as follows:

<u>Type</u>	<u>Size</u>	<u>Pull</u>
Top Rails and Brace	1-1/4" Min.	2.27 lbs.
Line Posts and Gate Frame	1-1/2" Min.	2.72 lbs.
End Corner or Pull Post	2" Min.	5.79 lbs.

Concrete Bases shall be sized as follows:

<u>Type</u>	<u>Diameter</u>	<u>Depth</u>
Line Post	12"	3'-6"
End Corner Gate	16"	4'
Pull Post	16"	4'

Installation

The fencing shall be installed as shown on the plans, as approved by the District. Poles shall be set in 30" deep concrete bases so that the pole bottom rests 6" higher than the concrete base bottom. Horizontal support bars shall be installed half way between the top rail and the ground. A #7 tension wire shall be installed at the bottom of the fencing fabric and stretched taught so as not to allow the bottom of the fencing fabric to be lifted away from the fencing poles and/or the ground. Double twisted steel ties shall be used to fasten the fencing fabric to the poles.

Section 4.11 Testing

Testing shall consist of introducing water into the wet well to ensure that the pumps operate as proposed and all controls and alarms shall be operated in the presence of a District representative to demonstrate that they operate as intended. All alarm conditions shall be simulated and the dialer or SCADA shall be programmed and shown to operate as intended.

Leakage testing as specified by the Engineer and approved by the District Engineer shall be completed by the Contractor for the wet well, storage chamber, and valve vault.

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Article V. LIFT STATION CONTROL SYSTEM AND ELECTRICAL

Section 5.01 General

Major Equipment and Services

- Pump Control Panel with Moscad-L RTU, antenna, including all software programming, start-up, and training, per the following specifications.
- The SCADA "site" shall be added to the existing SCADA PLC/computer network by an authorized Motorola Moscad Value Added Reseller (VAR) and by an authorized Intellution Systems Integrator familiar with the existing Intellution computer network.

Installation

The Contractor shall provide and install all hardware, software, labor, materials, and equipment required to provide a complete control panel with the District's Supervisory Control and Data Acquisition system (SCADA), in strict accordance with the requirements of these specifications.

The electrical and control system shall be as specified and shall all be installed in accordance with the National Electrical Code. The complete system shall be provided and installed by a single supplier.

The Contractor shall contact the local power supplier and install all lines to the control panel, including metering in accordance with their requirements. The electric meter shall be installed as close to the lift station as allowed by the power utility.

The control panel shall be located from 3 feet to 8 feet from the wet well and installed per the plans, as approved by the District, and as called for in these specifications.

Section 5.02 Quality Assurance

(1) Equipment Qualifications

SCADA telemetry units shall be Motorola Moscad/Moscad-L as specified elsewhere. Motorola Moscad equipment shall be made an integral part of the control panel being manufactured by the systems integrator. Alternatives to the Motorola Moscad equipment shall not be accepted.

(2) Manufacturer's Qualifications

It is the intent of these specifications that all motor control and control components be supplied by a single supplier. Controls shall not be assembled on site. System supplier shall be a UL 508 certified facility and shall be regularly engaged in the manufacture of controls for the municipal water industry. The system specified herein shall be the product of a manufacturer having at least ten years of experience in the construction of such control equipment.

The control panel and SCADA system integration shall be the responsibility of a single manufacturer/supplier, hereafter designated as the Systems Integrator. All aspects of the system including fabrication, programming, start-up, and training shall be by one entity. Sub-letting of work shall not be accepted. The Systems Integrator shall provide a fully complete system operating in a satisfactory manner.

All Moscad programming and system start-up shall be performed by the Systems Integrator. The Systems Integrator shall be an authorized Motorola Moscad Value Added Reseller (VAR), proof of which shall be submitted with the bid documents, if required by the Engineer/Owner.

All Intellution programming and system start-up shall be performed by the Systems Integrator. The Systems Integrator shall be an authorized Intellution Systems Integrator familiar with Intellution SCADA system equipment.

The Systems Integrator/Motorola Moscad VAR/Intellution SI shall have offices located within 100 miles of the District's office to facilitate timely system support. The Systems Integrator shall employ at least two (2) full time field service technicians, and two (2) full time programming technicians.

(3) Submittals

Complete submittals shall be provided to the Engineer/Owner for review and approval prior to purchasing of equipment or equipment fabrication. Submittal data shall include the following:

A. Drawings

A master wiring diagram for the control panel(s) shall be submitted for Engineer's review and approval before beginning construction. This diagram shall be drawn in standard ladder logic format. All ladder rungs shall be numbered in the left hand margin, and all relay contacts referenced to these numbers in the right hand margin. Each electrical node in the control schematic shall have a different wire number. A bill of materials and a layout drawing of the enclosure door/inner bracket components shall appear on this drawing with a listing of nameplates pertaining to the components. Submittal drawings may be on 11" x 17" paper.

B. Product Data

Included in the submittal package shall be data sheets of all equipment used in the control panel, as listed in the bill of materials.

(4) As-Built

Complete as-built drawings shall be provided to the Engineer/Owner upon project completion. As-Built data shall be on full-size 24" x 36" paper. Five (5) sets and an electronic copy in PDF shall be provided. An additional full-size as-built drawing shall be placed in the control panel.

A waterproof reduced copy of the master "as built" wiring diagram shall be laminated in clear plastic and permanently fastened to the inside of the panel door.

(5) Start-up

Provide on-site start-up of supplied equipment.

(6) Training

An on-site training program shall be provided to employees as selected by the District. The objective of the training is to provide a common working knowledge concerning the operation of the system. Training shall include one (1) two-hour training session provided at the completion of start-up.

(7) Warranty

System warranty shall be for a period of 1 year commencing upon successful completion of startup. Warranty includes parts and labor for all equipment/software/services provided. Warranty excludes surge/transient damage.

Section 5.03 Operation

(1) Demand

Basic operation of the pumps shall be as a pump-down, lead/lag, common off system with high level alarm. Panel shall accommodate connection of floats, with the following functionality:

High Level	Lag Demand
Lead Demand	Stop

(2) Control

Each pump shall have a "Hand-Off-Auto" selector switch.

Hand: Pump shall be demanded and shall run continuously until the selector switch is turned to Off or Auto.

Off: Pump shall not be demanded.

Auto: Pump shall be controlled by the floats in the wet well. A demand for each pump shall be delayed through adjustable time delay relays with a range of .1 - 10 seconds. Initially, the time delay for the first pump demand shall be set at 8 seconds, with required additional pump demand time delays being staggered 8 seconds apart. Operation of the lag pump(s) shall not be dependent on the lead demand float.

(3) Alarms

The alarm system shall operate individual pilot lights as described under Section 5.04, and a common general alarm for the external red light upon the following faults:

(1) High Wet Well Level

A contact closure from the high level float shall indicate a high level alarm condition. This alarm shall automatically reset.

(2) Pump Fail (No Pressure)

A time delay shall begin when the pump is demanded. If the pump pressure switch does not indicate pressure prior to the time expiring, a "No Flow" alarm shall exist. This alarm shall latch and prevent the pump from running. Alarm annunciation shall remain on until manually reset.

(3) Pump Seal Fail

A pump seal failure shall be annunciated only by the individual pilot light. This alarm shall not stop the pump from running.

Section 5.04 Equipment

Pump control panels shall meet the following specifications:

(1) Enclosure

Enclosure shall be NEMA 12 basic construction modified with a drip shield to have a NEMA 3R rating, and shall have a swing-out inner door and separate sub panel. A standard NEMA 3R enclosure shall not be acceptable. Enclosure shall be constructed from 12 gauge 304 stainless steel with a #4 finish. All hardware on exterior of panel shall be stainless steel. Exterior door shall be held shut with a padlock. 3-point door latch shall be Austin #48-5655SSX, or equal. The padlock is to be provided by the owner. Inner door shall be held shut with latch, Emka wing knob #1000-U78 and cam #1000-50, or equal. All doors shall be mounted to the enclosure with continuous hinges. Exterior door shall be gasketed to provide a watertight seal to the enclosure. Sub panel and inner door shall be 12 gauge mild steel primed and painted white. All control switches, pushbuttons, elapsed time meters, and indicator lights shall be mounted on or through the inner door. All panel wiring and equipment layout shall be performed per N.E.M.A. and J.I.C. specifications. N.E.C. gutter spacing shall be observed. A minimum of 6" additional D.I.N. rail shall be provided for future mounting expansion.

All panels and panel doors shall be bonded to earth ground. Hinges shall not be considered as an adequate grounding path.

(2) Power Distribution Block

Provide a main power distribution block sized for incoming power to the panel. Each pole of the block shall be supplied with a clear cover for operator protection. Power distribution block shall be Gould 63000, 67000, or 69000 series or approved equal, as required.

(3) Surge Suppression

Provide a silicon oxide varistor surge/lightning suppressor connected to the power distribution block and sized for incoming voltage. Minimum ratings shall be 60,000 amps, 1500 Joules. Suppressor shall be Delta LA series, or approved equal.

(4) Phase Monitor

Where three-phase motors are controlled, provide a plug-in style phase monitor designed to monitor phase loss, under voltage, and phase sequence with a SPDT contact to interrupt all control power in the event of phase loss. Phase monitor shall be supplied with fused protection of the three phase sensing circuit. Phase monitor shall be Diversified Electronics SLA series, Symcom model #250A, or approved equal. Fuse holder shall be three-pole Gould USM_I series, or approved equal. Fuses shall be fast-acting Gould ATM series, or approved equal.

If a phase converter is being used to provide three phase power, a current monitor and controls shall be installed to provide protection against phase imbalance damaging the motors. An alarm should exist for when the motor is stopped due to a possible phase imbalance.

(5) Circuit Breakers

Provide individual, properly sized, thermal-magnetic circuit breaker for each load served. Combination circuit breaker and overload mechanism shall not be allowed. Circuit breakers for motors and other loads shall have a minimum rating of 10,000 AIC (230 vac breakers) or 14,000 AIC (480 vac breakers).

Provide individual, properly sized, thermal-magnetic circuit breaker for each of the following:

- (A) Transformer
- (B) Each motor load
- (C) TVSS (where a TVSS is present)

Provide 1-pole, properly sized circuit breakers for the following loads:

- (A) Panel receptacle/condensation heater/service light.
- (B) Generator battery charger (at stations where a generator is present)
- (C) Generator jacket heater (at stations where a generator is present)
- (D) Control circuit
- (E) 120 vac power filter
- (F) Telemetry Unit
- (G) Power Transfer Switch (at stations where a generator is present)
- (H) Generator Connections (at stations where a generator is present)

(6) Contactors/Overload Relay

A magnetic, across the line, horsepower/current rated motor contactor with ambient temperature compensated overload relay shall be provided for each motor load served.

Contactor shall be Cutler Hammer CE 15 Series, ABB Series A, or approved equal. Overload relay shall be Cutler-Hammer #C316, ABB Series TA, or approved equal.

