SECTION 7
WASTE WATER SPECIFICATIONS

SUBSECTION 7.01
WASTEWATER FACILITIES GENERAL CONSTRUCTION STANDARDS

I. SCOPE

Construction performed under these specifications shall cover the installation of wastewater pipelines and appurtenances as shown on the plans and itemized in the proposal.

II. WORKMANSHIP

These specifications contain instructions and descriptions covering the major items of construction and workmanship necessary for building and completing the various units or elements of the project. The specifications are intended to be so written that only first class workmanship and finish of the best grade and quality will result. The fact that these specifications may fail to be so complete as to cover all details will not relieve the Contractor of full responsibility for providing a completed project of high quality, first class finish, good appearance, and satisfactory operation, all within the intent of the plans and specifications.

III. SITE

The Contractor shall be responsible for viewing the proposed routes prior to submission of his proposal and shall satisfy himself as to the conditions which may be encountered.

IV. RIGHT-OF-WAY

Construction will be in locations as shown on the plans which may include streets, alleys, easements or other right-of-way. The Contractor shall make provisions for his working space to limit interference with traffic and other utilities. The City shall secure necessary permits for construction and the Contractor shall abide by all requirements of the agencies controlling the right-of-way. Special conditions or requirements regarding right-of-way are included in the **"SPECIAL REQUIREMENTS"** of the contract.

V. FENCES

Where it is necessary for the Contractor to cut fences, such fences shall be protected, repaired, and replaced by the Contractor in a condition equal to, or better than, the original condition. Cuts in fences shall be made in a neat and workmanlike manner, and the Contractor shall be responsible for preventing the loss of stock or pets through gates, breaks, or holes in fences due to construction operations.

VI. NOTICE TO CUSTOMERS, INTERRUPTION OF SERVICE

When sanitary sewer service must be interrupted during the construction of any wastewater collection project, it will be the responsibility of the Contractor to notify all affected customers prior to the interruption. The Contractor shall coordinate all interruptions with the customers and the City notifying them of the cause of service interruption and the approximate time required before service will be restored. If the interruption is to be for an extended period of time or if the quantity of discharge from the customer is large, the Contractor shall make arrangements for temporary service, such as pumping the service lines, all at the expense of the Contractor.

VII. MEASUREMENT AND PAYMENT

A. General:

1. The bid price for each and every item set forth in the proposal shall include furnishing all supervision, labor, tools, materials, machinery, appliance, and equipment appurtenant to and necessary for construction and completion in a first-class manner of all work as herein specified in strict accordance with these specifications and accompanying plans. The bid price shall also include any and all kinds, amount or class of excavation, backfilling, pumping or drainage, disposal of any and all surplus materials, testing, permanent protection of all overhead, surface or underground structures and lines, removal and replacement of any spools, conduits, pipe lines, cables, appurtenances and connections, property damage insurance, patent fees and royalties, risk due to the elements, and profits unless otherwise specified.

2. The bid price shall also include all other incidentals not specifically mentioned above that may be required to fully construct each and every item complete in place in accordance with the true intent and meaning of the specifications and accompanying plans.

3. On the twenty-sixth (26th) day of each month, all measurements for payment of pipe in place shall be made. The pipe and appurtenant construction shall be paid for at the unit prices set forth in the proposal. Payment estimates shall be prepared by the Engineer each month from the City's report for materials installed and any invoices submitted by the Contractor for materials on hand, see Subsection B below.

4. Final payment shall not be made until all conditions of the specifications are met, all known claims have been paid, and the installation has passed all testing requirements.

B. **Materials On Hand:** Payment for materials on hand shall be made at the invoice price paid by the Contractor, providing that invoices are provided to the Engineer by the twenty-sixth (26th) day of the month. In addition, materials must be on the job site for payment to be made. The Contractor shall indicate which bid items the payment for materials on hand will apply towards. The Contractor is responsible for protection of all material on hand. The City will not be responsible for damages or losses of material for any reason. **Material stored at any location other than the job site shall not be considered for payment.**

C. **Paving Cuts:** All paving cuts shall be paid at the unit price bid and shall be measured using the average length and multiplying it by the average width. **Payment for paving cuts shall at no time be larger than the size shown on the plans unless the increased size is approved ahead of time in writing by the Engineer.**

D. **Gravity Line:** Measurement of all pipe shall be by linear foot to the center of all manholes or fittings. The pipe and installation shall be paid for at the unit prices set forth in the proposal. The cost of all couplings and adapters between different types of pipe shall be included in the cost per lineal foot of pipe installed. It shall be the responsibility of the Contractor to verify existing pipe materials and size, no additional compensation shall be made for this. The depth of installation shall be figured from the flowline of the pipe being installed to the grade of the existing natural ground.

E. **Manholes and Drop Assemblies:** The manhole base, tie-in, lid and ring, etc. shall be paid for under the item for furnishing and installing a standard manhole from zero (0) feet to four (4) feet. Work paid for under furnishing and installing extra depth manhole shall include all items necessary to provide the extra depth required at each manhole requiring extra depth. Measurement of all drop assemblies shall be by linear foot to the center of all fittings. The bid price per linear foot of drop assembly shall include all appurtenances to provide a complete drop assembly as specified in the plans and in the specifications.

F. **Taps and Service Lines:** Measurement of all pipe for sanitary sewer service lines shall be by linear foot, along the actual service line, from the outside face of the gravity main on which the service tap tee is placed to the right-of-way line. The price bid for the service line shall include all service line pipe, fittings, and appurtenances to provide a complete service line as specified in the plans and in the specifications. Measurement of service tap tees shall be based upon the number installed and shall include all appurtenances to provide a complete service tap tee.

G. **Pressure Pipe and Fittings:** Measurement of all pipe shall be by linear foot to the center of all fittings and valves. Ductile iron and cast iron fittings shall be paid by weight including bolts and accessories. Where ductile iron short body fittings, AWWA C153, are specified, payment shall be based on ductile iron fitting weights only, even if cast iron fittings are used. The cost of all couplings and adapters between different types of pipe shall be included in the cost per lineal foot of pipe installed. It shall be the responsibility of the Contractor to verify existing pipe materials and size, no additional compensation shall be made for this. Fittings for all concrete steel cylinder pipe shall be included in the cost of the pipe per linear foot.

H. **Valves and Valve Boxes:** Valves shall be measured by the units of various sizes required complete in place. Payment will be made at the unit price bid per valve of the various sizes and types required, and payment shall be full compensation for the valve installation, including cast iron valve boxes and concrete cradles, all in accordance with the plans and specifications.

I. **Concrete Blocking:** Concrete blocking will be measured by the number of cubic yards in place as shown on the drawings or as directed by the Engineer. Payment will be made at the unit price bid per cubic yard, which shall be full compensation for excavation, furnishing and placing of concrete, forming, and all other work necessary for the complete unit in accordance with the plans and specifications. **In no case shall the quantity of blocking paid exceed the amount shown on the plans unless the increase is approved in writing ahead of time by the Engineer.**

VIII. CONSTRUCTION STAKING

The Engineer shall be responsible for all construction staking on this project. The Engineer shall provide permanent benchmarks from which all other elevations shall be established. The Contractor shall take the necessary precautions to preserve and protect all construction staking. Replacement of construction stakes shall be at the expense of the Contractor.

IX. SEPARATION DISTANCES REQUIRED BY THE TEXAS NATURAL RESOURCES CONSERVATION COMMISSION

The following rules apply to separation distances between potable water and wastewater treatment plants and waterlines and sanitary sewers.

