The City of San Angelo, Texas
Department of Water Utilities

2015-2016 Utility Trench Repair Contract

Technical Specifications

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Prepared By

The City of San Angelo, Texas
Department of Engineering Services Division

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5.0 - Utility Trench Repair Bid Sheet General Guidelines

5.0 General Guidelines

Trench Definition: The volume of the trench is calculated by multiplying the average depth measured from the top of the final paving or finished level to the bottom of the excavation then multiplying by the average width times the average length with both the length and width being measured from the extents of the excavation. This volume can either already be excavated by The City of San Angelo or the volume excavated by the CONTRACTOR. By this definition every permit will have a trench volume.

Item No.	Item	Description
1	Removal of Temporary Backfill	See Technical Specification 5.3 Existing temporary backfill shall be removed to the top of the embedment zone, unless otherwise directed by the OWNER.
2	Bedding Material	See Drawing W-BED-1 Excavated material shall not be used as bedding material. All excavated materials together with all debris; stones, stumps, and roots shall be removed from the site and disposed of by the CONTRACTOR. Removal of this material will be paid under item 16. The embedment zone for the utility pipe shall be Type II for installation with a minimum of thirty inches (30”) of cover at finished grade unless otherwise noted in the plans and/or specifications. Piping with less than thirty inches (30”) of cover at finished grade shall have Type V embedment unless specified by the OWNER. Bedding material shall be a granular material that will remain firm and not permit displacement of the pipe either during pipe laying and backfilling or following completion of construction. The crushed gravel meeting the requirements of ASTM Designation C33, Gradation 67 (3/4 in. to No. 4). Crushed stone or pea gravel meeting the TXDOT Grade 5 gradation per test method Tex-200-F, Part I and Turner Pit "D-bedding" are acceptable. Bedding material on all subaqueous installations shall consist of one inch (1”) non-angular washed river gravel, and must be installed under the bedding material.
3	Provide Flexible Base for Backfill	See Technical Specification 5.6 This bid item is for the cost of backfill material alone.

4	Placement and Compaction of Trench Backfill	See Technical Specification 5.3 Backfill operations are to extend from the top of the embedment zone to a prescribed surface. This item shall cover all cost associated with the placement and compaction of the backfill material from item 3. Backfill operations shall be accomplished without disturbance of proximate utilities or improvements. The OWNER reserves the right to require density control procedures and density control testing for backfill under the scope of this specification without any additional cost to the OWNER.
5	Removal of Sacrificial Flexible Base	If base material is filled to top of trench (i.e. level with street), and final paving surface is ready to be placed, this bid item is to cover the removal of the necessary sacrificial base for the final paving surface.
6	Placement of Temporary Asphalt	Temporary Asphalt shall be put in place if final paving is not completed within seventy-two (72) hours on non-emergency backfills and "Emergency Repair Work". Temporary asphalt shall be a minimum of one inch (1”) thick.
7	Hot Mix Asphaltic Concrete Pavement	See Technical Specification 5.7 & See Drawing W-UTR-ASP The pavement shall be constructed on the previously approved flexible base or concrete cap. For trench repairs greater than sixty inches (60”) wide and forty feet (40’) long or longer, asphalt shall be placed using a lay down machine.
8	Hot Mix - Cold Laid Asphaltic Concrete Pavement	See Technical Specification 5.7 & See Drawing W-UTR-ASP The pavement shall be constructed on the previously approved flexible base or concrete cap. For trench repairs greater than sixty inches (60”) wide asphalt shall be placed using a lay down machine.
9	Concrete Cap	See Technical Specification 5.45 & See Drawing W-CC-W Concrete caps shall be used when specified by the OWNER, in areas where major traffic lanes create excessive wheel-loading or where compaction of the base and sub-base is prone to failure. All concrete shall be Class A (3,000 psi). Concrete caps shall be six inches (6”) in thickness and of a length and width sufficient to extend a minimum of six inches (6”) beyond the edge of the utility trench.

10	Rigid Pavement	See Technical Specification 5.45 & See Drawing W-UTR-RIG Rigid Pavement shall be used when specified by the OWNER and in repair of utility trenches cut in rigid pavement. The surface course shall be concrete pavement Class P (3,500 psi). Bend existing rebar into center of new concrete. Replace as necessary with #4 rebar on twelve inch (12") centers each way and dowel in #4 rebar nine inches (9") deep with twenty-four inch (24") lap splice and must be allowed to cure for a period of not less than seventy-two (72) hours, or use concrete pavement Class P (3,500 psi) with thirty-six pounds (36lbs) of Novamesh 850 per cubic yard with #4 rebar dowels nine inches (9") deep and nine inches (9") into the trench on eighteen inch (18") centers and must be allowed to cure for a period of not less than twenty-four (24) hours. In order that the quality of the replacement pavement, reinforcement bars are to be placed as close to the initial positions as feasible. The concrete shall be properly placed and finished in accordance with OWNER specifications.
11	Provide & Place 6" Topsoil	See Technical Specification 5.33 Topsoil shall only be obtained from the 'A horizon' of the soil profile as defined by the U.S. Department of Agriculture Soil Survey. The topsoil source(s) shall be tested by the CONTRACTOR to ensure compliance with specifications. Topsoil shall be placed where directed by the OWNER.
12	Excavation	Excavation will be the removal of undisturbed ground. CONTRACTOR shall not charge for the removal of material under this bid item if items 1, 5 or 22 are being used. This item will only be paid for in conjunction with work involving Bid Items 29-37. In all other bid items requiring excavation, the cost of the work shall be considered subsidiary to that bid item.
13	Curb, Gutter, or Combined Curb & Gutter	See Technical Specification 5.44 Concrete used in conventionally formed construction shall be Class A (3,000 psi) concrete with a seven-sack grout topping. Concrete for extruded (machine laid) construction shall be Class A (3,000 psi) concrete. Reinforcing steel will be repaired in those areas where the steel already exists, and shall be compatible with the existing sections. Membrane curing materials shall be applied.
14	Concrete Pad	See Concrete Pad shown in Drawing W-FHI Concrete Pad shall be a two feet (2') x two feet (2') concrete block around a valve box that shall be a minimum of five inches (5") thick. Concrete shall be Class A (3,000 psi) concrete.

15	Hourly Rate for Site Clean-up	See Technical Specification 5.46 Areas in paved street roadways or alleys disturbed during construction shall be scraped and broomed, as necessary, and left in a clean and neat condition to the satisfaction of the OWNER. No direct compensation will be made for this work. Areas beyond the paved street roadway or alley disturbed during construction shall be scraped, raked, graded or broomed, as necessary, and left in a clean and neat condition to the satisfaction of the OWNER. Compensation for this work shall be at the hourly rate as bid on this item in the bid schedule. All site clean-up shall be done before final acceptance of construction will be considered.
16	Trench Spoil Removal	See Technical Specification 5.46 Trench spoil is either spoil material removed from the trench by the OWNER or unsatisfactory backfill material left on site by the OWNER outside of the trench repair boundaries. This material will not include Temporary Backfill. The CONTRACTOR will remove and dispose of this material unless otherwise directed by the OWNER.
17	Emergency Repair Mobilization Fee	Fee applied to all "Emergency Repair Work", often referred to as "Emergency Backfill", to compensate for mobilization. Mobilization shall include all equipment, materials, manpower, and other resources required to 1) secure the present site to the satisfaction of the OWNER providing for public safety and convenience and 2) relocate crews, equipment and materials to the "Emergency Repair" site.
18	Hot Mix - No BF - 200 SF or less	See Technical Specification 5.7 & See Drawing W-UTR-ASP When OWNER backfills trench properly and the only remaining item is final paving with hot mix, this item is used.
19	Hot Mix - No BF - 201 SF or more	See Technical Specification 5.7 & See Drawing W-UTR-ASP When OWNER backfills trench properly and the only remaining item is final paving with hot mix, this item is used.

20	Rigid Pavement - No BF - 200 SF or less	See Technical Specification 5.45 & See Drawing W-UTR-RIG When OWNER backfills trench properly and the only remaining item is final paving with rigid pavement, this item is used. The surface course shall be concrete pavement Class P (3,500 psi). Bend existing rebar into center of new concrete. Replace as necessary with #4 rebar on twelve inch (12") centers each way and dowel in #4 rebar nine inches (9") deep with twenty-four inch (24") lap splice and must be allowed to cure for a period of not less than seventy-two (72) hours, or use concrete pavement Class P (3,500 psi) with thirty-six pounds (36lbs) of Novamesh 850 per cubic yard with #4 rebar dowels nine inches (9") deep and nine inches (9") into the trench on eighteen inch (18") centers and must be allowed to cure for a period of not less than twenty-four (24) hours. In order that the quality of the replacement pavement, reinforcement bars are to be placed as close to the initial positions as feasible. The concrete shall be properly placed and finished in accordance with OWNER specifications.
21	Rigid Pavement - No BF - 201 SF or more	See Technical Specification 5.45 & See Drawing W-UTR-RIG When OWNER backfills trench properly and the only remaining item is final paving with rigid pavement, this item is used. The surface course shall be concrete pavement Class P (3,500 psi). Bend existing rebar into center of new concrete. Replace as necessary with #4 rebar on twelve inch (12") centers each way and dowel in #4 rebar nine inches (9") deep with twenty-four inch (24") lap splice and must be allowed to cure for a period of not less than seventy-two (72) hours, or use concrete pavement Class P (3,500 psi) with thirty-six pounds (36lbs) of Novamesh 850 per cubic yard with #4 rebar dowels nine inches (9") deep and nine inches (9") into the trench on eighteen inch (18") centers and must be allowed to cure for a period of not less than twenty-four (24) hours. In order that the quality of the replacement pavement, reinforcement bars are to be placed as close to the initial positions as feasible. The concrete shall be properly placed and finished in accordance with OWNER specifications.
22	Rigid Pavement Removal	Removal of boxed area one foot (1') outside widest trench openings. Removal shall include areas where cracks may have occurred from trench excavation.

23	Concrete Cap and Removal	See Technical Specification 5.45 & See Drawing W-CC-W This item includes all concrete capping of utility lines. Concrete cap shall be installed per the request made by OWNER. In the case, existing concrete capping has been damaged (i.e. cracks), damaged capping shall be removed and replace according to specifications.
24	Saw Cut Asphaltic Pavement	All cuts shall be one foot (1') outside trench width.
25	Saw Cut Concrete Pavement	All cuts shall be one foot (1') outside trench width.
26	Trench Safety	See Technical Specification 5.4 Submit to the OWNER a Trench Safety System Plan sealed by a registered Professional Engineer licensed in the State of Texas. Implement and maintain the provisions provided in plan throughout the duration of the contract.
27	Paint Fire Hydrants	See Technical Specification 5.38 ***No permits/work orders will be issued for this bid item in the 2015-2016 Utility Trench Repair Contract.***
28	Install New Fire Hydrant Assembly	See Technical Specification 5.13 & See Drawing W-FHI
29	Adjusting Manhole to Grade	See Drawing W-SA-MH-A or Drawing W-SA-MH-B OWNER will provide location where manhole lid is not flush with pavement/ground surface. CONTRACTOR is responsible for removing ring and lid and adjusting the existing ring and lid to grade. CONTRACTOR shall provide adjustment rings. Bricks are not allowed to be used as adjustment rings. Excavation and finished paving will be paid in accordance with corresponding bid items. All casting frames shall be set true to line and grade, firmly positioned, and grouted in place with mortar as shown on the plans. The thickness of the mortar from the outside of the frame shall be a minimum of 1'. The mortar shall be kept moist for a minimum period of forty-eight (48) hours. Mortar that does not bond properly with the adjustment rings shall be removed and replaced, and prior to acceptance, the adjustment rings, mortar, and frame must form one structural unit. In the case the existing manhole ring and lid are unable to be reused, the OWNER will provide CONTRACTOR with a new a new ring and lid at no cost to the CONTRACTOR. The CONTRACTOR shall install the new ring and lid at no extra cost to the OWNER.

30	Adjusting Cleanout to Grade	See Drawing W-SA-CO OWNER will provide location where cleanout cover is not flush with pavement/ground surface. CONTRACTOR is responsible for removing cleanout casting (boot), providing a new cleanout casting (boot), and installing new cleanout to be flush with final grade. The casting for cleanouts shall be set in concrete in accordance with the details shown on the plans to line and grade as staked. Concrete works shall be considered as a part of this bid item. Excavation and final paving will be paid in accordance with corresponding bid items.
31	Adjusting Valve Stand to Grade	OWNER will provide location where valve stand is not flush with pavement/ground surface. CONTRACTOR is responsible for removing valve stand and adjusting existing valve stand to grade. Valve and valve stand shall be set plumb. Each valve stand shall be placed directly over the valve it serves, with the top of the box brought flush with the finished grade. After being placed in proper position, base shall be filled in around each valve box and thoroughly tamped on each side of the box. Concrete box shall be installed as detailed in Bid Item 14. Concrete box, excavation and finished paving will be paid in accordance with corresponding bid items. In the case the existing valve stand is unable to be reused, the OWNER will provide CONTRACTOR with a new a new valve stand at no cost to the CONTRACTOR. The CONTRACTOR shall install the new valve stand at no extra cost to the OWNER.
32	1” Water Service Tap on 8” Water Main	See Technical Specification 5.1, See Technical Specification 5.14 & See Drawing W-SL-1 CONTRACTOR is responsible for providing the service saddle, 1” brass corporation stop, 1” copper pipe, and 1” X 1 ¼” swivel angel stop and installing the items according to the plans. Service shall be marked on the curb and by a cedar post. OWNER will be responsible for installing meter box and meter. Excavation, backfilling, and final paving will be paid in accordance with corresponding bid items.
33	4” Sewer Service Tap on 8” Sewer Main	See Technical Specification 5.27 & See Drawing W-SA-SL-1 CONTRACTOR is responsible for providing the service tee or service saddle encased in 6” of concrete, 4” schedule 40 PVC piping and fittings and installing the items according to the plans. Service shall be marked on the curb and by a cedar post. CONTRACTOR is also responsible for connecting the sewer service to the customer’s service line. Excavation, backfilling, and final paving will be paid in accordance with corresponding bid items.

34	8” Water Main Extension	See Technical Specification 5.1 OWNER will provide plans for work. Bid item shall include two tie-ins (one on each end of the extension and shall be eight inch (8”) tap saddles, tap valves, and wet taps), all materials, and the cost to lay pipe according to the plans. Excavation, bedding, backfill, services, fire hydrants, and final paving will be paid in accordance with corresponding bid items. All extensions under this bid item will be a minimum of 100’ and a maximum of 500’.
35	8” Gravity Sewer Main Extension	See Technical Specification 5.35 & See Technical Specification 5.28 for Testing OWNER will provide plans for work. Bid item shall include a tie-in to a manhole, installation of a clean-out at the end of the line, all materials, and the cost to lay pipe according to the plans. Excavation, bedding, backfill, services, manhole installation, and final paving will be paid in accordance with corresponding bid items. All extensions under this bid item will be a minimum of 100’ and a maximum of 500’.The maximum depth of the flowline for the new sewer main extension will be 6’.
36	Manhole Installation (0’ – 5’)	See Technical Specification 5.25 for Type A See Technical Specification 5.26 for Type B See Technical Specification 5.28 for Testing See Drawing W-SA-MH-A See Drawing W-SA-MH-B CONTRACTOR shall furnish all materials needed for manhole installation. Excavation and final paving will be paid in accordance with corresponding bid items.
37	Manhole Installation (5’ – 10’)	See Technical Specification 5.25 for Type A See Technical Specification 5.26 for Type B See Technical Specification 5.28 for Testing See Drawing W-SA-MH-A See Drawing W-SA-MH-B CONTRACTOR shall furnish all materials needed for manhole installation. Excavation and final paving will be paid in accordance with corresponding bid items.

5.1 - General Notes

5.1.2 Implementation and maintenance of trench protection according to OSHA regulations is the CONTRACTOR's responsibility.

5.1.3 It shall be the CONTRACTOR's responsibility to familiarize himself/herself with the location of controlling water valves in an area prior to commencing construction in that area.

5.1.4 Where unpaved driveways are disturbed by construction operations, CONTRACTOR shall back-slope, grade and surface with a minimum of six inches (6") (unless existing base material is thicker) of base material to the right-of-way line as necessary to restore to original or better condition.

5.1.5 Where paved driveways are disturbed by construction operations, CONTRACTOR shall repair in accordance with the City of San Angelo specifications.

5.1.6 The CONTRACTOR shall minimize any dust problems by sprinkling and/or sweeping as directed by the OWNER. Pay is subsidiary to the various bid items. After completing installation and pavement repair of each portion of the project, CONTRACTOR shall thoroughly sweep and clean up all dirt, material and debris from the street.

5.1.7 Wet connections occurring during utility line installation will not be paid for but are considered subsidiary to the item being constructed.

5.1.8 Wet taps of existing water lines will be by the CONTRACTOR. The CONTRACTOR shall perform all excavation and supply and install all tapping saddles, valves and other materials. Wet taps will be paid at the quote provided by the CONTRACTOR in the bid form. Connections to existing lines not itemized on the bid form will be subsidiary to line installation.

5.1.9 The CONTRACTOR will restore all disturbed areas, drives, yards, etc. to original or better condition as approved by the OWNER.

5.1.10 Bacteriological testing will be the responsibility of the CONTRACTOR. The CONTRACTOR shall select a lab that is certified with the Texas Commission of Environmental Quality for Bacteriological analysis and submit for OWNER acceptance. The CONTRACTOR will have the accepted lab collect the field samples in the presence of the OWNER, and have analytical results faxed to the OWNER at 325-655-6397.

5.1.11 Flushing of Mains/Test Water: All water flushed from a main shall be contained and not allowed to discharge onto the ground unless specifically authorized by the OWNER. The CONTRACTOR may discharge water into a City of San Angelo owned sewer manhole with the OWNER's approval and only at such flow rates as allowed by the OWNER. Any discharge or disposal of water shall be in compliance with all State and Federal regulations.

5.1.12 For all valves installed under this contract, the CONTRACTOR shall etch valve locations (direction and distance) into curb and gutter. All lettering and numbering shall be a minimum of three inches (3") in height.

5.1.13 All process control operations including but not limited to operating isolation valves, disinfecting mains, turning on/off customer service valves, and taking chlorine residuals and microbiological samples must be under the direct supervision of a person with a Class D water license or higher. The CONTRACTOR is responsible for providing individuals with these classifications for supervision of the work. The CONTRACTOR must submit a list of licensed individuals to the OWNER for approval before any work may be performed on the OWNER's distribution system.

5.1.14 On-Site Storage of Materials: The CONTRACTOR must have the OWNER's approval for on-site storage of materials. Stored materials shall not obstruct the flow of stormwater, vision of vehicle operations, or cause damage to personal or public property. Storage areas shall be kept neat and clean.

5.1.15 City of San Angelo Owned Materials: The CONTRACTOR shall provide all materials to complete the project. The OWNER will not provide materials to the CONTRACTOR unless otherwise specified.

5.1.17 All Concrete shall be 3,000 psi minimum at twenty-eight (28) days unless otherwise specified.

5.1.21 Some or all water meters may contain Automatic Meter Readers (AMR). An AMR consists of a meter body, register, M.I.U. box, antenna, and associated wiring. CONTRACTOR shall be trained by the OWNER (City of San Angelo Staff) prior to working on or around any meter boxes. Antenna wiring may be disconnected from M.I.U. boxes but must be reconnected according to the manufactures requirements. OWNER will provide wire connectors. The CONTRACTOR is responsible for any damages to an AMR. If an AMR is damaged, the CONTRACTOR shall pay $220.00 per each unit damaged to cover replacement and labor. All damaged AMRs shall be reported immediately to the OWNER.

5.1.22 Completed permits shall be submitted to OWNER's inspector as they are completed. CONTRACTOR shall not hold completed permits for processing until the end of the month, but rather turn them in daily as they are completed.

5.2 - Temporary Facilities

5.2.0 General

5.2.1 Office at Site of Work

During the performance of this contract, the CONTRACTOR shall maintain a suitable office at or near the site of the Work which shall be the headquarters of his representative authorized to receive drawings, instructions, or other communication or articles. Any communication given to the representative or delivered at the CONTRACTOR'S office at the site of the Work in his absence shall be deemed to have been delivered to the CONTRACTOR. The site office or any other facility at the site shall not be used as a residence.

Copies of the Plans, Specifications, and other Contract Documents shall be kept at the CONTRACTOR'S office at the site of the Work and available for use at all times.

5.2.2 Water

Water in reasonable amounts for proper completion of the Work will be furnished by the OWNER without charge to the CONTRACTOR. The CONTRACTOR shall furnish necessary temporary pipe, hose, nozzles, and tools and shall perform all necessary labor required to connect to existing water facilities. Unnecessary waste of water will not be tolerated. Special hydrant wrenches shall be used for opening and closing fire hydrants. In no case shall pipe wrenches be used for this purpose.