(7) Solid State Starter

Pumps 20 HP and larger shall be provided with a reduced voltage solid state starter with overload protection and across-the-line bypass contactor for each motor load served. Solid state starter shall be Cutler-Hammer IT series with line side surge protector, ABB PSS series, or approved equal.

(8) Transformer

If 120 volt, single phase is not available, a minimum 2KVA dry-type transformer shall be supplied with primary and secondary short circuit protection. Control power shall be 120 volt. Control circuit shall be connected so that a power outage of any duration does not require manual re-start of system.

(9) Fuse Holders and Fuses

Provide a fuse holder and fuse for the control circuit, minimum rating 5 amps (ampacity not to exceed relay contact rating). Fuse holders for control fuses shall be finger safe with neon light indication for a blown fuse. Control fuse, fuse holders shall be Gould USM_I series, Entrelec, or approved equal.

(10) Terminal Blocks

Numbered terminal blocks shall be supplied for all field terminations. Current capacity of terminal strips shall be equal to the load served. Terminal blocks shall be suitable for minimum 12 AWG wire at not less than 300 volts. Terminal blocks for control interface shall be Entrelec model 115116.07, or approved equal.

(11) Interior Service Light:

Provide an interior fluorescent service light w/ safety lens fastened to the top of the enclosure with two-position "Off-On" selector knob to control. Incandescent light fixtures shall not be acceptable. Light shall be mounted without penetrating the panel outer skin with screws or fasteners.

(12) Entry Switch

An entry switch shall be mounted in the panel, which shall close a contact wired to the telemetry unit when the exterior door of the enclosure is not closed. Switch shall be Microswitch #1AC2, or equal.

(13) Receptacle

Provide a 15-amp G.F.I. duplex receptacle connected to a separate circuit breaker, as described elsewhere, and mounted on the control panel inner door.

(14) Condensation Heater

Provide a 100 watt, 120 vac silicone rubber self-adhesive condensation heater mounted on a flange with integral 40 degree thermostat. Heater shall be Watlow #020100C1-EV11B, or approved equal.

(15) Powering Conditioning

Control systems utilizing microprocessor technology shall have power conditioning for incoming power to these pieces of equipment. The telemetry unit shall be protected by this surge suppressor. The power conditioning equipment shall be Amber Industries model AI-10*A-CM (* = Amp rating) or approved equal.

(16) Alternator

Provide an automatic electronic alternator for alternating pump operation on successive automatic cycles. Relay shall incorporate LED position indicators and a toggle switch to select pump #1 or pump #2 as the lead pump, or to allow automatic alternation. Alternator shall be Diversified Electronics ARB series or approved equal.

(17) Relays

Relays shall be general purpose plug-in relays with standard mounting configurations. The relays shall have the number of poles as shown on the drawings with neon indicating lamp and test button integral to each relay. Relay contact ratings shall be minimum 5 amps.

(18) Time Delay Relays

Time delay relays shall be dial or D.I.P. switch selectable, and shall have contact ratings of not less than 10 amps. Switch settings shall be labeled on the relay. Time delay relays shall be Diversified Electronics TB series, or approved equal.

(19) Selector Switches

Selector switches shall be 30 mm oil tight type with lever operators and 10 amp contacts. Knob operators shall not be accepted. Contact blocks shall be provided as required and shall be rated for a nominal voltage of 500 vac and 10 amps. Control switches shall be Cutler-Hammer Series E34 or approved equal. Contact blocks shall be Cutler-Hammer type 10250T or approved equal. Provide selector switches for the following functions (per pump where applicable):

Pump "Hand-Off-Auto" Three-position

(20) Pilot Lights

Pilot lights shall be push-to-test, oil-tight industrial units utilizing 120 volt bulbs (unless otherwise specified). Lenses shall be colored as shown on the drawings. Control panel lights shall be modular construction as manufactured by Cutler Hammer E34RPB or approved equal. Contact blocks shall be Cutler-Hammer type 10250T or approved equal. LED type lights shall not be acceptable. Provide pilot lights for the following functions (per pump where applicable):

(A) High Level	Red
(B) Pump Run	Green
(C) Pump Fail	Red
(D) Pump Seal Fail	Amber

(21) Pushbuttons

Pushbuttons shall be oil-tight industrial units. Contact blocks shall be provided as required and shall be rated for a nominal voltage of 500 vac and 10 amps. Control panel pushbuttons shall be modular construction as manufactured by Cutler Hammer Series E34 or approved equal. Provide push-buttons for the following functions:

- (A) Alarm horn silence
- (B) Pump Fail Reset

(22) Elapsed Time Meters

Provide an elapsed time meter for each pump controlled. Meter shall be 6-digit, non-resettable, reading in hours and tenths of hours. Elapsed time meter shall be Fourth Dimension, or approved equal.

(23) Seal Fail Relay

Provide a conductance actuated moisture sensing relay for each submersible pump controlled with field adjustable sensitivity. Specialized relays/sensors, if required by the pump manufacturer, shall be supplied to the panel manufacturer by the pump manufacturer prior to panel construction. Seal Fail Relay shall be Diversified Electronics, Syrelec, or approved equal.

(24) Alarm Light

Provide a red strobe light mounted to the top, exterior of the enclosure. Minimum ratings shall be 1.5 Joules at 70 flashes per minute. The strobe light shall be fully sealed to prevent water from entering the enclosure and be attached by mounting screws from inside the enclosure to prevent tampering.

(25) Alarm Dialer

Provide a 4-channel automatic alarm dialer mounted in the control panel. Dialer shall be Microtel, or as approved by the District. Dialer shall be mounted in a 15" x 15" space. The dialer shall be configured by the District.

The following alarms shall be wired to terminal blocks in the control panel, and then connected to the dialer:

- (A) Wet Well High Level
- (B) Pump #1 Fail
- (C) Pump #2 Fail
- (D) Power Failure

(26) Ground Buss/Lugs

Provide a ground lug sized for incoming power ground near the power distribution block. Provide a ground lug sized for pump ground near pump power wire terminations. Provide a ground buss for control equipment grounding, minimum 6 termination points.

(27) Corrosion Inhibitor

Provide a corrosion inhibitor mounted inside the control panel. Corrosion inhibitor shall be Hoffman #A-HCI-5E, or approved equal.

(28) Wiring

Power distribution wiring on the line side of panel fuses or circuit breakers shall be sized for the load served, minimum 12 AWG. Control wiring shall be minimum #16 gauge SIS type stranded wire for internal control panel circuits. All control wires shall be numbered at each termination corresponding to the master wiring diagram with clip-sleeve or heat-shrink type wire markers. Wrap-on or adhesive wire markers shall not be allowed. 120 vac wiring (except for neutrals) shall have red insulation. 120 vac neutral wiring shall have white insulation. 50 vac or less shall have yellow insulation. 12/24 vdc wiring shall have blue insulation.

(29) Nameplates

Provide adhesive backed printed nameplates for all internal devices such as contactors, circuit breakers, and relays. Provide engraved phenolic nameplates, black letters on white background, for door-mounted devices such as selector switches, push-buttons, circuit breaker toggles, and pilot lights. Nameplates shall be secured firmly to the panel.

Section 5.05 Telemetry Equipment/Services

Telemetry Unit

Each pump station shall have a MOSCAD-L RTU conforming to the District's existing system. A full MOSCAD may be required on certain individual pump station locations, and will be requested if required when the pump station plans are submitted for review, indicating size of MOSCAD and number and quantity of equipment. All hardware components for the RTU shall be supplied, installed, and programmed as an integral component of the control panel. The equipment shall be configured to operate on the District's operating frequency. The District utilizes a Motorola MOSCAD Central Station Transceiver for interrogation and acknowledgement of alarms.

The following telemetry equipment shall be supplied in the control panel, unless otherwise indicated:

- (1) Moscad-L with 5 watt conventional radio, Motorola
- (1) Mixed I/O Card (2 AI, 8 DI, 2 DO), Motorola #V436 OR 16 DI Card, Motorola #V115

- (1) Replace 1.2 AH battery with 3 AH battery, Motorola #V328
- (1) Coaxial Surge Arrestor, Polyphasor #IS-B50NX-C2-ME

The following telemetry equipment shall be supplied loose for installation by the electrical Contractor:

- (1) Antenna: Decible #DB230-L, Comtelco #Y3313A-E, or approved equal
- (1) Antenna Pole: Galvanized Heavy wall conduit mounted to electrical rack
- (* Coaxial cable: Type RG213U, Belden #8267, or equal, quality and length as required
- (* Coaxial cable connectors: RF Industries #RFN-1002-1S (Male), #RFN-1024-1 (Female), or equal, as required
- (1) Cold Shrink: 3M #8425-7 and #8426-9 (or as required for coaxial cable size)

Status Connections

Status connections shall be as follows:

Discrete Point 1	Intrusion
Discrete Point 2	Pump #1 Run
Discrete Point 3	Pump #2 Run
Discrete Point 4	Pump #1 Started Fault
Discrete Point 5	Pump #2 Started Fault
Discrete Point 6	Wet Well High Level
Discrete Point 7	Phase Fault
Discrete Point 8	Generator Run

Software Programming/Start-up Services

All Moscad/SCADA computer programming and start-up services shall be included and completed such that the Moscad in the control panel communicates all information as specified to the central Moscad, and that the information is displayed in the computer central and other SCADA network computers.

All Moscad programming and system start-up shall be performed by an authorized Motorola Moscad Value Added Reseller (VAR) familiar with the District's Moscad SCADA system. The SCADA "site" shall be programmed in the District's SCADA computer network by an authorized Intellution Systems Integrator familiar with the District's Intellution computer. The Motorola VAR/Intellution SI shall have offices located within 100 miles of the District office to facilitate timely system support. Systems Integrator shall be Electric Controls Company, Inc., 2735 Mercantile Drive, St. Louis, MO 63144, Ph. 314-645-2400, or approved equal.

Radio Frequency License Coordination

A licensed UHF frequency, with each site listed on the license is required. It shall be the responsibility of the Owner to obtain/update the radio frequency license(s) necessary for the installation and successful operation of the SCADA system.

Section 5.06 Control Panel Electrical Rack

An electrical equipment rack, as shown on drawings, shall be supplied by the manufacturer of the control panel for installation by the electrical Contractor. The equipment rack shall be constructed of double-back Unistrut™, hot dipped galvanized material with required conduit connecting meter base, fused disconnect switch, control panel, seal fittings, and FRP (fiberglass reinforced plastic) junction box. If a lightning arrestor for the control panel is specified elsewhere in the control panel specifications, it may be mounted on the exterior of the disconnect switch, in lieu of the control panel, if desired.