A. **Water Line/New Sewer Line Separation:**
When new sanitary sewers are installed, they shall be installed no closer to waterlines than nine feet in all directions. Sewers that parallel waterlines must be installed in separate trenches. Where the nine foot separation distance cannot be achieved, the following guidelines will apply:

1. Where a sanitary sewer parallels a waterline, the sewer shall be constructed of cast iron, ductile iron or PVC meeting ASTM specifications with a pressure rating for both the pipe and joints of 150 psi. The vertical separation shall be a minimum of two feet between

outside diameters and the horizontal separation shall be a minimum of four feet between outside diameters. The sewer shall be located below the waterline.

2. Where a sanitary sewer crosses a waterline and the sewer is constructed of cast iron, ductile iron or PVC with a minimum pressure rating of 150 psi, an absolute minimum distance of 6 inches between outside diameters shall be maintained. In addition the sewer shall be located below the waterline where possible and one length of the sewer pipe must be centered on the waterline.

3. Where a sewer crosses under a waterline and the sewer is constructed of ABS truss pipe, similar semi-rigid plastic composite pipe, clay pipe or concrete pipe with gasketed joints, a minimum two foot separation distance shall be maintained. The initial backfill shall be cement stabilized sand (two or more bags of cement per cubic yard of sand) for all sections of sewer within nine feet of the waterline. This initial backfill shall be from one quarter diameter below the centerline of the pipe to one pipe diameter (but not less than 12 inches) above the top of the pipe.

4. Where a sewer crosses over a waterline all portions of the sewer within nine feet of the waterline shall be constructed of cast iron, ductile iron, or PVC pipe with a pressure rating of at least 150 psi using appropriate adapters. In lieu of this procedure the new conveyance may be encased in a joint of 150 psi pressure class pipe at least 18 feet long and two nominal sizes larger than the new conveyance. The space around the carrier pipe shall be supported at 5 feet intervals with spacers or be filled to the springline with washed sand. The encasement pipe should be centered on the crossing and both ends sealed with cement grout or manufactured seal.

B. Water Line/Manhole Separation:
Unless sanitary sewer manholes and the connecting sewer can be made watertight and tested for no leakage, they must be installed so as to provide a minimum of nine feet of horizontal clearance from an existing or proposed waterline. Where the nine foot separation distance cannot be achieved, a carrier pipe as described in subsection (A)(4) of this section may be used where appropriate.

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SUBSECTION 7.02
WASTEWATER CONSTRUCTION MATERIALS

I. GENERAL

A. Only material of the best quality and grade will be accepted. The fact that the specifications may fail to be sufficiently complete or clear in some detail will not relieve the Contractor of full responsibility for providing materials of high quality and protecting them adequately until incorporation into this project. Only materials contained within these specifications are approved for use, unless otherwise approved for use by the Engineer.

B. The Contractor shall promptly remove from the site all materials found to be damaged and/or materials not meeting the specifications or not approved, whether they have been installed or not. **Where there are differences in these specifications and the Texas Commission on Environmental Quality (T.C.E.Q.) on Design Criteria for Sewerage Systems, the T.C.E.Q. criteria shall govern.**

II. CLAY GRAVITY PIPE

Clay pipe shall be designated as Extra Strength Pipe as specified in ASTM C 700 - latest revision, and shall be in lengths of at least five (5) feet. Pipe and specials shall be sound and thoroughly burned throughout, smooth on the inside and free from blisters, lumps or flakes which are greater than one-eighth (1/8) inch. The pipe shall be free from fire cracks extending through the shell. The pipe shall have a clear ring when tapped with a hammer. The bells and spigots shall be manufactured as permitted by ASTM.

Pipe, joint materials, and made-up joints shall be tested by the manufacturer, in accordance with the applicable ASTM Specification. Absorption shall not exceed eight (8) percent as per ASTM C 301 - latest revision. All joints shall have clay spigots and clay bells. Joints shall have rubber gasket seals conforming to the requirements of ASTM C 425 - latest revision. Certification of crushing and absorption test shall accompany each shipment of pipe before its installation shall be allowed. The Contractor shall be responsible for furnishing the Engineer with this certification.

III. POLYVINYL CHLORIDE GRAVITY PIPE

A. Small Diameter PVC, 6" - 15": For gravity PVC sewer pipe six (6) inch through fifteen (15) inch in diameter, the pipe shall meet all requirements as specified in ASTM D 3034 - latest revision. The pipe shall be clearly marked with the manufacturer's name or trademark, nominal pipe size, PVC cell classification, SDR 35 rating and ASTM D 3034. Gaskets shall comply with the requirements described in ASTM F 477 - latest revision. Joints must comply with ASTM D 3212 - latest revision. The pipe shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. The pipe shall be made of PVC plastic having a cell classification of 12454-B or 12454-C or 13364-B as defined in ASTM D 1784 - latest revision.

B. Large Diameter PVC, 18" or larger: For gravity sewer pipe eighteen (18) inches in diameter and larger, the pipe shall meet all requirements as specified in ASTM D3034 - latest revision. The pipe shall be clearly marked with the manufacturer's name or trademark, nominal pipe size, PVC cell classification, SDR 26 rating and ASTM D 3034. Gaskets shall comply with the

requirements described in ASTM F 477 - latest revision. Joints must comply with ASTM D 3212 - latest revision. The pipe shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. The pipe shall be made of PVC plastic having a cell classification of 12454-B or 12454-C or 13364-B as defined in ASTM D 1784 - latest revision.

IV. HIGH DENSITY POLYETHYLENE (TRENCHLESS) GRAVITY PIPE

For HDPE (trenchless) gravity sewer pipe, the pipe shall meet all requirements specified in ASTM F 894 - latest revision. The pipe and fittings shall be high density, high molecular weight polyethylene meeting ASTM D 1248 - latest revision, Type III, Class C, Category 5, Grade P34 requirements with a Plastic Pipe Institute (PPI) designation PE 3408. The cell classification per ASTM D-3350 is 3454 44C with a molecular weight category of extra high (ranging from 250,000 to 1,500,000; typical value of discover.). The actual inside diameter of the pipe at the time of installation shall be the specified nominal diameter plus or minus one-fourth (1/4) inch. Each standard and random run or length of pipe shall be clearly marked with the pipe size, profile number, production code, and class of pipe at two locations on the pipe.

Polyethylene pipe shall be butt-faced joined to true alignment by a personnel certified by a manufacturer of polyethylene pipe and/or fusing equipment. All joints must be leak-free having uniform beads at joints formed with proper temperature and pressure, resulting in leak free joints with a tensile strength equal to or greater that the pipe. All joints are subject to inspection and acceptance/rejection by the Owner. Pipe sections containing defects (gashes, abrasions, nicks, scrapes or other defects larger/deeper that 10% of pipe wall thickness) shall not be used unless the defect may be removed and the pipe fused together. Threaded or solvent-cement joints are not permitted.

Certified copies of tests by the pipe manufacturer in accordance with ASTM D 1248 - latest revision confirming the type, class, category, and grade of raw materials used in the pipe together with tests specified shall be furnished. The pipe shall be tested in accordance with ASTM D 2412 - latest revision and the Owner supplied with certified copies of results from the pipe flattening test and the pipe ring stiffness constant. The ring stiffness constant (RSC) for HDPE pipe is defined in terms of the load which causes a one percent reduction of pipe diameter. The Owner reserves the right to test any pipe after delivery and to reject pipe which fails to comply with the specified requirements. The pipe manufacturer shall pay for all such tests which show noncompliance with the specifications. Pipe which does not meet the specified requirements shall be promptly removed from the project site.