An account of all water usage will be required. CONTRACTOR is required to keep track of water usage during flushing of mains and filling of water trucks. Fire hydrant meters will require a deposit of $1,000.00, $15 permit fee, and a $40 fire hydrant wrench fee. The deposit, permit and wrench fee must be paid at the Utility Billing office. There will be a $20.00 connect fee to set a meter at each location requested. Truck or fill stand meters installed by the customer will also require the $20.00 connect fee. Meters and gate valves installed on fire hydrants will be secured to the hydrant and ONLY MOVED AND/OR REMOVED BY CITY PERSONNEL. Locations of truck or fill stand meters must be furnished to the Utility Billing office for reading purposes. If the meter cannot be located, a minimum amount of $200.00 will be charged each month until the meter is located. The license plate number of the truck to which a meter is installed on must be given to the Utility Billing office before a meter is issued. Utility Billing must be informed within three (3) business days if meter is transferred to another vehicle. All fire hydrant, truck and fill stand meters that are used for one (1) year must be returned to the Water Distribution office for testing. The CONTRACTOR will be responsible for loss or damage for each meter they are issued. No deposits will be refunded until the meter is returned and checked for damages. Any repairs made to returned meters will be deducted from the deposit. CONTRACTOR will be responsible for any damage to fire hydrant if failing to use proper fire hydrant tool when turning the hydrant on or off.

5.2.3 Power

The CONTRACTOR shall provide all power for heating, lighting, operation of the CONTRACTOR'S plant or equipment, or for any other use by the CONTRACTOR. Temporary heat and lighting shall be maintained until the Work is accepted.

5.2.4 Telephone Service

The CONTRACTOR shall make all necessary arrangements and pay all installation charges for telephone lines in his office at the site and shall provide all telephone instruments.

5.2.5 Sanitary Facilities

The CONTRACTOR shall furnish temporary sanitary facilities at the site, as provided herein, for the needs of all construction workers and other performing work or furnishing services on the Project.

Sanitary facilities shall be of reasonable capacity, properly maintained throughout the construction period, and obscured from public view to the greatest practical extent. Number of facilities shall be in accordance with federal, state, and local requirements. The CONTRACTOR shall enforce the use of such sanitary facilities by all personnel at the site.

5.2.6 Maintenance of Traffic

The CONTRACTOR shall conduct his work to interfere as little as possible with public travel, whether vehicular or pedestrian. Whenever it is necessary to cross, obstruct, or close roads, driveways, and walks, whether public or private, the CONTRACTOR shall provide and maintain suitable and safe detours or other temporary expedients for the accommodation of public and private travel, and shall give reasonable notice to owners of private drives before interfering with them.

5.2.7 Fences

All existing fences affected by the Work shall be maintained by the CONTRACTOR until completion of the Work. Fences which interfere with construction operations shall not be relocated or dismantled until written permission is obtained from the owner of the fence, and the period the fence may be left relocated or dismantled has been agreed upon. The CONTRACTOR shall restore all fences to their original or better condition.

5.2.8 Damage to Existing Property

The CONTRACTOR will be held responsible for any damage to existing structures, Work, materials, or equipment because of his operations and shall repair or replace any damaged structures, Work, materials, or equipment to the satisfaction of, and at no additional cost to the OWNER.

The CONTRACTOR shall protect all existing facilities and property from damage and shall provide bracing, shoring, or other work necessary for such protection.

The CONTRACTOR shall be responsible for all damage to streets, curbs, sidewalks, highways, shoulders, ditches, embankments, culverts, bridges, or other public or private property, which

may be caused by transporting equipment, materials, or men to or from the Work. The CONTRACTOR shall make satisfactory and acceptable arrangements with the agency having jurisdiction over the damaged property concerning its repair or replacement.

5.2.9 Security

The CONTRACTOR shall be responsible for protection of the site, and all Work, materials, equipment, and existing facilities thereon, against vandals and other unauthorized persons.

5.2.10 Access Roads

The CONTRACTOR shall establish and maintain temporary access roads to various parts of the site as required to complete the Project. Such roads shall be available for the use of all others performing work or furnishing services in connection with the Project.

5.2.11 Parking

The CONTRACTOR shall provide and maintain suitable parking areas for the use of all construction workers and others performing work or furnishing services in connection with the Project, as required to avoid any need for parking personal vehicles where they may interfere with public traffic or construction activities.

5.2.12 Noise Control

The CONTRACTOR shall take reasonable measures to avoid unnecessary noise. Such measures shall be appropriate for the normal ambient sound levels in the area during working hours. All construction machinery and vehicles shall be equipped with practical sound muffling devices, and operated in a manner to cause the least noise consistent with efficient performance of the Work.

5.2.13 Dust Control

The CONTRACTOR shall take reasonable measures to prevent unnecessary dust. The CONTRACTOR shall limit dust generation by clearing only those areas where immediate activity will take place, leaving the remaining area(s) in the original condition, if stable. Maintain the original cover as long as practicable. Earth surfaces subject to dusting shall be kept moist with water or by application of a chemical dust suppressant and repeat as needed. Water shall be furnished by the CONTRACTOR and shall be clean and free from industrial wastes and other objectionable matter. Do not apply water in quantities to cause runoff. Dusty materials in piles or in transit shall be covered when practicable to prevent blowing.

5.2.14 Temporary Drainage Provisions

The CONTRACTOR shall provide for the drainage of storm water and such water as may be applied or discharged on the site in performance of the Work. Drainage facilities shall be adequate to prevent damage to the Work, the site, and adjacent property.

Existing drainage channels and conduits shall be cleaned, enlarged or supplemented as necessary to carry all increased runoff attributable to the CONTRACTOR'S operations. Dikes shall be constructed as necessary to divert increased runoff from entering adjacent property (except in natural channels), to protect the OWNER'S facilities and the Work, and to direct

water to drainage channels or conduits. Ponding shall be provided as necessary to prevent downstream flooding.

5.2.15 Pollution Control

The CONTRACTOR shall prevent the pollution of drains and watercourses by sanitary wastes, sediment, debris and other substances resulting from construction activities. No sanitary wastes will be permitted to enter any drain or watercourse other than sanitary sewers. No sediment, debris or other substance will be permitted to enter sanitary sewers and reasonable measures shall be taken to prevent such materials from entering any drain or watercourse.

5.2.16 Erosion and Siltation Controls

The CONTRACTOR shall be responsible for complying with all applicable Local, State and Federal regulations concerning Erosion and Sediment Control. If required, the CONTRACTOR shall prepare and submit all required documentation, including but not limited to, "Notice of Intent" (NOI), "Notice of Termination" (NOT), and "Notice of Change" (NOC). The CONTRACTOR shall prepare and comply with the Storm Water Pollution Prevention Plan and Storm Water Management Plan. The plans shall be prepared by a Professional Engineer, Registered in the State of Texas, and show all necessary control measures in detail to effectively control erosion and sediment. Plans shall be submitted to the OWNER. The CONTRACTOR shall be responsible for all fees associated with the Permit.

The inspection and maintenance of the erosion prevention measures shall be the contractor's responsibility throughout all phases of the construction. All erosion control measures shall be in place prior to any construction activities. They shall remain in place until after construction is complete and the site has been stabilized.

The CONTRACTOR shall provide silt fencing and or erosion control blankets appropriate for erosion and siltation control, and shall maintain all such systems in effective operating condition throughout the entire construction process.

5.3 - Excavation and Backfill

5.3.0 General

5.3.0.1 Scope

This section covers excavation 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; construction of fills and embankments; surfacing and grading pavement replacement, concrete blocking; and other appurtenant work. Excavation shall provide adequate working space and clearances for the work to be performed therein.

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

Backfilling and construction of fills and embankments during freezing weather shall not be done except by permission of the OWNER. 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.

5.3.1 Classification of Excavated Materials

All excavation shall be classified as either common excavation or rock excavation. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work.

5.3.1.1 Common Excavation

Common excavation is defined as the removal of all material which is not classified as rock excavation.

5.3.1.2 Rock Excavation

Rock excavation is defined as the removal of all materials which, by actual demonstration, cannot in the OWNER's opinion, be reasonable excavated with a ¾ yard 336 Caterpillar Excavator equipped with a thirty feet (30') boom, heavy duty rock ripping bucket, or similar approved equipment.

The OWNER reserves the right to waive the demonstration of the material encountered as well defined rock. The term "rock excavation" shall be understood to indicate a method of removal and not a geological material. In addition, rock excavation may include removal of well-defined rock by the method of mechanical splitting. In the areas where rock removal is required, Technical Specification 5.43, "Vibration Monitoring Specification," shall be followed.

No payment will be made under "Rock Excavation" for any method of rock removal other than mechanical splitting. Measurement shall be the depth per linear foot. The depth is the difference in elevation between the theoretical bottom of bedding and the top of the original rock. The length or linear foot will be measured horizontally along the centerline of the trench.

5.3.2 Site Preparation

All areas of the site to be occupied by permanent construction or embankments shall be cleared of all trees, roots, brush, and other objectionable materials and debris. All stumps shall be grubbed. Subgrades for fills and embankments shall be cleaned and stripped of all surface vegetation, sod, and surface soils All waste materials shall be removed from the site and disposed of by and at the expense of the CONTRACTOR. Suitable surface soils shall be stockpiled on the site and used for final site grading. Excess surface soils, as determined by the OWNER, shall be removed at the CONTRACTOR`S expense.

5.3.3 Blasting

Blasting or other use of explosives for excavation will not be permitted without the consent of the OWNER.

5.3.4 Unauthorized Excavation

Except where otherwise authorized, shown, or specified, all materials 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. Excess excavation of trenches shall be refilled with material approved by the OWNER.

5.3.5 Dewatering

Dewatering equipment shall be provided 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 ground water shall be dewatered by lowering and keeping the ground water level beneath such excavations twelve inches (12") or more.

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 shall be responsible for the condition of any pipe or conduit which may be used for drainage purposes, and all such pipe or conduit shall be left clean and free of sediment.

All dewatering activities shall be in compliance with the Texas Commission on Environmental Quality (TCEQ) rules and guidelines, i.e. limit erosion, sediment disposal and permitting. All dewatering shall also be in compliance with Technical Specification 5.2.14, "Temporary

Drainage Provisions," and Technical Specification 5.2.15, "Pollution Control." of this project specification manual.

5.3.6 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 shall be reinforced with crushed rock or gravel. The stabilizing material shall be spread and compacted to a depth of not more than four inches (4"). If the required depth exceeds four inches (4"), the material shall be spread and compacted by vibration. The finished elevation of stabilized subgrades shall not be above subgrade elevations indicated on the Plans.

5.3.7 Earth Fills and Embankments

Fills and embankments shall be constructed to lines and grades indicated on the Plans.

All material placed in fills and embankments shall be free from rocks or stones larger than four inches (4") in their greatest dimension, brush, stumps, roots, debris, and organic or other deleterious materials and shall be approved by the OWNER.

No rocks or stones shall be placed in the upper eighteen inches (18") of any fill or embankment. Rocks or stones within the allowable size limit may be incorporated in the remainder of fills and embankments provided they are distributed so that they do not interfere with proper compaction.

5.3.8 Subgrade Preparation

After preparation of the fill or embankment site, the areas of the subgrade shall be leveled and compacted to ninety-five percent (95%) of modified proctor density as determined by ASTM D1557 at optimum moisture content.

5.3.9 Placement and Compaction

All fill and embankment materials shall be placed in approximately horizontal layers not to exceed eight inches (8") in compacted thickness. Material deposited in piles or windows by excavating and hauling equipment shall be spread and leveled before compaction.

Each layer of material shall have the best practicable moisture content for satisfactory compaction. The material in each layer shall be wetted or dried as required and thoroughly mixed to ensure uniform moisture content and adequate compaction. Each layer shall be thoroughly compacted to ninety-five percent (95%) of modified proctor density at optimum moisture content as determined by ASTM D1557. If the material fails to meet the density specified, compaction methods shall be altered.

Wherever a trench is to pass through a fill or embankment, the fill or embankment material shall be placed and compacted to an elevation not less than twelve inches (12”) or more than eighteen inches (18”) above the top of pipe elevation before the trench is excavated.

5.3.10 Granular Fills

Granular fills shall be provided where required. Granular fills shall be placed on suitably prepared subgrades and compacted by vibration. Granular fill material shall be pea gravel, well graded and clean, 2-inch to No.4, meeting all requirements of ASTM C33. Crushed limestone will not be permitted. Granular fill shall be compacted to eighty percent (80%) relative density as determined by ASTM 2049.

5.3.11 Unsuitable Foundation Material

Soft, loose, or otherwise unsuitable foundation soils that occur shall be excavated and removed to the limits designated by the OWNER and replaced with compacted backfill. The compacted backfill shall comply with the requirements specified.

5.3.12 Trench Excavation

Trenches shall be excavated so that pipes can be laid straight at uniform grade, without dips or humps. All fill material shall be in compliance with the utility trench repair details shown in the Plans.

5.3.13 Minimum Cover

Where pipe grades or elevations are not definitely fixed by the contract Plans, trenches shall be excavated to a depth sufficient to provide a minimum depth of thirty inches (30”) of backfill cover over the top of the pipe, including coupling or bells. In areas where thirty inches (30”) of cover is unachievable, a concrete cap must be installed as specified by the drawing W-CC-W.

5.3.14 Limiting Trench Widths

Trenches shall be excavated to a width which will provide adequate working space and sidewall clearances for proper pipe installation, jointing, and embedment. Trench widths from the bottom of the trench to an elevation one-foot above the top of the installed pipe shall be as follows:

Nominal Pipe Size	Minimum Trench Width	Max. Trench width
<=16"	Pipe OD plus 12"	Pipe OD plus 18"
>16"	As specified by pipe manufacturer and approved by the OWNER	

5.3.15 Compacted Backfill

Compacted backfill will be required for the full depth of the trench above the embedment in all locations.

Compacted backfill shall be placed in eight inch (8") compacted thick layers and compacted at optimum moisture content to ninety-five percent (95%) modified proctor density as determined by ASTM D1557. Where the trench for one pipe passes beneath the trench for another pipe, backfill for the lower trench shall be compacted to the level of the bottom of the upper trench.

The CONTRACTOR shall be responsible for providing all proctor data from all source pits used to be approved by the OWNER. The OWNER reserves the right to conduct density tests at any time, at the OWNER's expense.

Where well pulverized or granular material is available from the trench excavation, which meets the approval of the OWNER for Backfill, the CONTRACTOR will be allowed to use the approved material from the excavation for Backfill behind the curb only as instructed by the OWNER.

5.3.16 Structure Backfill

The quality and moisture content of materials for backfill around and outside of structures shall conform to the requirements for materials used for trench backfill. Backfill materials shall be deposited in layers not to exceed eight inches (8") in compacted thickness and compacted to at least ninety-five percent (95%) of modified proctor density at optimum moisture content as determined by ASTM D1557. Compaction of structure backfill by rolling will be permitted provided the desired compaction is obtained and damage to the structure is prevented. Water jetting of structural backfill shall be allowed only upon permission of the OWNER.

No backfill shall be deposited or compacted in water. Particular care shall be taken to compact structure backfill which will be beneath pipes, surface construction, or structures. In addition, wherever a trench is to pass through structure backfill, the structure backfill shall be placed and compacted to an elevation not less than twelve inches (12") above the top of pipe elevation before the trench is excavated. Compacted areas, in each case, shall be adequate to support the item to be constructed or placed thereon.

5.3.17 Final Grading and Placement of Topsoil

After other outside work has been finished, and backfilling and embankments completed and settled, all areas which are to be graded shall be brought to grade at the indicated elevations, slopes, and contours. All cuts, fills, embankments, and other areas which have been disturbed or damaged by construction operations shall be surfaced with topsoil to a depth of at least four inches (4"). Topsoil may consist of the surface soils cleared from the site during site preparation and shall be of a quality at least equal to the existing topsoil in adjacent areas, free from trash, stones, and debris, and well suited to support plant growth.

Use of graders or other power equipment will be permitted for final grading and dressing of slopes, provided the result is uniform and equivalent to hand work. Unless otherwise indicated, a slope of at least one percent shall be provided.

Final grading and surfacing shall be smooth, even, and free from clods and stones larger than one-inch in greatest dimension, weeds, brush, and other debris.

5.3.18 Disposal of Excess Excavated Materials

Insofar as needed, suitable excavated materials shall be used. All excess excavated materials together with all debris stones, stumps, and roots shall be removed from the site and disposed of by, and at the expense of, the CONTRACTOR. Excess material or material which cannot be made suitable for use in embankments will be declared surplus and shall become the property

of the CONTRACTOR to dispose of offsite at a permitted fill site, without liability to the OWNER or any individual. Such surplus material shall be removed from the Work site promptly following the completion of the portion of the utility involved.

5.3.19 Shoring and Sheathing of Excavations

Wherever necessary to prevent caving, excavation shall be adequately sheeted and braced. Where sheeting and bracing are used, the trench width shall be increased accordingly. Trench sheeting shall remain in place until the pipe has been laid, checked for defects and repaired if necessary and the trench backfilled to a depth of two feet (2') over the top of the pipe. The CONTRACTOR shall comply with all local, state and federal requirements for sheeting and shoring.

5.3.20 Settlement

The CONTRACTOR shall be responsible for all settlement of backfill, fills, and embankments which may occur within the correction period stipulated in the General Conditions.

The CONTRACTOR shall make, or cause to be made, all repairs or replacements made necessary by settlement within thirty (30) days after notice from the OWNER.

5.3.21 Pavement Replacement

Pavement surface, concrete, caliche, limestone, or asphaltic, replacement shall be done by the CONTRACTOR at his expense as indicated on the Plans.

5.3.22 Concrete Blocking

Concrete blocking shall be placed at bends, tees, wyes, crosses, plugs, hydrants, etc., in the water line. The concrete blocking shall be placed so as to rest against firm undisturbed trench walls. The supporting area for each block shall be sufficient to withstand the thrust, including water hammer. Each block, except those for upward thrusts, shall rest on a firm, undisturbed foundation of trench bottom. Where upward thrusts are to be blocked, the concrete blocking shall be of sufficient weight to resist the thrust and the concrete shall be reinforced as directed by the OWNER. Blocking shall not extend beyond any joints, cover any bolted connections or in any way restrict or inhibit the access to or workability of any component of the water line.

5.3.23 Measurement and Payment

Measurement and payment for this item will be based on the unit price bid. Depending on the type of excavation used, Bid Item 1, 5, or 12 will be used.

5.4 - Trench Safety Systems

5.4.0 General

5.4.0.1 Scope

This section shall govern for designing, furnishing, installing, maintaining and removal of Trench Safety Systems for trench excavation. Back-sloping and/or benching of the trench are not acceptable means of trench protection in roadways unless prior approval is obtained from the OWNER.

At a minimum, this work shall conform to the United States Department of Labor Rules 29 CFR, Part 1926 Occupational Safety and Health Administration (OSHA). The Competent Person(s) shall be on the project whenever workers are in an excavation trench.

Attention is called to the fact that excavations may contain potentially harmful environments or atmospheres. If working on or around the sanitary sewer system it has the capability of producing an environment that may be harmful to workers. The CONTRACTOR shall provide workers with personal protective equipment as necessary to provide adequate protection. The CONTRACTOR shall provide equipment to determine if a hazardous atmosphere exists prior to allowing workers to enter any areas that may contain a potentially harmful environment. The equipment shall be kept calibrated, maintained in good condition and all maintenance and calibration records kept on site for inspection.

At a minimum, the CONTRACTOR shall monitor and record atmosphere testing results for oxygen levels and the presence of combustible gases. These measurements should be made before lids are removed and shall be measured at various depths including the workspace. Testing shall continue as long as workers are present in the area.

5.4.1 Trench Safety System Plan Submittal

Prior to, or at the Pre-Construction Meeting, the CONTRACTOR shall submit to the OWNER a Trench Safety System Plan sealed by a registered Professional Engineer licensed in the State of Texas. The Trench Safety System Plan at a minimum shall conform to OSHA standards for sloping sides, utilization of trench boxes, and/or utilization of shoring, sheeting and bracing methods. The CONTRACTOR shall be responsible for obtaining all information necessary for the design of the Trench Safety System Plan. The Trench Safety System Plan submittal shall include:

a) A drawing or plan indicating specific designation of areas in which each type of system will be used, including length of trench to be opened, the length of time that trench will remain open, the means of egress, the storage of materials, allowable loads of trench walls, the methods for placing/compacting bedding/backfill within the safety system, any equipment restrictions and the subsequent removal of system,
b) Drawings or manufacturer's data, as applicable, that describes the various elements of the Trench Safety System in sufficient detail that the workers can properly install the Trench Safety System,

c) Recommendations and limitations for using systems.
d) Certification of Completion of an OSHA-approved program indicating that the CONTRACTOR's Competent Person(s) has received training in "Excavation Safety".

5.4.2 Construction

The CONTRACTOR's Competent Person(s) shall be responsible for the maintenance of a copy of appropriate OSHA regulations onsite and the implementation of OSHA trenching safety regulations at the work site. Trenching shall be completed to the lines and grades indicated on the Plans or as specified in various technical standard specification items requiring excavation and trenching and/or backfilling. The CONTRACTOR shall perform all trenching in a safe manner and shall maintain safety systems to prevent death or injury to personnel or damage to structures, utilities or property in or near the excavation.

If evidence of possible cave-ins or earthen slides is apparent or an installed trench safety system is damaged, the work in the trench shall immediately cease and personnel evacuated from the area. Personnel shall not be allowed to re-enter the excavation until necessary repairs or replacements are completed and are inspected and approved by the CONTRACTOR's Competent Person(s). Repair and/or replacement of the damaged safety system shall be at the CONTRACTOR's sole expense.

5.4.3 Changed Conditions

When changed conditions require modifications to the Trench Safety System, the CONTRACTOR shall provide to the OWNER a new design or an alternative Trench Safety System that is proposed by the CONTRACTOR's Trench Safety Engineer to address the changed conditions encountered. Copies of the new design or alternate system shall be provided to the OWNER in accordance with the requirements of Technical Specification 5.4.1, "Trench Safety System Plan Submittal". A copy of the most current Trench Safety System shall be maintained on site and made available to inspection and enforcement officials at all times.