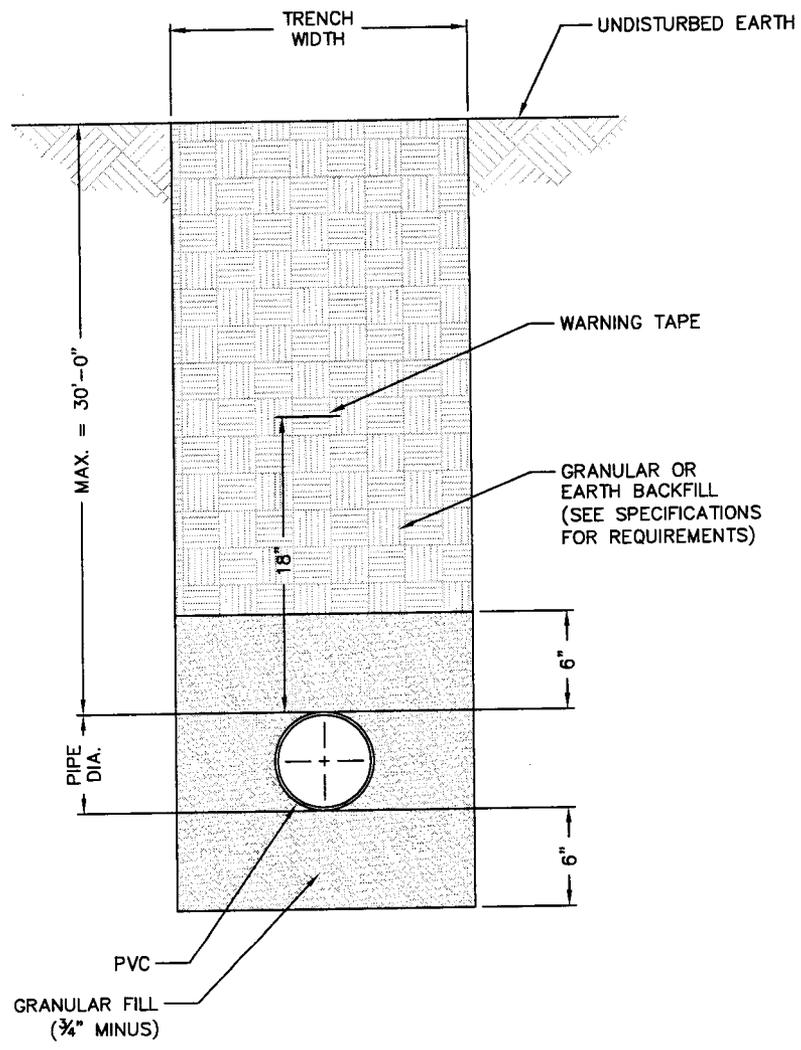
All wiring between components on the electrical rack shall be run in galvanized heavy wall conduit, minimum ½" diameter. All conduits shall be sealed to prevent gases from entering into the control panel.

All wire shall be not less than 12 AWG stranded type THHN/THWN, except control wiring, which may be 14 or 16 AWG stranded type THHN/THWN. All wiring shall be color coded by wire insulation, or colored tape on each end of the wire.

Section 5.07 Junction Box

Provide a fiberglass junction box for installation in valve vault. Junction box shall have sub panel and terminal blocks for each connection.

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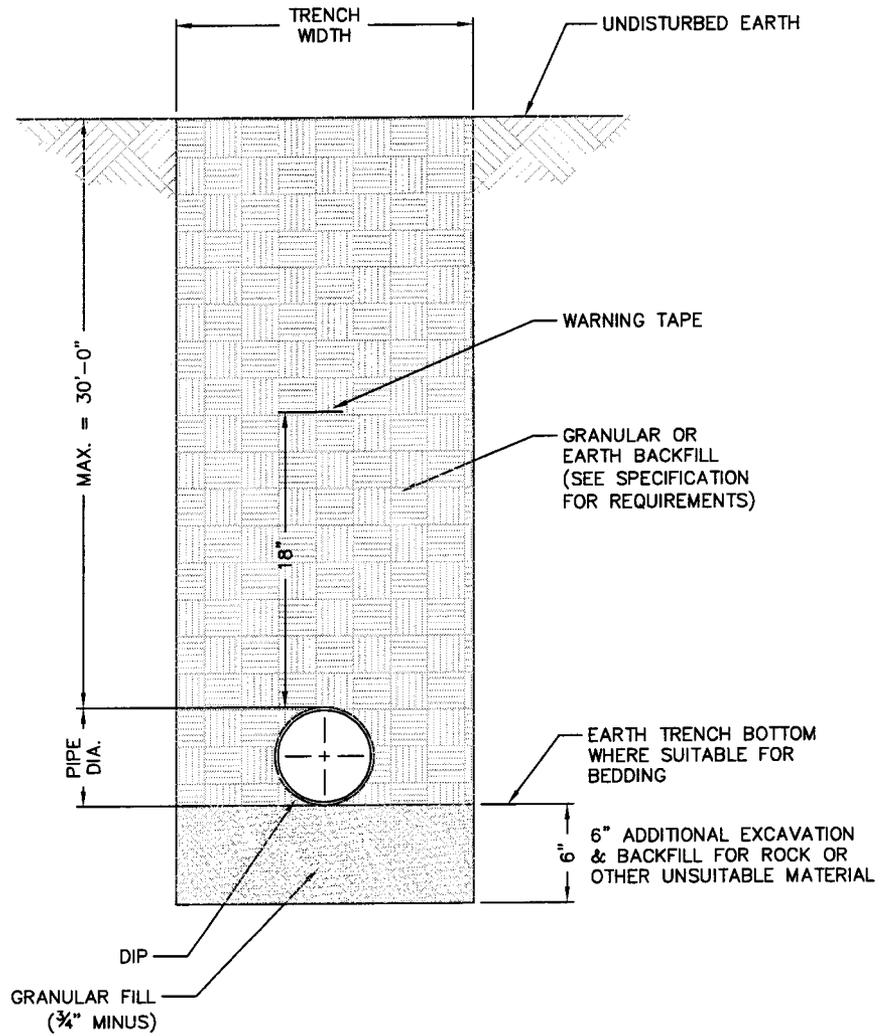


NOTE:

1. BACKFILL TO BE COMPACTED TO 95% PER STANDARD PROCTOR TEST METHOD (ASTM D698)
2. SEE SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.

TYPICAL GRAVITY SEWER TRENCH SECTION

NOT TO SCALE
DETAIL "A"
 PAGE 1 OF 3



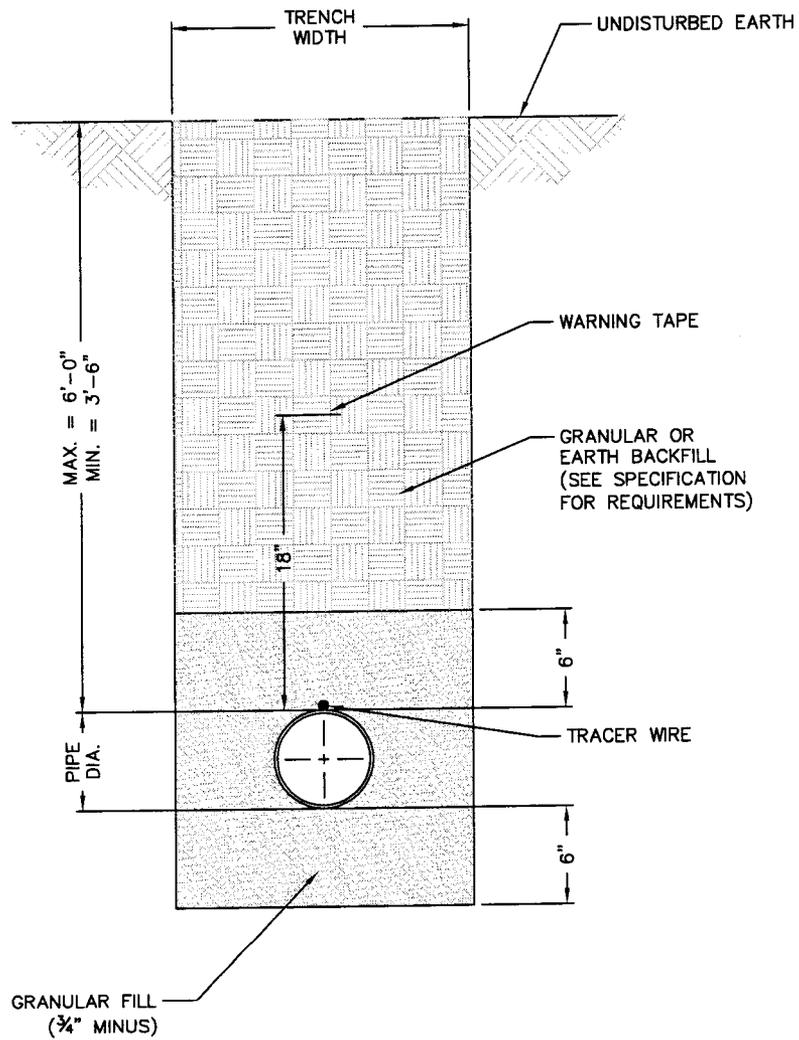
NOTES:

1. SEE SPECIFICATIONS FOR ADDITIONAL DETAILS FOR BEDDING AND BACKFILL.

**TYPICAL GRAVITY SEWER TRENCH SECTION
FOR DUCTILE IRON PIPE**

NOT TO SCALE
DETAIL "A"

PAGE 2 OF 3



NOTES:

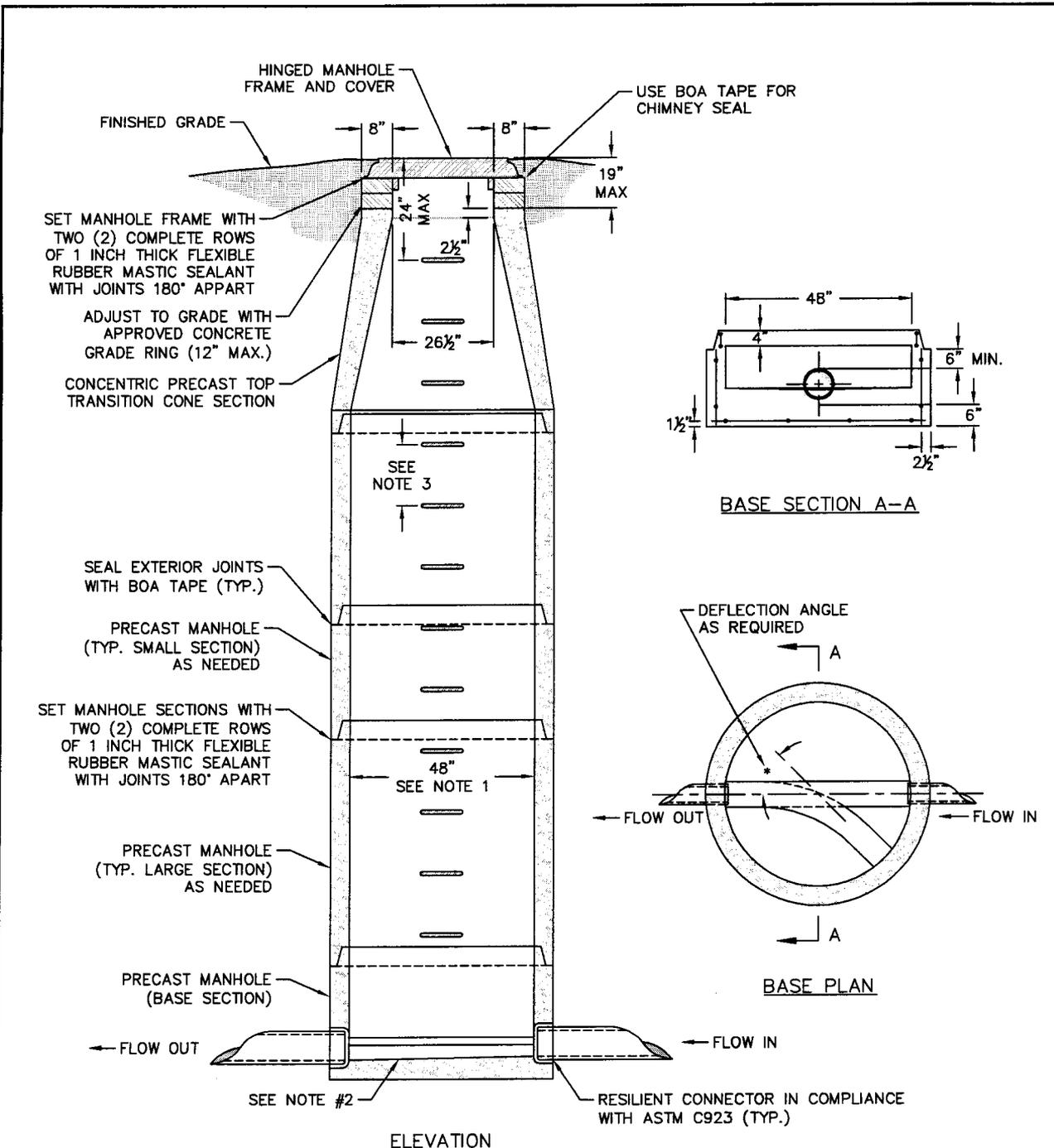
1. SEE SPECIFICATIONS FOR ADDITIONAL DETAILS FOR BEDDING AND BACKFILL.