V. POLYVINYL CHLORIDE PRESSURE PIPE

All six (6) inch through twelve (12) inch diameter PVC pressure pipe shall conform with AWWA Standard C900 Class 150, sixteen (16) inch through thirty-six (36) inch diameter PVC pipe shall conform with AWWA Standard C905. All PVC pressure pipe will have cast iron pipe outside diameter and rubber ring joints. The standard nominal length of the pipe shall be twenty (20) feet with a plus or minus tolerance of one (1) inch.

Couplings shall provide for contraction and expansion at each joint with a rubber ring and an integral thickened bell as part of each joint. Pipe and fittings must be assembled with a non-toxic lubricant.

Pipe markings shall include nominal pipe size and outside diameter (O.D.) base, material code designation, dimension ratio number, AWWA pressure class, AWWA designation number, manufacturer's name or trademark and production code, and seal of the testing agency that verified the suitability of the pipe material for potable water service.

VI. DUCTILE IRON GRAVITY AND PRESSURE PIPE

All ductile iron pipe shall be manufactured in accordance with AWWA C151 - latest revision, and shall have physical properties of 60,000 psi tensile strength and 42,000 psi yield strength and ten (10) percent minimum elongation. Pipe four (4") inch through twelve (12") inch shall be pressure class three hundred fifty (350) psi minimum. Pipe sixteen (16") inch through twenty (20") inch shall be pressure class two hundred fifty (250) psi minimum. Pipe twenty four (24") inch shall be pressure class two hundred (200) psi minimum. Pipe larger than twenty four (24") inch shall be pressure class one hundred fifty (150) psi minimum. The pipe shall have a minimum one (1) mil outside coat of Bituminous material; interior coating shall conform to section VII of this subsection. All joints in the pipe may be either mechanical joint or the slip-on rubber gasket joint of a type conforming to AWWA Standard C111 - latest revision.

VII. FITTINGS AND ADAPTERS

Mechanical joint fittings and specials for polyvinyl chloride pressure pipe and ductile iron pressure pipe larger than sixteen (16) inches shall be cast iron AWWA C110 - latest revision. Mechanical joint fittings and specials for polyvinyl chloride pressure pipe and ductile iron pressure pipe sixteen (16) inches and smaller shall be SSB-ductile iron AWWA C153 - latest revision, unless specified otherwise. **Mechanical joint ductile iron (D.I.) pipe fittings and adapters and specials for all wastewater applications shall have an interior protective lining of PROTECTO 401 Ceramic Epoxy. The material shall be an amine cured novalac epoxy containing, at a minimum, 20% by volume of ceramic quartz pigment. The minimum nominal dry film thickness of PROTECTO 401 shall be 40 mils. No substitutions will be allowed.**

The cost of all couplings or adapters between different types of pipe shall be furnished by the Contractor, and the price of same shall be included in the cost per lineal foot of pipe installed. The Contractor may use AWWA C110 cast iron fittings for piping sixteen (16) inches and smaller, but payment shall be made at the equivalent ductile iron weights, unless AWWA C110 fittings have been specified.

VIII. MANHOLES

A. General:

Manholes shall be constructed of precast reinforced concrete sections or one piece fiberglass units. The top ring and lid and base for any manhole shall be the same. All manholes shall have a minimum inside diameter of four (4) feet unless specified otherwise. Manholes shall have a concentric or eccentric reducer cone from four (4) feet in diameter to two (2) feet in diameter unless specified otherwise. The Engineer may require current submittal to confirm manhole material and construction conformance with the specifications. Grade rings used to adjust the manhole ring and lid shall have a minimum of two-(2) grade rings installed and shall not be stacked higher than twelve (12) inches.

B. Reinforced Precast Concrete Manholes:

All precast risers, grade rings and conical top cones shall be manufactured according to ASTM designation C 478-90b - latest revision. All parts of the manhole shall be designed to withstand H-20 AASHTO loadings and horizontal soil loadings of surrounding soil. Reducer cones shall be thirty six (36) inches in height. A flexible concrete sealant shall be installed between riser sections as recommended by the manufacturer. Significant surface defects on the interior of the precast riser sections shall be grouted to provide a smooth surface.

C. Fiberglass Manholes:

Manholes shall be a one piece unit manufactured to meet all requirements of ASTM D 3753 - latest revision. Resins shall be a commercial grade unsaturated polyester or other suitable polyester or vinyl ester resin. The reinforcing materials shall be a Grade "E" type glass. The inner surface shall be a resin-rich layer of one one-thousandth (0.010) to two one-thousandth (0.020) of an inch thickness. The exterior surface shall have a gray pigment added with a minimum thickness of one hundred twenty five (0.125) thousandths of an inch as an UV inhibitor. Bases may be fiberglass or concrete. If a concrete base is used, a minimum of four (4) inches of fiberglass manhole must be inserted in the concrete.

D. Ring and Cover:

Manhole rings and covers shall be made of gray iron and shall comply with the requirements of the current specifications for gray iron castings, ASTM A 48 - latest revision, and conform to Class No. 30. The dimensional requirements for the Amarillo Standard manhole ring and cover (Western Iron Works No. 40), as manufactured by Western Iron of San Angelo, Texas, shall be as shown on the Specifications Drawing. Lids shall be interchangeable and adaptable to all other rings of this pattern. The accuracy of the castings shall be such that the lid will have full bearing on the seat ring. Castings shall be free of blow or sand holes and other defects. They shall be cleaned by shot blasting and sharp edges shall be ground off. Lids shall not wobble or rattle after installation.

E. Concrete Manhole Base:

The manhole base shall be constructed of concrete with a minimum compressive strength of 3000 psi at twenty-eight (28) days.

F. Drop Assembly:

All pipe and fittings for the drop assembly shall be ductile iron, PVC pressure pipe, or PVC SDR 35 gravity pipe. Fittings and adapters for ductile iron or PVC pressure pipe shall be as specified in Subsection 7.02. PVC fittings and adapters shall comply with ASTM D 2729 - latest edition and shall be of the gasketed type joint. The assembly shall be held to the outer wall of the manhole with three-sixteenths (3/16) inch stainless steel straps spaced every thirty (30) inches along the drop assembly. Blocks shall be placed between the outside manhole wall and the pipe if necessary to prevent excessive deflection of the pipe. The bottom fitting shall have a sturdy concrete base poured in place under the fitting.

G. Manhole Connection:

At all manholes, the Contractor shall use manhole adapters which have received prior approval from the City. The adapters shall be casted, grouted with non-shrink grout, or pressed into the manhole wall to provide a watertight connection between the pipe and the manhole wall.

H. Manhole Inverts

The bottom of the manhole shall be provided with a "U" shaped channel that is as much as possible a smooth continuation of the inlet and outlet pipes. For manholes connected to pipes less than 15" inches in diameter the channel depth shall be at least half the largest pipe diameter. For manholes connected to pipes 15" to 24" inches in diameter the channel depth shall be at least three-fourths the largest pipe diameter. For manholes connected to pipes greater than 24" inches in diameter the channel depth shall be at least equal to the largest pipe diameter. In manholes with pipes of different sizes, the tops of the pipes shall be placed at the same elevation and flow channels in the invert sloped on an even slope from pipe to pipe. The bench provided above the channel shall be sloped at a minimum of 0.5" inch per foot. A drop pipe shall be provided for a sewer entering a manhole more than 30" inches above the invert.

IX. AIR RELEASE VALVE

The Contractor shall install sewage air release valves on force mains when required. The air release valve shall be Apco Model No. 400 or approved equal. Specifications for the valve shall be submitted to the City and the Engineer for approval. Approval must be given in writing before installation. The installation shall include a tapped stainless steel tee. The installation shall also include a forty-eight (48) inch manhole, precast concrete traffic top, steps, City of Amarillo standard ring and lid, three-fourths (3/4) inch to one and one-half (1-1/2) inch rock from the top of the pipe to the bronze double disc isolation gate valve, the air release valve, and all nipples and fittings to provide a complete working system. Cost of the installation shall be paid for at the unit price bid for same.