Any changes to the Trench Safety System Plan that are initiated by the CONTRACTOR for operational efficiency or as a result of changed conditions will not be cause for cost adjustment.

5.4.4 Contractor's Responsibility

The CONTRACTOR has sole and exclusive responsibility for the sufficiency of the trench excavation safety systems utilized conforming fully to all State and Federal laws applicable inclusive of the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) on excavation, trenching and shoring, which includes, but is not limited to, Subpart P, Part 1926, of the Code of Federal Regulations.

The CONTRACTOR shall specifically agree that neither the OWNER nor the Engineer nor any representative has such responsibility, and CONTRACTOR will not rely on the OWNER or the Engineer or any of their representatives for inspection, design, supervision, construction or any other aspect of trench excavation safety protection.

5.4.5 Measurement

Trench Excavation Protection shall be measured by the linear foot along the centerline of the trench.

5.4.6 Payment

All development, design, furnishing, installing the system, for dewatering, maintenance, replacement and removal of the Trench Safety Systems, for sloping, special clearing, excavation and work including material, plans and reports required to safely implement the trench safety system will be paid at the price bid and the units specified in the Bid Agreement Form for Trench Safety.

5.6 - Flexible Base (Backfill of Paved Areas)

5.6.0 General

5.6.0.1 Scope

The work covered by this section includes all necessary operations and materials involved with placing a flexible base or foundation course for surface course or other base courses and for pipe backfill zones. The flexible base shall be composed of crusher-run broken stone; and shall be constructed as herein specified in one or more courses in conformity with the typical sections shown on the Plans and to the lines and grades as established by the OWNER.

5.6.1 Material

5.6.1.1 Source

The material source shall be approved by the OWNER.

5.6.1.2 Crushed Stone

The material shall be crushed and shall consist of durable particles of stone mixed with approved binding material. Material shall meet all the provisions of Item 247, TxDOT specifications and shall be Type A, Grade 2. It shall consist of crushed limestone with the following physical requirements:

Grading Requirements		
Percent Retained		
1-3/4	**No. 4**	**No. 40**
0-10	45-75	60-85
Atterberg Limits		
LL	**PI**	
40 Maximum	12 Maximum	

5.6.2 Construction Methods

5.6.2.1 Preparation of Subgrade

The roadbed shall be excavated and shaped in conformity with the typical sections and to the lines and grades as established by the OWNER. All excess base material, sacrificial backfill and/or unstable or otherwise objectionable material shall be removed from the subgrade and replaced with approved material. All holes, ruts, and depressions shall be filled with approved material, and if required, the subgrade shall be thoroughly wetted with water and reshaped and rolled to the extent directed in order to place the subgrade in an acceptable condition to receive the base material. Subgrade shall be compacted to a minimum depth of eight inches (8") and a minimum ninety-five percent (95%) of Modified Proctor density at ± 2 percentage points optimum moisture content.

5.6.2.2 Compaction

Flexible base material shall be placed in uniform horizontal layers and compacted by mechanical means to a minimum of 95% Modified Proctor density at ± 2 percentage points optimum moisture content.

5.6.3 Measurement and Payment

Flexible Base will be measured per each cubic foot of material placed. The materials furnished in accordance with the Item and measured will be paid for at the unit price bid for “Provide Flexible Base for Backfill”. The work performed in accordance with the Item and measured will be paid for at the unit price bid for “Placement and Compaction of Trench Backfill”.

5.7 - Asphaltic Concrete Pavement

5.7.0 General

5.7.0.1 Scope

The work covered by this section includes the placement of a surface course composed of a compacted mixture of mineral aggregate and asphaltic material. The pavement shall be constructed on the previously approved flexible base or concrete cap. For trench repairs greater than sixty inches (60") wide asphalt shall be placed using a lay down machine.

5.7.1 Material

5.7.1.1 Prime Coat

The prime coat shall be of TXDOT MC-30 asphalt applied at the rate of 0.25 - 0.35-gallon per square yard of surface, unless otherwise approved by the OWNER.

5.7.1.2 Tack Coat

The tack coat shall be asphaltic materials approved by the OWNER and shall meet the requirements of TXDOT Item 300, "Asphalts, Oils, and Emulsions."

5.7.1.3 Asphalt Concrete Material

The asphaltic concrete surface coat material shall be of TXDOT Type D hot mix asphaltic concrete or hot mix - cold laid asphaltic concrete as approved by the OWNER.

5.7.2 Equipment and Machinery

5.7.2.1 General

It shall be the responsibility of the CONTRACTOR to assure that all equipment and machinery are of a type approved by the OWNER. Equipment shall include the spreading and finishing machine, motor grader, trench roller, and vibratory steel wheel roller.

Alternate equipment which will consistently produce satisfactory results and may be used only if written permission is obtained from the OWNER.

5.7.3 Inspection

5.7.3.1 General

It will be the CONTRACTOR's responsibility to provide safe and accurate means to enable inspection forces to take all required samples and to provide permanent means for checking the output of any specified metering device and to perform these calibration checks as required by the OWNER.

5.7.4 Construction Methods

5.7.4.1 General

It shall be the responsibility of the CONTRACTOR to produce, transport, place, and compact the specified paving mixture in accordance with these specifications and without delay to the lay-down operation.

If, after being discharged from the mixer and prior to placing, the temperature of the asphaltic mixture is fifty degrees (50ºF) or more below the temperature established by the OWNER, all or any part of the load may be rejected and payment will not be made for the rejected material.

5.7.4.2 Method A - Hot Mix Asphaltic Concrete Pavement

Place as follows:

a) Site Preparation:
All excavation and backfill shall be complete as otherwise specified in this contract. Sacrificial backfill and existing material, paving, etc. shall be removed to the extents defined in the trench repair detail. Sacrificial backfill shall be removed such that the resulting surface is smooth and uniform. All high areas shall be cut to the desired depth and all low areas shall be filled with processed flexible base and compacted. Once the sacrificial backfill has been removed the surface shall be compacted with a vibratory steel wheel roller (minimum 1-1/2 tons) to provide a smooth, uniform compacted surface. All holes, ruts, depressions and high spots shall be filled with approved materials. After correcting all deficiencies (holes, ruts, depressions, etc) the surface shall be re-compacted until the smooth, uniform surface is achieved. If pavement borders were not previously saw cut, they shall be saw cut providing an area of uniform width and smooth edges for the ultimate placement of the surface course.

b) Prime Coat:
Before the prime coat is applied, the surface upon which the tack coat is to be placed shall be cleaned thoroughly, by sweeping or other approved methods, to the satisfaction of the OWNER. If deemed necessary by the OWNER, the surface shall be lightly sprinkled just prior to application of the asphaltic material. The asphaltic material (prime coat) shall be applied smoothly and evenly on the clean surface by an approved pressure distributor. The CONTRACTOR shall provide all necessary facilities for determining the temperature of the asphaltic material in all of the heating equipment and in the distributor, for determining the rate at which it is applied, and for securing uniformity at the junction of two distributor loads. The prime coat shall be allowed to cure for a period of not less than twenty-four (24) hours.

All storage tanks, piping, retorts, booster tanks, and distributors used in storing or handling asphaltic material shall be kept clean and in good operating condition at all times. They shall be operated in such manner that there will be no contamination of the asphaltic material by foreign material. It shall be the responsibility of the CONTRACTOR to provide and maintain in good working order a recording thermometer at the storage heating unit at all times. The distributor shall have been recently calibrated and the OWNER shall be furnished an accurate and satisfactory record of such calibration. After beginning of the work, should the yield on the

asphaltic material applied appear to be in error, the distributor shall be calibrated in a manner satisfactory to the OWNER before proceeding with the work.

The OWNER will select the temperature of application based on the temperature-viscosity relationship. The recommended range for the viscosity of the asphalt is 100 to 125 centistokes. Hot Mix cannot be produced at more than 300º F. The CONTRACTOR shall apply to roadway before it reaches 260º F.

The CONTRACTOR shall be responsible for the maintenance of the surface until the work is accepted by the OWNER.

No traffic, hauling, or placement of any subsequent courses shall be permitted over the freshly applied prime coat until authorized by the OWNER.

c) Placing:
The surface coat shall be placed in two inch (2") horizontal layers and shall be compacted to ninety percent (90%) of the theoretical density. The OWNER reserves the right to conduct density tests at any time, at the OWNER's expense. The asphaltic mixture shall be dumped and spread on the approved prepared surface in such a manner that when properly compacted, the finished pavement will be smooth, of uniform density, and will meet the requirements of the typical cross-sections and the surface test. During the application of asphaltic material, care shall be taken to prevent splattering of adjacent pavement, curb and gutter, and structures.

Adjacent to flush curbs, gutters, liners, and structures, the surface shall be finished uniformly high so that when compacted it will be slightly above the edge of the curb and flush structure.

Prior to placement of the asphaltic concrete materials, the compacted backfill shall be primed. Where a concrete cap is placed, it shall be allowed to cure for seventy-two (72) hours; then a tack coat shall be applied.

d) Compacting:
The pavement shall be compacted thoroughly and uniformly with the necessary rollers to obtain the density, stability, and the cross section of the finished paving mixture meeting the requirements of the Plans and Technical Specifications and the approval of the OWNER.

All rollers must be in good mechanical condition. Necessary precautions shall be taken to prevent the dropping of gasoline, oil, grease, or other foreign matter on the pavement, either when the rollers are in operation or when standing.

Regardless of the method of compaction control followed, all rolling shall be completed before the mixture temperature drops below 175ºF.

The edges of the pavement along curbs, headers, and similar structures, and all places not accessible to the roller, or in such positions as will not allow thorough compaction with the rollers, shall be thoroughly compacted with lightly oiled tamps.

5.7.4.3 Method B - Hot Mix - Cold Laid Asphaltic Concrete

Place as follows:

a) Site Preparation:
All excavation and backfill shall be complete as otherwise specified in this contract. Sacrificial backfill and existing material, paving, etc. shall be removed to the extents defined in the trench repair detail. Sacrificial backfill shall be removed such that the resulting surface is smooth and uniform. All high areas shall be cut to the desired depth and all low areas shall be filled with processed flexible base and compacted. Once the sacrificial backfill has been removed the surface shall be compacted with a vibratory steel wheel roller (minimum 1-1/2 tons) to provide a smooth, uniform compacted surface. All holes, ruts, depressions and high spots shall be filled with approved materials. After correcting all deficiencies (holes, ruts, depressions, etc) the surface shall be re-compacted until the smooth, uniform surface is achieved. If pavement borders were not previously saw cut, they shall be saw cut providing an area of uniform width and smooth edges for the ultimate placement of the surface course.

b) Tack Coat:
Before the prime coat is applied, the surface upon which the tack coat is to be placed shall be cleaned thoroughly, by sweeping or other approved methods, to the satisfaction of the OWNER. The surface shall be given a uniform application of tack coat using asphaltic materials of this specification. The tack coat shall be applied with an approved sprayer at a rate not to exceed 0.05-gallon residual asphalt per square yard of surface, as directed by the OWNER. All contact surfaces of curbs and structures and all joints shall be painted with a thin uniform coat of the asphaltic material meeting the requirements for a tack coat. Where a concrete cap is placed, it shall be allowed to cure for seventy-two (72) hours; then a tack coat shall be applied.

c) Transporting of Asphaltic Concrete:
The asphaltic mixture, prepared as specified above, shall be hauled to the work site in tight vehicles previously cleaned of all foreign material. The dispatching of the vehicles shall be arranged so that all material delivered may be placed and rolling shall be completed during daylight hours. In cool weather or for long hauls, canvas covers and insulation of the truck body may be given a light coating of oil, lime slurry, or other material satisfactory to the OWNER, if necessary, to prevent mixture from adhering to the body. The material shall be loaded in such a manner as to prevent segregation.

d) Placing:
The surface coat shall be placed in two inch (2”) horizontal layers and shall be compacted to ninety percent (90%) of the theoretical density. The mixture shall be laid only on an approved base course or pavement which has been tack-coated as previously specified and shall be free of all foreign materials. All contact surfaces of curbs and

structures and all joints shall be painted with a thin, uniform coating of cut-back or emulsified asphalt as required for tack coating the base. The mixture shall be thoroughly aerated and then spread into place in a uniform layer of such depth that after compaction is complete, the requirements of the typical cross-sections will have been fulfilled. Hand spreading will be permitted where the mixture is placed on narrow strips or small irregular areas. During the application of asphaltic material, care shall be taken to prevent splattering of adjacent pavement, curb and gutter, and structures.

Where more than one course of pavement is to be placed and the material is to be laid cold, no succeeding course shall be placed until the preceding course has been in place for a sufficient period of time for the preceding course to dry and cure out. The drying and curing period shall be not less than forty-five (45) days, in any case, unless a variation is authorized in writing by the OWNER.

e) Compacting:
The pavement shall be compacted thoroughly and uniformly with the necessary rollers to obtain the density, stability, and cross-section of the finished paving mixture meeting the requirements of the Plans and Technical Specifications and the approval of the OWNER.

For mixtures being placed cold, rolling patterns will be established at the beginning of the placement with the equipment necessary to give a uniform density, stability, and cross-section of the finished paving mixture meeting the requirements of the Plans and specifications and the approval of the OWNER. This pattern will be followed until such time as it is determined by the OWNER that it is no longer giving a satisfactory pavement. At such time, the paving operation will stop until necessary corrective measures can be accomplished that meet the approval of the OWNER.

f) Substitutions:
Limestone Rock Asphalt Pavement (LRA) as specified per TXDOT Item 330 is an approved substitution for Method B – Hot Mix-Cold Laid Asphaltic Concrete.

5.7.5 Measurement and Payment

Asphaltic Concrete Pavement will be measured per each square foot of material placed. The work performed and materials furnished in accordance with the Item and measured will be paid for at the unit price bid for "Hot Mix Asphaltic Concrete Pavement" or "Hot Mix – Cold Laid Asphaltic Concrete Pavement," depending on type used. This price shall be full compensation for securing any necessary source(s) and any royalty involved; for furnishing all materials, for all excavation, loading, hauling, stockpiling and placing; and furnishing all labor, tools, equipment and incidentals necessary to complete the work.

"Rolling" will not be paid for directly, but will be considered subsidiary to this Item, unless otherwise shown on Plans. Payment will not be made for any material which is used for purposes other than as required by this Item.

5.9 - Polyvinyl Chloride (PVC) Pressure Pipe

5.9 General

5.9.1 Scope

This section covers the furnishing and installation of all PVC pipe. The Plans show the sizes and general arrangement of all pipes; however, the responsibility for furnishing exact lengths of the various pipes for proper "make-up" rests with the CONTRACTOR.

5.9.2 Material Specifications

PVC Pipe shall be the integral bell, elastomeric seal-type and meet the following requirements:

Nominal Diameter	
(in.)	**Requirements:**
2"	Schedule 40
4" ≤ d ≤ 12"	AWWA C900 CIOD, DR18
12" < d < 36"	AWWA C905 CIOD, DR18

PVC pressure pipe is to be manufactured from Class 12454 virgin compound as defined in ASTM D1784. All pipe shall bear the National Sanitation Foundation (NSF) seal for potable water pipe. In addition, C900 and C905 shall be listed with Underwriters Laboratories, Inc. (UL).

Pipe joints shall be spigot and integral wall section bell with a solid cross section elastomeric or rubber ring gasket conforming to the requirements of the latest revisions of ASTM D3139 and ASTM F477. Gaskets shall be factory-assembled and secured in place to prevent displacement. Lubricant shall be as recommended by the pipe manufacturer and shall not adversely affect the potable qualities of the water to be transported. Pipe and fittings shall be assembled with a non-toxic vegetable soap lubricant which also meets the pipe manufacturer's specifications. Joints shall meet the applicable sections of the latest revision of AWWA C111. Each length of pipe shall be clearly marked with the manufacturer's trade name, the size and class, and the specifications that it meets. Fittings used with PVC pipe shall be ductile iron and comply with requirements as stated in Technical Specification 5.12,"Ductile Iron Pipe and Fittings."

5.9.3 General Installation

PVC pipe, fittings and specials are to be installed at locations shown on Plans. The trench bottom should be smooth and free from stones greater than two inches (2") in diameter and large dirt clods. If the trench bottom is rocky or hard, as in shale, a four inch (4") layer of embedment material shall be placed to provide a cushion for the pipe. All pipe, fittings, and

specials shall be lowered into the trench by some suitable means, and shall not be rolled or dumped into trench. All dirt or trash shall be removed from the ends of the pipe. Any damaged, defective or unsound material shall be suitably repaired or replaced before use. Where it becomes necessary to deflect the pipe to avoid obstructions, the deflection of each joint must be approved by the OWNER and shall be within acceptable limits as suggested by the manufacturer. The pipe is to be kept clean during the laying operation and free of all sticks, dirt and trash, and at the close of each operating day, the open end of the pipe is to be effectively sealed against the entrance of all obstructions and especially water. Any pipe that becomes contaminated before or after installation shall be removed and replaced unless a method to clean the pipe is approved by the OWNER.

5.9.4 Bedding Material for Water Pipe

Unless designated otherwise on the Plans, bedding shall be Type II as detailed in the project drawings. Bedding material shall be a granular material that will remain firm and not permit displacement of the pipe either during pipe laying and backfilling or following completion of construction. The material shall consist of crushed gravel meeting the requirement of ASTM C33, Gradation 67 (3/4" to No. 4); Crushed stone or naturally round gravel meeting TxDOT Grade 5 gradation as per Tex-200-F, Part I; or other materials approved by the OWNER (such as Turner Pit 'D' Bedding).

5.9.5 Cutting and Beveling

When necessary, PVC pipe may be cut to properly locate appurtenances. Pipe may be cut with a fine toothed hacksaw, handsaw or portable skill-saw with a steel blade or abrasive discs. The pipe shall be marked around its entire circumference prior to cutting to assure a square cut. After the pipe is cut, the cut end shall be beveled. A factory beveled-end guide shall be used to determine the angle and length of the taper. The end may be beveled using a pilot plastic pipe beveling tool, coarse file, rasp or abrasive disc.

5.9.6 Joint and Pipe Testing

See Technical Specification 5.11, "Pressure Pipe Testing and Disinfection."

5.9.7 Blocking and Restraints

Concrete blocking shall be placed at bends, valves, tees, crosses and plugs in the pipe lines. The concrete blocking shall be placed so as to rest against firm, undisturbed trench walls, normal to the thrust. The supporting area for each block shall be at least as great as that indicated on the Plans or directed by the OWNER and shall be sufficient to withstand the thrust, including water hammer which may develop. The blocking shall, unless otherwise directed, be placed so that the pipe and fitting joints will be accessible for repair.

Mechanical restraints shall meet the requirements of AWWA C605, latest revision. Mechanical restraints (in addition to concrete blocking) shall be installed in the locations shown in the Drawing detail sheets. The devices shall meet the test requirements of the latest version of ASTM F1674 (formerly UNI-B-13) "Standard Test Method for Joint Restraint Products for use with PVC Pipe."

5.9.8 Wrapping of Ductile Iron Fittings

All sub-surface pipe and fittings shall be wrapped in two (2) layers of linear low-density polyethylene (LLDPE) film with a minimum thickness of eight millimeters (8mm). Wrapping shall precede placement of any required concrete (blocking, etc.). LLDPE film and installation shall meet the requirements of ANSI/AWWA C105/A21.5.

5.9.9 Connections with Existing Facilities

Where connections are made between new work and existing piping, such connections shall be made using fittings suitable for the conditions encountered. Each connection with an existing pipe shall be made at the time and under conditions which will least interfere with service to customers affected thereby, and as authorized by the OWNER. Facilities shall be provided for proper dewatering and for disposal of all water removed from the dewatered lines and excavations without damage to adjacent property.

Couplings shall be of a gasketed, sleeve type. Each coupling shall consist of a steel middle ring, two (2) steel followers, two (2) rubber compounded wedge section gaskets, and sufficient track head stainless steel bolts to properly compress the gaskets. Couplings shall be of the type to match piping on which installed. Couplings shall be Smith-Blair Type 442 or Mueller MaxiFit-Xtra. All mechanical joints shall be installed with EBBA iron “Mega Lug” pipe restrainers or equal as approved by the OWNER. All transition couplings or solid sleeves shall be long barrel (minimum of twelve inches (12”)).

5.9.10 Measurement and Payment

The measurement of pipe for payment purposes will be the horizontally measured length of the line along its main axis from center of fitting to center of fitting or end of pipe, without deduction for the length of intermediate fittings or valves. Payment will include full compensation for furnishing, hauling and laying pipe, fittings, testing, disinfection, etc., in accordance with the specifications, Plans, and/or instructions of the OWNER at the price stipulated on the bid sheet. Payment for excavation, embedment, backfill, separation of excavated material for backfill according to the specifications, asphalt/concrete repair, surface restoration (unless specified elsewhere), etc. will be paid in accordance with corresponding bid items.

