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WATER PROTECTION PROGRAM

STANDARD TECHNICAL SEWER SPECIFICATIONS

For The

CITY OF NIXA, MISSOURI

June 1, 2015

Prepared By

SHAFFER & HINES, INC.
CONSULTING ENGINEERS
P.O. BOX 493
NIXA, MISSOURI 65714
(417) 725-4663



ARTICLE II

WATER AND SEWER SPECIFICATIONS

Section 25-20. Excavation and Trenching.

- A. **SCOPE:** This section covers excavation and trenching work and shall include the necessary clearing, grubbing, and preparation of the site: removal and disposal of all debris; excavation and trenching as required; the handling, storage, transportation, and disposal of all excavated material; all necessary sheeting, shoring, and protection work; preparation of subgrades; pumping and dewatering as necessary or required; protection of adjacent property; backfilling; pipe embedment; surfacing and grading; and other appurtenant work.
- B. **GENERAL REQUIREMENTS:** Excavation work shall be performed in a safe and proper manner with appropriate precautions taken against all hazards. Excavations shall provide adequate work space and clearances for the work to be performed therein and for the installation and removal of concrete forms. In no case shall excavation faces be undercut for extended footings.

Subgrade surfaces shall be clean and free of any loose material when concrete is placed thereon.

Excavations for manholes and similar structures constructed of masonry units shall have horizontal dimensions with at least a 6-inch clearance provided for outside plastering.

Backfilling and construction of fills and embankments during freezing weather shall not be done except by permission of the City or City's Engineer. No backfill, fill, or embankment materials shall be installed on frozen surfaces, nor shall frozen materials, snow, or ice be placed in any backfill, fill or embankment.

- C. **BLASTING:** The Contractor shall comply with all laws, ordinances, applicable safety codes, requirements, and regulations relative to the handling, storage, and use of explosives and the protection of life and property. The Contractor shall be responsible for all damage caused by any blasting operations. Suitable methods shall be employed to confine all materials lifted by blasting within the limits of the excavation or trench.

The Contractor shall avoid excessive overbreak or damage to adjacent structures, equipment, utilities or buried pipeline. Blasting near utilities shall be subject to approval of the utility owner or City.

Before delivery of any explosives at the job site, the Contractor shall have blasting endorsement on his public liability and property damage insurance policy.

All rock which cannot be handled and compacted, as earth shall be kept separate from other excavated materials and shall not be mixed with backfill or embankment materials

except as specified or directed.

- D. **UNAUTHORIZED EXCAVATION:** Except where otherwise authorized, shown, or specified, all material excavated below the bottom of concrete walls, footings, slabs on grade, and foundations shall be replaced, by and at the expense of the Contractor, with concrete placed at the same time and monolithic with the concrete above.
- E. **DEWATERING:** The Contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all surface and ground water entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed, therein is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

All excavations for concrete structures or trenches, which extend down to or below groundwater, shall be dewatered by lowering and keeping the ground water level beneath such excavations, 12 inches or more below the bottom of the excavation.

Surface water shall be diverted or otherwise prevented from entering excavated areas or trenches to the greatest extent practicable without causing damage to adjacent property.

The Contractor will be held responsible for the condition of any pipe or conduit which is used for drainage purposes, and all such pipes or conduits shall be left clean and free of sediment.

- F. **SHEETING AND SHORING:** Except where banks are cut back on a stable slope, excavation for structures and trenches shall be properly and substantially sheeted, braced, and shored, as necessary to prevent caving or sliding, for protection of workmen, work, existing structures and facilities. Sheeting, bracing, and shoring shall be designed and built to withstand all loads that might be caused by earth movement or pressure, and shall be rigid, maintaining shape and position under all circumstances.

Trench sheeting shall not be pulled before backfilling unless pipe strength is sufficient, in the opinion of the City or City's Engineer, to carry trench loads based on trench width to the back of sheeting; nor shall sheeting be pulled after backfilling.

Where trench sheeting is left in place, such sheeting shall not be braced against the pipe, but shall be supported in a manner, which will preclude concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment has been completed.

- G. **STABILIZATION:** Subgrades for concrete structures and trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workmen.

Subgrades for concrete structures or trench bottoms, which are otherwise solid but which

become mucky on top due to construction operations, shall be reinforced with one or more layers of crushed rock or gravel. No more than 1/2 inch depth of mud or muck shall be allowed to remain on stabilized trench bottoms when the pipe bedding materials are placed thereon. The finished elevation of stabilized subgrades for concrete structures shall not be above subgrade elevations shown on the drawings.

All stabilization work shall be performed by and at the expense of the Contractor.

- H. **TRENCH EXCAVATION:** The Contractor shall not open more trench in advance of pipe laying than is necessary to expedite the work. One block or 400 feet (whichever is the shorter) shall be the maximum length of open trench on any line under construction.

Except where tunneling is shown on the drawings, is specified, or is permitted by the Engineer, all trench excavation shall be open cut from the surface.

1. Alignment, Grade, and Minimum Cover: The alignment and grade or elevation of each pipeline shall be fixed and determined from offset stakes. Vertical and horizontal alignment of pipes, and the maximum joint deflection used in connection therewith, shall be in conformity with requirements of Section 25-21 Installation of Mains.

Where pipe grades or elevations are not definitely fixed by the contract drawings, trenches shall be excavated to a depth sufficient to provide a minimum depth of 42-inch backfill cover over the top of the pipe. Greater pipe cover depths may be necessary on vertical curves or to provide necessary clearance beneath existing pipes, conduits, drains, drainage structures, or other obstructions encountered at normal pipe grades. Measurement of pipe cover depth shall be made vertically from the outside top of pipe to finished ground or pavement surface elevation.

2. Limiting Trench Widths: Trenches shall be excavated to a width, which will provide adequate working space and pipe clearances for proper pipe installation, jointing, and embedment. Unless otherwise shown on the drawings, the maximum trench widths, below an elevation of 6 inches above the top of the installed pipe, shall be no more than 24 inches greater than the outside diameter of the pipe. The minimum permissible clearances between the installed pipe and either trench wall shall be 6 inches.

Stipulated minimum clearances are not minimum average clearances, but are minimum clear distances that will be required.

Where necessary to reduce earth load on trench banks to prevent sliding and caving, banks may be cut back on slopes, not to extend lower than one foot above the top of the pipe.

3. Unauthorized Trench Widths: Where, for any reason, the width of the lower portion of the trench as excavated at any point exceeds the maximum permitted, either pipe of

adequate strength, special pipe embedment, or arch concrete encasement, as required by loading conditions and as determined by the Engineer, shall be furnished and installed by and at the expense of the Contractor.

4. Mechanical Excavation: The use of mechanical equipment will not be permitted in locations where its operation would cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground. In all such locations, hand-excavating methods shall be used. Mechanical equipment used for trench excavation shall be of a type, design, and construction, and shall be so operated that the rough trench excavation bottom elevation can be controlled, that uniform trench widths and vertical sidewalks are obtained at least from an elevation one foot (1') above the top of the installed pipe to the bottom of the trench, and that trench alignment is such that pipe when accurately laid to specified alignment will be centered in the trench with adequate clearance between the pipe and sidewalks of the trench. Undercutting the trench sidewalk to obtain clearance will not be permitted.
5. Cutting Concrete and Asphalt Surface Construction: No cutting of concrete/asphalt surfaces shall be allowed unless City approval is obtained in writing. Cuts in concrete or asphalt pavement and base pavements shall be no larger than necessary to provide adequate working space for proper installation of pipe and appurtenances. Cutting shall be started with a concrete saw in a manner which will provide a clean groove at least 1 1/2 inch deep along each side of the trench and along the perimeter of cuts for structures.

Concrete and asphalt pavement and concrete base pavement over trenches excavated for pipelines shall be removed so that a shoulder not less than 6 inches in width at any point is left between the cut edge of the pavement and the top edge of the trench. Trench width at the bottom shall not be greater than the top width; no undercutting will be permitted.

Pavement cuts shall be made to and between straight or accurately marked curved lines, which unless required, shall be parallel to the centerline of the trench. Pavement removed for connection to existing lines or structures shall not be of greater extent than necessary for the installation as determined by the City or City's Engineer.

Where the trench parallels the length of concrete walks and trench location is all or partially under the walk, the entire walk shall be removed and replaced. Where the trench crosses drives, walks, curbs, or other surface construction, the surface construction shall be removed and replaced between existing joints or between saw cuts.

6. Excavation Below Pipe Subgrades: Except where otherwise required, pipe trenches shall be excavated below the underside of the pipe, to provide for the installation of either 3/4 inch crushed limestone embedment pipe foundation material or sand if in accordance with the material manufactures design specifications. (#1578 4/09)

7. Artificial Foundations in Trenches: Whenever so ordered by the City or City's Engineer, the Contractor shall excavate to such depth below grade as directed and the trench bottom shall be brought to grade with such material as the City or City's Engineer may order installed.
8. Bell Holes: Bell holes shall provide adequate clearance for tools and methods used in installing pipe. No part of any bell or coupling shall be in contact with the trench bottom, trench walls, or granular embedment when the pipe is jointed.

Due to previous submission to MDNR of Technical Water Specifications the following Sections were omitted from the submittal to MDNR for Technical Sewer Specifications

Section 25-21. Installation of Water Mains.

Section 25-22. PVC Water Piping.

Section 25-23. Water Main Design.

Section 25-24. Fire Hydrants.

Section 25-25. Air Relief Valves.

Section 25-26. Crossings.

Section 25-27. Waterline Acceptance Testing.

Section 25-28. Waterline Disinfection.

Section 25-29. Protection of Potable Water Supply.

Section 25-30. Sewer Pipe.

A. PVC SEWER PIPE:

1. Scope: This section covers Polyvinyl Chloride Piping (PVC). PVC pipe shall be furnished complete with all fittings, jointing materials, anchors, blocking, encasement, and other necessary appurtenances. All sewer line construction shall be in accordance with 10CSR 20-8.120, effective January 30, 2012.
2. Materials: In depth less than 10 feet SDR-35 gasket-bell type pipe shall be used. All sewer pipe with a depth of 10 feet or greater shall be SDR-21 gasket-bell type pipe. PVC pipe and fittings 4 inches through 15 inches shall meet or exceed the requirements of the latest revision of ASTM D-3034 and shall be cell classification of 12454-B, 12454-C or 13364-B as defined in ASTM D-1784. Pipe and fittings 18

inches through 27 inches shall meet ASTM F-679 and shall be cell classification of 12364-C or 12454-C. (#1578 4/09)

Minimum pipe stiffness (F/Y) at 5ø deflection shall be 46 for all sizes when tested in accordance with ASTM D2412.

All joints of pipe and fittings shall have elastomeric gaskets and shall show no signs of leakage when tested in accordance with D 3212. Solvent weld joints will not be permitted below grade.

<u>SIZES</u>	<u>O.D. DIMENSIONS</u>	<u>WALL THICKNESS</u>
4"	4.215	.125 inches
6"	6.275	.180 inches
8"	8.400	.240 inches
10"	10.500	.300 inches
12"	12.500	.360 inches
15"	15.300	.414 inches
18" (T-1)	18.700	.536 inches
21" (T-1)	22.047	.632 inches
24" (T-1)	24.803	.711 inches

3. Location of Services: All SCH40 and SDR-21 PVC wyes or tee fittings will be located in the center of each lot for ease of location on future hookups.
4. Lateral Lines: All service lateral lines shall be schedule 40 meeting the requirements of ASTM D2665 or D2441.
5. Connection to existing: Any adaptation from SDR-35 to SDR-21 shall be completed with a solvent weld coupling.
6. Handling: Pipe, fittings, and accessories shall be handled in a manner that will insure installation in sound, undamaged condition. Equipment, tools, and methods used in unloading, reloading, hauling and laying pipe and fittings shall be such that the pipe and fittings are not damaged. Hooks inserted in ends of pipe shall have broad, well-padded contact surfaces.
7. Cutting Pipe: Cutting shall be done in a neat manner, without damage to the pipe. Cuts shall be smooth, straight, and at right angles to the pipe axis. After cutting, the end of the pipe shall be dressed with a file to remove all roughness and sharp corners.
8. Cleaning: The interior of all pipe and fittings shall be thoroughly cleaned of foreign matter before being installed and shall be kept clean until the work has been accepted. Before jointing, all contact surfaces shall be wire brushed, if necessary, wiped clean, and kept clean until jointing is completed.

Every precaution shall be taken to prevent foreign material from entering the pipe during installation. No debris, tools, clothing, or other materials shall be placed in the pipe.