**TYPICAL TRENCH SECTION
FOR FORCE MAIN PIPE**

NOT TO SCALE

DETAIL "A"

PAGE 3 OF 3



HINGED MANHOLE FRAME AND COVER

FINISHED GRADE

USE BOA TAPE FOR CHIMNEY SEAL

8"

8"

19" MAX

24" MAX

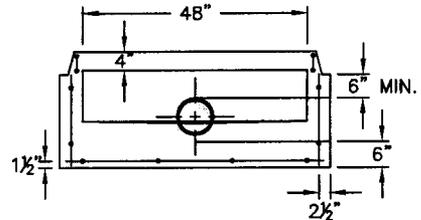
2 1/2"

26 1/2"

SET MANHOLE FRAME WITH TWO (2) COMPLETE ROWS OF 1 INCH THICK FLEXIBLE RUBBER MASTIC SEALANT WITH JOINTS 180° APART

ADJUST TO GRADE WITH APPROVED CONCRETE GRADE RING (12" MAX.)

CONCENTRIC PRECAST TOP TRANSITION CONE SECTION



BASE SECTION A-A

SEE NOTE 3

SEAL EXTERIOR JOINTS WITH BOA TAPE (TYP.)

PRECAST MANHOLE (TYP. SMALL SECTION) AS NEEDED

SET MANHOLE SECTIONS WITH TWO (2) COMPLETE ROWS OF 1 INCH THICK FLEXIBLE RUBBER MASTIC SEALANT WITH JOINTS 180° APART

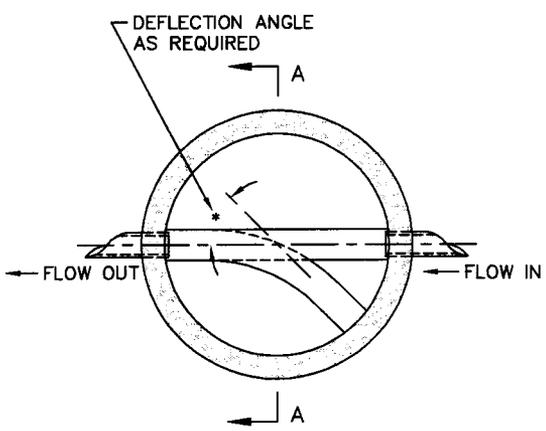
48"

SEE NOTE 1

PRECAST MANHOLE (TYP. LARGE SECTION) AS NEEDED

PRECAST MANHOLE (BASE SECTION)

SEE NOTE #2



BASE PLAN

← FLOW OUT

← FLOW IN

RESILIENT CONNECTOR IN COMPLIANCE WITH ASTM C923 (TYP.)

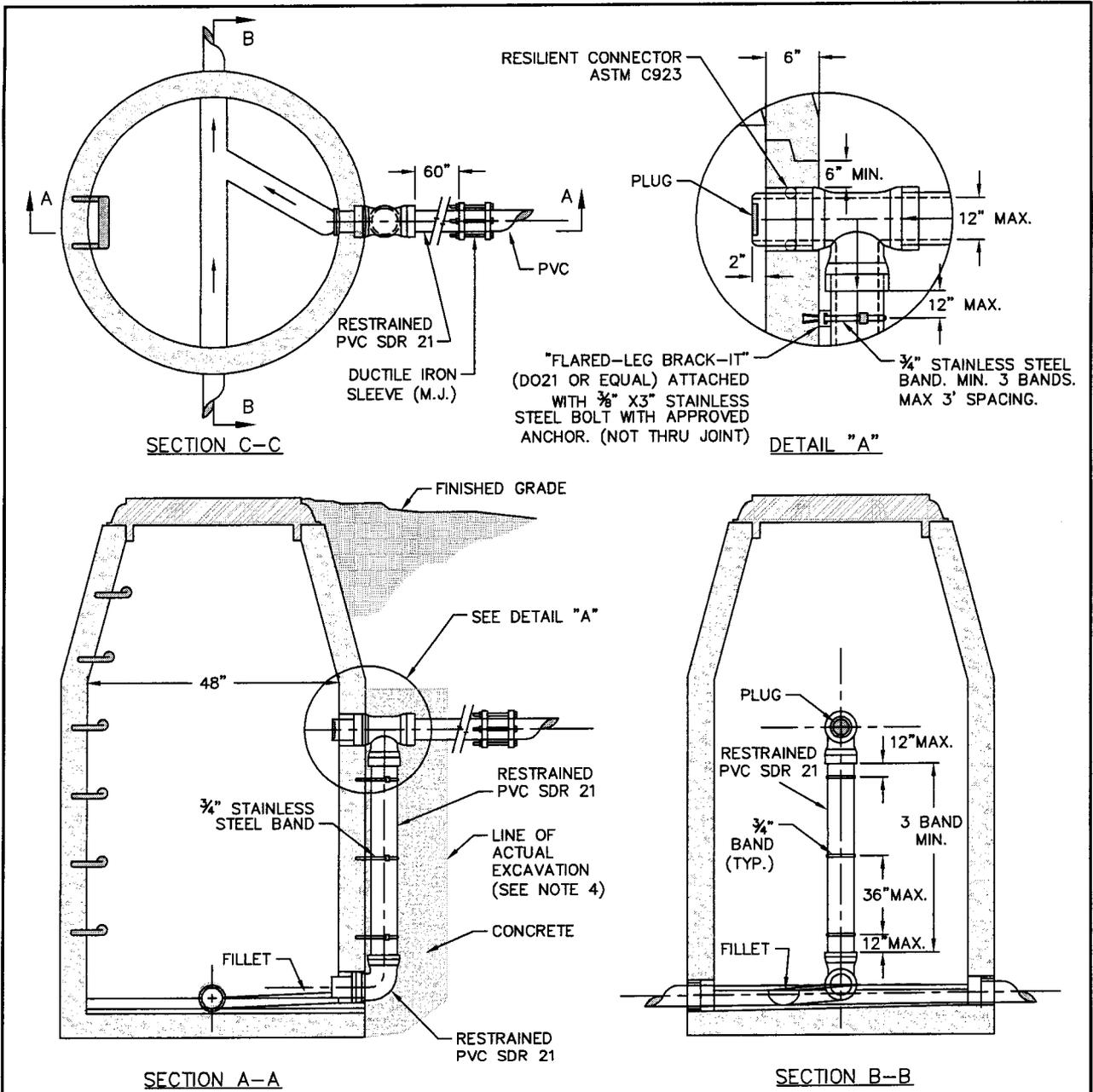
ELEVATION

NOTES:

1. THE MINIMUM INSIDE DIAMETER FOR THE BASE AND RISER SECTIONS SHALL BE 48" FOR ALL SANITARY SEWERS. MANHOLE SHALL MEET ASTM C-478 REQUIREMENTS.
2. FLOW LINE ELEVATION OF INCOMING PIPES SHALL BE 1 INCH HIGHER THAN THAT OF OUTGOING PIPE.
3. SHAFT STEPS UNIFORMLY SPACED AT 16" O/C. STEPS SHOULD NOT BE OVER TOP OF PIPES AND SHALL EXTEND 4 1/2" FROM WALL.
4. LINE OUTSIDE WITH URETHANE ASPHALT @ 20 MILS.

TYPICAL MANHOLE
NOT TO SCALE
DETAIL "B"