X. CONCRETE BLOCKING

Concrete shall be of Portland cement, fine aggregate and coarse aggregate, all materials complying with ASTM C 33 - latest revision and ASTM C 150 - latest revision, of the American Society for Testing Materials. Materials shall be properly proportioned and mixed to produce a twenty-eight (28) day compressive strength of 3000 psi.

XI. SERVICE TAP TEES

Service taps on new construction shall be made using a tee fitting. Service tees shall be constructed from the same material as the mains. Fittings for six (6) inch through fifteen (15) inch PVC gravity main sizes shall comply with ASTM Specification D 3034 - latest revision. Fittings for eighteen (18) inch through twenty-seven (27) inch gravity main sizes shall comply with ASTM Specification F 679 - latest revision. The service tee shall be a true tee, wyes and combination tee - wyes are not acceptable. Taps shall be four (4) inches in diameter unless otherwise specified. Mains may also be tapped using with an approved tap saddle arrangement such as polyurethane tap saddle kits with stainless steel straps or PVC Epoxy tap saddle kits. The tap shall be encased in concrete. This concrete shall provide at least four (4) inches of cover on all parts of the tap and shall be eighteen (18) inches long, centered on the tap.

XII. SERVICE LINES

Service lines from the service tee to the right-of-way line shall be PVC Schedule 40 (Pressure Pipe) pipe and PVC Schedule 40 fittings. Joints and connections shall have a sufficient seal to pass required pressure tests and exfiltration tests. Service lines shall be secured to the trench walls in a manner so as to prevent movement of the service line during backfill operations.

XIII. VALVES

A. General:

Unless otherwise specified all valves shall be gate valves. Unless otherwise specified all direct bury valves shall have mechanical joint connections. Unless otherwise specified all valves located inside of a lift station shall have flange joint connections.

B. Gate Valves:

1. All gate valves shall be either of the double disc or the resilient-seat type as specified herein. All double disc gate valves shall have an internal wedging type parallel seat with a cast iron body and bronze mountings. Gate valves shall meet working pressures of 200 psi and shall be in strict accordance with AWWA Standard C500 - latest revision, for "Gate Valves for Water Works Service" or AWWA Standard C509 - latest revision, for "Resilient-Seat Gate Valves." Gate valves which have a working pressure other than that specified above shall be in accordance with all applicable requirements of the AWWA Standards. Direct bury gate valves shall be of the non-rising stem type and furnished with a two (2) inch square operating nut. Extension stems shall only be required when specified on the plans or in the specifications. All valves shall turn counterclockwise to open and clockwise to close.

2. Valves located inside lift stations shall have flange joint connections and be of the non rising-stem type. All valves shall turn counterclockwise to open and clockwise to close. Flanges for valves shall be drilled to match connecting flanges. All flanges shall conform to the Standard Specification of the American National Standards Institute (ANSI). Flanges shall be Class 125 for all flange pipe, fittings, and valves.

C. Valve Boxes:

1. The Contractor shall furnish and install cast iron valve boxes for all buried service valves other than the air release valves. Valve boxes for gate valves shall be comprised of the following sections: base, center section, top section, and cover. The valve box shall be Tyler Pipe 6860 series, Size "A", or approved equal, with No. 6 round base for valves eight (8) inches and smaller, or No. 160 oval base for gate valves ten (10) inches and twelve (12) inches. Extensions of valve boxes shall be made with cast iron extensions manufactured for the valve box being used. **All lids shall be cast with the word "SEWER" clearly displayed on top of the lid.**

2. After the valve box is in place and allows proper operation of the valve, backfill material shall be firmly tamped around the outside so as to hold the box in proper position. The top of the box shall be adjusted to the proper elevation and securely held in place. Valve boxes which prohibit proper operation of the valve or have settled during backfilling or compaction of the backfill shall be excavated and reset properly at the expense of the Contractor.

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SUBSECTION 7.03
EXCAVATION AND INSTALLATION OF WASTEWATER PIPE AND FITTINGS

I. SCOPE

This section covers excavation work and installation of pipe and fittings, which shall include the necessary clearing, grubbing, preparation, removal and disposal of all debris, the excavation, handling, storage, transportation, disposal of all excavated material, structures or parts of structures in the area of or along the pipe, its connections and accessories, preparation of subgrades of adjacent property, backfilling, construction of fills and embankments, surfacing and grading, and other appurtenant work. The definitions in Section II are presented for the convenience of the Contractor and for clarification of these specifications.

II. DEFINITIONS

A. **Select Excavated Material** - Material which is excavated and removed from the ditch with a maximum dimension of no greater than one-half (1/2) inch which contains sands, clayey sands or clayey gravel and does not contain top soil or organic material. Fill sand is an approved select excavated material.

B. **Approved Backfill** - Excavated material which has a maximum dimension of three (3) inches and contains no frozen material, trash, debris, concrete, rock or organic material. Fill sand may substituted for the excavated material for backfill.

C. **Class I Material** - Angular, one-fourth (1/4) inch to three-fourths (3/4) inch, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.

D. **Class II Material** - Coarse sands and gravels with a maximum particle size of three-fourths (3/4) inch, including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil types GW, GP, SW, and SP are included in this class. Some approved examples include fly ash, dolomite screenings, coarse sand, and blow sand.

E. **Class III Material** - Fine sand and clayey gravels, including fine sands, sand-clay mixtures and gravel clay mixtures. Soil types GM, CC, SM and SC are included in this class.

III. CLASSIFICATION OF EXCAVATION

A. No classification of excavation will be made. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work, regardless of the type, character, composition, or condition thereof.

B. If the excavated material is determined by the Engineer to be of an unsuitable quality for approved backfill, the Contractor shall import a material approved by the Engineer for backfilling purposes. The cost of this backfill material shall be paid per unit volume on material only. The volume shall be determined from actual trench dimensions, with the trench width not to exceed the diameter of the pipe plus twenty-four (24) inches.

C. Bidders must satisfy themselves as to the actual existing subsurface conditions, including but not limited to the depth, location, and sizes of pipe, cables and lines of various kinds in place.

IV. BLASTING

A. It is anticipated that no material will be encountered that will require blasting; but, should such material be encountered, no blasting will be permitted until proper precautions are taken for the protection of persons and property. Authorization for blasting must be received from the proper officials prior to any preparations for blasting. The Contractor shall be responsible for all damages incurred as a result of blasting, and shall repair any damage immediately at his own expense.

B. Blasting will not be permitted in close proximity to existing structures or utilities which may be damaged from such operation or within twenty (20) feet of sanitary sewers or water mains six (6) inches in diameter or over. Blasting will be permitted only after proper precautions are taken for the protection of persons and property. When blasting is authorized, the blast shall be covered with heavy timbers chained together, a rope mat, or some other equally effective method. The amount of explosive in each charge and the number of simultaneous discharges must be so limited that no damage will be caused to existing utilities, structures, improvements, or property of any kind. Not more than fifty (50) pounds of dynamite shall be kept on the work site at any time. The exposed end of the water main shall be covered with plank during each blast. The Contractor's methods relative to blasting shall conform to all state laws and municipal ordinances.