9. Inspection: Pipe fittings shall be carefully examined for cracks and other defects immediately before installation. Spigot ends shall be examined with particular care since they are vulnerable to damage from handling. All defective pipe and fittings shall be removed from the site of the work.
10. Alignment: Sewers twenty-four inches (24") or less shall be laid with straight alignment between manholes. Straight alignment shall be checked by either using a laser beam or lamping.

Curvilinear alignment of sewers larger than twenty-four inches (24") may be considered on a case-by-case basis provided compression joints are specified and ASTM or specified 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, the recommended minimum slopes must be increased accordingly to provide a minimum velocity of two feet (2') per second when flowing full.

11. Laying Pipe: Pipe shall be protected from lateral displacement by placing the specified pipe embedment material. Under no circumstances shall pipe be laid in water and no pipe shall be laid under unsuitable weather or trench conditions.

Ledge rock, boulders, and large stones shall be removed to provide a minimum clearance of four inches (4") below and on each side of all pipe(s).

12. Embedment Materials: Plastic Pipe – Embedment materials for bedding, haunching, and initial backfill, Classes I, II, or III, as described in ASTM D2321, shall be used and carefully compacted for all flexible pipe provided the proper strength pipe is used with the specified bedding to support the anticipated load based on the type of soil encountered and potential groundwater conditions.

Composite pipe – Except as described in ASTM D2680, the bedding, haunching, and initial backfill requirements for composite pipe shall be the same as for plastic pipe.

Final Backfill – Shall be of a suitable material removed from excavation except where other material is specified. Debris, frozen material, large clods, stones, organic matter, or other unstable materials shall not be used for final backfill within two (2') of the top of the pipe.

13. Steep Slope Protection: Sewers on twenty percent (20%) slope or greater shall be anchored securely with concrete anchors or equal, spaced as follows:
 - a. Not over thirty-six feet (36') center-to-center on grades twenty percent

(20%) and up to thirty-five percent (35%);

- b. Not over twenty-four feet (24') center-to-center on grades thirty-five percent (35%) and up to fifty percent (50%); and
- c. Not over sixteen feet (16') center-to-center on grades fifty percent (50%) and over.

14. High Velocity Protection: Where velocities greater than fifteen feet (15') per second are attained, special provision shall be made to protect against displacement by erosion and impact.

15. Push-On-Joints: All instructions and recommendations of the pipe manufacturer relative to gasket installation and other jointing operations shall be followed by the Contractor. All joint surfaces shall be lubricated with heavy vegetable soap solution immediately before the joint is completed.

16. Cross Connections: There shall be no physical connections between a public or private potable water supply system and a sewer, or appurtenance thereto which would permit the passage of any wastewater or polluted water into the potable supply. No water pipe shall pass through or come in contact with any part of a sewer manhole.

17. Service Connections: Service connections to the sewer main shall be watertight and not protrude into the sewer. If a saddle-type connection is used, it shall be a device designed to join with the types of pipe which are to be connected. All materials used to make service connections shall be compatible with each other and with the pipe materials to be joined and shall be corrosion proof.

18. Relation to Water Mains:

- a. Horizontal Separation: Sewer mains shall be laid at least 10 feet (3.0 m) horizontally from any existing or proposed water main. The distances shall be measured from edge to edge. In cases where it is not practical to maintain a 10-foot separation, the City Superintendent may allow deviation on a case-by-case basis if supported by data from the design engineer. Such deviations may allow installation of the sewer closer to a water main, provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 18 inches (46 cm) above the top of the sewer.
- b. Crossings: Sewers crossing water mains shall be laid to provide a minimum vertical distance of 18 inches (46 cm) 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. The crossing

shall be arranged so that the sewer joints will be equal distance and as far as possible from the water main joints. Where a water main crosses under a sewer, adequate structural support shall be provided for the sewer to prevent damage to the water main.

- c. Special Conditions: When it is impossible to obtain proper horizontal and vertical separation as stipulated above, the sewer must be constructed of slip-on or mechanical joint pipe or continuously encased and be pressure tested to one hundred fifty pounds per square inch (150 psi) to assure watertightness.

19. Street Crossing: No cutting of concrete/asphalt surfaces shall be allowed unless prior City approval is obtained in writing. At all locations where sewer lines are placed within the street, sewer trench shall be backfilled with 3/4 inch crushed limestone to the subgrade of the proposed pavement. Creek gravel or similar material will not be allowed.

20. Stream Crossing: Sewers entering or crossing streams shall be constructed of ductile iron pipe with mechanical joints; otherwise, they shall be constructed so they will remain watertight and free from changes in alignment or grade. Material used to backfill the trench shall be stone, coarse aggregate, washed gravel, or other materials which will not readily erode, cause siltation, damage pipe during placement, or corrode the pipe.

Construction methods that will minimize siltation and erosion shall be employed. The design engineer shall include in the project specifications the method(s) to be employed in the construction of sewers in or near streams. Such methods shall provide adequate control of siltation and erosion by limiting unnecessary excavation, disturbing or uprooting trees and vegetation, dumping of soil or debris, or pumping silt laden water into the stream. Specifications shall require that clean-up, grading, seeding, planting, or restoration of all work areas shall begin immediately. Exposed areas shall not remain unprotected for more than seven (7) days.

21. Aerial Stream Crossing: Support shall be provided for all joints in pipes utilized for aerial crossings. The supports shall be designed to prevent frost heave, overturning, and settlement. Precautions against freezing, such as insulation and increased slope, shall be provided. Expansion jointing shall be provided between above-ground and below-ground sewers. Where buried sewers change to aerial sewers, special construction techniques shall be used to minimize frost heaving.

For aerial stream crossings, the impact of flood waters and debris shall be considered. The bottom of the pipe should be placed no lower than the elevation of the fifty (50) year flood.

Aerial crossings shall be constructed of ductile-iron pipe with mechanical joints; otherwise, they shall be constructed so that they will remain watertight and free from

changes in alignment or grade.

22. Marking: Each pipe and fitting shall have plainly and permanently marked thereon:

- a. Manufacturer's name or trademark.
- b. Nominal pipe size.
- c. ASTM Designation D3034 and Class Number
- d. SDR number.
- e. Material designation.

23. Acceptance Tests: Each reach of sewer shall meet the requirements of *SECTION 25-32. Sewerline Acceptance Testing*.

B. BUILDING SEWER:

1. General: It shall be the responsibility of the property owner to construct and maintain the sewer lines from the building to the sewer main. The property owner assumes all ownership of the line from the building to the main tap or "Y" on the City main.
2. Materials: All sewer service connection lines shall be a minimum of 4 inches diameter, Sch 40 PVC.
3. Laying of Pipe: All sewer lines shall have a minimum of 3 feet of cover over the top of the pipe with a fall of 1/4 inch per foot. At no time shall 90-degree turns be acceptable. It shall be acceptable to use 45-degree bends providing there is a minimum of 1 foot of pipe between each bend.
4. Service Hookup: The City shall be notified to provide assistance in locating building sewer extensions at the sewer main. No unauthorized connection to the sewer main at locations other than building sewer extensions shall be allowed. No split services will be allowed; all buildings will have a separate sewer service. Service connections to the sewer main shall be watertight and not protrude into the sewer. If a saddle-type connection is used, it shall be a device designed to join with the types of pipe which are to be connected. All materials used to make service connections shall be compatible with each other and with the pipe materials to be joined and shall be corrosion proof.

C. PVC FORCE MAIN:

1. Scope: This section covers bell and spigot rubber gasket PVC pressure pipe. Pipe shall be completely furnished with all fittings, jointing material, anchors, blocking, encasement, and other necessary appurtenances. All force main construction shall be in accordance with 10CSR 20-8.130, effective January 30, 2012.

2. Materials: All materials used in the manufacture of pipe, fittings, and accessories shall conform to ASTM D 1784, Type 1, Grade 1, Class 200. All pipe and fittings shall have integral bells and conform to the following:

Pipe Dimensions: ASTM D2241, SDR 21

Fittings: Rated to exceed pipe with MJ type fittings.

Rubber Joint Rings: ASTM D1869

3. Handling: Pipe, fittings, and accessories shall be handled in a manner that will insure installation in sound, undamaged condition. Extra care shall be used in handling during cold weather.

Pipe and fittings, which have been scratched during handling or installation, shall be replaced by and at the expense of the Contractor. Pipe repairs will not be permitted.

4. Storage: All pipe shall be stored on a flat surface so as to support the barrel evenly with the bell ends overhanging and not stacked in piles higher than 5 feet. Bells shall be inverted in alternate rows.

Pipes stored for an extended period (several months) shall be covered with an opaque material to protect the pipe from the sun's rays.

Rubber gaskets shall be stored away from grease, oil, ozone-producing electric motors, and excessive heat and in a cool dark place.

5. Cleaning: The interior of all pipe and fittings shall be thoroughly cleaned of foreign matter before being installed. All joint contact surfaces shall be kept clean until the jointing is completed.

Whenever pipe laying is stopped, the open end of the pipe shall be sealed with a watertight plug, which will prevent trench water, sand and earth from entering the pipe.

6. Cutting Pipe: Cutting shall be done with a fine-toothed saw and miter box or tubing cutter approved for PVC pipe. Remove all burrs from inside the cut end with a file or knife. The cut end shall be beveled with a milled curve-tooth flat file or beveling tool designed for PVC pipe.

7. Joints: All instructions and recommendations of the pipe manufacturer relative to gasket installation and other jointing operations shall be followed by the Contractor.

8. Alignment: Pipelines or runs intended to be straight shall be laid straight. Deflections from a straight line or grade shall be as shown on the drawings.

Either shorter pipe or fittings shall be installed if the alignment or grade requires them. Pipe shall not be bent.

9. Laying Pipe: Pipe shall be protected from lateral displacement by placing the specified pipe embedment material. Under no circumstances shall pipe be laid in water and no pipe shall be laid under unsuitable weather or trench conditions.

Pipe shall be laid with the bell ends facing the direction of laying, except where reverse laying is authorized by the City or City's Engineer.

A copper tracer wire (insulated #12 wire) shall be laid in the bedding within 1' above the top of the pipe. Tracer connections shall be placed in areas not to exceed 500'. Tracer connections shall be supplied at all air relief valves.

Ledge rock, boulders, and large stones shall be removed to provide a minimum clearance of four inches (4") below and on each side of all pipe(s).

10. Embedment Materials: Plastic Pipe – Embedment materials for bedding, haunching, and initial backfill, Classes I, II, or III, as described in ASTM D2321, shall be used and carefully compacted for all flexible pipe provided the proper strength pipe is used with the specified bedding to support the anticipated load based on the type of soil encountered and potential groundwater conditions.

Final Backfill – Shall be of a suitable material removed from excavation except where other material is specified. Debris, frozen material, large clods, stones, organic matter, or other unstable materials shall not be used for final backfill within two (2') of the top of the pipe.

11. Steep Slope Protection: Sewers on twenty percent (20%) slope or greater shall be anchored securely with concrete anchors or equal, spaced as follows:
- a. Not over thirty-six feet (36') center-to-center on grades twenty percent (20%) and up to thirty-five percent (35%);
 - b. Not over twenty-four feet (24') center-to-center on grades thirty-five percent (35%) and up to fifty percent (50%); and
 - c. Not over sixteen feet (16') center-to-center on grades fifty percent (50%) and over.

12. Street Crossing: No cutting of concrete/asphalt surfaces shall be allowed unless prior City approval is obtained in writing. At all locations where sewer lines are placed within the street, sewer trench shall be backfilled with 3/4 inch crushed limestone to the subgrade of the proposed pavement. Creek gravel or similar material will not be allowed.

Where pressure lines cross State maintained roadways, the PVC pipe shall conform to ASTM D-2241-76, or latest revision thereof, within the State right-of-way.

13. Stream Crossing: Sewers entering or crossing streams shall be constructed of ductile iron pipe with mechanical joints; otherwise, they shall be constructed so they will remain watertight and free from changes in alignment or grade. Material used to backfill the trench shall be stone, coarse aggregate, washed gravel, or other materials which will not readily erode, cause siltation, damage pipe during placement, or corrode the pipe.

Construction methods that will minimize siltation and erosion shall be employed. The design engineer shall include in the project specifications the method(s) to be employed in the construction of sewers in or near streams. Such methods shall provide adequate control of siltation and erosion by limiting unnecessary excavation, disturbing or uprooting trees and vegetation, dumping of soil or debris, or pumping silt laden water into the stream. Specifications shall require that clean-up, grading, seeding, planting, or restoration of all work areas shall begin immediately. Exposed areas shall not remain unprotected for more than seven (7) days.