Created 5-20-2015
2015 PMSD2/ECM Detail Specifications

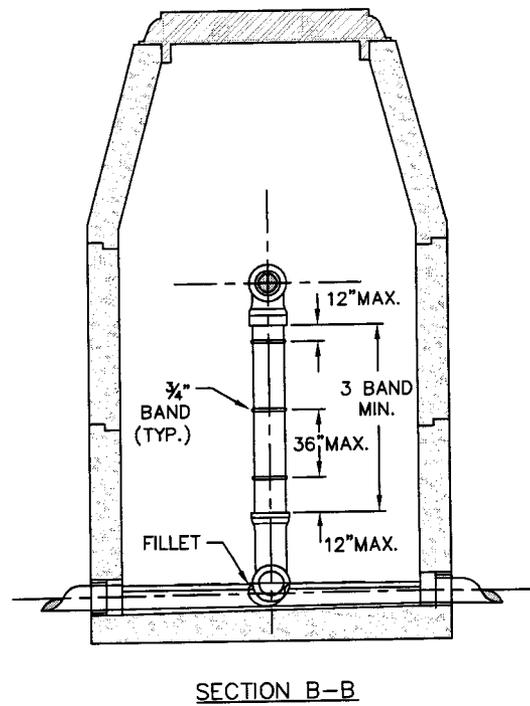
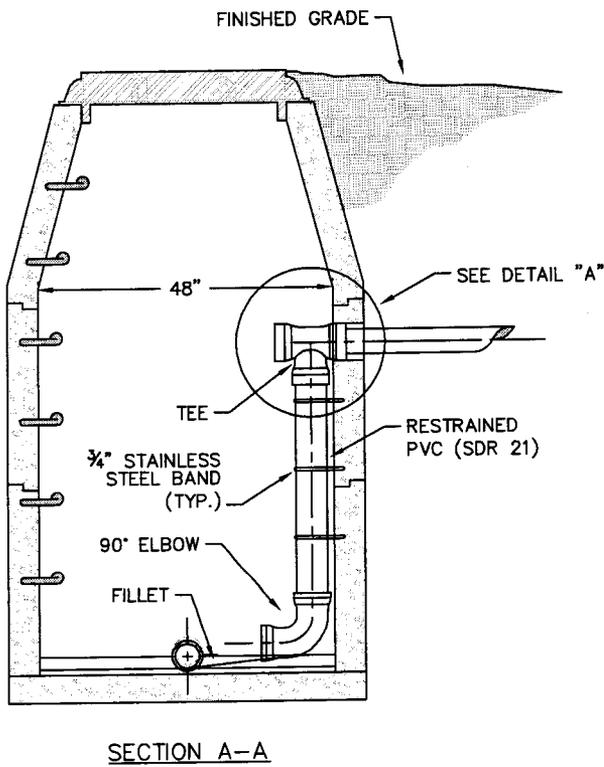
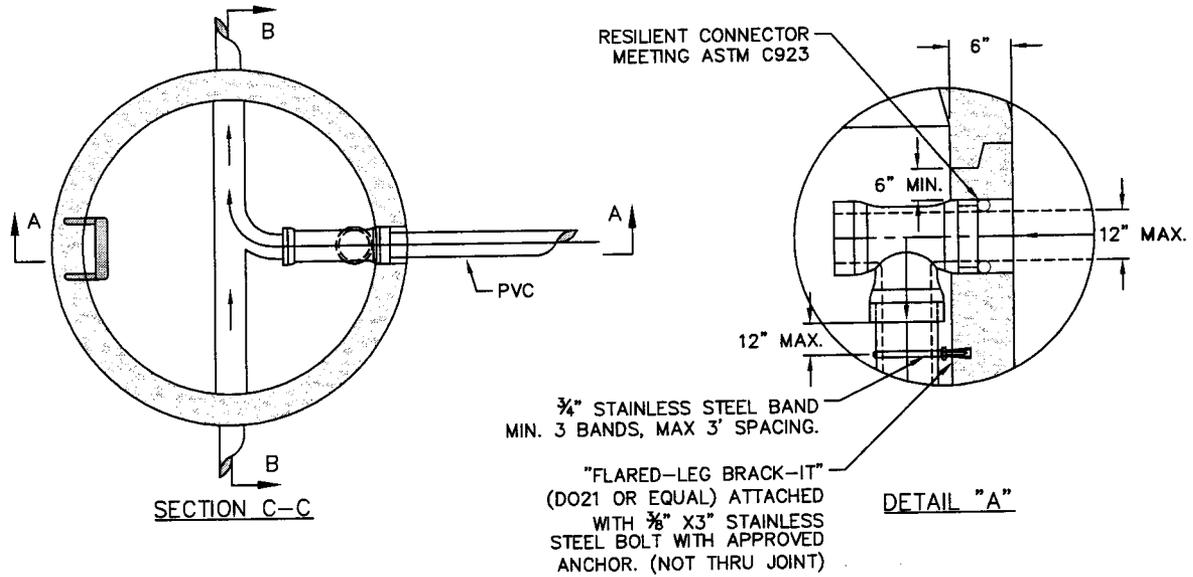


NOTES:

1. THE MINIMUM INSIDE DIAMETER FOR THE BASE AND RISER SECTIONS SHALL BE 48" FOR ALL SANITARY SEWERS.
2. NEW OUTSIDE DROP ON EXISTING MANHOLE REQUIRES THAT THE FLOW LINE OF THE NEW DROP PIPE ELBOW BE CONSTRUCTED AT THE SAME ELEVATION AS THE SPRINGLINE OF THE EXISTING SEWER MAIN AT THE CENTER OF THE EXISTING MANHOLE. A CLASS "A" CONCRETE FILLET AND INVERT SHALL BE CONSTRUCTED FOR DROP PIPE.
3. DIAMETER OF DROP PIPE FOR COMBINED SEWERS AND SANITARY SEWERS IS THE SAME AS INCOMING PIPE SEWER UNLESS OTHERWISE SHOWN ON PROJECT PLANS.
4. IF EXCAVATED SPACE OUTSIDE OF DROP PIPE EXCEEDS ONE FOOT (1'), PROVIDE 6" CLASS "A" CONCRETE ENCASUREMENT ON INCOMING LINE FROM WALL OF MANHOLE TO A MINIMUM OF TWO FEET INTO UNDISTURBED EARTH WITH A MINIMUM OF 4-#4 REBARS FOR THE LENGTH OF ENCASUREMENT.

TYPICAL DROP MANHOLE

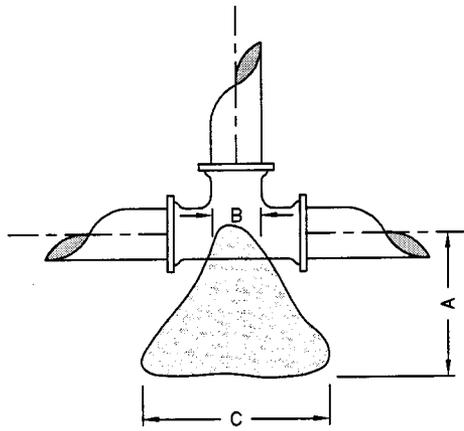
NOT TO SCALE
DETAIL "C"



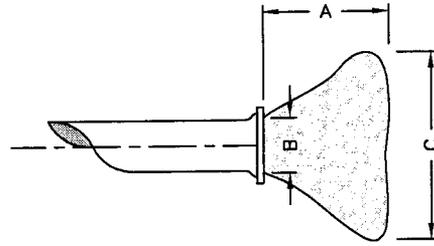
NOTES:

1. THE MINIMUM INSIDE DIAMETER FOR THE BASE AND RISER SECTIONS SHALL BE 48" FOR ALL SANITARY SEWERS.
2. DIAMETER OF DROP PIPE FOR SANITARY SEWERS IS THE SAME AS IN COMING PIPE SEWER UNLESS OTHERWISE SHOWN ON PROJECT PLANS.
3. INVERT BOTTOM SHALL BE WORKED TO PROVIDE POSITIVE DRAINAGE THROUGH MANHOLE.

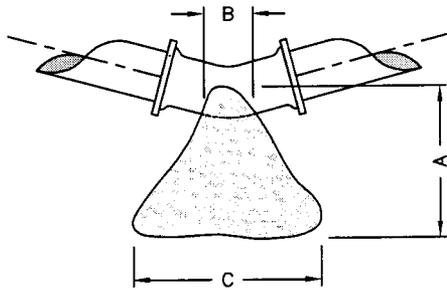
TYPICAL INSIDE DROP MANHOLE
 NOT TO SCALE
DETAIL "D"



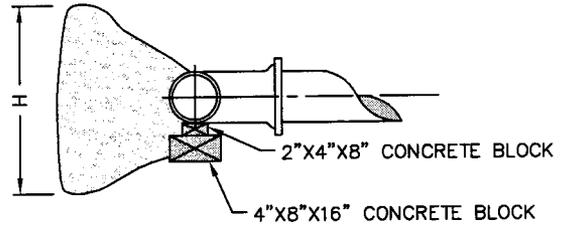
**TEES AND TAPPING
SLEEVE**
NOT TO SCALE



PLUGS
NOT TO SCALE



BENDS
NOT TO SCALE



TYPICAL SECTION
NOT TO SCALE

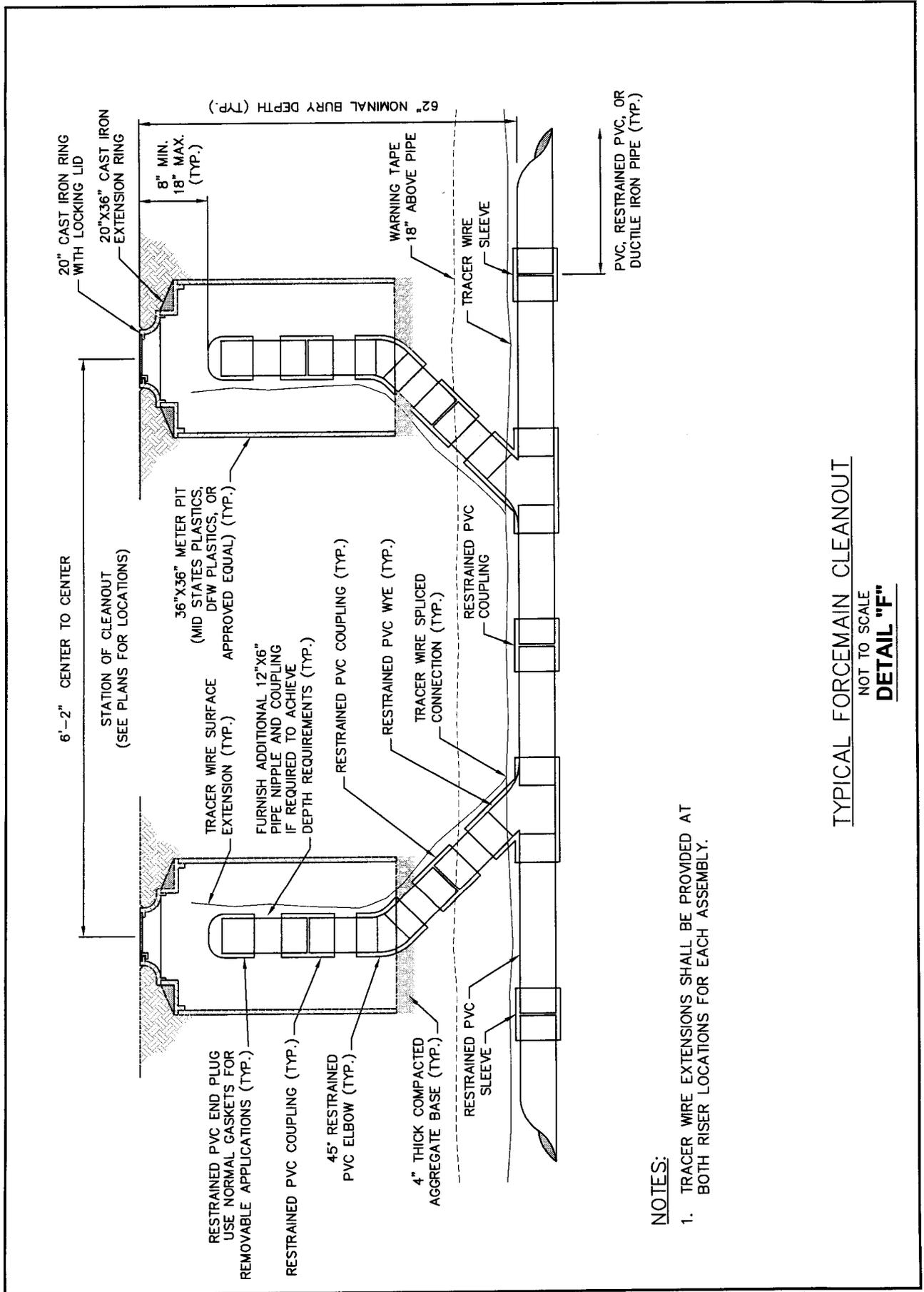
THRUST BLOCK DIMENSIONS - INCHES

PIPE DIA.	ALL FTGS.		TEE PLUG TAPPING		90 DEGREE BEND		45 DEGREE BEND		22-1/2 BEND		11-1/4 BEND	
	A	B	C	H	C	H	C	H	C	H	C	H
4	14	4	24	12	26	15	18	12	12	12	12	12
6	16	6	36	18	36	24	30	18	24	12	12	12
8	20	8	36	30	42	36	36	24	24	18	18	12
10	20	10	48	36	66	36	36	36	28	24	18	18
12	24	12	68	36	82	42	52	36	40	24	28	18

NOTE:

- FOR FITTINGS LARGER THAN 12", SPECIAL RESTRAINT DESIGNS ARE REQUIRED.