5.10 - Valves and Valve Installation

5.10.0 General

5.10.1 Section Includes

a) Resilient Seat Gate Valves
b) Butterfly Valves
c) Gate Valves and Ball Valves
d) Air Release Valves

5.10.2 General Description

Valves which are to be installed shall be the types and sizes and at the locations indicated on the Plans. Butterfly valves shall conform to AWWA C504, Class 150B and resilient seat gate valves shall conform to AWWA C509. All valves and fittings shall be 150 psi working pressure or better, unless otherwise specified in the Contract Documents. All valves shall turn counterclockwise to open. Unless otherwise shown on the Plans or directed by the OWNER, all valves shall be installed in the vertical position. Valves shall be equipped with slip-on, mechanical, or flanged joints suitable for use with the pipe on which they will be installed. Where practicable, valves installed underground shall be mechanical joint or slip-on, and valves installed above ground shall be flanged. All valves shall be furnished with the necessary bolts, nuts, glands, gaskets, and other accessories necessary for their complete installation. All manual operated valves shall have a two inch (2") square wrench nut for operation unless otherwise specified.

It is the intent of these specifications that all valves, valve boxes, and accessories furnished under this Contract shall be of the best quality for the use of purpose intended, and all materials incorporated shall meet the requirements of the service intended, regardless of the pressure specified for the valve.

All valves shall be fully supported by cast-in-place concrete. The concrete shall be placed on firm, undisturbed soil. The pipe and fitting joints shall remain accessible for repair. The minimum depth of concrete for valve foundations shall be six inches (6") for twelve inch (12") valves and smaller and shall be eight inches (8") for valves larger than twelve inches (12"). Reinforcement shall consist of 4x4 W2.9xW2.9 (6 gauge) or approved equal. The concrete shall extend a minimum of four inches (4") beyond all contact points with the valve.

5.10.3 Resilient Seat Gate Valves

All valves four inches (4") through thirty-six inches (36") shall be non-rising stem resilient seat gate valves, unless otherwise shown on the Plans or directed by the OWNER, as manufactured by American Darling, East Jordan Iron Works, J&S, Mueller, M & H or U.S. Pipe. The valves shall be tested for zero leakage past the seat at 200 psi and hydrostatically shell tested at 400 psi. The valves shall be wedge disc type and shall contain a machined surface in the valve body with solid guide lugs on the disc that travel within channels cast in the sides of the valve. The valve shall contain a bronze stem nut and O-ring seals above and below the thrust collar with a thermoplastic anti-friction washer above the thrust collar. Interior and exterior of the valve

shall be epoxy coated, 8 millimeters, dry film thickness, minimum. For each valve eighteen inches (18") and larger, the manufacturer shall provide an affidavit of compliance to demonstrate compliance with AWWA C509. Results of the Shell and Seat Tests shall be included with each affidavit. The affidavit shall demonstrate that the valves are of recent manufacture and that the valves have been tested within ninety (90) days of receipt. The CONTRACTOR shall operate each valve prior to installation to ensure free and proper functioning. During the operation, the CONTRACTOR shall allow the OWNER the opportunity to visually inspect and to operate the valves.

Two inch (2") Resilient Seat Gate Valves shall have a hand wheel operation; square wrench nut operation will not be allowed for this valve size.

Resilient seat gate valves twenty inches (20") and larger shall be supplied with spur gear operators installed by the valve manufacture, unless otherwise specified on the Plans.

5.10.4 Butterfly Valves

Butterfly valves shall be solid shaft type. All keys and pins used in securing valve discs to shafts shall be stainless steel. Valve body shall be high-strength cast iron ASTM A126 Class B with 18-8 Type 304 stainless steel body seat. Valve vane shall be high-strength cast iron ASTM A48 Class 40, having rubber seat mechanically secured with an integral 18-8 stainless steel clamp ring and 18-8 stainless steel nylon locked screws. Valve seats shall be 18-8 stainless steel. Shaft seals shall be O-ring type. The interior and exterior of the valve shall be epoxy coated, 8mil dry film thickness minimum.

5.10.5 Valve Bodies

a) Clear Water Opening: The diameter of the clear waterway opening through the valve shall be not less than the rated size of the valve.

b) Flanges: Flanges shall be furnished to true plane surfaces within a tolerance limit of 0.005 inch; the finished face shall be normal to the longitudinal valve axis within a maximum angular variation tolerance of 0.002 inch per foot of flange diameter.

c) Mechanical Joint Ends: Where mechanical joint ends are specified, either mechanical joint or flange conforming to ANSI A21.11 will be acceptable.

5.10.6 Valve Operations

Operator mounting arrangements and handwheel positions shall be as indicated on the Plans or as directed by the OWNER.

5.10.6.1 Manual Operations

Unless otherwise required by the OWNER, the direction of rotation of the wheel or wrench nut to open each valve 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.

Wrench nuts shall be standard AWWA wrench nuts as described in Section 4.16 of AWWA C500.

5.10.7 Gate Valves and Ball Valves

Unless otherwise shown or specified, all two inch (2") valves shall be all brass, non-rising stem gate valves as manufactured by James Jones. Valves smaller than two inches (2") shall be brass ball valves as manufactured by James Jones.

5.10.8 Valve Stands

All buried valves shall be provided with a three (3) piece adjustable valve stand. Valve stands shall be cast iron, extension sleeve type, suitable for the depth of cover required. Valve stands shall be not less than five inches (5") 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. Covers shall have cast thereon designation of the service for which the valve is used.

Valve and valve stands shall be set plumb. Each valve stand shall be placed directly over the valve it serves, with the top of the stand brought flush with the finished grade. After being placed in proper position, base shall be filled in around each valve stand and thoroughly tamped on each side of the box.

5.10.9 Air Release Valves

Air release valves shall be provided and installed by the CONTRACTOR at the locations as noted on the Plans. The air release valves shall be as specified on the Plans, or approved equal. Valve boxes shall be constructed as detailed on the Plans.

5.10.10 Drawings and Data

Complete drawings, details, and specifications covering the valves and their appurtenances shall be submitted in accordance with the submittals section.

5.10.11 Installation

For underground installations, valves shall be carefully lowered into position to prevent damage to any part of the valve. Place the valve in the proper position with stem truly vertical and securely hold until connections have been made. Furnish all bolts, nuts, gaskets and any other required hardware. The CONTRACTOR shall adjust the valve boxes to the proper length to conform to the finished or planned ground surface elevation. The CONTRACTOR shall provide a firm foundation for each valve. The firm foundation shall consist of compacting the sub-grade and placing minimum of six inches (6") of concrete with #3 rebar centered each direction. All sub-surface valves shall be wrapped in polyethylene sheeting of approximately 8 mil thickness. Wrapping shall precede concrete placement.

5.10.12 Measurement and Payment

Measurement and payment for this item will be based on the lump sum price bid. Payment will be full compensation for providing all materials, labor, machinery, blocking, valve box and incidentals needed for a complete in place facility.

5.11 - Pressure Pipe Testing and Disinfection

5.11.0 General

5.11.0.1 Scope

During the constructing operations utmost care shall be taken to see that parts of structures, inside of pipes, fittings, jointing materials, valves, etc., the surfaces of which will come in contact with the potable water, are maintained in a sanitary condition. Under no circumstances shall any part of a new line be placed in service prior to sterilization.

5.11.1 Testing

Prior to testing, chlorination shall be performed first as specified below in 5.11.2 "Chlorination." Chlorine shall be flushed out of the line, and then proceed with testing procedures.

All new pressure lines shall be tested by the CONTRACTOR with a hydrostatic test pressure of 150 pounds per square inch. The test period shall be four (4) hours for sixteen inch (16") pipe and smaller and twenty-four (24) hours for pipe sizes greater than sixteen inches (16"). Any items found to be defective shall be removed and replaced by the CONTRACTOR and retested after repairs are completed. In order to determine the quantity of water lost through leakage in a section of pipe under the required test pressure, the CONTRACTOR will be required to measure all water used in the pressure test through an approved meter. The maximum leakage permitted on the basis of 150 pounds per square inch shall not exceed ten (10) gal./inch dia./mile/day for PVC and ductile iron pipe, and fifty (50) gal./inch dia./mile/day for pretensioned concrete cylinder pipe.

The CONTRACTOR will be required to correct defects and bring the leakage within the specified limits before the contract is accepted by the OWNER. Permanent pavement shall not be placed over any pipe until all leakage tests on the section of pipe involved have been completed.

The cost of testing and finding the leaks, repairing and retesting, shall be at the expense of the CONTRACTOR.

5.11.2 Chlorination

When the entire pipe line or selected sections thereof have been completed, tested and are ready for turning over to the OWNER for use, the line or section shall be disinfected according to the following procedure:

a) A chlorinating material approved by the OWNER shall be injected at one end of the line, and water released from the opposite end until the coloring is present at the discharge end in such quantity to indicate a residual of fifty (50) parts per million (ppm). All valves shall then be closed, and the solution shall remain in the line for at least twenty-four (24) hours. All valves in the lines being sterilized shall be opened and

closed several times during the contact period. The CONTRACTOR shall make all necessary taps into the pipe to accomplish chlorination of a new line.

b) After twenty-four (24) hours, the solution shall be discharged from the line and flushed by water direct from the City of San Angelo main until the residual chlorine content is approximately the same as treated City of San Angelo water.

c) A water sample shall be taken from a suitable tap (not through a fire hydrant) under the supervision of the OWNER for analysis. If the tests show a satisfactory quality of water, the line may be placed into service. If the sample shows an unsatisfactory quality of water, the process of disinfection shall be repeated until a satisfactory sample is obtained. At least one satisfactory sample shall be obtained for every 1,000 feet of new line.

5.11.3 Water Service

Before any existing water service is interrupted, or before any existing valves are operated, the OWNER shall be notified and shall be present when such operation is made. The customer stall also be notified before water service is interrupted.

5.11.4 Measurement and Payment

No additional payment shall be made for material furnished or work done under this item, which is considered subsidiary of the various pay items. The disinfection tests for each section of pipe line will be the responsibility of the CONTRACTOR. Any additional tests required due to unsatisfactory quality of water will be the responsibility of the CONTRACTOR.

5.12 - Ductile Iron Pipe and Fittings

5.12.0 General

5.12.0.1 Section Includes

This section covers the furnishing and installing of all ductile iron pipe and fittings. The Plans show the general arrangement of all pipes and fittings; however, the responsibility for furnishing exact lengths of the various pipes for proper "make-up" rests with the CONTRACTOR. The ductile iron pipe and fittings shall be 250 psi working pressure or better, unless otherwise specified in the Plans or Contract Documents.

5.12.1 Material Specifications

All ductile iron pipe and fittings shall be manufactured in accordance with the various applicable specifications as listed below. Each length of pipe shall be clearly marked with the manufacturer's trade name, the size and class, and the specifications that it meets. Cast iron fittings are an acceptable alternate to ductile iron. The pipe and fittings furnished shall comply in all respects to the following American National Standards Institute Specifications:

- Pipe Properties and Materials ANSI A21.51 (AWWA C151)
- Cement Lining ANSI A21.4 (AWWA C104)
- Joint Detail ANSI A21.50 (AWWA C151)
- Fittings ANSI A21.10, ANSI A21.53 or ANSI B16.1 (AWWA C110, C153 and C111)
- Installation ANSI (AWWA C600)

Unless otherwise specified on the Plans or elsewhere in the Contract Documents, above ground joints shall be flanged, sub-surface joints shall be mechanical joint.

5.12.2 General Installation

Pipe, fittings and specials are to be installed at the line and grade shown on the Plans and as specified in these Contract Documents. Unless otherwise specified in the Plans or directed by the OWNER, the CONTRACTOR shall commence his work with a connection to an existing main carrying water or air and shall carry on his work progressively from such connection, and as each section of line is completed shall turn the line into service at the direction of the OWNER.

5.12.3 Pipe Handling

All pipe, fittings, and special casting shall be lowered into trench by suitable machinery and shall not be rolled or dumped into the trench. Pipe and fittings shall be handled in such a manner as not to damage the coating. Before lowering and while suspended, each piece of pipe shall be rung with a light hammer to detect flaws, and any unsound pipe shall be rejected. All dirt and trash that may be on the spigot or in the bell shall be removed while the pipe is suspended. Any pipe that has been contaminated with dirt, mud, debris, etc. shall be removed and replaced or cleaned to the satisfaction of the OWNER. All pipe and fittings shall be

handled and lowered into the trench with slings. The use of hooks for handling pipe and fittings will not be permitted.

Where it becomes necessary to deflect the pipe to avoid obstructions, the deflection of each joint must be approved by the OWNER and shall be within acceptable limits of the manufacturer. The pipe is to be kept clean during the laying operation and free of all sticks, dirt, trash, water, insects, and rodents. At the close of each operating day the open end of the pipe shall be effectively sealed with a water and air tight plug. Any pipe section that becomes contaminated shall be removed and replaced unless a method to clean the pipe is approved by the OWNER.

5.12.4 Mechanical Joints

The CONTRACTOR shall wire brush and thoroughly clean the surfaces with which the gasket comes in contact on the bell and spigot. The cleaned surfaces of the bell and spigot shall then be lubricated with a nontoxic vegetable soap lubricant suitable for use in a potable water system just prior to slipping the gasket over the spigot end and into the bell. The follower ring shall then be bolted into compression against the gasket. The gland shall be tightened toward the flange, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. If effective sealing is not attained at the maximum torque recommended by the manufacturer, the joint shall be disassembled and reassembled after thorough cleaning. Over stressing of bolts to compensate for poor installation practice will not be permitted.

5.12.5 Flanged Joints

Flanged connections shall be made by means of erection bolts and drift pins without undue forcing and with no restraint on the ends of the pipe or fitting which would prevent pressure from being evenly and uniformly applied to the gasket. The pipe or fitting must be free to move in any direction while bolting. Bolts shall be gradually tightened, each in turn, at a uniform rate around the entire flange. Flange bolts shall be installed with all bolt heads in one direction.

5.12.6 Blocking

For lines carrying water, concrete blocking shall be placed at bends, valves, tees, crosses and plugs in the pipe lines. The concrete blocking shall be placed so as to rest against firm, undisturbed trench walls, normal to the thrust. The supporting area for each block shall be at least as great as that indicated on the Plans or directed by the OWNER and shall be sufficient to withstand the thrust, including water hammer which may develop. The blocking shall, unless otherwise directed, be placed so that the pipe and fitting joints will be accessible for repair.

5.12.7 Wrapping of Ductile Iron Pipe and Fittings

All sub-surface pipe and fittings shall be wrapped in two (2) layers of linear low-density polyethylene (LLDPE) film with a minimum thickness of eight millimeters (8mm). Wrapping shall precede placement of any required concrete (blocking, etc.). LLDPE film and installation shall meet the requirements of ANSI/AWWA C105/A21.5.

5.12.8 Lining and Coating

Ductile iron pipe and fittings shall be lined with Type II cement mortar lining. Outside coating shall be manufacturer's standard coal-tar dip coating.

5.12.9 Connections with Existing Lines

Where connections are made between new work and existing piping, such connections shall be made using fittings suitable for the conditions encountered. Each connection with an existing pipe shall be made at the time and under conditions which will least interfere with normal operation and as directed by the OWNER. If Solid Sleeves are utilized, only 'long' sleeves are approved unless prior approval is obtained from the OWNER.

5.12.10 Bedding

Unless designated otherwise on the Plans, bedding shall be Type II as detailed in the project drawings. Bedding material shall be a granular material that will remain firm and not permit displacement of the pipe either during pipe laying and backfilling or following completion of construction. The material shall consist of crushed gravel meeting the requirement of ASTM C33, Gradation 67 (3/4" to No. 4); Crushed stone or naturally round gravel meeting TxDOT Grade 5 gradation as per Tex-200-F, Part I; or other materials approved by the OWNER (such as Turner Pit 'D' Bedding).

5.12.11 Measurement and Payment

Measurement and payment for this item will be based on the lump sum price bid. Payment will include full compensation for excavation, embedment, backfill, furnishing, hauling and laying pipe, fittings (other than valves), testing, disinfection, etc., in accordance with the specifications, Plans and /or instructions of the OWNER.

5.13 - Fire Hydrants

5.13.0 General

5.13.0.1 Scope

Fire hydrants shall meet or exceed the minimum standard of AWWA Standard C-502 latest revision. Hydrants shall be traffic model with breakaway safety flange and stem coupling; "O" ring stem seals with sealed oil reservoir lubricating stem operation; compression type main valve 5-1/4 inch, closing with pressure; bronze seat ring shall thread into a bronze drain ring forming an all bronze drainway with positive sealing; and two bronze drain outlets; main valve gasket shall be 3/4 inch thickness 90 durometer neoprene; 1-1/2 inch all bronze pentagon operating nut with anti-friction washer opening left; two 1-1/2 inch hose nozzles and one 4-1/2 inch pumper nozzle with National Standard Hose Threads; openings shall be in line with each other. Hydrants shall have asphaltic base varnish on the outside of lower barrel and shoe. The inside of the shoe shall be epoxy coated, minimum eight (8) mils thickness. The Fire Hydrant shall be painted Sherwin Williams B54Y17 or 6170807, yellow, or equal. Hydrants shall be lowered into the trench, inspected, and joined to the pipe as specified. Reaction thrust blocking shall be provided for all hydrants. Hydrants shall be thoroughly cleaned prior to installation.

5.13.1 Location

Hydrants shall be located as specified on the plans or by the OWNER. Hydrants shall be located to provide complete accessibility and to minimize the possibility of damage from vehicles or injury to pedestrians. The following provisions shall govern unless the OWNER specifies otherwise:

a) The bowl of the hydrant placed behind the curb shall be set so that no portion of the hydrant or hose nozzle caps on the street side shall be less than twelve inches (12”) or more than forty inches (40”) from the face of the curb.

b) All hydrants shall be plumb.

c) Pumper nozzles shall be at right angles to and facing the curb.

d) The breakaway flange shall be at finish ground or curb level. It shall not be below or more than two inches (2") above the finished grade. If the hydrant exceeds these limits, it will not be accepted.

5.13.2 Connection to Main

Each hydrant shall be connected to the main with six inch (6”) pipe and shall be controlled by an independent six inch (6”) valve.

5.13.3 Drainage

Hydrants shall be set with a drainage pit. The pit shall be filled completely with coarse gravel or broken stone mixed with sand under and around the bowl of the hydrant to a level six inches (6”) above the drain opening. No hydrant drainage pit shall be connected to a sewer.

5.13.4 Measurement and Payment

Fire hydrants shall be shall be measured per each complete installed in place. Payment will be made at the unit price per each hydrant which includes the hydrants, the line from the main to the hydrant, the independent valve on the main, the hydrant installation and all miscellaneous fitting, blocking, materials, and labor for a complete working installation.

5.14 - Service Lines

5.14.0 General

5.14.0.1 Scope

This section covers the furnishing and installation of all service lines. The plans show the sizes and general arrangement of all service lines and fittings, however, the responsibility for furnishing exact lengths of the various lines for proper "make-up" rests with the CONTRACTOR. The CONTRACTOR shall provide all materials, fittings, equipment and resources required for complete installation.

5.14.1 Materials

All 2” service lines will be Schedule 40 PVC. All 1” service lines will be Type K copper tubing.

5.14.2 Installation

It is intended that the line be laid to such a depth that there will be a minimum cover of thirty inches (30”). Where a line passes under the curb, the line shall be at least twenty-four (24") below the bottom of the curb. Where the existing meter location is more than five feet (5’) behind the curb line, at the direction of the OWNER, the CONTRACTOR shall relocate the meter to within five feet (5’) of the curb; including re-plumbing of the customer service line. Installation of a service line that replaces an existing service shall include disconnection and removal of the existing service line, installation of the new line, re-connection to the meter and re-connection of the private service line to the meter, resetting of the meter box and site grading and clean-up. The CONTRACTOR shall retain a Licensed Plumber for relocation of services on the customer side of the meter where applicable and shall obtain all permits and observe all plumbing code requirements of the City of San Angelo.

5.14.3 Relocation of Services

All existing alley services adjacent to the proposed water line street alignment shall be relocated to street side services, as noted on the plans. Where the existing meter location is more than five feet (5’) behind the curb line, at the direction of the OWNER, the CONTRACTOR shall relocate the meter to within five feet (5’) of the curb; including re-plumbing of the customer service line. For relocates, service lines on customer side of meter shall be a minimum of 1½” diameter but shall not be any smaller than the existing service line size. The CONTRACTOR shall retain a Licensed Plumber for relocation of services on the customer side of the meter where applicable and shall obtain all permits and observe all plumbing code requirements of the City of San Angelo.

5.14.4 Measurement and Payment

Service lines shall be measured per each by the various sizes, complete in place. Payment will be made at the unit price bid per each on the various sizes, which payment shall be full compensation for the service line installation complete in place, all in accordance with the plans and specifications.

5.15 - Highway, Creek, and River Crossings

5.15.0 General

5.15.0.1 Scope

This specification shall govern for the construction of water or sanitary sewer mains on or across streets, alleys, highways, creeks, or river crossings as detailed in the plans. The CONTRACTOR shall provide and employ adequate warning signs, barricades, light, watchmen, etc., to fully protect his workers and the traveling public. No changes shall be made in location as shown on the plans without prior authorization of the appropriate agency and the OWNER.

All crossings shall comply fully with the Plans and Technical Specifications, OWNER's direction, and the requirements of the agency of authority. If boring or tunneling is indicated or specified, the work shall be performed in accordance with the Highway/Railway Boring of Tunneling specification section of this document.

5.15.0.2 Blasting

Blasting will not be allowed without prior authorization of the appropriate agency and the OWNER.

5.15.1 State Highway Crossings

5.15.1.1 State Requirements

All highway crossings shall conform to the Texas State Department of Highways and Public Transportation Utility Accommodation Policy Manual Special Specifications and the following requirements.