14. Aerial Stream Crossing: Support shall be provided for all joints in pipes utilized for aerial crossings. The supports shall be designed to prevent frost heave, overturning, and settlement. Precautions against freezing, such as insulation and increased slope, shall be provided. Expansion jointing shall be provided between above-ground and below-ground sewers. Where buried sewers change to aerial sewers, special construction techniques shall be used to minimize frost heaving.

For aerial stream crossings, the impact of flood waters and debris shall be considered. The bottom of the pipe should be placed no lower than the elevation of the fifty (50) year flood.

Aerial crossings shall be constructed of ductile-iron pipe with mechanical joints; otherwise, they shall be constructed so that they will remain watertight and free from changes in alignment or grade.

15. Cross Connections: There shall be no physical connections between a public or private potable water supply system and a sewer, or appurtenance thereto which would permit the passage of any wastewater or polluted water into the potable supply. No water pipe shall pass through or come in contact with any part of a sewer manhole.
16. Pressure Test: Pressure testing is required and is covered under *SECTION 25-32. Sewerline Acceptance Testing*.
17. Marking: Each pipe and fitting shall have plainly and permanently marked thereon:

- a. Manufacturer's name or trademark.
- b. Nominal pipe size.
- c. ASTM Designation D2241.
- d. SDR Number.

D. VITRIFIED CLAY SEWER PIPE:

Vitrified Clay Sewer Pipe is not allowed.

E. DUCTILE IRON PIPING:

1. Scope: This section covers ductile iron piping. Ductile iron pipe shall be furnished complete with all fittings, jointing materials, anchors, blocking, encasement, and other necessary appurtenances.

Piping, furnished complete with all joint gaskets, bolts, and nuts, is required for installation.

2. Materials: Unless otherwise required by the drawings or specified herein, joints in ductile iron piping shall be mechanical or push-on type.

Ductile	ANSI A21.51; AWWA C151, ASMT A536, Grade 60-42-10; thickness Class 50.
Fittings	ANSI A21.10, AWWA C110, except shorter laying lengths will be acceptable.
12" and Under	250 psi pressure rating.
Over 12"	150 psi pressure rating.
Mechanical Joints	ANSI A21.11, AWWA C111
Locked Joints	American "Loc-Fastite", U.S. Pipe "Lok-Tyton", or Clow "Super-Lock".
Push-On Joints	ANSI A21.11, except gaskets shall be neoprene or other synthetic rubber. Natural rubber will not be acceptable.
Flexible Couplings	Elastomeric polyvinyl chloride or resin impregnated fabric provided with stainless steel tightening bands. Assemblies shall be capable of connecting pipe of different size and material with a flexible leak-proof joint.

Shop Coating and Lining

- Cement Lining ANSI A21.4

- Bituminous Coating Manufacturer's Standard.
- Field Coating Heavy coal tar epoxy, MIL-C-18480;
 Koppers "50 Bitumastic", Tnemec "476 Super"

3. Handling: Pipe fittings and accessories shall be handled in a manner that will insure installation in sound, undamaged condition.

Equipment, tools, and methods used in unloading, reloading, hauling and laying pipe and fittings shall be such that the pipe and fittings are not damaged. Hooks inserted in ends of pipes shall have broad, well-padded contact surfaces.

Pipe fittings, in which the cement lining has been broken or loosened, shall be replaced by and at the expense of the Contractor.

4. Cutting Pipe: Cutting shall be done in a neat manner, without damage to the pipe or to the cement lining. Cuts shall be smooth, straight, and at right angles to the pipe axis. After cutting, the end of the pipe shall be dressed with a file to remove all roughness and sharp corners.

Ends of ductile iron pipe shall be cut with a saw, abrasive wheel, or oxyacetylene torch. Field cutting of holes for saddles shall be done by mechanical cutters; oxyacetylene cutting will not be permitted.

5. Cleaning: The interior of all pipe and fittings shall be thoroughly cleaned of foreign matter before being installed and shall be kept clean until the work has been accepted. Before jointing, all joint contact surfaces shall be wire brushed if necessary, wiped clean, and kept clean until jointing is completed.

Every precaution shall be taken to prevent foreign matter from entering the pipe during installation. No debris, tools, clothing, or other materials shall be placed in the pipe.

Whenever pipe laying is stopped, the open end of the pipe shall be sealed with a watertight plug, which will prevent trench water from entering the pipe.

6. Inspection: Pipe and fittings shall be carefully examined for cracks and other defects immediately before installation. Spigot ends shall be examined with particular care since they are vulnerable to damage from handling. All defective pipe and fittings shall be removed from the site of the work.

7. Laying Pipe: The pipe shall be protected from lateral displacement by placing the specified embedment material. Under no circumstances shall pipe be laid in water, and no pipe shall be laid under unsuitable weather or trench conditions.

Pipe shall be laid with the bell ends facing the direction of the laying except when

reverse laying is specifically authorized by the City or City's Engineer.

8. Mechanical Joints: Mechanical joints shall be carefully assembled in accordance with the manufacturer's recommendations. If effective sealing is not obtained, the joint shall be disassembled, thoroughly cleaned, and reassembled. Over tightening of bolts to compensate for poor installation practice will not be permitted.
9. Push-on Joints: All instructions and recommendations of the pipe manufacturer, relative to gasket installation and other jointing operations shall be followed by the Contractor. All joint surfaces shall be lubricated with heavy vegetable soap solution immediately before the joint is completed.

Lubricant shall be suitable for use in potable water, shall be stored in closed containers, and shall be kept clean. Each spigot shall be suitably beveled to facilitate assembly.

10. Couplings: Dresser couplings shall be carefully installed in accordance with the manufacturer's recommendations.

Flexible couplings shall be installed at joints between ductile iron pipe and pipe of unlike material. Flexible couplings shall be concrete encased.

11. Shop Coating and Lining: The interior surfaces of all pipe for gravity sewers, drain lines and dewatering lines shall be provided with the standard cement lining. The exterior surfaces of all pipe and fittings shall be shop coated with a bituminous coating.
12. Concrete Encasement: Concrete encasement shall be installed where and as shown on the drawings. Concrete and reinforcing steel shall be in accordance with the cast-in-place concrete section. All pipe to be encased shall be suitably supported and blocked in proper position and shall be anchored against flotation.
13. Cross Connections: There shall be no physical connections between a public or private potable water supply system and a sewer, or appurtenance thereto which would permit the passage of any wastewater or polluted water into the potable supply. No water pipe shall pass through or come in contact with any part of a sewer manhole.
14. Leakage: All joints shall be watertight and free from leaks. Each leak, which is discovered within one year after final acceptance of work by the City, shall be repaired by and at the expense of the Contractor.
15. Marking: Each pipe or fitting shall be plainly and permanently marked thereon:
 - a. Pipe Class.
 - b. Manufacturer's Name or Trademark.
 - c. Nominal Pipe Size.

- d. Weight.
- e. Date of Manufacture.
- f. Sampling Period.

Section 25-31. Manholes.

- A. GENERAL: This section covers standard, drop, and wet well manholes. Manholes shall be constructed complete with covers, steps, fittings, and other appurtenances, in accordance with the details shown on the drawings.

At the option of the Contractor, manholes shall be constructed of precast concrete sections or cast-in-place concrete.

1. Standard Manholes:

Manholes shall be installed at the end of each line, at changes in grade, size or alignment, at all sewer pipe intersections, at distances not greater than four hundred feet (400') for sewers fifteen inches (15") or less and at distances not greater than five hundred feet (500") for sewers sixteen inches to thirty inches (16"-30"). Greater distances may be permitted on larger sewers.

2. Drop Type Manholes:

A drop type manhole shall be provided for a sewer entering a manhole at an elevation of twenty-four inches (24") or more above the manhole invert. Where the difference in elevation between the incoming sewer and the manhole invert is less than twenty-four inches (24") the invert shall be filleted to prevent solids deposition.

Only manholes, which are required to have inside pipe and fittings for dropping sewage into the lower line, will be designated as drop manholes. All drop manholes shall have a minimum inside diameter of 5 feet to allow for securing the drop pipe to the interior wall of the manhole and providing adequate access for cleaning. When using precast manholes, drop connections shall not enter the manhole at a joint.

B. MATERIALS:

- 1. Portland Cement: ASTM C150, Type II.
- 2. Concrete: ASTM C94 with compressive strength of 3000 psi at 28 days. Curing and protection shall be in accordance with "Cast-In-Place Concrete".
- 3. Brick: ASTM C32, Grade MS or ASTM C62, Grade SW.
- 4. Granular Backfill: See bedding requirements, *Section 25-20 Excavation and Trenching and Section 25-31 Manholes.*

5. Precast Sections:

- a. Standard and Drop Manhole: Circular precast concrete; ASTM C478 Manhole except as modified.
- b. Wetwell Manhole: Reinforced concrete pipe; ASTM C76, Class II, Wall B.
- a. Minimum Thickness: As indicated on drawings.
- b. Openings: Circular shaped boxout for each connecting pipe with A-Lock locking-type gaskets installed by manhole manufacturer.
- c. Hydrated Lime: ASTM C207, Type S.
- f. Sand: Concrete sand, fine aggregate, sieved through 8-mesh screen.
- g. Shrinkage-Correcting: Master Builders "Embeco" Sida "Kemox", or Sonneborn Aggregate "Ferrolith G-DS".
- h. Mortar: One part Portland cement, 1/2 part hydrated lime, three parts sand.
- i. Non-shrinking Mortar: Premixed or job mixed; job mixed shall be one part shrinkage-correcting aggregate, one part Portland cement, and one part sand.

6. Gaskets:

- a. Mastic: Fed Spec SS-S-210; K.T. Snyder "Ram-Nek."
- b. Rubber: Neoprene or other synthetic, 40 plus or minus five hardness when measured by ASTM D2240, Type A durometer.
- c. Rubber Joint Filler: Natural or synthetic.
- d. Hardness: 40 plus or minus five when measured by ASTM D2240, Type A durometer.
- e. Tensile Strength: 1200 psi minimum.

7. Manhole Steps:

- a. Cast Iron: ASTM A48, with asphalt varnish coating applied at the foundry.
- b. Composition: Plastic ASTM 2146 Type II, Grade 16906. Steel reinforcing bar ASTM A615.
- c. Manhole Frame: ASTM A48, with coating applied at the foundry. Frame and cover shall be equal to a Neenah R-1642, Deeter 1247, or EJ 1045 Frame with 1040 AGS Cover imprinted with "City of Nixa Sanitary Sewer".

C. DELIVERY: Precast concrete sections shall not be delivered to the job until representative concrete control cylinders have attained strength of at least 80 percent of the specified minimum.

D. INSPECTION: Precast concrete sections and brick shall be inspected when delivered and all cracked or otherwise visibly defective units rejected.

E. CONSTRUCTION: All mortar shall be used within 40 minutes after mixing. Mortar, which has begun to take on initial set, shall be discarded and not mixed with additional cement or new mortar. In no case shall the invert section through a manhole be greater than that of the outgoing pipe. The shape of the invert shall conform exactly to the lower half of the pipe it connects. Side branches shall be connected with as large radius of curve as practicable. All inverts shall be troweled to a smooth clean surface.

Circular precast sections shall be provided with a rubber or mastic gasket to seal joints between sections. The space between connecting pipes and the wall of precast sections shall be equipped with A-Lock Locking-type gaskets or equal to be installed at the factory.

F. WATERPROOFING: Manholes shall be waterproofed by application of heavy-duty coal tar coating applied over entire exterior surface to attain a dry film thickness of not less than 15 mils. Surface to receive coating shall be thoroughly dry.

G. FRAMES AND COVERS: Frames shall be set so that the top of the cover is flush with finished pavement or 2 inches higher than finish grade in unpaved areas except where noted otherwise on the drawings. Watertight manhole covers shall be used wherever the manhole tops may be flooded by street runoff or high water. Bolt-down cover assemblies may be required on manholes subject to displacement by sewer surcharging. Locked manhole covers may be desirable in isolated easement locations or where vandalism may be a problem.

H. PIPE CONNECTIONS: Pipe connections shall be such that differential settlement between

pipe and manholes is permitted and shall be made using water stops, A-Lok gaskets, standard O-ring gaskets, special manhole couplings, or other methods as approved.