**HORIZONTAL THRUST BLOCKING
FOR FORCE MAINS
DETAIL "E"**



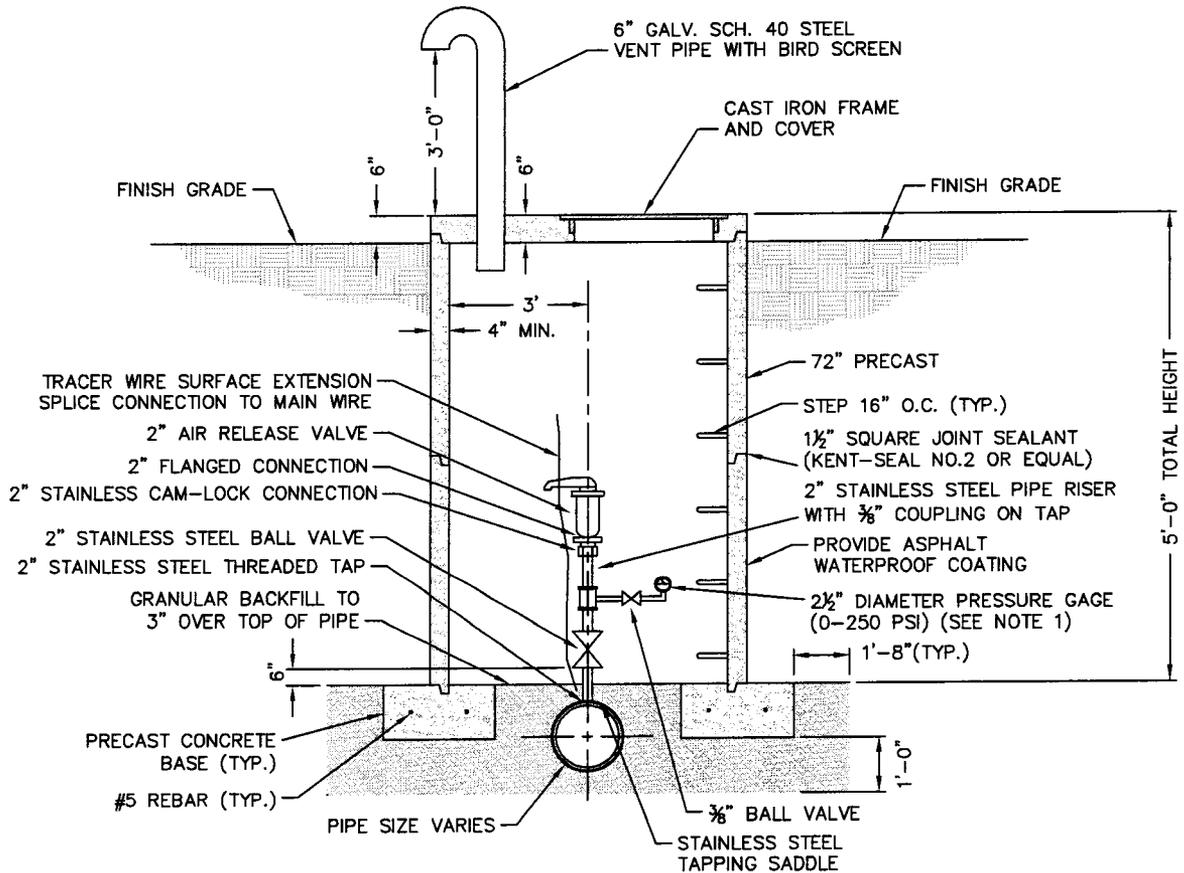
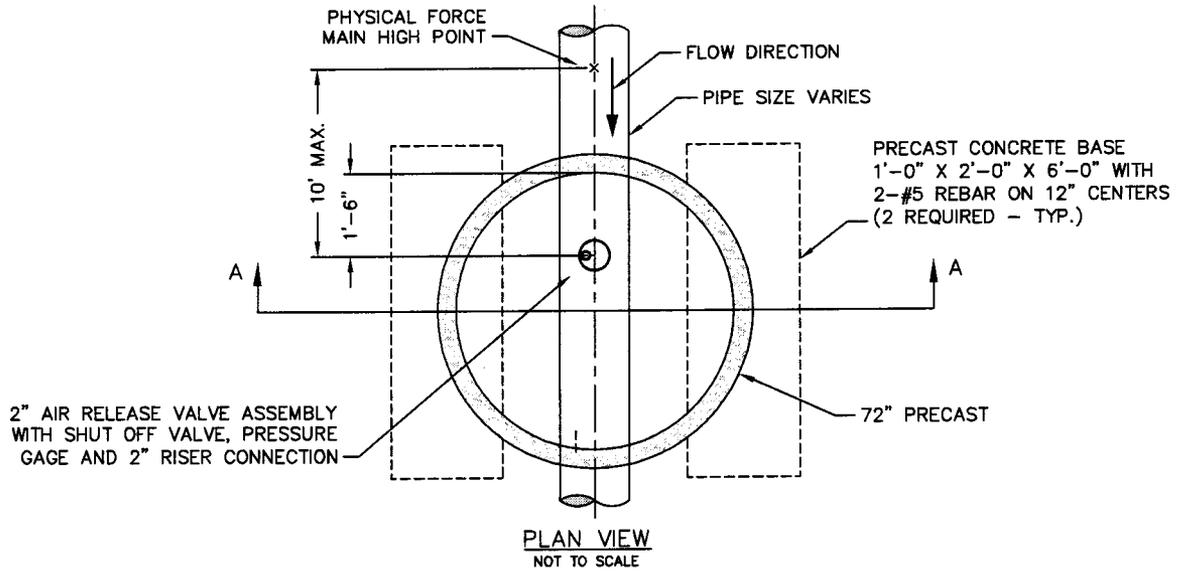
NOTES:

1. TRACER WIRE EXTENSIONS SHALL BE PROVIDED AT BOTH RISER LOCATIONS FOR EACH ASSEMBLY.

TYPICAL FORCEMAIN CLEANOUT

NOT TO SCALE

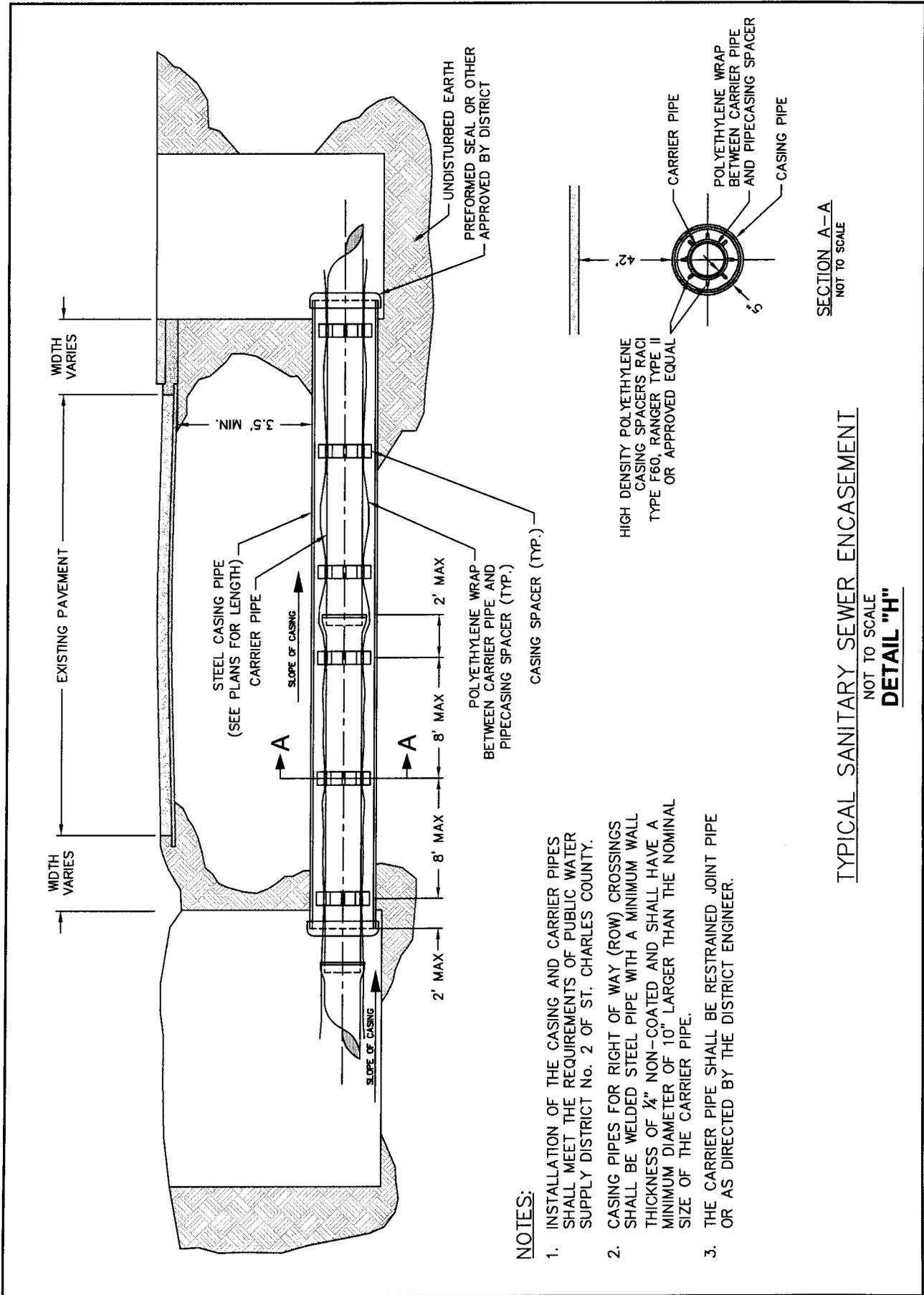
DETAIL "F"



NOTE:

1. FACE OF PRESSURE GAGE SHALL BE VIEWABLE THROUGH THE AIR RELEASE VALVE VAULT HATCH WITHOUT ENTERING THE VAULT.

**TYPICAL AIR RELEASE
NOT TO SCALE
DETAIL "G"**



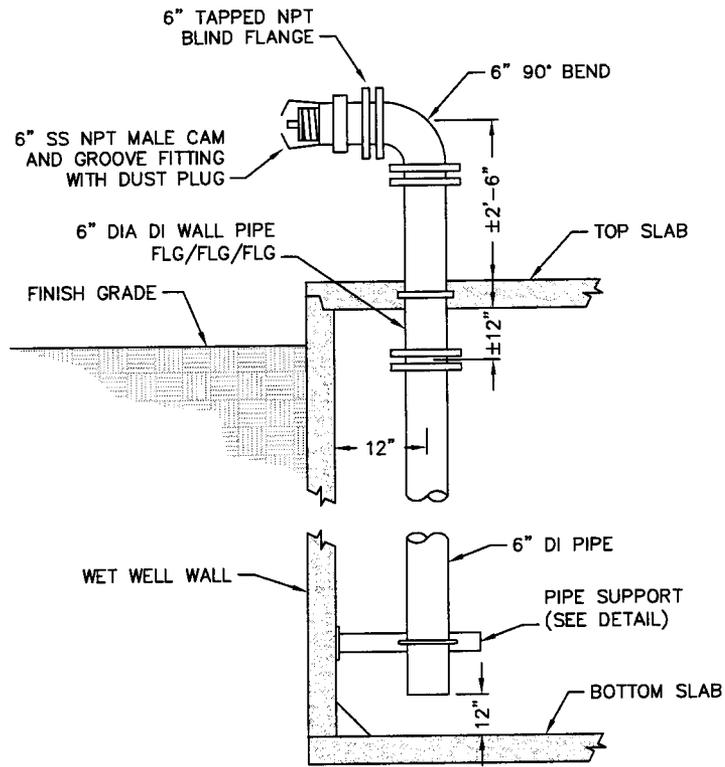
NOTES:

1. INSTALLATION OF THE CASING AND CARRIER PIPES SHALL MEET THE REQUIREMENTS OF PUBLIC WATER SUPPLY DISTRICT No. 2 OF ST. CHARLES COUNTY.
2. CASING PIPES FOR RIGHT OF WAY (ROW) CROSSINGS SHALL BE WELDED STEEL PIPE WITH A MINIMUM WALL THICKNESS OF 1/2" NON-COATED AND SHALL HAVE A MINIMUM DIAMETER OF 10" LARGER THAN THE NOMINAL SIZE OF THE CARRIER PIPE.
3. THE CARRIER PIPE SHALL BE RESTRAINED JOINT PIPE OR AS DIRECTED BY THE DISTRICT ENGINEER.

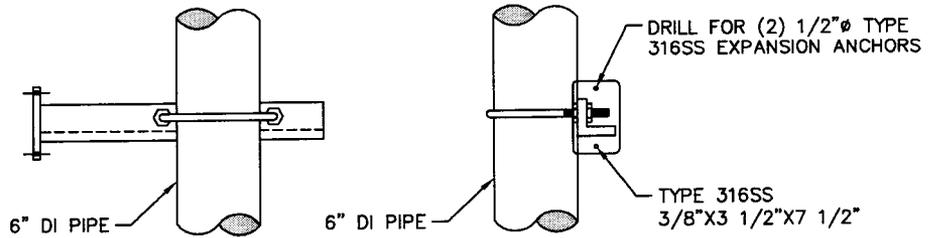
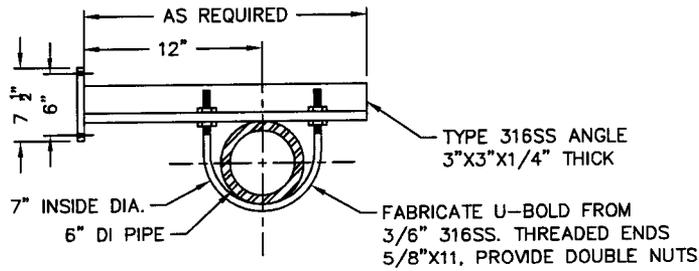
SECTION A-A
NOT TO SCALE

TYPICAL SANITARY SEWER ENCASEMENT

NOT TO SCALE
DETAIL "H"

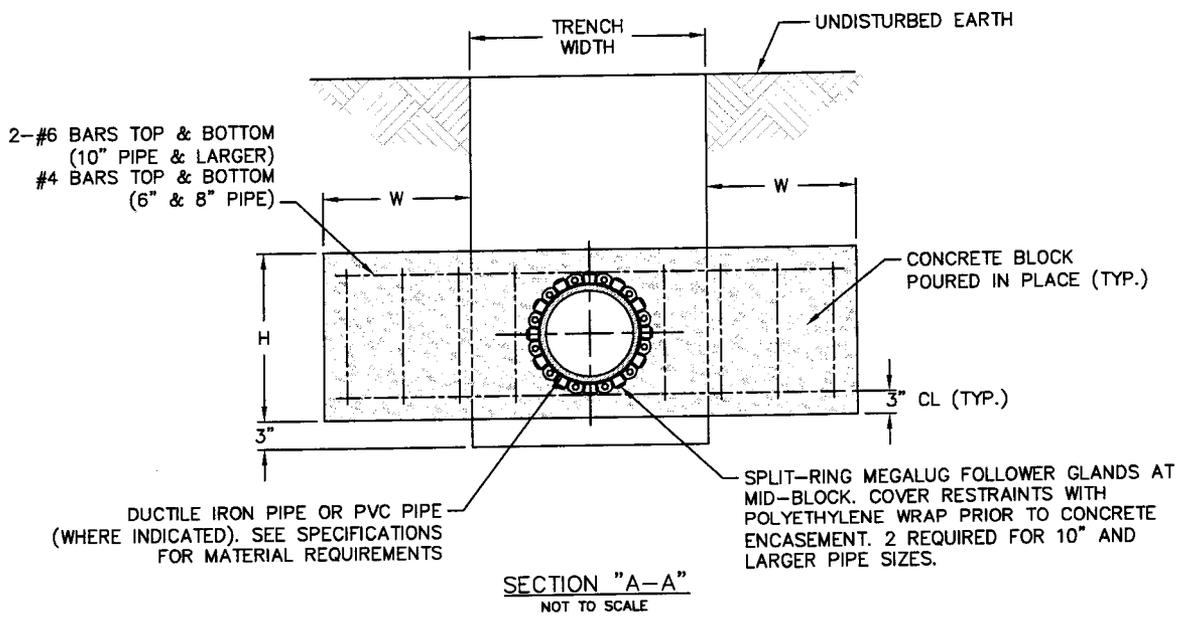
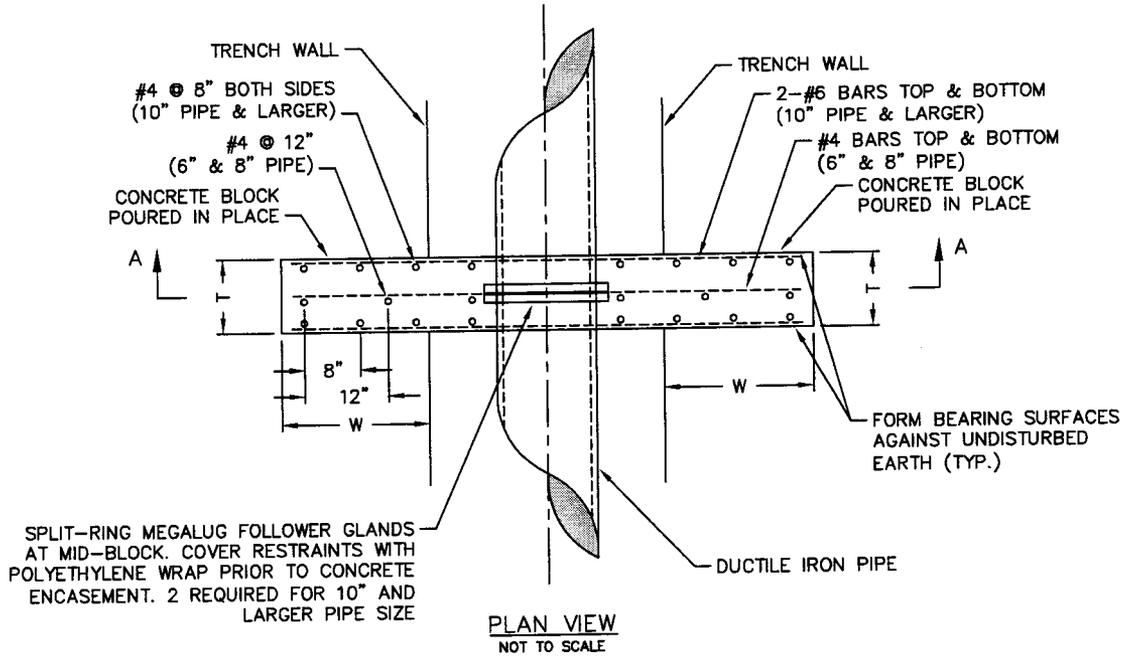


ELEVATION
NOT TO SCALE



PIPE SUPPORT DETAIL
NOT TO SCALE

TYPICAL BY-PASS PUMP SUCTION CONNECTION
NOT TO SCALE
DETAIL "I"

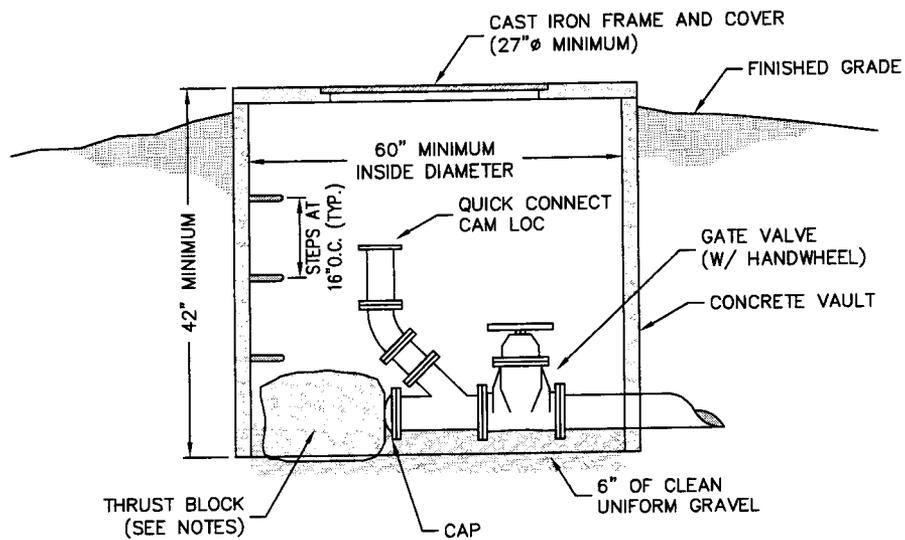


NOTES:

1. CONSTRUCT CROSS BLOCKS AT A MINIMUM OF 15' FROM CONNECTION POINT AND 5' FROM THE BELL END OF PIPE.
2. CROSS BLOCKS SHALL BE PRE-POURED PRIOR TO SHUTDOWN AND CONNECTIONS.