V. SAFETY

A. The Contractor is advised that portions or all of the project work areas are adjacent to or crossing existing pipelines or communication cables and are subject to vibration from traffic. Soil in any area of construction may have been disturbed and may be unstable. **The Contractor shall have sole responsibility for determining what safety procedures and equipment are necessary for protecting his employees and the general public. The Contractor shall have sole responsibility for implementing safety procedures and for the proper use of all safety equipment to insure a safe working place and working environment.** The Contractor is directed to the Occupational Safety and Health Administration (OSHA) standards, regulations, and guidelines concerning trench safety. **The processes, equipment, and procedures shall be the responsibility of the Contractor.**

B. The Contractor is hereby advised that the work area in and around wastewater may contain viruses, microorganisms, and bacteria that may be hazardous to human health. In addition, toxic gases including but not limited to hydrogen sulfide, sulfur dioxide, methane, and carbon dioxide may be present in the work area. The Contractor shall have the sole responsibility for testing and determining what safety procedures and equipment are necessary to protect his employees and the general public from these hazards. The Contractor shall have sole responsibility for implementing those safety procedures and for the proper use of all safety equipment.

VI. TRENCH EXCAVATION

A. General:

1. The Contractor shall provide, before commencing any excavation, ample equipment and materials to insure the work will be carried on without interruption and in such manner as to prevent damage to all existing installations.

2. Excavations for pipe laying operations shall be conducted in a manner to cause the least interruption of traffic. Excavated material shall be piled in a manner which does not block sidewalks and driveways or obstruct traffic. Driveways must be immediately cleared to permit free ingress and egress. Gutters and drainage channels shall be kept clear, or other means of securing proper drainage shall be provided. Where traffic must cross open

trenches, the Contractor shall provide suitable bridges at street intersections and driveways. Hydrants under pressure, valves boxes, fire or police call boxes, and other utility controls shall be left unobstructed and accessible during the construction period.

3. **Equipment must not be allowed to bear on driveways, concrete curbs, sidewalks, gutters, or directly on pavement.** Where the excavation and backfilling is along, across, or adjacent to driveways, concrete curbs, sidewalks, gutters, or directly on pavement, sufficient timbers or planking must be placed under the tracks and wheels of the excavating and backfilling machines to completely protect the curbs, gutters, sidewalks, driveways, and pavement. The use of machinery must be controlled to preclude possible danger or damage to existing structures and/or existing pipes, valves, or other underground structures. Damage to curbs, gutters, driveways, sidewalks or any pavement not designated for removal shall be the responsibility of the Contractor to repair or replace to original condition at his expense.

4. Principal roots of trees shall not be cut and the Contractor will be held strictly accountable for any damage resulting from his operations to any trees, shrubbery and/or flowers and must replace or make good at his own cost to the satisfaction of the property owners involved in any such damage. When work crosses maintained lawns, the Contractor shall save, protect, and care for or replace the lawn grass. The top twelve (12) inches of topsoil shall be preserved and replaced across all lawns or other developed areas. The Contractor is urged to take photographs of the job site prior to construction in order to avoid differences in opinion as to the condition of all personal property prior to construction. Final payment shall not be made until all disputes have been resolved completely.

5. The Contractor is responsible for the location and verification of all existing utilities. The City of Amarillo has attempted to provide the Contractor with the locations and types of existing utilities on the plans for his convenience. However, the responsibility of actual locations and types of line crossings rest with the Contractor. Any cost incurred by the Contractor due to relocation of utilities shall be at the Contractor's expense.

6. Where excavation endangers adjacent structures and utilities, the Contractor shall at his own expense support and protect all such structures and/or utilities so there will be no failure or settlement. Where it is necessary to move services, poles, guy wires, pipe lines or other obstructions, the Contractor shall notify and cooperate with the appropriate utility owner. In case damage to an existing structure or utility occurs, whether failure or settlement, the Contractor shall restore the structure or utility to its original condition and position without compensation or compensate the owner of such structure or utility for the damages.

B. **Trench Width and Depth:** The maximum allowable trench width in the pipe zone shall be the outside diameter (O.D.) of the pipe plus twenty-four (24) inches, and the minimum allowable trench width in the pipe zone shall be the outside diameter (O.D.) of the pipe plus twelve (12) inches unless otherwise recommended by pipe manufacturer. The trench walls in the pipe zone shall be vertical. The pipe zone shall be considered as the vertical distance from the bottom of the trench to an elevation one (1) foot above the top of pipe when the pipe is at the specified grade.

Where joints are made, the trench shall be excavated to sufficient depth and width to provide ample space for the joint making operations. Bell holes shall provide adequate clearance for tools and methods used in jointing and installing pipe. No part of any bell or coupling shall be in contact with the trench bottom or trench walls. Excavation for bells shall be provided so the pipe is uniformly supported along its length. Trenches shall be excavated to a depth such that the pipe can be installed as specified or shown on the plans.

The excavation shall leave an undisturbed subgrade upon which to lay the pipe or install bedding. In no case shall the trench be overexcavated more than four (4) inches. All overexcavation shall be backfilled to grade with Class I or II material and tamped to a minimum density of ninety-five (95) percent Standard Proctor Density.

C. **Dewatering:** Trenches shall be dewatered so that pipe laying may be performed on dry ground. Where ground water is encountered, the water table shall be lowered by pumping or other means so that necessary work can be carried on in the dry. The water shall be kept down until the unit or section under construction is completed. Under no circumstances shall water be permitted to flow through or over unset concrete or through the pipeline. All water removed from trenches shall be conducted to natural drainage ways, drains or storm sewers in such a manner as to prevent damage to property or the public. If wet soil is encountered, the wet soil shall be removed and replaced with a Class I or II material thoroughly compacted to grade. The Contractor shall supply pumps of ample capacity to prevent damage to property or the public and to insure that once an excavation is made dry, the water will be kept down until that part of the construction is completed at his cost.

D. **Rock Excavation:** Where rock, cemented gravel, boulders or unyielding shale are encountered in the trench bottom, all such materials shall be removed to a depth of not less than six (6) inches below subgrade for the full width of the trench. The excavation below subgrade in rock or unyielding material shall be backfilled and tamped to proper grade with a Class I or II material. The use of material removed from the trench will not be permitted. The trench shall be backfilled in accordance with the excavation procedure specified herein.

VII. PIPE INSTALLATION

A. General:

1. Sewer mains shall be installed at the depth and grade shown on the plan and profile. The approximate alignment of the pipe is shown on the plans and shall not be changed except at the direction of the Engineer. The Owner reserves the right to make changes in alignment and grade as necessary. Pipe shall be laid up to the ditching machine or back hoe at quitting time every day. The Contractor shall uncover pipe, conduits and utilities when asked to do so. This work may be required prior to issuance of cut cards without additional compensation. The Contractor may lay up to a bore, but may not proceed until the bore has been checked and accepted by the Engineer for use.

2. Trenches shall be excavated so pipes will be laid straight, at uniform grade, without dips or humps between the terminal elevations shown on the drawings. The pipe shall not vary more than one-tenth (1/10) of a foot from true line and not more than two-hundredths (2/100) of a foot from the theoretical grade.

3. Before any pipe or fitting is put in place, its interior shall be free of dirt, trash, and any other foreign matter. A temporary end closure, bulkhead or plug shall be used during periods of time when laying operations are not active so debris, mud, and animals will be prevented from entering the pipe.

4. All installation of pipe shall be in accordance with manufacturer's instructions. Prefabricated joints shall be wiped with a dry cloth to remove grit and moisture. Joint lubricant shall be applied with a brush swab and spread evenly over all surfaces of both joints. The joints of pipe shall be placed together making sure the spigot seals properly and the pipe is firmly in place. Joints of all sizes and types of pipe shall be made in-place in the ditch. Joints shall not be accomplished using mechanical equipment to push the spigot into the bell, this shall be done by hand or with a bar and block.