- I. STUBS: Future connections shall be provided in manholes at the locations shown on the drawings. Stubs shall be not less than 3 feet and shall terminate in a bell plug. Final length shall be determined by City for future anticipated connection.
- J. HOLES: Core holes and handling holes shall be repaired by cementing a properly shaped concrete plug in place with epoxy cement or by other methods acceptable to the Engineer.
- K. PAINTING: If castings arrive on the job without a foundry coating, one coat of coal tar paint shall be applied. Before painting, all castings shall be thoroughly cleaned and properly supported. All loose rust shall be removed by wire brushing. Castings shall not be handled until the paint is dry and hard.
- L. BENCH: 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 (0.50 in/ft). No pipe shall discharge onto the surface of the bench.
- M. CORROSION PROTECTION FOR MANHOLES: Where corrosive conditions due to septicity or other causes are anticipated, corrosion protection on the interior of the manholes shall be provided.
- N. STRUCTURES IN RELATION TO STREAMS: Manholes or other structures shall be located so they do not interfere with the free discharge of flood flows of the stream.
- O. MANHOLES IN RELATION TO WATER MAINS: Manholes shall be located at least ten feet (10') horizontally from any existing or proposed water main.

Section 25-32. Sewer Acceptance Testing.

- A. SCOPE: This section covers the performance testing of the installed sewer, force main, and manholes.
- B. GENERAL: The Contractor shall provide at his expense all necessary pumping equipment, testing water, means of conveying test water to the testing site to include piping connections between the piping and the nearest available source of test water, pressure gauges, and other equipment, materials and facilities necessary for the tests.

All pipe, fittings, valves, pipe joints and other materials that are found to be defective shall be removed immediately and replaced with new and acceptable material by and at the expense of the Contractor.

- C. SEWER PERFORMANCE TESTING: Each reach of sewer shall be performance tested. It shall be the responsibility of the contractor to notify the City of Nixa personnel at least 24

hours in advance of the time and place at which testing work will be done. All defects shall be repaired to the satisfaction of the Engineer and the City of Nixa. (#1578 4/09)

1. Lamping: Each straight section of sewer between manholes shall be straight and uniformly graded. Each such section will be lamped by the Contractor in the presence of the City Inspector. (#1578 4/09)
2. Exfiltration: The Contractor shall conduct an exfiltration test on each reach of sewer between manholes. Exfiltration tests shall be conducted by blocking off all manhole openings except those connecting with the reach being tested, filling the line and measuring the water required to maintain a constant level in the manholes.

Each manhole shall be subjected to at least one exfiltration test. During the exfiltration test, the water level shall be maintained at the top of the frame and cover on each manhole to locate all leaks. Testing shall conform to the test procedures in ASTM C969.

The total exfiltration shall not exceed 100 gallons per inch of nominal diameter per mile of pipe per day for each reach tested. For purposes of determining maximum allowable leakage, manholes shall be considered sections of 48 inch pipe. The exfiltration tests shall be maintained on each reach for at least 2 hours and as much longer as necessary, in the opinion of the City Inspector, to locate all leaks. (#1578 4/09)

The Contractor shall provide, at his own expense, all necessary piping between the reach to be tested and the source of water supply, together with equipment and materials required for the tests.

If the leakage in any reach exceeds the allowable minimum, it shall be re-tested after the leaks are repaired.

In lieu of water testing of manholes, vacuum testing will be allowed. A vacuum of 5 psi for a period of 5 minutes is required or as much longer as necessary, in the opinion of the City Inspector, to locate all leaks. (#1578 4/09)

Air testing will be in accordance with ASTM F1417-92 "Installation Acceptance of Plastic Gravity Sewer Pipe Using Low Pressure Air." A minimum pressure of 4 psi for 4 minutes or longer, as necessary in the opinion of the City Inspector, shall be maintained through each reach of sewer. (#1578 4/09)

3. Vacuum Test for Manhole: A vacuum test for manholes can be used in place of exfiltration. Ten inches of mercury is needed for 2 minutes if the manhole is less than 10 feet deep. Ten inches of mercury for 2.5 minutes is needed if the manhole depth is 10 to 15 feet deep. Ten inches of mercury for 3 minutes is needed if the manhole depth is from 15 to 25 feet deep. A loss of 1 inch of mercury per test is all that is allowed. Testing shall conform to the test procedures in ASTM C1244 or the

manufacturer's recommendations.

4. Infiltration: Infiltration shall also be tested by maintaining a minimum test pressure of 2 feet above the maximum groundwater elevation above the top of the pipe. If at any time prior to the expiration of the guarantee period infiltration exceeds 100 gallons per inch of nominal diameter per mile of sewer per day, the Contractor shall locate the leaks and make repairs as necessary to control in the infiltration.
1. Vertical Deflection: Initial installed vertical deflection for flexible pipe (PVC sewer pipe) shall not exceed 5 percent. The Contractor shall test the initial installed vertical deflection by pulling a mandrel or other device through all reaches of sewer to demonstrate that the 5 percent deflection limitation has not been exceeded. The deflection testing shall not be performed until a minimum of 30 days after backfilling of pipe. The method of test shall be acceptable to the Engineer and done in the presence of the City Inspector. The City Inspector shall submit all deflection test results to the Engineer. (#1578 4/09)

The rigid ball or mandrel used for the deflection test shall have a diameter not less than ninety-five percent (95%) of the base inside diameter or average inside diameter of the pipe depending on which is specified in the ASTM specification, including the appendix, to which the pipe is manufactured. The test shall be performed without mechanical pulling devices. A mandrel must have nine (9) or more odd number of flutes or points.

- D. **FORCE MAIN PERFORMANCE TESTING**: The force main shall be subjected to hydrostatic pressure testing and leakage testing as specified herein.

All testing work shall be done in the presence of the City Inspector. The Contractor shall notify the City Inspector at least three days in advance of the times and places at which testing work is to be done. (#1578 4/09)

1. Pressure Testing: The Contractor shall provide all necessary pumping equipment, piping connections, pressure gauges, anchored or blocked test plugs, and all other equipment, materials, and facilities necessary for the tests.

The test pressure at any point in the pipeline shall be equal to 100 psi. The test pressure shall be maintained for at least 30 minutes and for whatever longer period is necessary for the City Inspector to inspect the pipeline. (#1578 4/09)

All pipe, fittings, valves, pipe joints, and other materials that are found to be defective shall be removed immediately and replaced with new and acceptable material, by and at the expense of the Contractor. Following such replacement, the pressure test shall be repeated. Such replacement of defective materials and re-testing shall continue until the line and all parts thereof withstand the test pressure in a satisfactory manner.

2. Leakage Test: After the specified pressure test is completed and all pipeline repairs have been made and retested to the satisfaction of the Engineer, the line being tested

shall be subjected to a leakage test. The hydrostatic pressure during leakage testing may be any predetermined pressure selected by the Contractor, provided that it does not exceed and is at least 75 percent of the pressure specified for pressure testing. The selected pressure shall be maintained constant (within a maximum variation of plus or minus 5 percent) during the entire time that line leakage measurements are being made.

Leakage measurements shall not be started until a constant test pressure is established; compression of air trapped in unvented pipes or fittings will give false leakage readings under changing pressure conditions. After the selected test pressure is stabilized, the line leakage shall be measured by means of a suitable water meter installed in the pressure supply piping on the line side of the force pump. The water meter shall be furnished and installed by the Contractor.

Line leakage shall be the total amount of water introduced into the line as measured by the meter during the leakage test.

Each leakage test shall have a duration of 2 hours plus whatever additional period is necessary to accurately determine leakage in the opinion of the Engineer.

The pipeline will not be accepted if the leakage indicated by the test is in excess of that determined by the following formula:

where: $Q = 0.015 D \times L \times N$
Q = Allowable leakage in gallons per hour
D = Nominal diameter of pipe in inches
L = Length of section tested in thousand feet
N = Square root of average test pressure in psi

3. Defects: It is the intent of these specifications that all joints in piping shall be watertight and free from visible leaks during the prescribed leakage test and each and every leak which may be discovered at any time prior to the expiration of one year from and after the date of final acceptance of the work by the City shall be located and repaired by and at the expense of the Contractor, regardless of any amount that the total line leakage rate during the specified leakage test may be below the specified maximum rate.

The specified leakage test is to be made after the pipeline has been backfilled and the joints covered. If such test shows a leakage rate in excess of the permissible maximum, the Contractor shall make all necessary surveys in connection with the location and repair of leaking joints to the extent required to reduce the total leakage to an acceptable amount. Where evidence of leaking joints does not appear on the ground surface above or near the leaks, the Contractor shall prospect the line by sinking a hole, with an auger or otherwise, at the location of each joint and determine any undue saturation of the soil which would indicate a leak at such joint; such prospecting shall be done after pressure has been maintained in the line for a

sufficient time to provide adequate soil saturation for locating leaks by this method.

Sections 25-33 thru 25-39 Reserved

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**ARTICLE V
EQUIPMENT**

Section 25-60. Submersible Pump Station.

WATER PROTECTION PROGRAM

- A. **SCOPE:** The pump station shall be furnished and installed complete as shown, including wet well, wet well cover, pumps, controls, valves, valve box, slide rails, supervisory system, high level alarms with lights and horn, security fencing, and all equipment and appurtenances required to provide a complete and satisfactory pumping installation. Potable water shall be extended to pump station location.
- B. **GENERAL:** The complete pump station assembly including all equipment and appurtenances shall be fabricated, assembled, erected and placed in proper operating condition in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the sewage pumping station manufacturer unless exceptions are noted by the Engineer.

The station shall be designated to withstand soil pressure based on a soil weight of at least 120 pounds per cubic feet. All sizes, thickness, and deflection of the component parts shall be acceptable to the Engineer.

- C. **WET WELL/VALVE BOX ACCESS:** A wet well cover and valve box cover shall be constructed of 1/4 " steel plate as shown. The wet well cover shall consist of a double door access opening provided in the top to allow removal of either the pump from the wet well or access to the float switch assembly. Each cover shall be provided with a continuous hinge welded to a support frame. Each cover at the wet well shall be reinforced to allow the total weight of a pump to be rested on it during removal. Each cover at the wet well shall be reinforced with an angle anchored to the circular wall to provide sufficient support if deemed necessary by the Engineer.
- D. **SEWAGE PUMPING EQUIPMENT:** The sewage pumping equipment to be furnished and installed in the pumping station shall consist of motor driven, non-clog sewage pumps, each complete with all specified accessories and appurtenances.

Pumps shall be non-clog submersible pumps. All pumps in a station shall be the same type. Each pumping unit shall conform to the following requirements:

1. **Performance and Design Requirements:**

Number of pumps and motors	2
Rated total head, feet	As Required
Capacity at rated head, gpm	As Required
Min. shutoff head, feet	As Required
Min. total head for continuous operation, feet	As Required
Max. bhp requirement of pump at any total head in excess of min. head for continuous operation	As Required
Operation speed, rpm	As Required
Min. diameter of test sphere, inches.	As Required
Min. suction inlet diameter, inches	As Required

Min. discharge outlet diameter, inches As Required

Head losses through the pump, including pump suction elbow losses, are not included in the total pumping heads stipulated in the foregoing design data tabulation.

2. Pump Materials:

<u>Item</u>	<u>Material</u>
Case	Cast iron, ASTM A48
Impeller	Cast iron, ASTM A48
Shaft	Stainless steel or carbon steel w/ stainless steel sleeve
Mechanical Seal	Dura metallic "Dura Seal", double seal, carbon and ceramic with No. 9 or better carbon rings.

3. Non-Clog Submersible Pump Construction:

- a. Motor - Pump motor shall be of the sealed submersible type rated as necessary to meet the specified performance and design requirements. Motors shall be for 240/480 volt, 60 Hz, 3 phase power supply. Stator winding to be of the open type with insulation good for 80 degrees C. Winding housing to be filled with a clean high dielectric oil that lubricates bearings and seals and transfers heat from winding and rotor to outer shell.

Motor shall have two heavy duty ball bearings to support pump shaft and take radial and thrust loads and a sleeve guide bushing directly above the lower seal to take radial load and act as flame path for seal chamber. Ball bearings shall be designed for 30,000 hours B-10 life. Stator shall be heat shrunk into motor housing.

A heat sensor thermostat shall be attached to and imbedded in the winding and be connected in series with the motor starter contactor coil to stop motor if temperature of winding is more than 220 degrees F. Thermostat to reset automatically when motor cools to safe operating temperature. Two heat sensors to be used on 3 phase motors. The common pump motor shaft shall be of 416 stainless steel.

- b. Seals - Motor shall be protected by two mechanical seals mounted in tandem with a seal chamber between the seals. Seal chamber shall be oil filled to lubricate seal face and to transmit heat from shaft to outer shell. Seal face shall be carbon and ceramic and lapped to a flatness of one light band.

A double electrode shall be mounted in the seal chamber to detect any water entering the chamber through the lower seal. Water in the chamber shall cause a red light to turn on at the control panel. This signal shall not stop the motor but shall act as a warning only, indicating service is required.