5.15.1.2 Backfill

All Excavations within the right-of-way and not under surfacing shall be backfilled by compacting six inch (6”) horizontal layers. All surplus material shall be removed from the right-of-way, and the excavation finish shall be flush with the surrounding natural ground.

5.15.1.3 Re-vegetation Requirements

Where sodding is disturbed by excavation or backfilling operations, such areas shall be reseeded. Re-vegetation will be performed in compliance with Texas Department of Transportation Standard Specifications for Construction and Maintenance of Highway, Streets and Bridges (latest version).

5.15.1.4 Encasement Pipe

The diameter of encasement pipe shall be as shown on the plans. Encasement pipes shall be seamless or welded carbon steel. The CONTRACTOR is responsible for determining the thickness required for each bore. Steel casing shall be designed to support the load of the highway and all other superimposed loads, including loads placed on the casing during installation. Minimum thickness required for all pipe diameters is 1/4 inch. Regardless of the

method used in installing the encasement pipe, it shall be installed with even bearing throughout its length and all voids between the pipe and the earth or rock shall be filled with grout.

5.15.1.5 Method of installation

The pipe shall be installed by boring or tunneling in full conformance with the Highway/Railway Boring or Tunneling Specifications section of this document. The pipe shall be installed with even bearing throughout its entire length, and all voids between the pipe and the earth or rock shall be grouted per ASTM C476.

5.15.2 River Crossings

River crossings, siphons, and miscellaneous pipe structures shall be constructed according to the detail drawings. Any proposed alternate method of installation shall be submitted as designed by a registered engineer and approved by the OWNER.

5.15.3 Measurement and Payment

Measurement and payment for this item will be based on the lump sum price bid. Payment will include all trench protection, rock excavation, material, equipment, labor, and resources required for complete installation inclusive to the lump sum bid per each crossing and will be all casing pipe, carrier pipe, concrete blocking, trench protection, rock excavation, and all other materials and resources required for construction.

5.16 - Cast in Place Concrete

5.16.0 General

5.16.0.1 Scope

This section covers all cast-in-place concrete, including reinforcing steel, forms, finishing, curing, and other appurtenant work. All cast-in-place concrete shall be accurately formed and property placed and finished as shown on the Plans and specified herein.

The CONTRACTOR shall inform the OWNER at least twenty-four (24) hours in advance of the times and places at which he intends to place concrete.

5.16.1 Data and Drawings

All submittals of data and drawings shall be in accordance with the submittals section unless otherwise noted herein.

5.16.2 Materials

a) **Cement** - ASTM C150, Type I, II, or III

b) **Fine Aggregate** - Clean natural sand, ASTM C33.Artificial or manufactured sand will not be acceptable.

c) **Coarse Aggregate** - Crushed rock, washed gravel, or other inert granular material conforming to ASTM C33, except that clay and shale particles shall not exceed one percent.

d) **Water** - Clean and free from deleterious substances.

e) **Admixtures**:

1. **Retarder** - ASTM C494, Type D; Grace "Daratard-HC", Master Builders "MB-HC", Protex "Protard", or Sika Chemical "Plastiment".

2. **Plasticizer** - ASTM C494, Type A; Grace "WRDA-HC", or Master Builders "MBHC-N".

3. **Super Plasticizer** - ASTM C494, Type F, American Admixtures "Melment 10A", Gifford-Hill "PSI-Super", Sida "Sikament", or W.R. Grace "WRDA-19".

4. **Air-Entraining** - ASTM C260; Grace "Darex AEA", Master Builders "MB-AE10", Protex "AES", or Sika Chemical "AER".

f) **Reinforcing Steel** - Bars, Except ASTM A615 (and Supplement S1) Weldable Grade 60, deformed. Bars, Weldable ASTM A706 or A615 (and Supplement S1) Grade 60, deformed, with maximum carbon equivalent of 0.55.

g) **Welded Wire Fabric** - ASTM A185 or A497.

h) **Bar Supports** - CRSI Class 1, plastic protected, or Class 2, stainless steel protected.

i) **Forms** - Prefabricated Simplex "Industrial Steel Frame Forms", Symons "Steel Ply", or Universal "Uni-form".

j) **Plywood** - Product Standard PS1, water-proof, resin-bonded, exterior type Douglas fir; face adjacent to concrete Grade B or better.

k) **Fiberboard** - Fed Spec LLL-B-810, Type II tempered, waterproof, creenback, concrete form hardboard.

l) **Lumber** - Straight, uniform width and thickness, and free from knots, offsets, holes, dents, and other surface defects.

m) **Chamfer Strips** - Clear white pine, surface against concrete planed.

n) **Form Coating** - Non-Crete "Form Coating", L&M "Debond", Protex "Pro-Cote, or Richmond "Rich Cote".

o) **Wedge Inserts** - Malleable iron, with galvanized askew-head bolts, nuts, and washers; Hohmann and Barnard "HW", Richmond "Peerless", or Weston "WC50".

p) **Polyethylene Film** - Product Standard PS17; 6 mil. Membrane Curing Fed Spec TT-C-800, Type I,

q) **Compound and Floor** - Class 1; min eighteen percent (18%) solids.

r) **Sealer** - Non-yellowing; unit moisture loss 0.039 gm/cm^2 max; ProSoCo "Dure and Seal", Protex "Acrychlor", or Sonneborm Kure-N-Seal".

5.16.3 Preliminary Review

All tests and reports required for preliminary review shall be made by an independent testing laboratory at the expense of the CONTRACTOR. Reports covering the source and quality of concrete materials and the concrete proportions proposed for the work shall be submitted to the OWNER for review before concrete work is started. Review of these reports will be for general acceptability only and continued compliance with all contract provisions will be required.

5.16.4 Aggregates

Reports on aggregates shall include the following information:

a) Fine Aggregate.
   - Source and type
   - Gradation.

- Deleterious Substances.

b) Coarse Aggregate.
   - Source and type.
   - Gradation and abrasion loss.
   - Deleterious substances.
   - Results of sodium or magnesium sulfate soundness test.

5.16.5 Mix Design

A tentative concrete mix shall be designed and tested for each size and gradation of aggregates and for each consistency intended for use in the work. Design quantities and test results of each mix shall be submitted for review. Mixes shall be adjusted in the field as necessary to meet the requirements of these specifications. The report for each tentative concrete mix submitted shall contain the following information:

a) Slump on which design is based.

b) Total gallons of water per cubic yard.

c) Brand, type, composition, and quantity of cement.

d) Specific gravity and gradation of each aggregate.

e) Ratio of fine to total aggregates.

f) Weight (surface dry) of each aggregate per cubic yard.

g) Brand, type, ASTM designation, active chemical ingredients, and quantity of each admixture.

h) Air content.

i) Compressive strength based on seven (7) day and twenty-eight (28) day compression tests.

j) Time of initial set.

5.16.6 Testing

Aggregates shall be sampled and tested in accordance with ASTM C33. In addition, the bulk specific gravity of each aggregate shall be determined in accordance with ASTM C127 and ASTM C128.

Two sets of compression test cylinders, three cylinders per set, shall be made from each proposed concrete mix. One set of three cylinders shall be tested at an age of seven (7) days and the other set shall be tested at an age of twenty-eight (28) days. Concrete test specimens

shall be made, cured, and stored in conformity with ASTM C192 and tested in conformity with ASTM C39.

Slump shall be determined in accordance with ASTM C143 and total air content shall be determined in conformity with ASTM C231. Initial set tests shall be made at ambient temperatures of seventy degrees (70°F) and ninety degrees (90°F) to determine compliance with the initial set time specified hereinafter. The test at seventy degrees (70°F) shall be made using concrete containing the specified plasticizing and air-entraining admixtures. The test at ninety (90°F) shall be made using concrete containing the specified retarding and air-entraining admixtures. Initial set shall be determined in accordance with ASTM C403.

5.16.7 Limiting Requirements

Unless otherwise specified, each concrete mix shall be designed and concrete shall be controlled within the following limits.

5.16.7.1 Cement Content

The quantity of Portland cement, expressed in pounds per cubic yard, shall be as shown in the following table. These minimum cement quantities shall apply only to concrete containing a specified water reducing admixture. If, for any reason, the water reducing admixture is omitted, the cement shall be increased ten percent (10%).

Concrete Slump (in.)	Course Aggregate Size (lbs. Cement per Cubic Yd.)		
	No. 4 to 2"	3/4"	1"
2	573	545	517
3	593	56	536
4	611	583	555
5	630	602	573
6	649	620	593

5.16.7.2 Total Water Content

Total water content of concrete shall not exceed six (6) gallons of water per hundred pounds of cement in the mix.

5.16.7.3 Slump

Concrete slump shall be kept as low as possible consistent with proper handling and thorough compaction. Unless otherwise authorized by the OWNER, slump shall not exceed four inches (4”).

When Super plasticizer is used, slump, for concrete shall not exceed three inches (3”) prior to adding any super plasticizer. Slump for concrete after super plasticizer has been added shall be six inches (6”) plus or minus one inch (1”).

5.16.7.4 Ratio of Fine to Total Aggregates

The ratio of fine to total aggregates based on solid volumes (not weights) shall be:

Coarse Aggregate Size (in.)	Minimum Ratio	Maximum Ratio
2	0.40	0.55
3/4	0.35	0.50
1	0.30	0.46

5.16.7.5 Initial Set

The initial set as determined by ASTM C403 shall be attained 5 2 hours plus or minus one hour after the water and cement are added to the aggregates. The quantity of retarding or accelerating admixture shall be adjusted to compensate for variations in temperature and job conditions.

5.16.7.6 Total Air Content

The total volumetric air content of concrete after placement shall be five to seven percent (5%-7%). Air may be omitted from interior slabs which are to be trowel finished.

5.16.7.7 Admixtures

Admixtures, other than air-entraining and water reducing admixtures will not be permitted unless approved by the OWNER. The admixture content, batching method, and time of introduction to the mix shall be in accordance with the manufacturer's recommendation for compliance with these specifications. A water reducing admixture shall be included in all concrete. No calcium chloride or admixtures containing chloride from other than impurities from admixture ingredients will be acceptable. At the option of the CONTRACTOR, a super plasticizer may be used in addition to any water reducing admixture in all concrete for the pre-stressed concrete reservoir. Super plasticizer shall be as specified, as recommended by the manufacturer, and acceptable to the OWNER. Easy verification of each admixture dose when dispensed at the site will be required. Super plasticizer shall be accurately proportioned for each load into a separate dispensing container prior to any discharge into the truck. When truck-mounted dispensers are used, no flushing or cleaning of the system with water will be allowed until after the entire load of concrete has been discharged. Redosing of concrete with super plasticizer may be done only once when acceptable to the OWNER. Redosing procedures shall be as recommended by the manufacturer and acceptable to the OWNER.

5.16.7.8 Chloride Content

Maximum water soluble chloride in the concrete shall be 0.06 percent by weight.

5.16.7.9 Storage of Materials

Cement shall be stored in suitable moisture-proof enclosures. Cement which has become caked or lumpy shall not be used.

Aggregates shall be stored so that segregation and the inclusion of foreign materials is prevented. The bottom six inches (6”) of aggregate piles in contact with the ground shall not be used.

Reinforcing steel shall be carefully handled and shall be stored on supports which will keep the steel from contact with the ground.

5.16.8 Forms

Forms shall be designed to produce hardened concrete having the shape, lines, and dimensions shown on the Plans. Forms shall conform to ACI 347 and the following additional requirements.

Forms for surfaces which will be exposed to view when construction is completed shall be prefabricated plywood panel forms, job-built plywood forms, or forms that are lined with plywood or fiberboard. Forms for exposed surfaces shall be laid out in a regular and uniform pattern with the long dimension of panels vertical and all joints aligned. The forms shall produce finished surfaces that are free from offsets, ridges, waves, and convex areas, within the tolerances specified herein.

Plywood or lined forms will not be required for surfaces which are normally submerged or not ordinarily exposed to view, such as the insides of manholes, basins, and reservoirs. Other types of forms, such as steel or unlined wooden forms, may be used for surfaces which are not restricted to plywood or lined forms and may be used as backing for form linings. Concrete forms are required above all extended footings. Flat segmented forms not more than 24-inches wide may be used for forming curved surfaces twenty-five feet (25') in diameter or larger. Where concrete is placed against gravel or crushed rock which does not contain at least twenty-five percent (25%) material passing a No. 4 sieve, such surfaces shall be covered with polyethylene film to protect the concrete from loss of water. Joints in the film shall be lapped at least 6 inches. Where concrete is placed against rock, all loose pieces of rock shall be removed and the exposed surface cleaned with a high pressure hose.

5.16.8.1 Design

Forms shall be substantial and sufficiently tight to prevent leakage of mortar. Forms shall be braced or tied to maintain the desired position, shape, and alignment during and after concrete placement. Walers, studs, internal ties, and other form supports shall be sized and spaced so that proper working stresses are not exceeded.

Beams and slabs supported by concrete columns shall be formed so the column forms may be removed without disturbing the supports for the beams or slabs. Wherever the top of a wall will be exposed to weathering, the forms on at least one side shall not extend above the top of the wall and shall be brought to true line and grade. At other locations, forms shall be brought to a true line and grade, or a wooden guide strip shall be provided at the proper location on the forms so that the top surface can be finished with a screed or template for concrete which is to be finished to a specified elevation, slope, or contour. At horizontal construction joints in walls, the forms on one side shall not extend more than two feet (2') above the joint.

Temporary openings shall be provided at the bottom of column and wall forms and at other points where necessary to facilitate cleaning and inspection.

5.16.8.2 Form Ties

Form ties shall be of the removable end, permanently embedded body type and shall have sufficient strength and rigidity to support and maintain the form in proper position and alignment without the use of auxiliary spreaders. Cones shall be provided on the outer ends of each tie and the permanently embedded portion shall be at least one-inch back from the concrete face. Form ties for water bearing walls shall be provided with water-seal washers located on the permanently embedded portions of the ties at the approximate center of the wall. Permanently embedded portions of form ties which are not provided with threaded ends shall be constructed so that the removable ends are readily broken off without damage to the concrete. The type of form ties used shall be acceptable to the OWNER. Form ties in exposed surfaces shall be uniformly spaced and aligned in horizontal and vertical rows.

5.16.8.3 Edges and Corners

Chamfer strips shall be placed in forms to bevel all salient edges and corners, except the top edges of walls and slabs which are to be tooled and edges which are to be buried. Equipment bases shall have formed beveled salient edges for all vertical and horizontal corners unless specifically shown otherwise on the Plans. Unless otherwise noted, bevels shall be 3/4- inch wide.

5.16.8.4 Form Removal

Forms shall not be removed or disturbed until the Concrete has attained sufficient strength to safely support all dead and live loads. Shoring beneath beams or slabs shall be left in place and reinforced as necessary to carry any construction equipment or materials placed thereon. Care shall be taken in form removal to avoid surface gouging, corner or edge breakage, and other damage to the concrete.

5.16.8.5 Reinforcements

Reinforcements shall be accurately formed and shall be free from loose rust, scale, and contaminants which reduce bond. Unless otherwise shown on the Plans or specified herein, the details of fabrication shall conform to ACI 315 and 318.

5.16.8.6 Shop Drawings and Bar Lists

Bar lists and drawings for the fabrication and placing of reinforcements shall be submitted for review to the OWNER.

5.16.8.7 Placements

Reinforcements shall be accurately positioned on supports, spacers, hangers, or other reinforcements and shall be secured in place with wire ties or suitable clips.

With the exception of contact splices, the clear distance between parallel bars shall be not less than two inches (2”). Where reinforcements in beams are placed in two (2) or more layers, the bars in the upper layer shall be placed directly above the bars in the lower layer.

Reinforcements shall not be installed for beams or slabs which are supported by concrete columns until after the concrete for the column has been placed.

5.16.8.8 Splices

Splices shall conform to the details shown on the Plans. Splices at locations other than those shown on the Plans shall be acceptable to the OWNER. Except where indicated on the Plans, welding or tack welding of reinforcement is prohibited. Where welding is indicated on the Plans, weldable reinforcing steel having a carbon equivalent of not more than 0.55 shall be provided, and preheating and welding shall conform to AWS D1.4. Reinforcements upon which improper or unauthorized welding has been done shall be removed and replaced.

5.16.9 Embedments

Anchor bolts, castings, steel shapes, conduit, sleeves, masonry anchorage, and other materials that are to be embedded in the concrete shall be accurately positioned in the forms and securely anchored. Conduits shall be installed between the reinforcing steel in walls or slabs which have reinforcement in both faces. In slabs which have only a single layer of reinforcing steel, conduits shall be placed under the reinforcement. Unless installed in pipe sleeves, anchor bolts shall have sufficient threads to permit a nut to be installed on the concrete side of the form or template. A second nut shall be installed on the other side of the form or template and the two nuts shall be adjusted so that the bolt will be held rigidly in proper position.

Embedments shall be clean when installed. After concrete placement, surfaces not in contact with concrete shall be cleaned of concrete spatter and other foreign substances.

5.16.10 Batching and Mixing

Concrete shall be furnished by an acceptable read-mixed concrete supplier and shall conform to ASTM C94.

5.16.11 Consistency

The consistency of concrete shall be suitable for the placement conditions. Aggregates shall float uniformly throughout the mass and the concrete shall flow sluggishly when vibrated or spaded. The slump shall be kept uniform.

5.16.12 Delivery Tickets

A delivery ticket shall be prepared for each load of ready-mixed concrete. A copy of each ticket shall be handed to the OWNER by the truck operator at the time of delivery. Tickets shall show the mix identification, quantity delivered, the amount of each material in the batch, the outdoor temperature in the shade, the time at which the cement was added, and the numerical sequence of the delivery.

5.16.13 Placement

The limits of each concrete pour shall be predetermined by the CONTRACTOR and shall be acceptable to the OWNER. All concrete within such limits shall be placed in one continuous operation. Before concrete is placed, forms, reinforcements, water stops, anchor bolts, and embedments shall be rigidly secured in proper position; all dirt, mud, water, and debris shall be removed from the space to be occupied by concrete; all surfaces incrusted with dried concrete from previous placement operations shall be cleaned; and the entire installation shall be acceptable to the OWNER.

5.16.14 Bonding to Hardened Concrete

The surface of hardened concrete upon which fresh concrete is to be placed shall be rough, clean, sound, and damp. The hardened surface shall be cleaned of all laitance, foreign substances (including curing compound), washed with clean water, and wetted thoroughly preceding placement of fresh concrete. Coarse aggregate shall be omitted from the concrete placed immediately adjacent to hardened concrete in wall or column forms. The mortar puddle shall cover the hardened concrete to a depth of one inch (1"). Standard concrete mix, as specified, shall then be placed over the mortar.

5.16.15 Conveying Concrete

Concrete shall be conveyed to the point of final deposit by methods which will prevent separation or loss of ingredients. Concrete shall be placed in final position without being moved laterally in the forms more than five feet (5').

5.16.16 Placing Concrete

Concrete shall be placed in approximately horizontal layers of proper depth for effective compaction; however, the depth of a layer shall not exceed twenty-four inches (24"). Each layer of concrete shall be plastic when covered with the following layer and the forms shall be filled at a rate of vertical rise of not less than two feet (2') per hour. Vertical construction joints shall be provided as necessary to comply with these requirements.

Concrete shall be placed and compacted in wall or column forms before any reinforcing steel is placed in the system to be supported by such walls or columns. The portion of any wall or column placed monolithically with a floor or roof slab shall not exceed six feet (6') of vertical height. Concrete in walls or columns shall settle at least two (2) hours before concrete is placed in the structural systems to be supported by such walls or columns. Concrete shall be thoroughly settled when top finished. All laitance, debris, and surplus water shall be removed from concrete surfaces at tops of forms by screeding, scraping, or other effective means. Wherever the top of a wall will be exposed to weathering, the forms shall be overfilled and after the concrete has settled, the excess shall be screeded off.

5.16.17 Compaction

During and immediately after placement, concrete shall be thoroughly compacted and worked around all reinforcements and embedments and into the corners of the forms. Mechanical vibrators shall be used which will maintain at least 9,000 cycles per minute when immersed in the concrete. Number and type of vibrators shall be acceptable to the OWNER. Jitterbugs will not be acceptable.

5.16.18 Cold Weather Concreting

Except as modified herein, cold weather concreting shall comply with ACI 306. The temperature of concrete as the time of mixing shall be not less than that shown in the following table for corresponding outdoor temperature (in shade) at the time of placement:

Outdoor Temperature	Concrete Temperature
Below 30˚ F	70˚ F

Between 30˚ and 45˚ F	60˚ F
Above 45˚ F	45˚ F

Do not place concrete in contact with any material coated with frost or having a temperature of thirty-two degrees (32°F) or lower. Do not place concrete when the ambient temperature in the shade is below forty degrees (40°F) and falling unless approved. Concrete may be placed when the ambient temperature in the shade is thirty-five (35°F) and rising or above forty degrees (40°F). When placed, heated concrete shall not be warmer than eighty degrees (80˚F). Maintain temperature of all other concrete, including the bottom slabs (footings) of culverts, placed on or in the ground above thirty-two degrees (32º F) for seventy-two (72) hours from the time of placement. Concrete and adjacent form surfaces shall be kept continuously moist. Sudden cooling of concrete shall not be permitted.