5. Gravity sewer pipe shall be laid upgrade unless approved otherwise by Engineer.

B. Flexible Gravity Pipe (PVC or HDPE):
Unless otherwise specified, flexible gravity pipe shall be installed per the following specifications. Trenches shall be over excavated by four (4) inches and the Contractor shall provide four (4) inches of Class I or Class II material as bedding under the pipe and compact this material to a minimum density of eighty-five (85) percent standard proctor. After the pipe is placed on the bedding, joints made, and pipe barrel fully supported, the same material used for bedding shall be tamped into place to the spring line. Care shall be taken to fill all voids under pipe and to prevent pipe movement or deflection. Initial backfill from the spring line to a minimum of six (6) inches above the top of pipe shall be tamped in place. Initial backfill may be Class I, II, III or select excavated material.

C. Clay Tile Pipe:
Unless otherwise specified, ductile clay tile pipe shall be installed per the following specifications. The bottom of the pipe trench shall be excavated to proper grade and bell holes of suitable size shall be dug at each joint to permit proper jointing. Extreme care shall be used to provide the full length of the barrel with full support. If subgrade bottom is unacceptable to the Engineer or the pipe barrel cannot be fully supported by the trench bottom, the Contractor shall install bedding material as specified for flexible gravity pipe. After pipe is laid, select excavated material shall be tamped to the spring line of the pipe filling all voids under pipe. Initial backfill shall be installed from the spring line to at least six (6) inches above top of pipe.

D. PVC Pressure Pipe:
If subgrade of trench bottom is undisturbed and of acceptable quality to the Engineer, the pipe may be installed directly on the trench bottom, otherwise bedding shall be installed. The following bedding materials and compaction densities shall be used:

Class I	Inplace Density
Class II	85% standard proctor density
Class III	90% standard proctor density
Select Excavated Material	90% standard proctor density

Extreme care shall be taken to provide the full length of the barrel with full bearing. Haunching from the bottom of the pipe to the spring line shall be installed using the same materials and densities specified for bedding. Haunching material shall be hand tamped in-place. Care shall be taken to insure the material fills all voids and is properly compacted under the pipe. The Contractor shall then install approved backfill material to natural ground as specified herein.

E. Ductile Iron Pipe:
Unless otherwise specified, ductile iron pipe shall be installed per the following specifications. The bottom of the pipe trench shall be excavated to proper grade and bell holes of suitable size shall be dug at each joint to permit proper jointing. Extreme care shall be made to provide the full length of the barrel with full support. If subgrade bottom is unacceptable to the Engineer or the pipe barrel cannot be fully supported by the trench bottom, the Contractor shall install bedding material specified for PVC pressure pipe. After pipe is laid, select excavated material shall be tamped to the spring line of the pipe filling all voids under pipe.

F. Concrete Steel Cylinder Pipe (CSC):
Unless otherwise specified, CSC pipe shall be installed per the following specifications. The bottom of the pipe trench shall be excavated to proper grade and bell holes of suitable size shall be dug at each joint to permit proper jointing. Extreme care shall be made to provide the full length of the barrel with full support. If subgrade bottom is unacceptable

to the Engineer or the pipe barrel cannot be fully supported, the Contractor shall install bedding material specified for PVC pressure pipe. After pipe is laid, select excavated material shall be tamped to the top of the pipe filling all voids under pipe.

G. Valve Installation:
All valves shall be carefully handled and lowered into position by mechanical equipment in a manner so as to prevent damage to all parts of the valve. Each valve shall be placed in the proper position with the operating stem truly vertical and shall be securely held in-place until all connections have been made.

H. Concrete Blocking:
Blocking shall rest against undisturbed trench walls. The supporting area of each block shall be at least as great as that indicated on the plans.

I. Manholes:

1. **General:** Main lines entering in and exiting out of manholes shall have a two (2) feet long concrete encasement immediately adjacent to the exterior manhole wall. The encasement shall provide four (4) inches of cover around all portions of the pipe.

2. **Concrete Manholes:** The concrete base shall be either separate or cast with the manhole barrel section. Concrete mix design shall conform to appropriate section of ASTM C 478 - latest revision.

Manholes shall be constructed with a four (4) foot inside diameter unless specified otherwise, and approximately the top three (3) feet shall be conical in order to receive the manhole ring and cover. Invert channels shall be smooth and semi-circular in shape conforming to the inside of the adjacent sewer section. Changes in directions of flow shall be made with a smooth curve of as large a radius as the manhole will permit. Changes in size and grade of the channels will be formed directly in the precast base sections after it is set and the pipe is laid. The floor of the manhole outside the channel shall be semi-smooth and slope downward towards the channel not less than one (1) inch per one (1) foot, nor more than two (2) inches per one (1) foot.

3. **Fiberglass Manholes:** Fiberglass manholes utilizing a fiberglass base shall be set on a minimum of four (4) inches of clean sand or clean pea gravel.

J. Service Line Crossings:

1. Wherever water service connections are crossed and the excavation is being done using machinery, service lines are to be removed immediately ahead of the excavation and reset immediately after the excavating machine has passed the service, in order to give the least interruption possible of service to the customer. It shall be the Contractor's responsibility to notify each customer affected and the City amply prior to the time of disconnection of a service. The Contractor shall provide ample support for services across the open ditch. Where the trench is excavated by hand, services are not to be disconnected; however, ample support shall be provided for the services across the open ditch. After completion of the backfilling, services are to be reinstalled to the satisfaction of the Engineer, in a workmanlike manner providing a firm support which will not settle.

2. Services or laterals cut or excessively bent during construction, or where it is necessary to replace same due to their crossing over the main under construction, shall be replaced by the Contractor using necessary adapters and piping to the existing service or lateral. All materials and costs necessary to make complete repairs, including pipe and fittings, shall be furnished by the Contractor.

3. Cuts or breaks in existing mains, laterals, or connections shall be restored at the earliest practicable moment in order to give the least possible interruption in service. The Contractor shall be responsible for notifying all customers prior to service being disrupted.

K. **Boring of R.O.W.:** All bores shall be checked and approved by the Engineer before their use. Piping may be laid up to the bore from the outfall end, but the laying of pipe may not proceed through the bore until that bore has been checked and accepted for use.

L. **Alternate Bedding:** Contractor may submit an alternate bedding proposal provided the pipe manufacturer supplies written certification of the alternate bedding technique to the City. No extra compensation shall be granted to the Contractor for any approved alternate bedding proposal.

VIII. TRENCH BACKFILL AND COMPACTION

A. General:

1. As soon as practical after completion of laying and jointing of the pipe, the backfilling of the trench shall begin. Compacted backfill shall be required for the full depth of the trench above the pipe zone in all locations. Compacted backfill shall consist of excavated material free from debris, organic material, frozen material, trash, and stones larger than three (3) inches in greatest dimension. Dust is to be kept to an absolute minimum by sweeping and/or wetting of fill.

2. The top portion of backfill beneath established cultivated, landscaped or sodded areas shall be finished with not less than twelve (12) inches of topsoil. The top soil shall be the top twelve (12) inches of soil and this soil shall be removed and stored in a separate location from the rest of the excavated material, and replaced to as near original condition as possible.

3. Water for compacting the backfill shall be provided by the Contractor at his own expense. Water may be obtained as specified in Subsection 3.04 "Requirements for Water Usage."

4. Backfilling of the trench shall be less than five hundred (500) feet behind the pipe laying operation at all times. The cost of this work shall be included in the cost of the pipe.

5. It is the intent of these specifications that, by good backfill procedures, the backfill will be of such density as to preclude any settlement. The Contractor, upon request, shall refill and/or repair any trench areas which settle within one year after the date of final acceptance of the project.

6. If the depth of the trench over the pipe is greater than eight (8) feet in depth, the Contractor shall provide select excavated material to at least twelve (12) inches above the top of pipe, tamped in place before beginning backfill procedure.