- c. Impeller - Shall be cast iron and of the 2 vane non-clog enclosed type. Vane inlet tips shall be carefully rounded to prevent stringy material from catching in vanes. Pump-out vane shall be used in front and back chamber and impeller shall be dynamically balanced by grinding on shroud faces. No holes are to be drilled for balancing.

Impeller to be driven by stainless steel shaft key and impeller held in place with lock screw and washer.

Impeller and motor shall lift off case as a unit without disturbing discharge piping.

Impeller neck shall run in bronze wear ring that is pressed into volute case.

- d. Pump Case - The volute case shall be cast iron and have aflanged center line discharge. Discharge flange shall be 4 inch standard with bold holes straddling center line. Bronze wear ring to be pressed into case for guiding impeller neck and to prevent corrosion freeze up.

Wear ring to be held from rotating by locking with stainless steel set screw in end of ring.

- e. Pump and Motor Casting - All castings shall be of high tensile cast iron and shall be treated with phosphate and chromate rinse.
- f. Bearing End Cap - Upper motor bearing cap shall be a separate casting for easy mounting and replacement.
- g. Power Cables - Power cord and control cord shall be double sealed. The power and control conductor shall be single strand sealed with epoxy potting compound and then clamped in place with rubber seal bushing to seal outer jacket against leakage and to provide for strain pull. Cords shall withstand a pull of 300 pounds to meet U.L. requirements.

Insulation of power control cords shall be type SO or STOW. Both control and power cords shall have a green carrier ground conductor that attaches to motor frame.

- E. DATA TO BE SUBMITTED: Each request from the Contractor for review of equipment shall be accompanied by complete descriptive, performance and engineering data covering equipment offered. Two copies of the following items are required information.

Pump Data:

Name of Manufacturer,
Type and Model,
Design rotative speed,
Size of pump section inlet,
Size of suction elbow outlet,

Type and number of bearings,
Maximum bhp requirement of pump at any total head
specified minimum for continuous operation,
Maximum diameter of test sphere,
Complete performance curves showing capacity, head, &
NSPE requirements, efficiency and bhp requirements,
Shaft diameter,
Type of pump seal

Motor Data:

Name of manufacturer
Type designation
Rated size of motor (hp), service factor, and temperature rating
Full load rotative speed
Weight
Input-Output efficiency at:
 (a) Full Load
 (b) Rated pump condition
Full Load current
Locked rotor current
Shaft diameter
Type of lubricant
Description of special moisture resistant treatment of motor air gap surfaces

- F. **SHOP TESTS:** Each pump shall be shop tested for capacity, power requirement, and efficiency at specified minimum head for continuous operation, rated head, shutoff head, and at as many other points as necessary for accurate performance curve plotting in each case. All tests shall be made in conformity with the requirements and recommendations of the Hydraulic Institute. Shop tests shall be conducted by the pump manufacturer or by the pumping station manufacturer after installation in the pumping station.

Not less than two certified copies of a report covering each test, and capacity, power, and efficiency curves based on shop test results shall be prepared and delivered to the Engineer not less than 10 days prior to shipment of the equipment from the factory.

- G. **RESPONSIBILITY:** The manufacturer of the pumping station assembly shall be responsible for proper installation, alignment, and operating conditions of the pumping equipment when placed in service.

- H. **PUMPING STATION ELECTRICAL SYSTEM:** The pumping station shall be designed for 3 phase, 3 wire, 240 volt power service. Single phase, 120 volt auxiliary power requirements and 24 volt control power requirements shall be provided for by furnishing suitably sized dry type transformers within the station. All wiring shall conform to the National Electrical Code and shall comply with local regulations and ordinances of the community for which the station is constructed.

1. **Conduit:** Except for plug-in cords and in control enclosures, all wiring shall be in rigid galvanized steel or aluminum conduit or enclosed galvanized steel or aluminum rectangular raceways. Conduit entering the wet well and control

panel shall be caulked to prevent the movement of gases from the wet well into the control panel.

2. Cable: Except for continuation of exterior cables, cable and wiring shall be factory installed. On stations where the disconnect shall employ more than one breaker, breaker cable lugs shall be sized to fully accommodate both service entrance conductors and branch service conductors. Removal of outer strands of conductors to make up branch connections will not be permitted. Where breaker lugs will not accommodate service, and branch conductors, T type connectors or double lugs shall be provided. Thermoplastic insulated neoprene covered service entrance conductors of the size required shall be provided.

All power and control cable installed in the station shall be copper, insulated for 600 volts, 75C, wet and dry locations, Underwriters Laboratories Type RHH for power cable and Type RHH or THW for control cable. Bare copper conductors shall be installed in all but lighting conduits for grounding connections.

3. Equipment: All equipment and devices expressly intended as a means of switching, adjusting, or actuating shall be mounted within convenient reach of an attendant.

Externally operable circuit breaker type disconnect means shall permit disconnecting all phase conductors in the station from service entrance conductors.

Control and switching equipment enclosures shall be NEMA Type 3 finished steel or rigid heavy-duty construction. Enclosures housing an assembly of switches, contactors, relays, starters, etc., shall have hinged doors with latches.

Each pump motor and auxiliary circuit shall be provided with thermal-magnetic circuit breakers. Breakers for 3 phase loads shall be 3 pole. All breakers shall be operable from outside the control panel. A three position selector switch with HAND-OFF-AUTO position shall be flush mounted on the panel door for operation of each pump motor. Auxiliary and control power may be supplied through a circuit breaker load center.

All equipment shall be identified by nameplates and device identifications in agreement

4. Panel Wiring: All control wiring in switching and control assemblies shall be color coded or numbered. Color coding shall be such that electrically common interconnections of devices are the same color. The colors may be used more than once but not in the same circuit or cable grouping. Color of plug-in cord conductors does not need to comply with the color code. The power and control enclosure shall contain ground lugs or an AWG ground in the service entrance circuit and each ground cable to devices in the station. The enclosure shall be well grounded to the station shell by mounting or by an AWG band jumper.
5. Controls: Wet well level and alarm controls shall be 120 volt and shall be provided by sealed float type mercury switches. The mercury tube switches

shall be sealed in a solid polyurethane float for corrosion and shock resistance. The support wire for each float switch shall have a heavy neoprene jacket. A weight shall be attached to each support cord above the float to hold the switch in place in the wet well. Weight shall be above the float to effectively prevent sharp bends in the cord when the float operates. Each float switch shall hang in the wet well supported only by the individual cord connected thereto.

Three level sensors (normally open) and an electric alternator shall provide automatic operation. The lower control shall be at the turn-off (STOP) level, the upper control is to be set at the turn-on (START #1) level required and the override control (START #2) is to be set above the upper control so both pumps will come on if the level rises above the upper control. If one pump fails for any reason, the other pump shall automatically operate on the override control until cause of failure is corrected. A fourth level sensor (normally open) shall operate a high level alarm and the supervisory system.

An automatic alternator with manual switch shall be provided to change the sequence of operation at the end of each pumping cycle. The manual switch shall allow for either pump to be selected as lead pump or for automatic alteration.

An explosion proof junction box, suitable for a corrosive environment and mounting outside the wet well, shall be furnished to connect the four control cords to cables connecting the wet well controls to the pump station. This box shall be constructed so incoming control wires are individually sealed with mechanical rubber seal and so no sealing compounds are required to make explosion-proof joints. Box shall be provided with terminal strip to connect incoming wires with control cords. Control cords shall be sealed in box with mechanical held rubber seal. Box cover shall be bolted on and sealed with rubber "O" ring. Box and all connections shall be completely explosion-proof and waterproof and shall not leak under an outside pressure of 10 psi. A galvanized steel control cord support bracket shall be attached to the junction box and the outside of the wet well top slab. Cord snubbers shall be furnished to hold control cords at any set height.

6. Convenience Outlets: Convenience outlets for auxiliaries shall be 3 wire, polarized grounded type, 15 amp, and 125 volt. At least one similar duplex convenience outlet shall be provided on a separate circuit for maintenance tools.
7. Wiring Diagrams: The manufacturer shall provide both connection diagrams and schematics, identifying all items in wiring connections in accordance with terminal identification of equipment.
8. Supervisory: An audio/visual supervisory system shall be located at the pump station to monitor the occurrence of a high wet well level situation. The supervisory information shall be provided by normally open switches which are wired into the control panel.
9. Elapsed Time Meters: An elapsed time meter capable of recording actual running time shall be provided for each motor. Elapsed time meters shall be mounted in the control panel of the pump station.

- I. **PIPING:** Except where otherwise shown, all sewage piping shall be cast iron. Cast iron pipe shall be ANSI Class 22 conforming to ANSI A21.6 or A21.8. Fittings shall conform to ANSI A21.10. Mechanical joints shall conform to ANSI A21.11 and flanges shall be ANSI 125 lb. All pipe and fittings shall be coated inside and out with the manufacturer's standard bituminous coating. Flange bolts and nuts shall be ASTM A307, Grade B, of such length that, after installation, bolts will project 1/8 to 3/8 inch beyond the outer face of the nut. Flange gaskets shall be of ring type made from 1/11 inch thick red rubber or other approved material. Flanged or mechanical joint pipe and fittings shall be used inside the pumping station, and mechanical joint type bells shall be provided outside the station walls.
- J. **VALVES:** Each pump discharge shall be provided with a check valve and an eccentric plug valve. The check valves shall be located between the pumps and the plug valve. In addition, the manufacturer shall provide auxiliary valve and piping as shown on plans to a portable gasoline powered sewage pump.
1. Gate Valves: All 4 inch and larger gate valves shall conform to AWWA C500 as modified herein. Gate valves shall be double disc. AWWA gate valves shall have O-ring stem seals.
 2. Eccentric Plug Valves: Eccentric plug valves shall have a port area of at least 80 percent of the cross-section of the connecting piping and shall be equivalent to DeZurik "Eccentric Valves". Eccentric plug valves shall be installed with the shaft horizontal and the plug in the upper half of the body.
 3. Check Valves: All check valves shall be flanged, iron body, horizontal swing type with all seats, seat rings, pins, bushings and other parts subject to wear constructed of bronze. Vertical check valves and straight globe check valves will not be acceptable.
- K. **PAINTING AND CORROSION PROTECTION:** Preparation of surfaces to be painted and all painting shall be done in the shop before shipment of the station assembly so that field painting will be limited to coating joints or areas not previously painted, or damaged or abraded areas.
- All pumps, motors, the control cabinet, explosion-proof junction box and controls and other machines or equipment shall be painted in the shop using epoxy coating or machinery enamel.
- Exposed surfaces of copper tubing, including fittings, and valves, inside the station shall have a natural finish obtained by cleaning and burnishing with "00" steel wool and applying a coat of clear lacquer or shall be painted with epoxy.
- All joints in wrought metal piping, including exposed threads, to be buried underground, shall be painted with one heavy coat of Tnemec "Tnemecol 456", Koppers "Bitumastic 50" or equal.
- All painted surfaces damaged during shipment or installation shall be repainted using the same or equivalent materials as used in the original application.
- L. **FACTORY TESTS:** Before shipment from the factory, the pumping station shall be

operated to check alignment; faulty equipment and controls; proper wiring; leaks in piping, seals, or welds; and proper operation of the automatic control system and auxiliary equipment.

Pump suction and discharge lines shall be connected to a water tank and the sewage pumps operated at least one hour to simulate the field service conditions. The automatic control shall be adjusted to the specified levels. Defective equipment and materials disclosed by such tests shall be replaced and the station placed in satisfactory operating condition before shipment.

- M. **INSTALLATION OF PUMPING STATION:** Backfill around structures shall be placed as soon as the station installation is completed to the Engineer's satisfaction. Backfilling shall be performed in accordance with the requirements of "Structural Backfill" under "Excavation and Trenching."
- N. **ACCESS ROAD:** An access road shall be constructed from the nearest City street to the lift station to provide access. Road shall be a minimum of fifteen feet wide and shall meet all requirements for base rock, bituminous base and asphalt as contained in these specifications. (See Detail Drawing D-1 in the City of Nixa Technical Specifications Book)
- O. **SECURITY FENCING:** Fencing shall be installed along the entire property line and shall be constructed as approved on the design plans. Chain link or wood privacy are most common and shall be 8' in height. Gates shall be provided for access by necessary equipment for future maintenance of the facility.
- P. **POTABLE WATER:** A 1-inch PVC waterline shall be extended from the nearest City water main to the pump station. A frost proof hydrant shall be installed at the pump station for cleanup.
- Q. **GRADING:** Maximum grading at the pump station shall be 3:1 for maintenance purposes. Any grades exceeding 3:1 shall be poured concrete 4-inches in thickness to a point where 3:1 slope can be achieved.
- R. **DRAWINGS AND DESCRIPTIVE DATA:** Shop drawings shall be submitted showing materials and assembly of all elements of the pump station. In addition to pump and motor data to be submitted in paragraph "Data to be Submitted" descriptive literature shall clearly indicate all information necessary to evaluate conformance with specification requirements for all features of the pump station including valves. Complete data for all electrical items, switches, enclosures, relays, motor starters and controls, and a drawing of the control panel layout and a schematic diagram of the control panel circuitry shall be included.