5.16.19 Hot Weather Concreting

Except as modified herein, hot weather concreting shall comply with ACI 305. At air temperatures of ninety degrees (90˚F) or above, concrete shall be kept as cool as possible during placement and curing. The temperature of the concrete when placed in the work shall not exceed ninety degrees (90˚F). Plastic shrinkage cracking, due to rapid evaporation of moisture, shall be prevented. Concrete shall not be placed when the evaporation rate (actual or anticipated) equals or exceeds 0.2 pound per square foot per hour, as determined by Figure 2.1.5 in ACI 305.

5.16.20 Batch Plant Testing

Field control tests, including aggregate gradation tests, slump tests, air content tests, and making compression test cylinders, shall be performed by testing laboratory personnel. The testing laboratory shall provide all facilities and the services of one or more employees as necessary to assist with the field control testing activities. As stipulated in the quality control section, tests required during the progress of the work shall be made at the expense of the CONTRACTOR. The frequency hereinafter specified for each field control test is approximate. A greater or lesser number of tests may be made, as required by the OWNER.

Field testing prior to any addition of super plasticizer shall be as required by the OWNER to determine compliance with the specifications and shall be conducted as specified. Field testing after the addition of super plasticizer shall be conducted as specified and as required to determine that the concrete is in compliance with the specifications. Air tests shall be conducted whenever field tests are conducted.

5.16.20.1 Aggregate Gradation

Each 100 tons of fine aggregate and each 200 tons of coarse aggregate shall be sampled and tested in accordance with ASTM D75 and C136.

5.16.20.2 Slump

A slump test shall be made for each fifty cubic yards (50 yd^3) of concrete. Slump shall be determined in accordance with ASTM C143.

5.16.20.3 Air Content

An air content test shall be made from one of the first three (3) batches mixed each day, and from each batch of concrete from which concrete compression test cylinders are made. Air content shall be determined in accordance with ASTM C231.

5.16.20.4 Compression Tests

A minimum of one set of four (4) concrete compression test cylinders shall be made for each forty cubic yards (40 yd^3) of concrete that is placed. Two (2) additional sets shall be made from each additional 100 cubic yards, or major fraction thereof, placed in any one day. Two cylinders of each set shall be tested at an age of seven (7) days and the other cylinders shall be tested at an age of twenty-eight (28) days. Compression tests will be evaluated in accordance with ACI 214 and 318.

Tests cylinders shall be made, cured, stored, and delivered to the laboratory in accordance with ASTM C31 and tested in accordance with ASTM C39. Each set of compression test cylinders shall be marked or tagged with the date and time of day the cylinders were made, the location in the work where the concrete represented by the cylinders was placed, the delivery truck or batch number, the air content, and the slump.

5.16.20.5 Test Reports

Test reports shall be prepared in three (3) copies and shall be distributed by the testing laboratory directly to the OWNER and CONTRACTOR in accordance with the quality control section.

5.16.21 Construction Joints

Construction joints shall be made at locations indicated on the Plans or specified. Construction joints shall not be made at other locations without the concurrence of the OWNER.

5.16.22 Watertight Joints

Construction joints in the following locations shall be watertight and shall be provided with continuous water stops:

a) Walls in contact with liquid.

b) Other locations where specifically shown on the Plans.

Water stops shall be of the size and thickness indicated on the Plans and shall be clean and free from coatings that would weaken the bond with concrete. Each water stop shall be continuous throughout the length of the construction joint in which it is installed. Junctions between adjacent sections shall be lapped six inches (6”) and securely bolted or welded together. All water stops shall be maintained in proper position until the surrounding concrete has been deposited and compacted. Water stops shall be constructed of material acceptable to the OWNER.

5.16.23 Finishing Unformed Surfaces

Buried and permanently submerged concrete blocking and encasement will require no finishing except that necessary to obtain the required surface elevations or contours. The unformed surfaces of all other concrete shall be screeded and given an initial float finish followed by additional floating, and troweling where required.

5.16.24 Screeding

Screeding shall provide a concrete surface conforming to the proper elevation and contour with all aggregates completely embedded in mortar. All screeded surfaces shall be free of surface irregularities within a height or depth of 1/4-inch as measured from a ten foot (10') straightedge.

5.16.25 Floating

Screeded surfaces shall be given an initial float finish as soon as the concrete has stiffened sufficiently for proper working. Any piece of coarse aggregate which is disturbed by the float or which causes a surface irregularity shall be removed and replaced with mortar. Initial floating shall produce a surface of uniform texture and appearance with no unnecessary working of the surface. Initial floating shall be followed by a second floating at the time of initial set. The second floating shall produce a finish of uniform texture and color. Unless additional finishing is specifically required, the completed finish for unformed surfaces shall be the float finish produced by the second floating. Floating shall be performed with hand floats or suitable mechanical compactor-floats.

5.16.26 Broom Finish

Surfaces of exterior slabs shall be given a light broom finish providing a nonslip surface. Brooming shall be done after the second floating and at right angles to the normal traffic direction.

5.16.27 Edging

Unless specified to be beveled, exposed edges of floated surfaces shall be edged with a tool having 1/4-inch corner radius.

5.16.28 Curing

Concrete shall be protected from loss of moisture for at least seven (7) days after placement; however, when concrete is being protected from low temperatures, the time period for curing by saturation shall be one day less than the duration of the low temperature protection. Curing of concrete shall be by methods which will keep the concrete surfaces adequately wet during the specified curing period. All cast-in-place concrete in the water reservoir floor slab shall be water cured; membrane or film curing will not be acceptable.

5.16.29 Water Curing

Water saturation of concrete surfaces shall begin as quickly as possible after initial set of the concrete. The rate of water application shall be regulated to provide complete surface coverage with a minimum of runoff. The application of water to walls may be interrupted for grout cleaning only over the areas being cleaned at the time, and the concrete surface shall not be permitted to become dry during such interruption.

5.16.30 Membrane Curing

Membrane curing compound shall be spray applied at coverage of not more than 300 square feet per gallon. Unformed surfaces shall be covered with curing compound within thirty (30) minutes after final finishing. If forms are removed before the end of the specified curing period, curing compound shall be immediately applied to the formed surfaces before they dry out. Curing compound shall be suitably protected against abrasion during the curing period.

5.16.31 Film Curing

Except where otherwise required to be water cured, film curing with polyethylene sheeting may be used in lieu of water curing on concrete which will be covered later with mortar or additional concrete, or will otherwise be covered or hidden from view.

Film curing shall begin as quickly as possible after initial set of the concrete. Polyethylene sheeting shall completely cover the surfaces. Sheeting shall overlap the edges for proper sealing and anchorage. Joints between sheets shall be sealed. All tears, holes, and other damage shall be promptly repaired. Covering shall be anchored continuously at edges and shall be anchored on the surface as necessary to prevent billowing.

5.16.32 Repairing Defective Concrete

Defects in formed concrete surfaces shall be repaired within twenty-four (24) hours, to the satisfaction of the OWNER, and defective concrete shall be replaced within forty-eight (48) hours after the adjacent forms have been removed. All concrete which is honeycombed or otherwise defective shall be cut out and removed to sound concrete, with edges square cut to avoid feathering.

Concrete repair work shall conform to Chapter 9 of ACI 301 and shall be performed in a manner that will not interfere with thorough curing of surrounding concrete. Repair work shall be adequately cured.

5.16.33 Finishing Formed Surfaces

Fins and other surface projections shall be removed from all formed surfaces except exterior surfaces that will be in contact with earth backfill and are not specified to be damp-proofed. A power grinder shall be used, if necessary, to remove projections and provide a flush surface.

5.16.34 Tie Holes

Tie holes in all formed surfaces shall be cleaned, wetted, and filled with patching mortar. Tie hole patches shall be finished flush and shall match the texture of the adjacent concrete.

5.16.35 Tolerances

Unless otherwise specified, tolerances for cast-in-place concrete work shall be as stipulated in ACI 347. Formed surfaces stipulated in Article 3.3.8 of ACI 347 shall be considered as Class C for all concrete work.

5.16.36 Surface Treatment

All concrete surfaces exposed to wastewater and/or sewer gases, inclusive of manholes, interior and exterior wall surfaces of vaults shall be coated with a minimum application of eighty (80) mils of Fosroc Epoxy Liner HBS, Poli-Brid 705, or OWNER approved equal. OWNER's approval will require submittal of product specification, history, and installation list for review at least ten (10) days prior to submission of bid package. Separate payment will not be made for surface treatment, all material, labor and resources are considered subsidiary to the item under construction.

5.16.37 Concrete for Pipe Blocking and Encasement

Concrete for buried blocking and encasement of pipe shall conform to the limiting requirements specified hereinbefore, except that air-entraining and water-reducing admixtures may be omitted and the cement factor and total water content may be adjusted to provide a minimum compressive strength of 3,000 psi at twenty-eight (28) days. Concrete shall have a slump of not less than two inches (2”) nor more than five inches (5”) when placed.

5.23 - Polyvinyl Chloride (PVC) Gravity Sewer Pipe

5.23.0 General

5.23.0.1 Scope

This section covers the furnishing and installation of PVC gravity sewer pipe. The plans show the sizes and general arrangement of all pipes; however, the responsibility for furnishing exact lengths of the various pipes for proper "make-up" and for providing special items as may be required to simplify or facilitate the installation rests with the CONTRACTOR.

5.23.1 Material Specifications

PVC Gravity Pipe shall conform to the latest revision of ASTM D3034 SDR 35 for six inches (6”) through fifteen inches (15”) diameter and latest revision of ASTM F679 PS 46 for diameters greater than fifteen inches (15”) in diameter. Pipe shall be SDR 26 if the pipe has less than thirty inches (30”) (unless pipe is protected by a concrete cap) or more than fifteen feet (15’) of cover at finished grade.

Joints shall be integral wall bell and spigot which complies with all the requirements of the latest revision of ASTM D3212. The rubber gasket shall meet the requirements of the latest revision of ASTM F477 for elastomeric seals. Pipe and fittings shall be assembled with a non-toxic vegetable soap lubricant which also meets the pipe manufacturer's specifications. Each length of pipe shall be clearly marked with the manufacturer's trade name, the size and class, and the specifications that it meets. Fittings used with PVC pipe shall be PVC gasketed fittings.

5.23.2 General Installation

PVC pipe, fittings and specials are to be installed at locations shown on plans. The trench bottom should be smooth and free from stones greater than 1/2" diameter and large dirt clods. All pipe, fittings, and specials shall be lowered into the trench by some suitable means, and shall not be rolled or dumped into trench. All dirt or trash shall be removed from the ends of the pipe. Any damaged, defective or unsound material shall be suitably repaired or replaced before use. Where it becomes necessary to deflect the pipe to avoid obstructions, the deflection of each joint must be approved by the OWNER and shall be within acceptable limits as suggested by the manufacturer. The pipe is to be kept clean during the laying operation and free of all sticks, dirt and trash, and at the close of each operating day, the open end of the pipe is to be effectively sealed against the entrance of all obstructions and especially water. Any pipe that becomes contaminated before or after installation shall be removed and replaced unless a method to clean the pipe is approved by the OWNER.

5.23.3 Embedment and Bedding Material

The embedment zone for PVC gravity sewer pipe shall be Type II for installation with a minimum of thirty inches (30”) of cover at finished grade unless otherwise noted in the plans and/or specifications. Piping with less than thirty inches (30”) of cover at finished grade shall have “Concrete Cap” embedment as shown on drawing W-BED-1 unless otherwise noted in the plans and/or specifications. Bedding material shall be a granular material that will remain firm

and not permit displacement of the pipe either during pipe laying and backfilling or following completion of construction. The crushed gravel meeting the requirements of ASTM Designation C33, Gradation 67 (3/4 in. to No. 4). Crushed stone or pea gravel meeting the TXDOT Grade 5 gradation per test method Tex-200-F, Part I, is acceptable.

5.23.4 Cutting and Beveling

When necessary, PVC pipe may be cut to properly locate appurtenances. Pipe may be cut with a fine toothed hacksaw, handsaw or portable skill-saw with a steel blade or abrasive discs. The pipe shall be marked around its entire circumference prior to cutting to assure a square cut. After the pipe is cut, the cut end shall be beveled. A factory beveled-end guide shall be used to determine the angle and length of the taper. The end may be beveled using a pilot plastic pipe beveling tool, coarse file, rasp or abrasive disc.

5.23.5 Joint and Pipe Testing

See Technical Specification 5.28, "Sewer Line and Manhole Testing".

5.23.6 Connections with Existing Facilities

Where connections are made between new work and existing piping, such connections shall be made using fittings suitable for the conditions encountered. New connections/lines shall be tested as stated in 5.23.5 “Joint and Pipe Testing.” Each connection with an existing pipe shall be made at the time and under conditions which will least interfere with service to customers affected thereby, and as authorized by the OWNER. Facilities shall be provided for proper dewatering and for disposal of all water removed from the dewatered lines and excavations without damage to adjacent property.

5.23.7 Measurement and Payment

Measurement and payment for this item will be based on the unit price bid. Payment will include full compensation for excavation, embedment, backfill, furnishing, hauling and laying pipe, fittings (other than valves), testing, etc., in accordance with the specifications, Plans, and/or instructions of the OWNER.

5.25 - Closed Bottom Fiberglass Manhole – Type A

5.25.0 General

Fiberglass reinforced polyester manhole shall be manufactured from commercial grade polyester resin or other suitable polyester or vinyl ester resins with fiberglass reinforcements. Manhole shall be a one piece unit manufactured to meet or exceed all specifications of A.S.T.M. D-3753 latest edition as manufactured by L.F. Manufacturing, Inc., Giddings, Texas, 1-800-237-5791 or an approved equal.

5.25.1 Materials

a) **Resin**: The resins used shall be a commercial grade unsaturated polyester resin or other suitable polyester or vinyl ester resin.

b) **Reinforcing Materials**: The reinforcing materials shall be commercial Grade "E" type glass in the form of continuous roving and chop roving, having a coupling agent that will provide a suitable bond between the glass reinforcement and the resin.

c) **Interior Surfacing Material**: The inner surface exposed to the chemical environment shall be a resin-rich layer of 0.010 to 0.020 inch thick. The inner surface layer exposed to the corrosive environment shall be followed with a minimum of two passes of chopped roving of minimum length 0.5 inch (13 mm) to maximum length of two inches (2” / 50.8 mm) and shall be applied uniformly to an equivalent weight of three (3) oz. /ft. Each pass of chopped roving shall be well rolled prior to the application of additional reinforcement. The combined thickness of the inner surface and interior layer shall not be less than 0.10 inch (2.5 mm).

d) **Fillers and Additives**: Fillers, when used, shall be inert to the environment and manhole construction. Sand shall not be accepted as an approved filler. Additives, such as thixotropic agents, catalysts, promoters, etc., may be added as required by the specific manufacturing process to be used to meet the requirements of the A.S.T.M D-3753 standard. The resulting reinforced-plastic material must meet the requirements of this specification.

e) **Wall Construction Procedure**: After the inner layer has been applied the manhole wall shall be constructed with chop and continuous strand filament wound manufacturing process, which insures continuous reinforcement and uniform strength and composition. The cone section, if produced separately, shall be affixed to the barrel section at the factory with resin-glass reinforced joint resulting in a one-piece unit. Seams shall be fiberglassed on the inside and the outside using the same glass-resin jointing procedure. Field joints shall not be acceptable.

f) **Exterior Surface**: For a UV inhibitor the resin on the exterior surface of the manhole shall have gray pigment added to a minimum thickness 0.125 inches.

g) **Stub-outs and Connections**: Manholes shall be provided with couplings or stub-outs cast into the manhole body by the manhole manufacturer. The couplings and stub-outs shall be provided by the same pipe manufacture used to provide pipe in the project. All pipe specifications related to couplings and connections shall apply.

h) **Manhole Bottom**: Fiberglass manholes will be required to have resin fiber-reinforced bottom. Deeper manholes may require a minimum of two fiberglass channel stiffening supports. All fiberglass manholes manufactured with a fiberglass bottom will have a minimum three inch (3") wide anti-flotation ring. The manhole bottom shall be a minimum of ½ inch thick. Manholes shall be manufactured such that concrete is not required on the inside of the manhole. Manholes shall have a factory installed integral fiberglass bench and invert area.

i) **Fiberglass Enclosed Invert and Bench Area**: A fiberglass enclosed invert and bench area shall be installed in the manhole by the manufacturer. The invert will be formed using a non-corrosive material and completely enclosed in a minimum 1/4-inch layer of fiberglass chop.

j) **Height Adjustment**: Fiberglass manholes must have the ability to be height adjustable with the use of a height adjustment ring. Height adjustment can be made as a field operation without the use of uncured resins or fiberglass lay-ups. Fiberglass manholes must maintain all load and soundness characteristics required by A.S.T.M. D3753 after height adjustment has occurred.

5.25.2 Manufacture

Manhole cylinders, manway reducers, and connectors shall be produced from fiberglass-reinforced polyester resin using a combination of chop and continuous filament wound process.

a) **Interior Access:** All manholes shall be designed so that a ladder or step system can be supported by the installed manhole.

b) **Manway Reducer:** Manway reducers will be concentric with respect to the larger portion of the manhole diameters through sixty inches (60"). Larger manholes may have concentric or eccentric manway reducer openings.

c) **Cover and Ring Support:** The manhole shall provide an area from which a grade ring can be installed to accept a typical metal ring and cover and have the strength to support a traffic load without damage to the manhole.

5.25.3 Requirements

a) **Exterior Surface:** The exterior surface shall be relatively smooth with no sharp projections. Handwork finish is acceptable if enough resin is present to eliminate fiber show. The exterior surface shall be free of blisters larger than 0.5 inch in diameter, de-lamination or fiber show.
b) **Interior Surface:** The interior surface shall be resin rich with no exposed fibers. The surface shall be free of crazing, de-lamination, blisters larger than 0.5 inch in diameter,

and wrinkles of 0.125 inch or greater in depth. Surface pits shall be permitted if they are less than 0.75 inch in diameter and less than 0.0625 inch deep. Voids that cannot be broken with finger pressure and are entirely below the resin surface shall be permitted if they are less than 0.5 inch in diameter and less than 0.0625 inch thick.

c) **Wall Thickness:** Fiberglass manholes forty-eight inches (48") in diameter and up to twenty feet (20') in depth will have a minimum wall thickness of 0.3125 inches. Fiberglass manholes forty-eight inches (48") in diameter and twenty feet (20') to thirty feet (30') in depth will have a minimum wall thickness of 0.5 inches.

d) **Repairs:** Any manhole repairs are subject to meet all requirements of this specification.

e) **Manhole Length:** Manhole lengths shall be in six inch (6") increments ± two inches (2").

f) **Diameter Tolerance:** Tolerance of inside diameter shall be ± one percent (1%) of required manhole diameter.

g) **Load Rating:** The complete manhole shall have a minimum dynamic-load rating of 16,000 lbs. when tested in accordance with A.S.T.M. 3753 8.4 (note 1). To establish this rating the complete manhole shall not leak, crack, or suffer other damage when load tested to 40,000 lbs. and shall not deflect vertically downward more than 0.25 inch at the point of load application when loaded to 24,000 lbs.

h) **Stiffness:** The manhole cylinder shall have the minimum pipe-stiffness values shown in the table below when tested in accordance with A.S.T.M. 3753 8.5 (note 1).

LENGTH - FT.	F/AY - PSI
3 - 6.5	0.75
7 - 12.5	1.26
13 - 20.5	2.01
21 - 25.5	3.02
26 - 35	5.24

i) **Soundness:** In order to determine soundness, the manufacturer shall apply an air or water pressure test to the manhole test sample. Test pressure shall not be less than three (3) psig or greater than five (5) psig. While holding at the established pressure, inspect the entire manhole for leaks. Any leakage through the laminate is cause for failure of the test. Refer to A.S.T.M. 3753 8.6.

j) **Chemical Resistance:** The fiberglass manhole and all related components shall be fabricated from corrosion proof material suitable for atmospheres containing hydrogen sulfide and dilute sulfuric acid as well as other gases associated with the wastewater collection system.

5.25.4 Physical Properties

Property (PSI)	Hoop Direction	Axial Direction
Tensile Strength	18,000	5,000
Tensile Modules	0.6×10^6	0.7×10^6
Flexural Strength	26,000	4,500
Flexural Modules	1.4×10^6	0.7×10^6
Compressive	18,000	10,000

5.25.5 Test Methods

All tests shall be performed as specified in A.S.T.M. 3753 latest edition, section 8. Test method D-790 (see note 5) and test method D-695.

5.25.6 Quality Control

Each completed manhole shall be examined by the manufacturer for dimensional requirements, hardness, and workmanship. All required A.S.T.M. 3753 testing shall be completed and records of all testing shall be kept and copies of test records shall be presented to customer upon formal written request within a reasonable time period.

5.25.7 Certifications

As a basis of acceptance the manufacturer shall provide an independent certification which consists of a copy of the manufacturer's test report and accompanied by a copy of the test results stating the manhole has been sampled, tested, and inspected in accordance with the provisions of this specification and meets all requirements.

5.25.8 Shipping and Handling

Do not drop or impact the fiberglass manhole. Fiberglass manhole may be lifted by inserting a 4"x4"x30" timber into the top of manhole with cable attached or by a sling or "choker" connection around the center of manhole, lift as required. Use of chains or cables in contact with the manhole surface is prohibited.

5.25.9 Installation

Bottom of excavation should be compacted to ninety-five percent (95%) Standard Proctor Density. Manholes shall have a poured reinforced concrete base at least one foot (1') deep and at least two feet (2') larger than fiberglass manhole outside diameter. The fiberglass manhole shall be lowered into the wet concrete and brought to plumb. Pour reinforced concrete over the anti-flotation flange.