B. Tamping Method:

Care shall be exercised in mechanically compacting the first lift to insure that the backfill used shall be placed in lifts not to exceed an eight (8) inch depth, wetted to approximately optimum moisture content, compacted with optimum moisture content with pneumatic, vibratory or other approved mechanical tamps. Additional lifts shall not be placed until the lift being compacted has attained a density of at least ninety (90) percent of Standard Proctor Density. If necessary for maximum compaction, water must be added at the Contractor's expense.

C. **Water Jetting Method:**

1. All backfill material shall be compacted and the Contractor at his discretion, may use either the pneumatic tamp method in eight (8) inch lifts or the pressure jetting with water method. If the jetting method is used, the first and subsequent lifts shall not exceed ten (10) feet and shall be thoroughly jetted before additional backfill is placed. When the first lift is jetted, the Contractor shall take extreme care not to disturb the bedding material under and around the sewer pipe with the jetting pipe and pressurized water. Pressure jetting shall continue in each lift until that lift is completely saturated.

2. The equipment for pressure jetting shall be equal to a fire hose having a length of three-fourths (3/4) inch diameter or larger pipe attached to the end, which can be inserted down into the backfill while large quantities of water are being forced through the pipe under pressure. The source of water should preferably be a tank truck equipped with a pump for supplying large quantities of water under pressure. The jet pipe shall be inserted at six (6) foot maximum intervals, and sufficient water shall be injected, and there will be no bridging across or dry areas.

D. **Backfilling Around Structures:**
Excavations around structures shall be backfilled with excavated or other material to the elevation shown on the plans. Backfill material shall be select material free from rock or boulders measuring more than three (3) inches in their greatest dimensions. Normally, the backfill material may be dumped or pushed into the excavation and stabilized by flooding and jetting. However, where directed by the Engineer, the backfill material shall be placed in layers, not exceeding six (6) inches in thickness, by hand or pneumatic tamping until the backfill is the same density as the undisturbed earth in the sides of the excavation.

E. **Backfilling Trenches (Other than R.O.W.):**

1. Except as specified for backfilling trenches in paved streets, proposed paved streets, or in rock, where approved backfill is required, trenches shall be backfilled using materials excavated from trenches.

2. After the pipe has been laid and the Engineer's approval obtained as otherwise specified, the trench shall be backfilled with select excavated material and tamped to a level of at least twelve (12) inches above the top of the pipe. The backfill material shall be placed in layers not exceeding four (4) inches in thickness and tamped on both sides of the pipe for the full width of the trench. Tamping shall be thoroughly done on each side of the pipe and under the pipe to secure firm contact between backfill material and the outside pipe surface. Backfilling with hand or pneumatic tamping shall be continued until the pipe has been completely backfilled to a height of at least twelve (12) inches above the top of the pipe.

3. As an alternate, compaction in the pipe zone may be done by jetting under the proper pressure with water. The Engineer must approve this method both before it is commenced and also while in progress. Select excavated material shall be deposited in the trench simultaneously on both sides of the pipe for the full width of the trench and to the spring line of the pipe. The backfill shall then be jetted with sufficient water under the proper pressure to cause the fill material to "melt together", thereby filling all the voids under and around the pipe. Additional select backfill shall be placed simultaneously on both sides of the pipe to an elevation of twelve (12) inches above the pipe. This backfill shall be compacted and settled by the jetting method described above. Where jetting is done, the jet nozzle shall be inserted into the fill at six (6) foot maximum spacings to preclude any possibility of "bridging" between points where the nozzle is inserted. Care shall be taken not to float the pipe during the process. Any pipe which has been "floated" shall be taken

up, the ditch reworked, and the pipe relaid to the proper grade, all at the Contractor's expense.

Except in roadways or across streets and highways, the balance of the backfill will be water jetted. Water for compacting the backfill will be provided by the Contractor at his own expense. Water may be obtained as specified in Subsection 3.04 " Requirements for Water Usage."

No rock shall be placed in the backfill. Where such rocks or boulders occur in the soil bank, non-selective backfilling with bulldozers or other mechanical equipment will not be permitted.

F. **Backfilling Trenches (R.O.W.):**

1. Where the trench lies in or across County roadways or City streets, the backfill above the pipe zone shall be made with an approved material, to be placed in uniform layers of six (6) inches maximum thickness and each layer will be compacted to a density equal to the adjacent undisturbed soil. To obtain the proper density the backfill material may be moistened.

2. At the Contractor's option, trench excavation in or across City streets may be backfilled with sand, approved by the Engineer, above the pipe zone. If there is to be a lapse of time between backfilling the trench and installation of the base material, the excavation in the street may be backfilled with sand to the bottom of the base material to be placed, or to the grade of adjacent paving.

3. Sand backfill shall be placed in layers not to exceed twelve (12) inches in depth and each layer shall be moistened sufficiently to uniformly settle the layer of sand before the next layer is placed in the trench. There will be no extra reimbursement to the Contractor for sand backfill used in street excavations.

G. **Backfill in Fields and Pastures:**

1. Cultivated fields shall be backfilled in such a manner as to leave the fields in a good state of cultivation. All rock, caliche, and other debris shall be removed at the Contractor's expense. Terraces shall be backfilled in such a manner that the original grade will be maintained after settlement. Cultivated fields shall be left in a condition equal to or better than original.

2. Pastures will be left in a condition equal to or better than it existed before construction. Care shall be taken to minimize damage to grass.

H. **Backfilling Trenches in Rock:**
When excavated materials from a trench in rock or loose rock is composed largely of rock fragments which will not pass through a one (1) inch mesh sieve, such material shall not be used for backfilling within the pipe zone to a level twelve (12) inches above the top of the pipe, but, in lieu thereof, sandy backfill shall be used. Above the pipe zone, except as specified for sand backfill, the remainder of the trench may be backfilled with excavated material as set forth for earth backfill, provided, however, that no rock fragments with a dimension larger than three (3) inches shall be used in the backfill.

IX. RESTORATION OF SURFACES

The Contractor shall replace all surface materials and restore fencing, sod, and other surfaces to a condition equal to or better than the condition before the work began.

X. SURPLUS EARTH

Surplus excavated materials from all excavations shall be disposed of by the Contractor at his expense.

XI. CLEAN UP

The Contractor shall remove all surplus pipeline materials, tools, equipment, scraps, broken pipe, debris, rubbish and temporary structures. The Contractor shall leave the construction site in a first class workmanlike manner, to the satisfaction of the City. Clean up shall be no more than two thousand (2000) feet behind pipe laying operations, or as otherwise directed by the City.