Section 25-61. Wet Well Mounted Pump Station.

Though some older Wet Well Mounted systems still exist on the system, no new systems of this type shall be allowed.

Section 25-62. Standby Generator.

- A. **SCOPE:** This section covers the furnishing and installation of a standby generator system, complete including all material and control wiring, etc., required for a complete installation.

- B. GENERAL: The generator set shall be as specified herein; with dry-type transformer and all accessories and transfer switches as required and shall be supplied by an authorized distributor of the engine generator set manufacturer who warrants and services the entire package, and having a service and parts organization within a reasonable distance of this project, backed up by a national sales and service organization.

The generator set shall be rated for continuous service at the required loading 80% power factor, 240/480 Volts AC, 3 Phase, at 60 Hertz, for operation at 38 degrees C ambient temperature, and 1500 meters altitude. Approved manufacturers are Onan, Cummings and Caterpillar. Dry-type transformer and all appurtenances shall be installed to carry required 120v systems installed with the project during generator operations.

- C. ENGINE: The engine shall be L.P. fueled, liquid-cooled and capable of satisfactory performance operating on L.P. fuel. Engine speed shall be governed within 5 percent from no load to full rated output.

Engine shall be equipped with 12 Volt starting motor, battery charging alternator with automatic regulator, 50 degree C (122 degree F) ambient radiator with fan guards, engine coolant heater, 1500 watts minimum, thermostatically controlled to maintain engine block coolant temperature between 120 and 140 degrees F.

- D. ALTERNATOR: The alternator, having a single, maintenance free bearing, shall be direct connected to the engine and shall be a broad range, 12 lead re-connectable, four pole rotating field unit with rotating brushless exciter. It shall be self-ventilated, with skewed stator and full amplitude windings with 2/3 pitch for smooth voltage wave form. Temperature rise shall be within NEMA MG1-22.40, IEEE, and ANSI standards for standby duty at rated output. The balanced telephone influence factor (TIF) shall not exceed 50. Insulation shall be within class F with vacuum pressure impregnated epoxy on both rotor and stator.

The voltage regulator shall be of the static type and regulation shall be within plus or minus two percent of rated voltage from no load to full load. The voltage regulator shall include under frequency protection and moisture resistance protection. On application of rated load at rated Power Factor, instantaneous voltage dip shall not exceed 20% with recovery within one second.

- E. FUEL TANK: The generator shall be equipped with a 250 gallon L.P. fuel tank. The tank shall be equipped with level gauge. The tank shall be filled with L.P. as recommended by the manufacturer.

- F. CONTROLS: Set mounted controls shall include automatic start/stop control operable by a remote contact with a switch to select off, automatic or test (allowing set operation without interrupting the normal power supply) modes, a voltage adjustment rheostat, automatic shutdown protection against high engine coolant temperature, low engine oil pressure, engine cranking over 30-45 seconds, and over speed by directly cutting off the fuel supply, and a lamp to indicate an engine failure has occurred.

- G. INSTRUMENTS: The following engine and generator instruments will be set mounted through vibration isolators in a NEMA 1 enclosure and fully wired with

appropriate reading lights: ENGINE: battery voltmeter, engine oil pressure and coolant temperature gauges and running time hour-meter. GENERATOR: A.C. voltmeter, A.C. ammeter, phase selector switch, and frequency meter.

- H. MOUNTING: The electric plant shall be equipped with vibration isolators mounted between the engine-generator and steel skid base.
- I. ACCESSORIES: All accessories required for a complete operating system shall be furnished. These shall include: one 12 volt lead acid battery sized per engine manufacturers requirements, battery cables and rack, automatic float charger (5 amp minimum), residential muffler, stainless steel flexible exhaust connector, fuel lines, 60 amp main line thermal magnetic circuit breaker, oil pan heater, and a weather protective housing with removable side panels.
- J. TRANSFER SWITCH: A manually operated transfer switch shall be provided by the generator set manufacturer, rated at 400 amperes, 480 volts and 60 hz. The switch shall have closing, withstanding and interrupting ratings equal to the available short circuit current on the normal supply and shall be rated for continuous duty. It shall be housed in a NEMA-1 enclosure suitable for wall mounting, shall conform with Underwriters Laboratories 1008 Standards and all classes of load, and meet the National Electric Code (NEC) requirements for critical applications. The transfer mechanism shall be a circuit breaker type. Control circuitry shall be solid state.

The transfer switch shall be equipped with; normal push buttons, transfer push buttons, fixed 5 minute time delay for engine cool down, a test switch to simulate a normal power source failure, pilot lights to visually indicate the transfer switch position, and one set of normally open and normally closed contacts that indicate switch position. The switch shall also be equipped with the following; volt, amp, and frequency meters, 7-day exerciser clock for exercising with or without load.

- K. TEST: Certified final factory test report shall be provided to the Engineer certifying the units full power rating, voltage stability, and frequency regulation.
- L. START-UP INSTRUCTIONS: A factory trained representative shall consult with the contractor during installation and start-up. The representative shall fully instruct the owner's personnel as to correct operating and testing procedures and supply a parts book and a complete operator's manual for installation, operation and maintenance.
- M. WARRANTY: The generator set, transfer switch and accessories as furnished will carry a one-year guarantee (two years if installed in the U.S. or Canada) against defective parts and workmanship from the date of field testing and acceptance by the first owner and shall include 100 percent parts and labor coverage.

Section 25-63. Lift Cranes.

A. PORTABLE CRANES:

1. General: Work under this section consists of furnishing and installing portable hand winch operated crane and base for removal of the submersible pumps at the pump station site.

2. **Portable Crane:** Portable cranes shall be geared hand winch operated, adjustable boom type having a minimum lift capacity of 1,000 pounds. Boom shall be easily detachable for moving. Mast height shall be a minimum of 61 inches above base and boom shall be adjustable with a range of 41 to 65 inches of reach and shall rotate a minimum of 240 degree. Winch shall be double geared with automatic safety brake handle for safe positive to lower load. Portable crane shall be Therm-o-matic Portacrane Model 533, Gilco Type Jt10 or equal. Winch shall have a minimum of 30 feet of 1/2 inch lift cable.

Section 25-64. Mechanical and Plumbing.

A. VALVES

1. **General:** All valves shall comply with the following:

- a. **Ends:** All buried valves shall have push-on or mechanical joint ends and conform to ANSI A21.11.
- b. **Rotation:** The direction of rotation of the wrench nut to open shall be to the left (counterclockwise). Each valve body or operator shall have cast thereon the word OPEN and an arrow indicating the direction to open.
- c. **Shop Painting:** The interior and exterior of all valves shall be shop painted for corrosion protection. The valve manufacturer's standard paint will be acceptable.

- B. **GATE VALVES:** Distribution valves in sizes through 12 inches shall be of the iron body, non-rising bronze stem, resilient seated wedge type manufactured to equal or exceed all applicable provisions of AWWA Standard C509. Gate valves shall be wedge type epoxy coated 200 psi or approved equal to Mueller Series A-2360.

- C. **FIRE HYDRANTS:** Fire hydrants shall be 3-way, 6" mj shoe, 3'6" bury traffic model with non-freezing, cast iron bodies, full bronze mounted, suitable for a working pressure of 200 psi. Hydrants will be Mueller A-423, or approved equal.

All hydrants will be installed with a mechanical joint hydrant swivel tee and a 6"x13" swivel coupling for a complete restrained assembly from tee to hydrant. No star bolts, dvc lugs, all thread rod, mega-lug or retainer glands will be accepted.

- D. **VALVE BOXES:** All gate valves in water lines shall be provided with valve boxes. Valve boxes shall be a cast iron, extension sleeve type or Sch 40 PVC, suitable for the depth of cover required by the drawings. Valve boxes shall not be less than 5 inches in diameter, shall have a minimum thickness at any point of 3/16 inch, and shall be provided with suitable cast iron bases and covers.

- E. **FLANGED JOINTS:** Whenever screwed-on flanges are used, the pipe shall extend completely through the flange. The pipe end and flange face shall be finish machined in a single operation. Flange faces shall be flat and perpendicular to the pipe centerline.

When bolting flange joints, care shall be taken to insure that there is no restraint on the opposite end of the pipe or fitting which would prevent uniform gasket

compression or which would cause unnecessary stress in the flanges. One flange shall be free to move in any direction while the flange bolts are being tightened. Bell and spigot joints shall not be packed or assembled until all flanged joints affected thereby have been tightened. Bolts shall be tightened gradually and at a uniform rate, so that gasket compression is uniform.

Special care shall be taken when connecting to pumping equipment to insure that no stresses are transmitted to the pumping equipment to insure that no stresses are transmitted to the pump flanges by the connected piping. All such piping shall be permanently supported so that accurate matching of bolt holes and uniform contact over the entire surface of abutting pump and piping flanges are obtained before installation of any bolts in those flanges. In addition, pump connection piping shall be free to move parallel to its longitudinal centerline while the bolts are tightened.

- F. **CONNECTIONS WITH EXISTING PIPELINES:** Where connections are made between new work and existing piping, such connections shall be made using suitable fittings for the conditions encountered. Each connection with an existing pipe shall be made at a time and under conditions which will least interfere with service to customers, and as authorized by the Owner. Live tapping will be required. Facilities shall be provided for proper dewatering and for disposal of all water removed from the dewatered lines without damage to adjacent property.
- G. **REACTION TO ANCHORAGE AND BLOCKING:** All piping exposed in interior locations and subject to internal pressure in which mechanical or similar type joints are installed shall be blocked, anchored, or harnessed to preclude separation of joints. All steel clamps, rods, bolts, and other metal accessories used in reaction anchorages or joint harnesses shall be painted with two coats (in addition to a prime coat) of paint acceptable to the Engineer.
- H. **LEAKAGE:** All joints shall be watertight and free from leaks. Each leak which is discovered within one year after final acceptance of the work by the Owner shall be repaired by and at the expense of the Contractor.

Section 25-65. Meter Services.

- A. **METER PITS AND COVERS:** All 5/8 x 3/4 meters shall be housed in an 18" diameter by 30" deep "White" PVC meter pit with a notched bottom for tube entry into the pit.

Lids for meter pits shall be a cast iron, two piece raised similar to Crouch Foundry Model C-104 or approved equal.

- B. **METER BRASS:** All 5/8 x 3/4 meters shall be supplied with a brass service saddle similar to a Ford S70 series or equal.

Service corporation stops shall be similar to Mueller H-15000 series or approved equal.

Meter setters shall be a 5/8 x 3/4 x 7 setter similar to Mueller H-1404 and will have a ball valve with lockwing. Yoke connectors will be Mueller 3/4 H-14227 or similar.

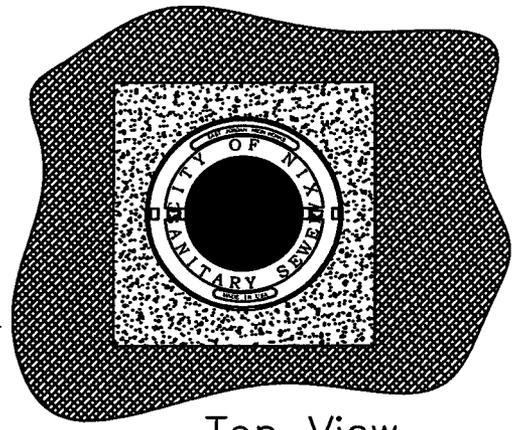
Where meter services are split, all services shall be 1" from the service corporation stop to a service wye similar to Ford Y44-243 or approved equal.