CROSS BLOCK DIMENSIONS			
PIPE DIA. "D"	WIDTH "W"	HEIGHT "H"	THICKNESS "T"
4	12	12	12
6	24	24	12
8	24	24	12
10	30	30	16
12	36	36	18

**CROSS BLOCK
DETAIL "J"**



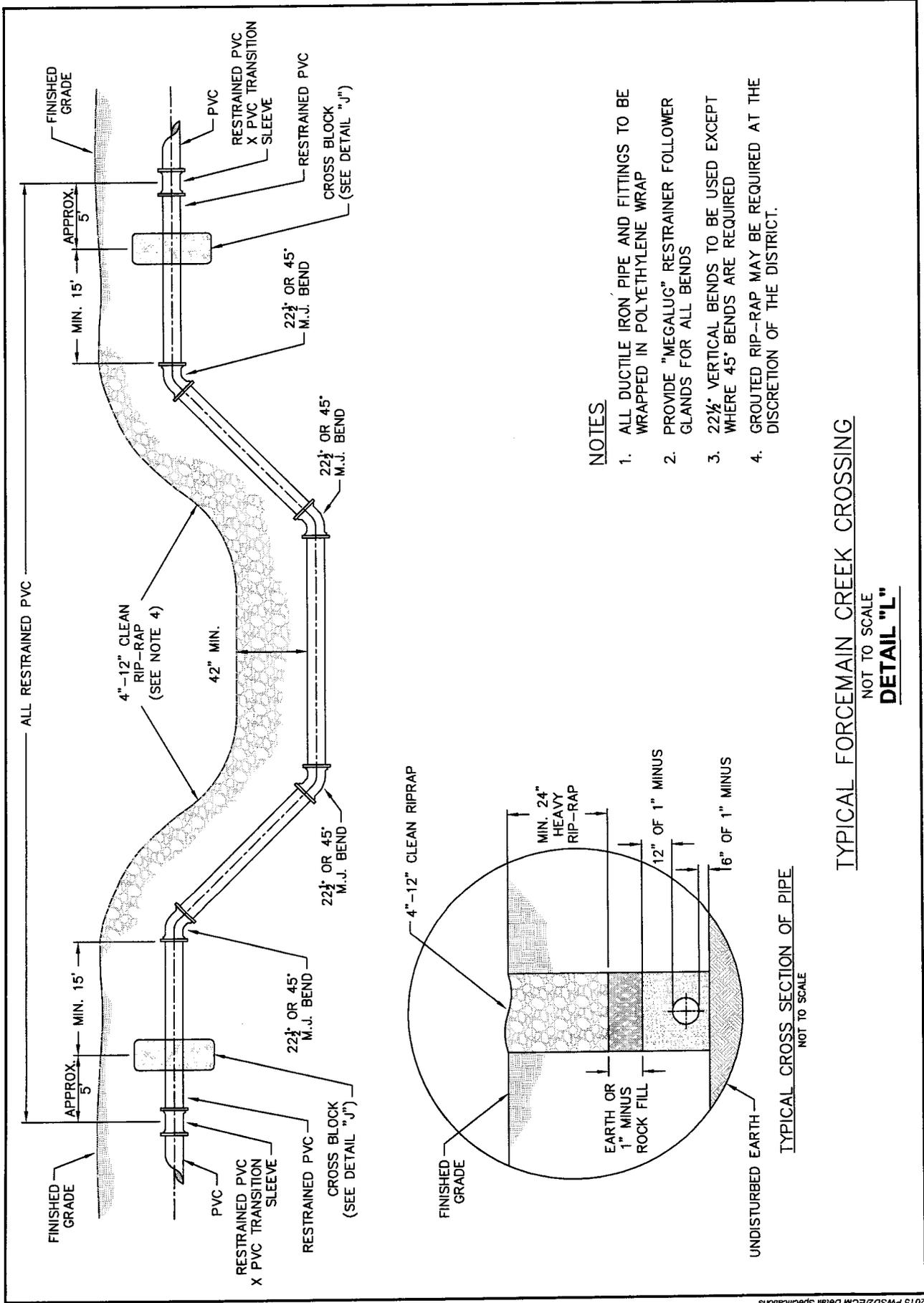
SECTION A-A
NOT TO SCALE

NOTES:

1. SEE DETAIL "E" FOR THRUST BLOCK MINIMUM REQUIREMENTS.
2. FOR FITTINGS LARGER THAN 12", SPECIAL RESTRAINT DESIGNS ARE REQUIRED.
3. SEE SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS FOR BEDDING AND BACKFILL.

TERMINAL FORCEMAIN CLEANOUT

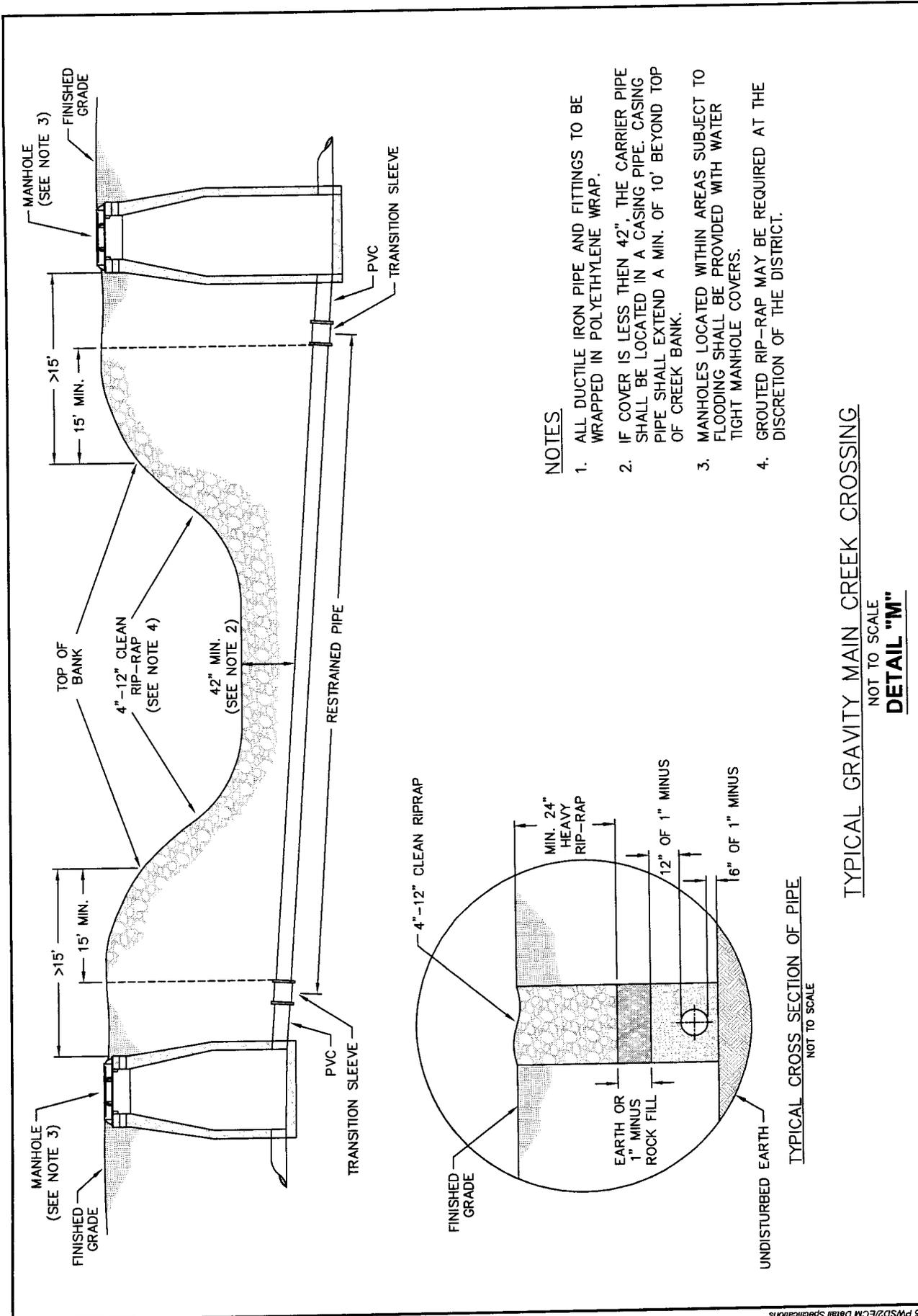
NOT TO SCALE
DETAIL "K"



NOTES

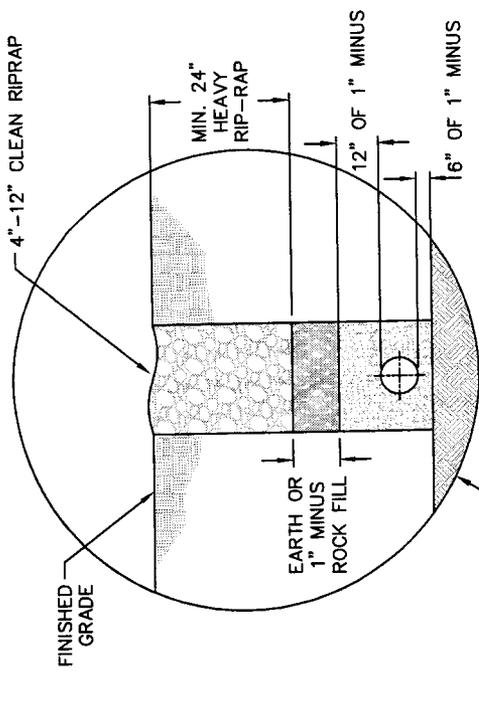
1. ALL DUCTILE IRON PIPE AND FITTINGS TO BE WRAPPED IN POLYETHYLENE WRAP
2. PROVIDE "MEGALUC" RESTRAINER FOLLOWER GLANDS FOR ALL BENDS
3. 22 1/2° VERTICAL BENDS TO BE USED EXCEPT WHERE 45° BENDS ARE REQUIRED
4. GROUTED RIP-RAP MAY BE REQUIRED AT THE DISCRETION OF THE DISTRICT.

TYPICAL FORCEMAIN CREEK CROSSING
 NOT TO SCALE
DETAIL "L"



NOTES

1. ALL DUCTILE IRON PIPE AND FITTINGS TO BE WRAPPED IN POLYETHYLENE WRAP.
2. IF COVER IS LESS THEN 42", THE CARRIER PIPE SHALL BE LOCATED IN A CASING PIPE. CASING PIPE SHALL EXTEND A MIN. OF 10' BEYOND TOP OF CREEK BANK.
3. MANHOLES LOCATED WITHIN AREAS SUBJECT TO FLOODING SHALL BE PROVIDED WITH WATER TIGHT MANHOLE COVERS.
4. GROUTED RIP-RAP MAY BE REQUIRED AT THE DISCRETION OF THE DISTRICT.



TYPICAL GRAVITY MAIN CREEK CROSSING
 NOT TO SCALE
DETAIL "M"