LAST PAGE OF THIS SUBSECTION

SUBSECTION 7.04
SANITARY SEWER MAIN TESTING REQUIREMENTS

I. MANDREL TEST FOR GRAVITY MAINS

A deflection test shall be made by the installing Contractor on all flexible gravity pipe. The test shall not be made on any section of gravity pipe until all backfill on that section of pipe has been compacted in place for thirty (30) days. The deflection test shall be conducted using a rigid mandrel providing a precision of two tenths of one percent (0.2%) deflection. The mandrel must have a diameter equal to at least ninety-five (95%) percent of the inside diameter of the pipe. No mechanical pulling devices may be utilized during the test. If a pipe fails the deflection test, the problem shall be corrected and a second test conducted after the pipe has been backfilled for an additional thirty (30) days. The inside diameter of the pipe shall be defined as the average inside barrel diameter of the pipe listed in the manufacturer's dimension sheet or the field measured inside diameter of the pipe as witnessed by the Engineer. Shop drawings of all mandrels shall be submitted to the Engineer for approval prior to their use. **Tests performed prior to approval of the mandrel by the Engineer shall not be acceptable.** All mandrels shall have a minimum of nine vanes as long as the total number of vanes is an odd number. The barrel section of the mandrel shall have a length of at least seventy-five (75%) percent of the inside diameter of the pipe. No pipe shall exceed a deflection of five (5%) percent of the inside diameter of the pipe. All excessive deflections shall be corrected. The installing Contractor shall correct the deficiency and retest the pipe. Corrections may be made by reworking the embedment and backfill, or by replacing that section of pipe. This portion of pipe shall again be backfilled, compacted, and the mandrel pulled through again a minimum of thirty (30) calendar days after the compaction of the backfill. If the pipe fails the five (5) percent allowable deflection a second time, the pipe shall be replaced. This process shall be repeated until the pipe is clear of all obstructions. All testing and repair work shall be at the Contractor's expense. **Final payment shall not be made until all sections of the pipe line have passed the mandrel test.**

II. HYDROSTATIC TEST FOR PRESSURE MAINS

A. General:

1. After the pipe has been laid and backfilled, each valved section of newly laid pipe shall be subjected to a hydrostatic pressure test. For any section being tested, the pressure applied shall be such that at the lowest point in the section the pressure shall be 150 psi. Tests may be conducted between Monday and Friday and all tests must conclude by 5:00 p.m.

2. Each valved section of pipe shall be slowly filled with water to the specified test pressure, measured at the point of lowest elevation. The pressure shall be applied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection, and all necessary apparatus including gauges and meters shall be furnished by the Contractor at his expense.

B. Procedure:

1. The Contractor may test the pipeline in sections when all pipe in the section is at least seven (7) days old where concrete blocking is involved. Care shall be used to see that all air vents are open during the filling of the line and all air shall be expelled from the line prior to the pressure test. After the line has been completely filled, it shall be allowed to stand under a slight pressure for a minimum of forty-eight (48) hours to allow the lining to absorb what water it will and to allow the escape of air from any air pockets. During this

period, the project shall be examined for leaks. The water necessary to maintain the test pressure shall be measured through a meter or by other means satisfactory to the Engineer.

2. The duration of the test shall be four (4) hours and the line shall be repressurized at both 30 minute intervals and when the line pressure falls to 100 psi. During the last two hours of the test, the entire route of the pipe line shall be inspected for leaks or breaks. Any and all leaks shall be repaired and all defective materials removed and replaced with sound material and the test completely repeated until satisfactory results are obtained.

C. Allowable Leakage:

The pipe line shall not be accepted by the City until the line has passed the pressure test without exceeding the amount of allowable leakage as specified herein. The amount of leakage is defined as the quantity of water needed to maintain the required pressure on the pipe line for the full duration of the test after the test is begun.

D. Cast Iron and Ductile Iron Pipe:

The allowable leakage is defined as, $L = \frac{S*D*P^{0.5}}{133,200}$ where:

L = allowable leakage, in gallons per hour
S = length of pipe tested, in feet
D = nominal diameter of the pipe, in inches
P = average test pressure during the test, in psi (gauge)

This formula comes from AWWA Standard C600, pp. 17-19.

E. Polyvinyl Chloride (PVC) Pipe:

The allowable leakage is defined as, $L = \frac{N*D*P^{0.5}}{7400}$ where:

L = allowable leakage, in gallons per hour
N = number of joints in the length of pipeline tested
D = nominal diameter of the pipe, in inches
P = test pressure during the test, in psi (gauge)

Allowable leakage per 1000 Feet of Pipeline - gph

Pipe Diameter (Inches)	150 psi Test Pressure at Lowest Point
6	0.50
8	0.66
10	0.83
12	0.99

This formula comes from the Uni-Bell PVC Pipe Association Handbook of PVC Pipe - Design and Construction, p. 286.

III. AIR TEST FOR GRAVITY MAINS

A low pressure air test shall be performed on all gravity pipe. The test shall conform to ASTM C 828, ASTM C 924, or ASTM C 969 - latest revisions for low pressure air test for gravity sections of pipe with the following safety procedures incorporated in the test.

1. No one shall be allowed in the manholes during the air testing.
2. All plugs shall be securely installed, including bracing if necessary.
3. The lines shall not be over pressurized.

TABLE 1 Minimum Test Time for Various Pipe Sizes

Pipe Size (Inches)	Minimum Time (Seconds)	Length For Minimum Time (Feet)	Time For Longer Length (Seconds)
6	340	398	0.855(L)
8	454	298	1.520(L)
10	567	239	2.374(L)
12	680	199	3.149(L)
15	850	159	5.342(L)
18	1020	133	7.693(L)
21	1190	114	10.471(L)
24	1360	100	13.676(L)
27	1530	88	17.309(L)
30	1700	80	21.369(L)
33	1870	72	25.856(L)

The section of line being tested shall have all openings plugged. Air shall then be added to the test section **slowly** until the internal pressure of the line is raised to approximately 4.0 psi. The line shall be allowed to stabilize for five (5) minutes. The pressure may be reduced to 3.5 psi before starting the test. If the pressure drops more than one psi during the test time, the line shall fail the test. If a pressure drop of less than one psi occurs during the full duration of the test, the line shall pass the test. The test may be stopped if **no** pressure loss occurs during the first twenty five (25%) percent of the calculated testing time. If **any** pressure loss has occurred during the first twenty five (25%) percent of the testing time then the test shall continue for the entire test duration or until failure. A gravity line shall not be accepted for use until all sections of that line pass the low pressure air test. The cost of the air test shall be included in the lineal feet of pipe bid. **Final payment shall not be made until all sections of the pipeline have passed the air test.**

IV. TV INSPECTION FOR GRAVITY MAINS

The City may, at its option, run a TV camera through a portion of, or all of the gravity pipe which has been installed by the Contractor. In the event that a TV inspection reveals inadequate draining of the line, settlement of the line, cracks or physical damage to the pipe, or other problems with the new line, the Contractor shall be required to repair or replace the line at his expense. After the repairs have been completed, an air test shall be required, and a mandrel test shall be required again after the line has been backfilled and compacted in place for a minimum of thirty (30) calendar days.

V. MANHOLE TESTING

Manholes shall be tested for leakage separately of the wastewater lines by hydrostatic exfiltration testing or vacuum testing. If a manhole fails a leakage test, the manhole must be made watertight and retested.

A. Hydrostatic Testing:

The maximum leakage for hydrostatic testing shall be 0.025 gallons per foot diameter per foot of manhole depth per hour. All wastewater lines coming into the manhole shall be

sealed with an internal pipe plug, then the manhole shall be filled with water and maintained full for at least one (1) hour. For concrete manholes a wetting period of twenty four (24) hours may be used prior to testing in order to allow saturation of the concrete.

B. **Vacuum Testing:**

The maximum vacuum drop shall be less than or equal to one (1" Hg) inch Hg (mercury). Testing shall conform with ASTM C 924 - latest revision. A vacuum shall be pulled on the manhole. The vacuum pulled shall be at least ten (10" Hg) inches Hg. For forty eight (48") inch diameter manholes, less than thirty (30') feet in depth, the vacuum shall be held for a minimum of sixty (60) seconds with no greater than a one (1" Hg) inch Hg drop in the vacuum. For sixty (60") inch diameter manholes, less than thirty (30') feet in depth, the vacuum shall be held for a minimum of seventy five (75) seconds with no greater than a one (1" Hg) inch Hg drop in the vacuum. For seventy two (72") inch diameter manholes, less than thirty (30') feet in depth, the vacuum shall be held for a minimum of ninety (90) seconds with no greater than a one (1" Hg) inch Hg drop in the vacuum.

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