C. SERVICE TUBE: All service tubing shall be as follows:

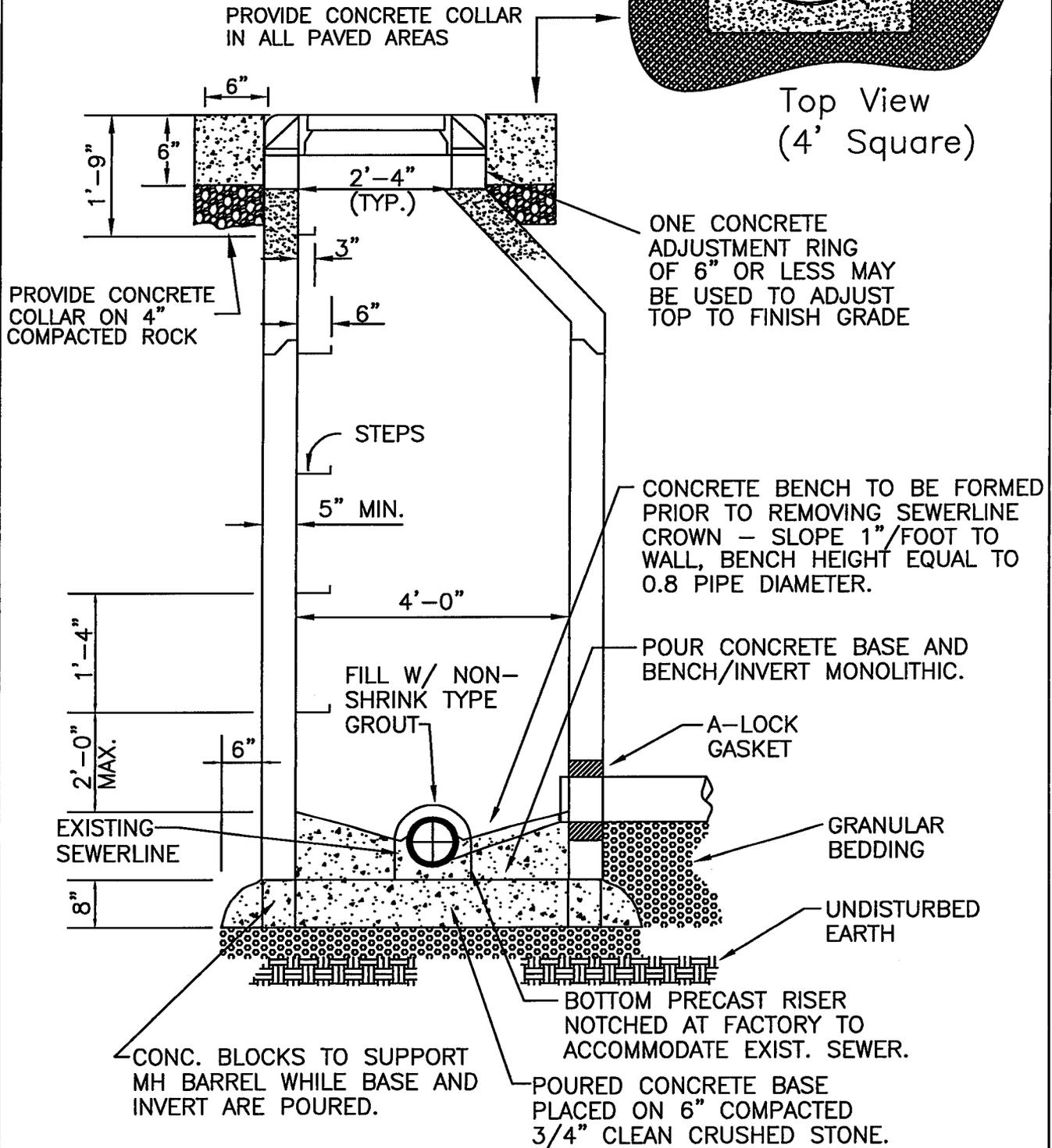
All services shall be Type K copper tubing.

D. METERS: All meters when not supplied by the city shall be a 5/8 x 3/4 bronze disc meter with cast iron freeze plate. Meters shall be equal to Badger M-25 and shall meet the AWWA C-700 standard. All registers shall read in U.S. gallons.

Sections 25-66 thru 25-69 Reserved.

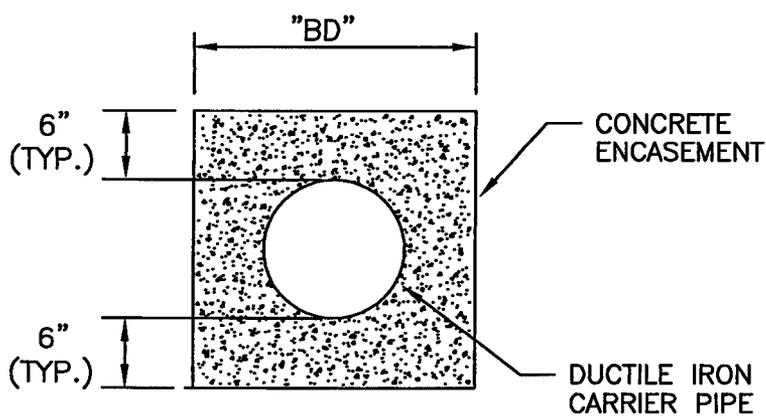
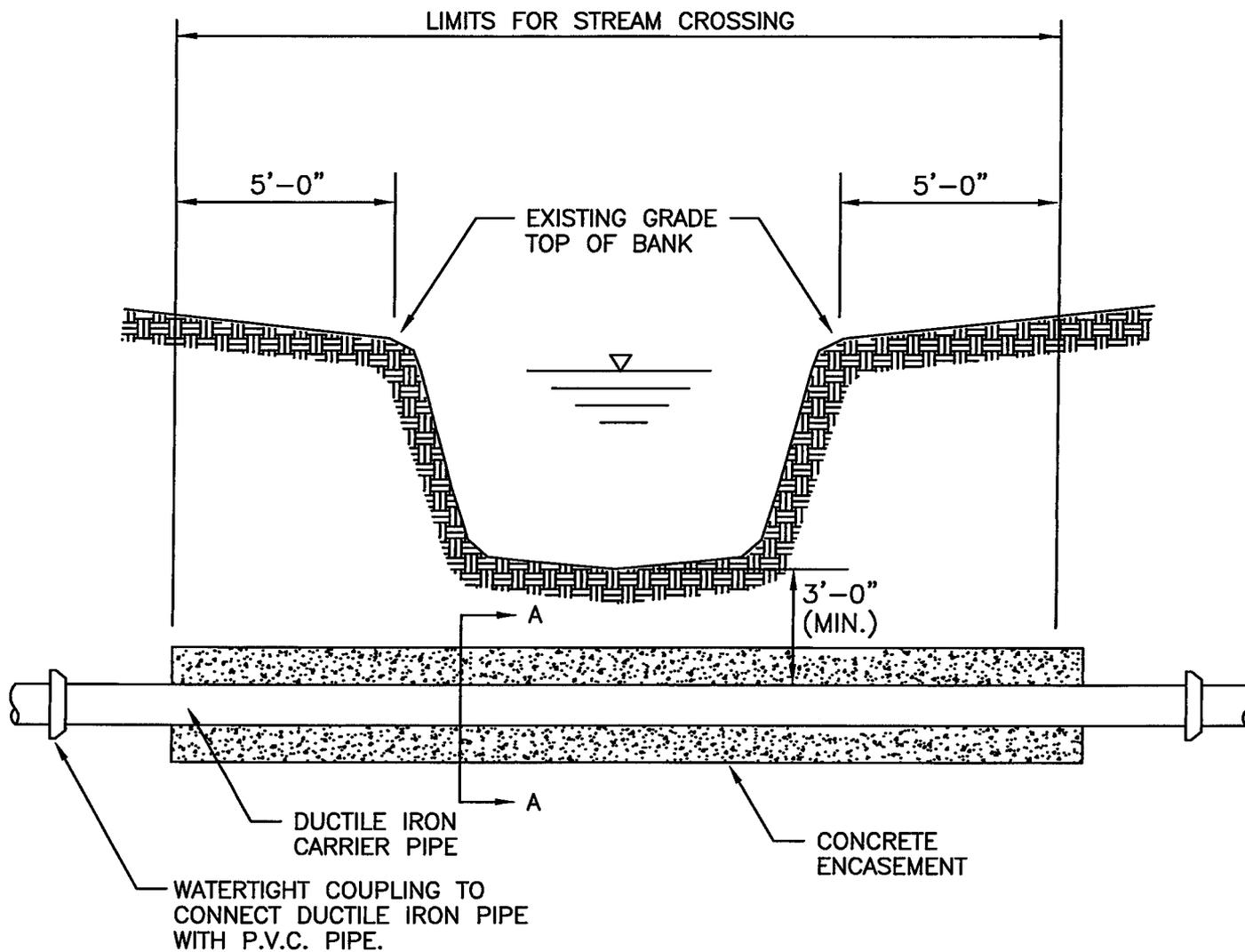


Top View
(4' Square)



STANDARD MANHOLE OVER
EXISTING SEWER DETAIL

DATE: 5/15/15
DWG: C3a



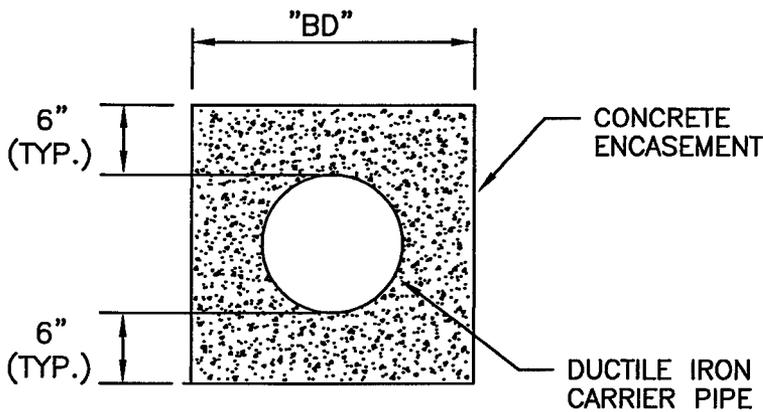
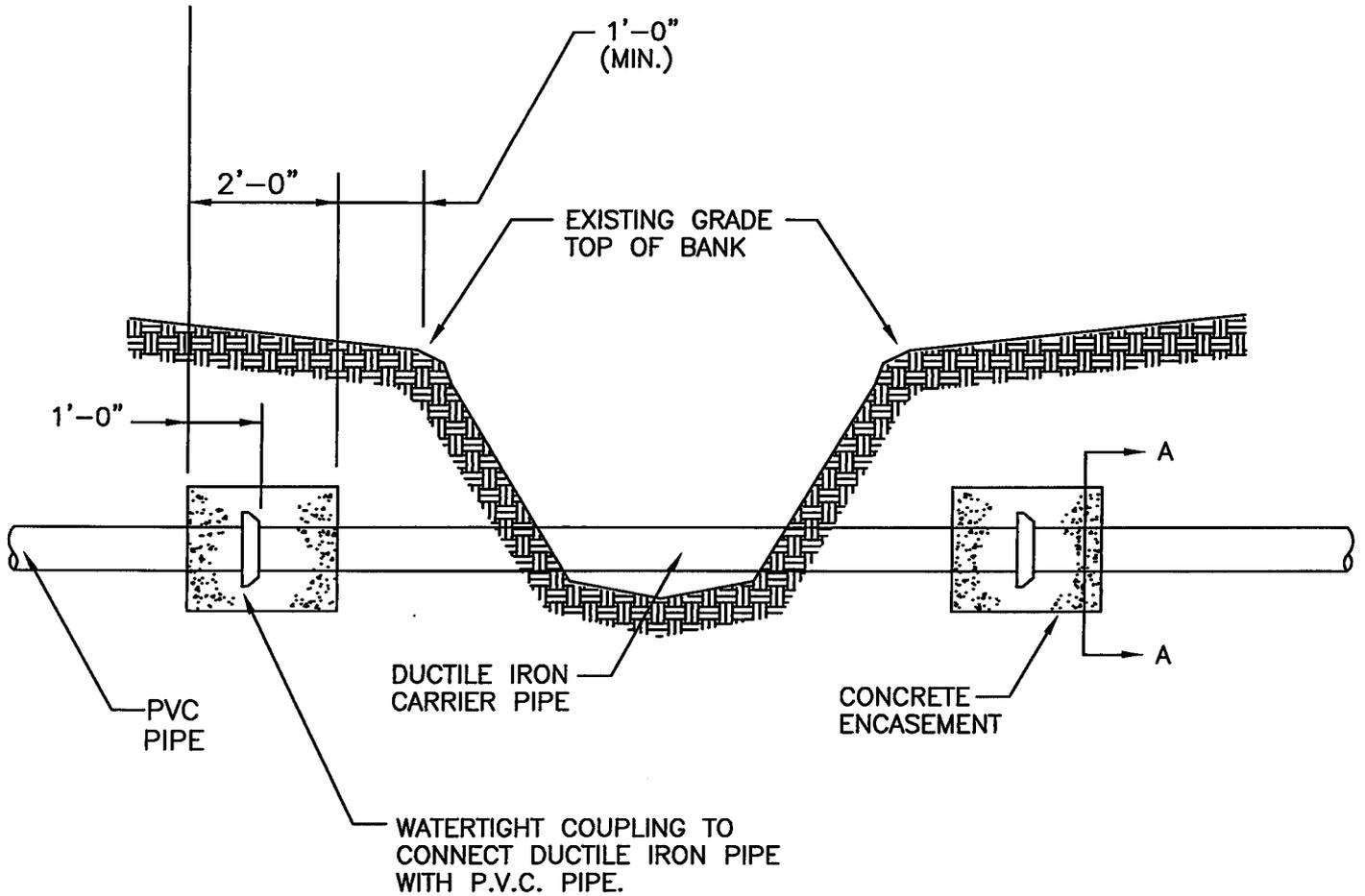
SECTION A-A