Manholes shall be manufactured such that concrete is not required on the inside of the manhole. Manholes shall have a factory installed integral fiberglass bench and invert area.

5.25.10 Backfill

Material used for backfill around the manhole for a minimum distance of one foot from the outside surface and extending from the bottom of the excavation to the top of the reducer section shall consist of sand or stabilized soil.

Backfill shall be placed in layers of not more than twelve (12) loose measure inches and mechanically tamped to ninety-five (95%) Standard Proctor Density, unless otherwise approved by the engineer. Flooding will not be permitted. Backfill shall be placed in such a manner as to prevent any wedging action against the fiberglass manhole structure.

5.25.11 Marking and Identification

Each manhole shall be marked on the inside and outside with the following information:

a) Manufacturer's name or trademark
b) Manufacturer's factory location
c) Manufacturer's serial number
d) Total manhole depth.

5.25.12 Measurement and Payment

Measurement and payment for this item will be based on the lump sum price bid.

5.26 - Fiberglass Manholes – Type B

5.26.0 General

This section covers glass-fiber reinforced polyester (FRP) manholes and related equipment for the construction of the project. The CONTRACTOR shall furnish all materials, labor and equipment for the installation of the manholes and accessories including concrete sections as shown on the Plans and as specified in these documents. The FRP manholes are underground vertical vessels described as "fiberglass cylinders" and require poured-in-place reinforced concrete bases and reinforced concrete tops.

5.26.1 Submittals

The CONTRACTOR shall submit, with bid package, manufacturer's history, design reports, details, tests and specifications.

5.26.2 Materials

5.26.2.1 Resin

The resins used shall be a commercial grade unsaturated polyester resin.

5.26.2.2 Reinforcing Materials

The reinforcing materials shall be commercial Grade "E" type glass in the form of mat, continuous roving, chopping roving, roving fabric, or a combination of the above, having a coupling agent that will provide a suitable bond with the resin and leave a resin rich surface.

5.26.2.3 Surfacing Materials

If reinforcing materials are used on the surface exposed to the contained substance, it shall be a commercial grade chemical-resistant glass or organic surfacing mat having a coupling agent that will provide a suitable bond with the resin and leave a resin rich surface.

5.26.2.4 Fillers and Additives

Fillers, when used, shall be inert to the environment and wet well construction. Additives, such as thixotropic agents, catalysts, promoters, etc., may be added as required by the specific manufacturing process to be used. The resulting reinforced plastic material must meet the requirement of this specification.

5.26.3 Fabrication

5.26.3.1 Exterior Surface

The exterior surface shall be relatively smooth with no sharp projections. Hand-work finish is acceptable if enough resin is present to eliminate fiber show. The exterior surface shall be free of blisters larger than two inches (2") in diameter, de-lamination and fiber show.

5.26.3.2 Interior Surface

The interior surface shall be resin rich with no exposed fibers. The surface shall be free of crazing, blisters larger than two inches (2") in diameter, de-lamination and wrinkles of 1/8 inch

or greater in depth. Surface pits shall be permitted up to six (6) per square foot if they are less than 3/4 inch in diameter and less than 1/16 inch deep.

5.26.3.3 Defects Not Permitted

a) Exposed fibers: glass fibers not wet out with resin.
b) Resin runs: runs of resin and sand on the surface.
c) Dry areas: areas with glass not wet out with resin.
d) De-lamination: separation in the laminate.
e) Blisters: light colored areas larger than two inches (2") in diameter.
f) Crazing: cracks caused by sharp objects.
g) Pits or voids: air pockets.
h) Wrinkles: smooth irregularities in the surface.
i) Sharp projection: fiber or resin (any projection necessitation gloves for handling).

5.26.4 Physical Requirements

5.26.4.1 Load Rating

The complete manhole shall have a minimum dynamic load rating of 16,000 ft-lbs when tested in accordance with Technical Specification 5.26.6, "Testing". In order to establish this rating, the complete manhole shall not leak, crack or suffer other damage when load tested to 40,000 ft-lbs and shall not deflect vertically downward more than 1/4 inch at the point of load application when loaded to 24,000 lbs.

5.26.4.2 Stiffness

The manhole cylinder shall have a minimum pipe stiffness value as shown in the table below when tested in accordance with Technical Specification 5.26.6, "Testing."

Stiffness Requirements	
Length, (ft)	**F/dY (psi)**
3 to 9	1.26
10 to 20	2.01
21 to 30	3.02
31 to 40	5.24

5.26.4.3 Physical Properties

Property (PSI)	Hoop Direction	Axial Direction
Tensile strength	18,000	5,000
Tensile Modulus	800,000	700,000
Flexural Strength	26,000	4,500
Flexural Modulus		
(no ribs - 48", 60", 72")	1,400,000	700,000
(with ribs - 96", 144")	700,000	700,000

5.26.5 Placement

5.26.5.1 Installation

This is a general guide to placement of fiberglass manholes; the CONTRACTOR should follow procedures as directed by the manufacture and to the approval of the OWNER.

- Before attempting to install any manhole, ensure excavation has been shored properly.
- Cut out manhole to set over pipe (maximum OD + one inch (1") usual).
- Concrete base to be poured in place in trench.
- Install manhole by inserting into wet concrete base.

5.26.6 Testing

5.26.6.1 Material and Fabrication

Test shall be performed as specified in ASTM D3753, latest revision, Section 8.

5.26.6.2 Placement

Test shall be conducted according to Technical Specification 5.28, "Sewer Line and Manhole Testing".

5.26.7 Measurement and Payment

Measurement and payment for this item will be based on the lump sum price bid.

5.27 - Sewer Service

5.27.0 General

5.27.0.1 Scope

This section covers material and installation requirements for sewer service line pipe and appurtenances. A sewer service is a branch sanitary sewer line constructed from the main sanitary sewer line to a point described in the plans or as established by the OWNER, for the purpose of serving a specific building or buildings. Service shall be marked on the curb and by a cedar post.

5.27.1 Material

5.27.1.1 General

Approved pipe and fitting material for sewer service shall be polyvinyl chloride (PVC). All materials shall conform to these specifications.

5.27.1.2 Polyvinyl Chloride (PVC) Pipe

Pipe shall be Schedule 40 Poly Vinyl Chloride (PVC) with tapered socket type joints and shall conform to the latest revision of ASTM D2466 - 78. Joints shall be glued with a medium bodied solvent cement having a minimum viscosity of 500 cP or as recommended by the pipe manufacturer. Solvent cement shall conform to the latest revision of ASTM 2564 - 80. For new main installation, service saddle fitting shall be PVC gasketed tee. For sewer service installation on existing main, PVC tap saddle may be used for four inch (4") sewer service only. Six inch (6") sewer service or large requires a manhole for tie-in.

5.27.2 Installation

5.27.2.1 Placing and Laying

The service lines shall be placed where shown on the plans or as directed by the OWNER. The lines shall be extended from the collection main to a distance of two feet (2') within the property line of the location to be served and plugged until placed in service. Sewer lines shall be installed at a uniform slope of not less than 1/8 inch per foot toward the point of disposal. Placement shall meet the requirements for construction of similar materials as directed in these specifications.

5.27.3 Testing

Sewer service lines shall be tested by capping the ends of the service and testing the entire main line following the procedure in Technical Specification 5.28 "Sewer Line and Manhole Testing," section of these contract documents.

5.27.4 Measurement and Payment

Measurement and payment for this item will be based on the lump sum price bid. Payment shall be full compensation for the furnishing of all labor, materials, tools, equipment and incidentals necessary to complete the work, including but not limited to excavation, concrete

encasement, if required, disposal of excess material, backfill, embedment, concrete blocking, paving, and sod, all in accordance with the plans and specifications. There shall be no additional payment for maintaining and restoring existing service laterals.

5.28 - Sewer Line and Manhole Testing

5.28.0 General

5.28.0.1 Scope

This Section will outline required testing for acceptance of construction of sewer lines, manholes, and other appurtenances as needed for complete and proper installation as described in the plans, details, specifications and contract documents provided.

5.28.1 Testing Procedure

5.28.1.1 General

After the underground conduit is in place and backfilled, the CONTRACTOR shall conduct, furnishing all material, equipment and resources required, applicable tests on all new sewer systems as directed in this specification and approved by the OWNER.

5.28.1.2 Pneumatic Exfiltration Test for Pipe

The Low Pressure Air Test procedure shall conform to the procedures described in ASTM C-828, ASTM C-924, ASTM F-1417 or other appropriate procedures, except for testing times. The test times shall be as outlined in this section. For sections of pipe less than thirty-six inches (36") average inside diameter, the following procedure shall apply unless the pipe is to be joint tested. The pipe shall be pressurized to 3.5 psi greater than the pressure exerted by groundwater above the pipe. Once the pressure is stabilized, the minimum time allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge shall be computed from the following equation:

$$T = \frac{0.085 \times D \times K}{Q}$$

$T = Ti \quad f \quad P \quad t \quad D \quad 1.0\,P \quad p \quad S \quad In \quad h\,G \quad in \quad S$

$K = 0.000419 \times D \times L, B \quad N \quad L \quad tha \quad 1.0$

$D = A \quad In \quad P \quad D \quad in \quad In \quad he$

$L = L \quad h\,o \quad L \quad o \quad Sc \quad P \quad S \quad B \quad T \quad , in \quad F$

$Q = R \quad o \quad L \quad , 0.0015\,C \quad F \quad p \quad M \quad p \quad S \quad F \quad In \quad S \quad Sha \quad b \quad U \quad d$

Since a K value of less than 1.0 shall not be used, there are minimum testing times for each pipe diameter as follows:

Pipe Diameter (in.)	Minimum Time (sec.)	Length for Min. Time (linear ft.)	Time for Longer Length (sec.)
6	340	398	0.855xLF
8	454	298	1.520xLF
10	567	239	2.374xLF
12	680	199	3.419xLF
15	850	159	5.342xLF
18	1020	133	7.693xLF
21	1190	114	10.471xLF
24	1360	100	13.676xLF
27	1530	88	17.309xLF
30	1700	80	21.369xLF
33	1870	72	25.856xLF
36	2031	66	30.634xLF

The test may be stopped if no pressure loss has occurred during the first twenty-five percent (25%) of the calculated testing time. If any pressure loss or leakage has occurred during the first twenty-five percent (25%) of the testing period, then the test shall continue for the entire test duration as outlined above or until failure. Lines with a twenty-seven inch (27") average inside diameter and larger may be air tested at each joint. Pipe greater than thirty-six inches (36") in diameter must be tested for leakage at each joint. If the joint test is used, a visual inspection of the joint shall be performed immediately after testing. The pipe is to be pressurized to 3.5 psi greater than the pressure exerted by groundwater above the pipe. Once the pressure has stabilized, the minimum time allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge shall be ten (10) seconds.

5.28.1.3 Vacuum Testing Manholes

All manholes vacuum tested shall in accordance with the ASTM C1244. The vacuum tester shall be a device approved for use by the OWNER.

All lift holes and pipes entering the manhole shall be plugged prior to a vacuum being drawn and the drop over a specified time determined. The test head shall be placed at the top of the manhole in accordance with the manufacturer's recommendations. A vacuum of ten inches (10") of mercury shall be drawn on the manhole, the valve line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop to nine inches (9") of mercury. The manhole shall pass if the time for the vacuum reading to drop from ten inches (10") of mercury to nine inches (9") of mercury meets or exceeds the values indicated below.

Manhole Depth (ft.)	Manhole Diameter (in.)				
	48	54	60	68	72
	Time (Sec.)				
<=8	20	23	28	29	33
10	25	29	33	38	41
12	30	35	39	43	49
14	35	41	46	51	57
16	40	46	52	58	65
18	45	52	59	65	73
20	50	63	65	72	81
22	55	64	72	79	89
24	59	64	78	87	97
26	64	75	85	94	105
28	69	81	91	101	113
30	74	87	98	108	121

5.28.1.4 Hydrostatic Exfiltration Test for Manholes

After all manholes are in place and backfilled, an exfiltration test shall be made on all manholes in the following manner:

1) Plug the sewer(s) entering and leaving the manhole.
2) Fill the manhole with water to the level directed by the OWNER.
3) Let the water stand in the manhole for a minimum duration of four (4) hours.
4) Record the change in elevation of the water surface.

The allowable change in water surface elevation is one-eighth inch (1/8") per foot of manhole depth.

5.28.1.5 Hydrostatic Exfiltration Test for Sewer Pipes

After sewer pipe is in place and backfilled, and when specified by the OWNER, an exfiltration test shall be made on pipe in the following manner:

1) Plug the lower end of the section of line to be tested.
2) Fill the line and the manhole at the upstream end of the line with water to two feet (2') above the crown of the line being tested.
3) Let the water stand in the pipe and manhole for a minimum of four (4) hours.
4) After the water has stood for a minimum of four (4) hours, refill the manhole to the original depth.
5) After a period of one (1) hour, record the difference in elevation of the water surface and convert into gallons.

The allowable leakage shall not exceed 8.3 gallons per inch pipe diameter per mile of pipe tested per hour.

5.28.1.6 Hydrostatic Test for Subaqueous Pipe Installations

After pipe is in place, and when specified by the OWNER, hydrostatic testing shall be performed by infiltration or exfiltration methods as determined by the OWNER.

Infiltration Test:
After pipe is in place and all backfill has been placed or fill removed to the satisfaction of the Engineer, the pipe to be tested shall be inspected by the OWNER via video camera to verify the presence or absence of water within the pipe. If present, all water shall be removed from the pipe by the CONTRACTOR. Testing shall proceed after a follow up inspection of the pipe by the OWNER.

Infiltration testing shall be performed in the following manner:

1) Place watertight plugs within the pipe or at manholes both upstream and downstream of the entire length of pipe where the water and or groundwater level is above the top of the pipe to prevent the accumulation of extraneous moisture within the pipe.
2) After pipes have been sufficiently plugged, the pipe shall be subjected to 'in place' hydrostatic water pressures for a period of no less than two (2) weeks.
3) After the testing period has expired, the OWNER shall order that all plugs be removed. The OWNER will then perform a visual inspection of the pipe prior to final acceptance of the installation.
4) Allowable infiltration leakage rate is zero (0) gallons during the minimum two week testing period.

5.28.1.7 Deflection Test - Mandrel Test

Deflection tests shall be performed on all flexible and semi-rigid pipe after the final backfill has been in place at least thirty (30) days according to the procedures described in these specifications:

a) The deflection test shall be run using a rigid ball or mandrel having a diameter equal to ninety-five percent (95%) of the nominal inside diameter of the pipe. No allowances shall be made for out-of-roundness or any other deviation from the nominal pipe diameter.
b) The test shall be performed without mechanical pulling devices.

c) No pipe shall exceed a deflection of five percent (5%).

5.28.2 Test Results

All tests performed on the sanitary sewer system shall be presented to the OWNER. Test results shall indicate conformance/nonconformance to these Technical Specifications.

5.28.3 Nonconformance

Should the system fail exfiltration or deflection tests, the CONTRACTOR shall find and repair any and all leaks or discrepancies, at no additional cost to the OWNER, and re-test. All costs associated with material, equipment and labor required for the testing of the system shall be included in the unit cost bid for each item.

5.28.4 Safety Provisions

Plug used to close the pipe for either air or exfiltration testing must be securely braced to prevent the unintentional release of a plug which can become a high velocity projectile.

Gages, air piping manifolds and valves shall be located at the top of the ground. No one shall be allowed to enter a manhole where a plugged pipe is under pressure.

5.28.5 Test Equipment

The test equipment used with either method of air pressure testing shall be certified as satisfactory by the OWNER at the beginning of the project. The inspector may at any time require a calibration check of the instrumentation used.

5.28.6 Manufacturer's Instructions

The CONTRACTOR shall perform the air testing in strict accordance with the manufacturer's instructions for the equipment used.

5.28.7 Measurement and Payment

No additional payment shall be made for material furnished or work done under this item, which is considered subsidiary of the various pay items.

5.33 - Furnishing and Placing Topsoil

5.33.0 Description

This Item shall govern for the furnishing and placing of approved topsoil to the depths and area shown on the plans or as directed by the OWNER.

5.33.1 Materials

Topsoil shall only be obtained from the 'A horizon' of the soil profile as defined by the U.S. Department of Agriculture Soil Survey. The topsoil shall be fertile soil, be easily cultivated, be free from objectionable material, have a relatively high erosion resistance and be readily able to support the growth of planting, seeding or sodding. Topsoil shall consist of a loam, sandy loam, clay loam, silt loam, sandy clay loam or loamy sand. Topsoil shall NOT be a mixture of contrasting textured sub-soils. It shall be free of stones, noxious weeds, grass, cinders, stones, slag, coarse fragments, gravel, sticks, roots or other materials. No trash will be acceptable in the topsoil. Any separating operations conducted by the CONTRACTOR shall be conducted at the material source pit and shall not be performed after the topsoil has been placed to merely "dress-up" the visible portion of the topsoil.

Topsoil shall contain not less than three percent (3%) or more than twenty percent (20%) organic matter, by weigh. Organic material shall be decomposed and free of wood. The Soluble Salt content of the topsoil shall not exceed 1.5 mmho/cm. Soil pH shall be between 6.1 and 7.5.

5.33.2 Sources

The topsoil source(s) shall be tested by the CONTRACTOR to ensure compliance with these specifications. Soil samples shall be obtained following the guidelines established by the Texas A&M Soil, Water and Forage Testing Laboratory. Test results (Textural Analysis, Organic Matter, Soluble Salt and pH) shall be provided to the OWNER prior to placement of topsoil.

5.33.3 Construction Methods

Topsoil shall be placed where directed by the OWNER. Any trash, wood, brush, stumps or other objectionable materials encountered at the source shall be removed and disposed of prior to final placement of the topsoil. The source and stockpile areas shall be kept drained, insofar as practicable. Prior to placement, topsoil shall contain adequate moisture to eliminate dust and to facilitate rolling.

The placement of the topsoil shall be undertaken as soon as the final backfill has been completed. Topsoil shall not be placed when the ground or topsoil is frozen, excessively wet or in any other condition that is otherwise detrimental to the work being performed. The topsoil shall be spread so as to form a cover of a minimum of six inches (6") of uniform thickness. After the topsoil has been placed and shaped, it shall be lightly rolled a light corrugated drum roller or other approved equipment. Topsoil shall not be overly compacted. The final grading of the topsoil shall be to a tolerance that will not permit ponding of water.

5.33.4 Measurement and Payment

This Item will be measured by the square foot of material placed. The minimum thickness shall be six inches (6”) unless specified otherwise on the plans.

The work performed and materials furnished in accordance with this Item and measured will be paid for at the unit price bid for "Furnishing and Placing Topsoil" for the depth specified. This price shall be full compensation for securing any necessary source(s) and any royalty involved; for furnishing all materials, for all excavation, loading, hauling, stockpiling and placing; and for furnishing all labor, tools, equipment and incidentals necessary to complete the work.

"Rolling" will not be paid for directly, but will be considered subsidiary to this Item, unless otherwise shown on the plans. Payment will not be made for any material which is used for purposes other than as required by this Item.

Excavation, for topsoil, in areas upon which backfill was previously placed will neither be measured nor paid for directly; its cost will be included in the unit price bid for this Item.

5.35 - Sanitary Sewer Main Installation

5.35.0 General

5.35.0.1 Scope

This section covers pipe and appurtenances required for the construction of this sewer project. The pipe, manholes, clean-outs and other appurtenances required shall be of the classification, size, types and dimensions as designated on the plans, details and profiles, or by the OWNER in accordance with these specifications, and in conformity with the lines and grades given.

The materials called for in these specifications shall be finally inspected by the OWNER or his representative immediately before being used in the construction. This inspection shall take precedence over any or all inspections of the same material that may have been previously made. The OWNER will not attempt to designate between materials rejected to factory defects and that are rejected because of transportation damage.

5.35.1 Materials

5.35.1.1 Pipe

Except as otherwise specified in the plans or specifications, sanitary sewer pipe shall be Glass Fiber Reinforced (GFR) or Polyvinyl Chloride (PVC). Joints shall be integral wall gasketed bell and spigot joints or butt fusion joints unless otherwise specified. Pipe shall conform to all material specifications, installation guidelines and drawing details. The material chosen for a site shall be used continuously throughout the location unless otherwise noted on the plans.

5.35.1.2 Manhole Shaft and Concentric Cone Top

The manhole shaft and concentric cone top shall be fiberglass conforming to the material specifications provided in these documents or approved by the OWNER. Concrete manholes may be used only as approved by the OWNER.

5.35.1.3 Manhole Frames, Covers, and Cleanouts

All castings of manhole frames, covers, steps and cleanouts shall be good quality gray or malleable cast iron, tough resilient, and even grain; castings shall be sound, and free from cracks, sand holes or bellow holes. The cast iron shall have a tensile strength of 18,000 pounds per square inch. All castings shall be of the design shown on the plans or provided in these specifications and are subject to approval by the OWNER.

5.35.1.4 Manhole Frames and Covers

Manhole frames and covers shall be East Jordan Iron Works V1177 (or V2432 for water tight applications) or approved equal with a minimum weight of 300 pounds. All frames and covers shall be approved by the OWNER prior to installation.

5.35.1.5 Steps

No steps shall be constructed in manholes.

5.35.1.6 Cleanouts

Cleanouts shall be of the size, type and design shown on the standard detail sheet of the plans.