PIPE SIZE "D" (IN.)	TRENCH WIDTH "BD" (FT.)
6	2.00
8	2.33
10	2.50
12	3.00
15	3.25
18	3.83
24	4.42



SANITARY SEWER
STREAM CROSSING DETAIL

DATE:
5/15/15
DWG:
C9



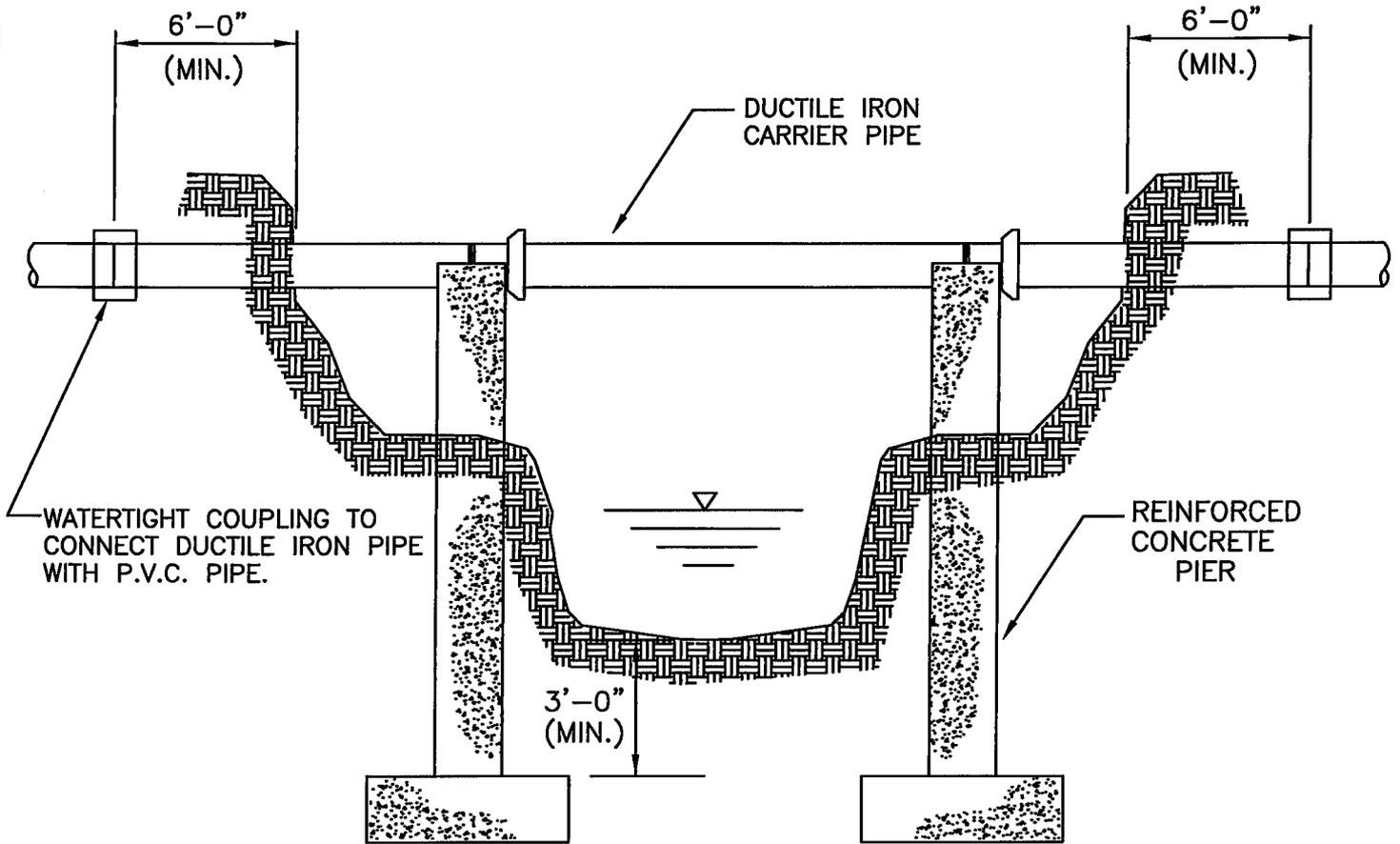
SECTION A-A

PIPE SIZE "D" (IN.)	TRENCH WIDTH "BD" (FT.)
6	2.00
8	2.33
10	2.50
12	3.00
15	3.25
18	3.83
24	4.42



SANITARY SEWER
AERIAL CROSSING DETAIL

DATE: 5/15/15
DWG: C11



NOTE:

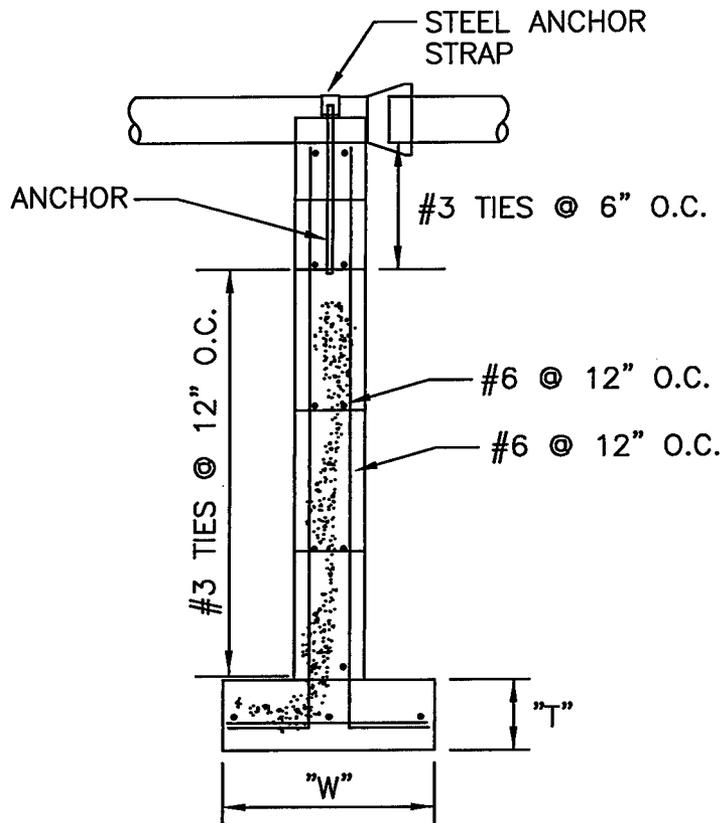
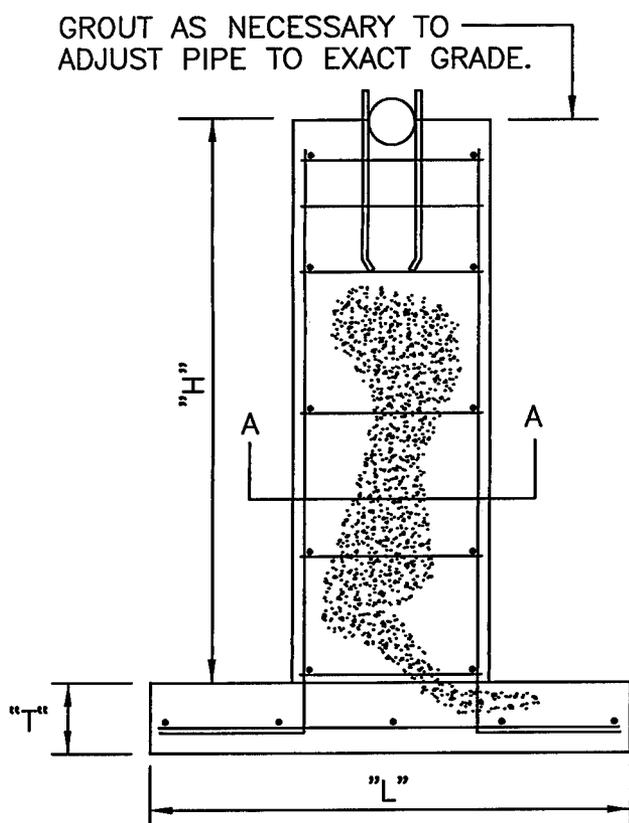
1. WHENEVER POSSIBLE NO PIERS SHALL BE PLACED WITHIN NORMAL FLOW OF CREEK. FOOTINGS SHALL BE PLACED A MINIMUM OF 3 FEET BELOW THE CREEK BED.
2. REINFORCED CONCRETE PIERS SHALL BE PLACED BEHIND THE BELL OF EACH JOINT OF DUCTILE IRON PIPE.
3. ALL PIER PLACEMENT SHALL BE APPROVED BY CITY OF NIXA PUBLIC WORKS DEPARTMENT.
4. DISTURBED AREA SHALL BE RIP-RAPPED AS REQUIRED TO ELIMINATE EROSION.
5. CONCRETE PIERS ARE NOT REQUIRED FOR AERIAL SPANS LESS THAN 20'-0" IN LENGTH.



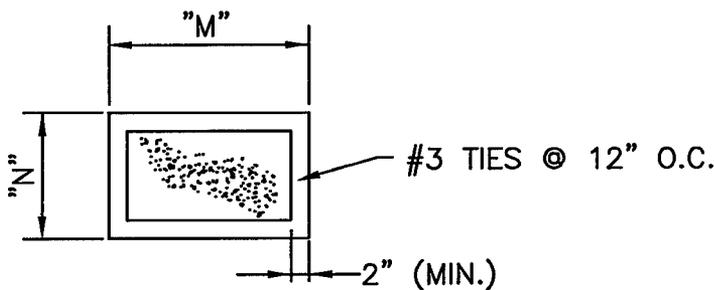
SANITARY SEWER AERIAL
CROSSING W/PIERS DETAIL

DATE: 5/15/15
DWG: C11a

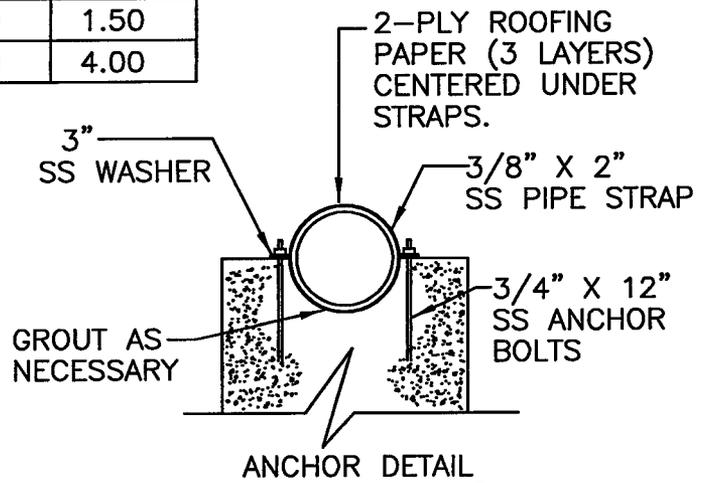
GROUT AS NECESSARY TO ADJUST PIPE TO EXACT GRADE.



PIER HEIGHT "H" (FT.)	0-5 (FT.)	5-10 (FT.)	10-15 (FT.)
"W"	3.00	4.00	5.00
"L"	4.00	5.00	7.00
"T"	1.00	1.00	1.50
"N"	1.00	1.00	1.50
"M"	2.00	3.00	4.00



SECTION A-A



ANCHOR DETAIL

NOTE:
 THIS CONSTRUCTION DETAIL IS A SUGGESTED DESIGN ONLY AND DOES NOT RELIEVE DESIGN ENGINEER FROM PROPER DESIGN OF ALL STRUCTURES. ENGINEER SHALL SUBMIT ALL PIER SUPPORTED PIPING SYSTEMS TO CITY OF NIXA PUBLIC WORKS FOR APPROVAL.



SANITARY SEWER CONCRETE PIER DETAIL

DATE:
 5/15/15
 DWG:
 C12