5.35.1.7 Concrete

Concrete shall conform to the material standards set for in Technical Specification 5.16, "Cast in Place Concrete."

5.35.2 Pipe Installation

5.35.2.1 General

The CONTRACTOR shall remove as much of the street or road surfaces as may be necessary and where necessary; excavate the trenches to the required dimensions; and grade, sheet, brace and support the adjoining ground or structures where necessary; handle all drainage or ground water; guard the site; construct and maintain all bridges required for traffic control; unload, haul, distribute, construct and test all pipe and accessories; rearrange other conduits, ducts, or pipes where necessary; replace all damaged utility services, fences, utilities and other structures; backfill the trenches and pits; remove surplus excavated material; clean the site of the work, and maintain the streets or other surfaces over the trenches for the successful completion of the project.

5.35.2.2 Equipment

All equipment necessary for the construction of these sanitary sewer improvements shall be available for the project, in first-class working condition, and shall have been approved by the OWNER before construction is permitted to commence.

The CONTRACTOR shall provide hand tampers and pneumatic tampers to obtain compaction of the pipe bed and backfill as required on the plans.

5.35.2.3 Pipe Handling

All pipe and fittings shall be lowered into trench by suitable machinery and shall not be rolled or dumped into the trench. Pipe and fittings shall be handled in such a manner as not to damage the material or any coatings. All dirt and trash that may be on the spigot or in the bell shall be removed while the pipe is suspended. Any pipe that has been contaminated with dirt, mud, debris, etc. shall be removed and replaced or cleaned to the satisfaction of the OWNER. All pipe and fittings shall be handled and lowered into the trench with slings. The use of hooks for handling pipe and fittings will not be permitted. The pipe is to be kept clean during the laying operation and free of all sticks, dirt, trash, water, insects, and rodents. At the close of each operating day the open end of the pipe shall be effectively sealed with a watertight plug. Any pipe section that becomes contaminated shall be removed and replaced unless a method to clean the pipe is approved by the OWNER.

5.35.2.4 Stringing of Pipe

Unless prior approval from the OWNER is granted to do otherwise, stringing of pipe in advance of the laying operation shall be restricted to one week's laying and shall be done in such a manner as to create neither hazard to nor interference with traffic. Ready access shall be

provided to all streets, alleys and driveways. The pipe shall be protected at all times with barricades and warning signs, as well as protecting the pipe from stormwater flows. Any damage to the pipe shall be corrected at the expense of the CONTRACTOR.

Where it becomes necessary to deflect the pipe to avoid obstructions, the deflection of each joint must be approved by the OWNER and shall be within acceptable limits of the manufacturer.

5.35.2.5 Laying Pipe

All sewer pipe, unless otherwise specified shall be furnished by the CONTRACTOR. The CONTRACTOR will contact the OWNER for approval of pipe delivery and "stringing" plans. Precaution will be taken by the CONTRACTOR to insure that pipe will be kept clean and in good condition until laid and that the pipe shall be stored in a manner causing minimal inconvenience to the public and be satisfactory to the OWNER.

1. Before being lowered into the trench, each pipe section shall be carefully inspected, and those not meeting specifications shall be rejected and removed from the job. All lumps or excrescences on the ends of conduit shall be removed before it is lowered into the trench. Before laying the pipe, the interior of the joints shall be carefully bored smooth and clean and the annular space shall be kept free from dirt, stones or water. Pipe shall be installed and joints made up in complete conformance with the instructions and recommendations regarding proper installation and assembly furnished by the manufacturer. No pipe shall be laid except in the presence of the OWNER, unless otherwise specified; and the OWNER may order the removal of and re-laying of any pipe not so laid.

2. The pipe shall be laid to the line and grade shown on the plans. The pipe shall be laid on the required embedment and shall not vary more than one tenth (1/10) foot from the true line nor more than two hundredths (2/100) foot from the theoretical grades.

3. The embedment to receive the pipe shall be placed to a grade slightly higher than that required for the grade of pipe and the pipe brought to grade by tamping or the removal of the slight excess embedment under the pipe.

4. Lower pipe and accessories into trench by means of derrick, ropes, belt slings, or other equipment approved by the OWNER. Do not dump or drop any of the materials into the trench.

5. Sewers shall be laid with the bell or groove end upgrade unless otherwise approved by the OWNER; and shall be laid with the bell or collar away from the last section placed. Place pipe and fittings in trench so that identifying markings will be visible for inspection.

6. Adjustment to grade and line shall be made by scraping away or filling with embedment material, and wedging up or blocking of pipe will not be permitted. Each pipe section

shall have a uniform bearing on the embedment for the full length of the barrel of the pipe. The pipe shall not rest on bells or cap couplings.

7. Do not lay pipe in water or when trench conditions are unsuitable for the work; keep water out of the trench until joining is complete.

8. Securely close open ends of pipe, fittings and valves when work is not in progress.

9. Where any part of the coating or lining is damaged, repair to the approval of the OWNER and at no additional cost to the OWNER.

10. All pipe shall be uniform throughout the circumference of the joint. Where curves in the alignment are indicated on the Plans, standard pipe (short sections of pipe or bevels) shall be used with the outside edge of the joint pulled away from the seat to make a smooth curve.

11. After the pipe has been placed and jointed, the embedment shall be brought to the full depth required. Such part of concrete embedment or encasement where required that may be placed after the pipe is laid, shall be tamped to make a bond with the original concrete, care being exercised in tamping to prevent lifting the pipe out of alignment or grade.

12. Take up and re-lay pipe that has the grade or joint disturbed after laying or has been improperly installed at no additional cost to the OWNER.

13. After embedment is brought to full depth, the trench shall be backfilled as necessary to hold the pipe firmly in position. Such backfilling to be done as herein specified. Concrete embedment shall have acquired its initial set before backfilling.

14. When work is suspended on the line for any reason, the end of the line shall be closed with an effective watertight seal or plug manufactured for the purpose.

15. All existing and/or previously used sewer mains removed by the CONTRACTOR shall be disposed in accordance with Texas Commission on Environmental Quality, Federal, State and local regulations.

5.35.2.6 Mechanical Joints

The CONTRACTOR shall wire brush and thoroughly clean the surfaces with which the gasket comes in contact on the bell and spigot. The cleaned surfaces of the bell and spigot shall then be lubricated with a nontoxic vegetable soap lubricant suitable for use in a potable water system just prior to slipping the gasket over the spigot end and into the bell. The follower ring shall then be bolted into compression against the gasket.

The gland shall be tightened toward the flange, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. If effective sealing is not attained at the maximum torque recommended by the manufacturer, the joint shall be

disassembled and reassembled after thorough cleaning. Over stressing of bolts to compensate for poor installation practice will not be permitted.

5.35.2.7 Slip-on Joints

Slip-on type joints shall be made in the following manner. The gasket and the gasket seat inside the bell shall be wiped clean of all extraneous matter. The gasket shall be placed in the bell in the position prescribed by the manufacturer. A thin film of nontoxic vegetable soap lubricant shall be applied to the inside of the gasket and the outside of the spigot prior to entering the spigot into the bell. Petroleum lubrication shall not be permitted. The spigot shall be forced home in the bell by manufacturer recommended method or other method approved by the OWNER.

5.35.2.8 Flanged Joints

Flanged connections shall be made by means of erection bolts and drift pins without undue forcing and with no restraint on the ends of the pipe or fitting which would prevent pressure from being evenly and uniformly applied to the gasket. The pipe or fitting must be free to move in any direction while bolting. Bolts shall be gradually tightened, each in turn, at a uniform rate around the entire flange. Flange bolts shall be installed with all bolt heads in one direction.

5.35.2.9 Blocking

Concrete blocking shall be placed at bends, valves, tees, crosses and plugs in the pipe lines.

The concrete blocking shall be placed so as to rest against firm undisturbed trench walls normal to the thrust. The supporting area for each block shall be at least as great as that indicated on the Plans or directed by the OWNER.

5.35.2.10 Connections with Existing Lines

Where connections are made between new work and existing piping, such connections shall be made using fittings suitable for the conditions encountered. Each connection with an existing pipe shall be made at the time and under conditions which will least interfere with service to customers affected thereby, and as authorized by the OWNER. Facilities shall be provided for proper dewatering and for disposal of all water removed from the dewatered lines and excavations without damage to adjacent property.

5.35.2.11 Pipe Laid on Trench Bottom

Before the pipe is lowered into the trench:

a) A bell hole shall be excavated with sufficient length, width, and depth to permit assembly and provide a minimum clearance of two inches (2”) below the bell, and

b) The trench bottom shall be graded such that the pipe will be continuously supported between couplings.

5.35.3 Manhole Construction

5.35.3.1 General

Manholes shall be constructed at locations indicted on the plans, or as otherwise directed by the OWNER. Development of areas through which the sewer passes may dictate changes in location or increase the number of manholes required. Manholes shall be constructed to details shown on the plans or described in these specifications. Excavation of manholes shall be as required for complete and proper installation.

5.35.3.2 Manhole Bottoms

Concrete manhole bottoms shall be in accordance with the structural details shown on the plans and in complete conformity with these specifications. Tremies shall be used for drops in excess of six feet (6'). The concrete shall be placed only after the reinforcement has been inspected by the OWNER. The excavation shall be free of water when concrete is placed.

Where indicated on the plans, fiberglass bottom manholes shall be used. See Technical Specification 5.25, "Closed Bottom Fiberglass Manhole – Type A".

5.35.3.3 Placement of Manhole and Cleanout Castings

All casting frames shall be set true to line and grade, firmly positioned, and grouted in place with mortar as shown on the plans. The mortar shall be kept moist for a minimum period of forth-eight (48) hours. Mortar that does not bond properly with the brick masonry shall be removed and replaced, and prior to acceptance, the brick masonry, mortar, and frame must form one structural unit. The frames for cleanouts shall be set in concrete in accordance with the details shown on the plans, to line and grade as staked. Where required by the OWNER, stub-outs shall be made from the manholes for future connections at the elevation designated by the OWNER, with one joint of pipe which shall be set in the wall of the manhole and plugged at the outer end.

5.35.3.4 Manhole Tie-Ins

All lines entering or exiting manholes shall be fully encased in 3,000 p.s.i. concrete, bedding condition "Concrete Encasement" as shown on drawing W-BED-1, for a minimum distance of one foot (1') from the exterior surface of the manhole wall.

5.35.4 Service Lines

5.35.4.1 General

Service lines shall be installed as shown on the plans and details as specified herein and as needed for a complete and proper installation. The location of the service will be field verified by the OWNER prior to installation and the connection point shall be assumed to end two feet (2') within the property line of the customer to be served.

5.35.5 Testing

5.35.5.1 Testing

All testing shall be completed with the supervision of the OWNER and as directed in Technical Specification 5.28, "Sewer Line and Manhole Testing".

5.35.6 Line and Grade

5.35.6.1 General

The CONTRACTOR shall be responsible for providing horizontal and vertical controls to ensure the proposed sanitary sewer system is constructed in accordance with the plans and specifications. At a minimum, hubs shall be set every fifty feet (50'). CONTRACTOR shall maintain on-site lasers and other equipment to continuously monitor the work to ensure compliance with the lines and grades established on the plans. CONTRACTOR shall retain the services of a professional registered land surveyor to verify exact manhole depths required, to establish the line, set hubs and to provide cut sheets. CONTRACTOR shall provide a copy of the surveyor's information to the OWNER prior to start of construction activities. Upon request, the OWNER will provide an electronic copy of the project plan and profile sheets. However the lines are not geographically located.

5.35.7 Safety

5.35.7.1 Potentially Harmful Environments

The sanitary sewer system has the capability of producing an environment that may be harmful to workers. The CONTRACTOR shall provide workers with personal protective equipment as necessary to provide adequate protection. The CONTRACTOR shall provide equipment to determine if a hazardous atmosphere exists prior to allowing workers to enter any areas that may contain a potentially harmful environment. The equipment shall be kept calibrated, maintained in good condition and all maintenance and calibration records kept on site for inspection.

At a minimum, the CONTRACTOR shall monitor and record atmosphere testing results for oxygen levels, presence of combustible gases, hydrogen sulfide or other toxic gases that may be present. These measurements should be made before lids are removed and shall be measured at various depths including the workspace. Testing shall continue as long as workers are present in the area.

5.38 - Painting Existing Fire Hydrants

5.38.0 General

5.38.0.1 Scope

This section covers painting of existing Fire Hydrants and shall include removing loose, flaking paint with a steel brush or other approved methods; cleaning the exposed parts of the hydrant; and painting both the barrel and bonnet.

5.38.0.2 Procedures

First, the CONTRACTOR shall remove all loose and/or flaking paint and pressure-wash the hydrant. Next, the hydrant shall be completed degreased by application of solvent and removal of all residuals by physically wiping the hydrant. Once the hydrant has been degreased and cleaned, the barrel, nozzles and caps shall be painted yellow and the bonnet shall be painted its original color (green, orange or red). Templates or shields shall be utilized to provide a clean border between the two colors.

5.38.0.3 Materials

The OWNER will provide the following materials in the specified quantities:

- Absolute Degreaser, dilute 5:1; (one (1) gallon per 100 Fire Hydrants)
- Sherwin Williams B54Y17 or 6170807; yellow paint (one (1) gallon per twenty (20) FHs)
- Spray Paint, Green, Orange & Red; (one (1) can per ten (10) Fire Hydrants)

If degreaser and paint quantities are required in excess of those listed above, the CONTRACTOR will supply as necessary to complete the quantity stated at no cost to the OWNER. The CONTRACTOR shall supply all other materials and equipment necessary to remove loose paint, apply the degreaser, remove the degreaser and all residuals, paint the barrel and bonnet and maintain a clean distinction between the barrel and bonnet colors.

5.38.1 Measurement and Payment

Fire Hydrant Painting shall be measured per each assembly cleaned and painted as specified herein. Payment will be made at the unit price bid per each hydrant and shall be full compensation for providing all materials specified herein, labor, equipment and incidentals required to complete the work in accordance with the plans and specifications.

5.44 - Concrete Curb, Elevated Concrete Curb, Gutter, Curb and Gutter

5.44.0 General

5.44.1 Scope

The work covered by this section includes the replacement of curb, gutter, or combined curb and gutter.

5.44.2 Material

5.44.2.1 Concrete

Concrete used in conventionally formed construction shall be Class A (3,000 psi) concrete with a seven-sack grout topping. Concrete for extruded (machine laid) construction shall be Class A concrete. Membrane curing materials shall be applied.

5.44.2.2 Reinforcing Steel

Reinforcing steel shall be standard billet steel deformed bars with minimum sixty kips per square inch (60 ksi) yield strength and will be required in those areas where the steel already exists, and shall be compatible with the existing sections.

5.44.3 Inspection

It will be the CONTRACTOR's responsibility to provide safe and accurate means to enable inspection forces to take all required samples, and to provide permanent means for checking the output of any specified metering device and to perform these calibration checks as required by the OWNER.

5.44.4 Construction Methods

5.44.4.1 General Requirements

For conventionally formed concrete, the subgrade, foundation, or pavement surface shall be shaped to line, grade, and cross-section of the existing portions, and, if considered necessary by the inspector, hand-tamped and sprinkled. If dry, the subgrade or foundation material shall be sprinkled lightly immediately before concrete is deposited thereon. Outside forms shall be of wood or metal, of a section satisfactory to the OWNER, straight, free of warp and of a depth equal to the depth required. They shall be securely staked to line and grade, and maintained in a true position during the depositing of concrete. Inside forms for curbs shall be of approved material, shall be of such design as to provide the curb required, and shall be rigidly attached to the outside forms. The reinforcing steel, if required, shall be placed in position as required by the site location. Care shall be exercised to keep all steel in its proper location. After the concrete has been struck off and has become sufficiently set, the exposed surfaces shall be thoroughly worked with a wooden float. The exposed edges shall be rounded by the use of an edging tool to the radius indicated on plans. Unless otherwise specified on the plans, when the concrete has become sufficiently set, the inside form for curbs shall be carefully removed and

the surface shall be plastered with a seven-sack grout topping. The mortar shall be applied with a template made to conform to the dimensions of the existing curb. All exposed surfaces shall be brushed to a smooth and uniform surface. Membrane curing materials shall be applied. All concrete placed under the item shall contain 7% + 1-1/2% entrained air. The completed work shall be cured for a period of not less than seventy-two (72) hours.

5.44.5 Measurement and Payment

5.44.5.1 Measurement

Work and accepted material for concrete curb, elevated concrete curb, concrete gutter, or concrete curb and gutter will be measured by the linear foot, complete in place.

5.44.5.2 Payment

The unit prices provided shall be full compensation for all required excavation and disposal of excess material, required compaction and/or fine grading of the surface, sprinkling, materials, equipment, labor, and incidentals necessary for a complete, in-place curb, gutter, or combined curb and gutter.

5.45 - Concrete Cap and Rigid Pavement

5.45.0 General

5.45.1 Scope

The work covered by this section includes all necessary operations and materials involved with placing a concrete cap or rigid pavement at locations as required.

5.45.1.1 Concrete Cap

Concrete caps shall be used when specified by the OWNER, in areas where major traffic lanes create excessive wheel-loading or where compaction of the base and sub-base is prone to failure.

5.45.1.2 Rigid Pavement

Rigid Pavement shall be used when specified by the OWNER and in repair of utility trenches cut in rigid pavement.

5.45.2 Material

5.45.2.1 Concrete

All concrete shall be Class A, 3,000 psi.

5.45.2.2 Curing Material

All concrete shall be treated with a curing material capable of protecting the pavement from loss of moisture for a period of not less than seventy-two (72) hours.

5.45.2.3 Reinforcement Steel

Reinforcing steel shall be standard billet steel deformed bars of minimum sixty kips per square inch (60 ksi) strength.

5.45.3 Construction Methods

5.45.3.1 Concrete Caps

Concrete caps shall be six inches (6") in thickness and of a length and width sufficient to extend a minimum of six inches (6") beyond the edge of the utility trench. The concrete shall be properly placed and finished in accordance with OWNER's specifications and shall be allowed to cure without disturbance for a period of not less than seventy-two (72) hours.

5.45.3.2 Rigid Pavement

Rigid pavement shall be concrete a minimum of six inches (6") in thickness and extending six inches (6") each way transverse to the utility trench placed over existing subgrade. In order that the quality of the replacement pavement shall be consistent with or exceed the quality of the original pavement, reinforcement bar sizes shall be equal to or larger than those in the existing pavement and at locations as close to the original installation as feasible. In no case shall reinforcement bars be smaller than #4 and on spacings greater than twelve inches (12")

each way. New rigid pavement shall be doweled a minimum of twelve inches (12") into existing rigid pavement with minimum #4 bars twenty-four inches (24") in length on twelve inch (12”) centers.

The concrete shall be properly placed and finished in accordance with OWNER's specifications and shall be allowed to cure without disturbance for a period of not less than seventy-two (72) hours.

5.45.4 Measurement and Payment

5.45.4.1 Measurement

That portion of the work which is applicable and completed will be measured at the rate of square foot of surface area.

5.45.4.2 Payment

The unit prices bid shall be full compensation for all required excavation and disposal of sacrificial backfill and existing material required for complete construction and repair, compaction, and/or fine grading of the utility trench surface, sprinkling, materials, equipment, labor, and incidentals necessary for a complete in-place concrete cap or rigid pavement.

a) Concrete Cap Six Inch (6") Thickness: Placement of concrete cap with six inch (6") thickness where the CONTRACTOR has placed the trench backfill.

b) Rigid Pavement: Placement of rigid pavement where the CONTRACTOR has placed the trench backfill.

c) Rigid Pavement and Removal of Excess Base or Sacrificial Backfill: Placement of rigid pavement where the OWNER has placed the trench backfill.

d) Concrete Cap Six Inch (6") Thickness and Removal of Excess Base or Sacrificial Backfill: Placement of concrete cap with six inch (6") thickness where the OWNER has placed the trench backfill.

5.46 - Site Clean-up

5.46.0 General

5.46.0.1 Scope

This section of the specifications outlines the responsibilities of site clean-up. Any work performed under this contract shall include site clean-up.

Areas in paved street roadways or alleys disturbed during construction shall be scraped and broomed, as necessary, and left in a clean and neat condition to the satisfaction of the OWNER. No direct compensation will be made for this work.

Areas beyond the paved street roadway or alley disturbed during construction shall be scraped, raked, graded or broomed, as necessary, and left in a clean and neat condition to the satisfaction of the OWNER. Compensation for this work shall be at the hourly rate as bid on this item in the bid schedule.

All site clean-up shall be done before final acceptance of construction will be considered.

5.46.1 Trench Spoil Removal

Trench spoil is either spoil material removed from the trench by the OWNER or unsatisfactory backfill material left on site by the OWNER outside of the trench repair boundaries. This material will not include Temporary Backfill. The CONTRACTOR will remove and dispose of this material unless otherwise directed by the OWNER.

5.46.2 Measurement and Payment

5.46.2.1 Measurement

a) Hourly Site Clean-up: Prior to initiation of work on the site, the CONTRACTOR shall meet with the City of San Angelo Inspector to define the limits of site clean-up within the general area of the job site. The CONTRACTOR and the City of San Angelo Inspector shall come to a mutual agreement as to the amount of clean-up required outside the job site limits and set a reasonable time for the amount of hours required to clean-up.

b) Trench Spoil Removal: Measurement shall be for each cubic foot removed as determined by the City of San Angelo Inspector either by volume of trench work, trucked volume, or physical measurement.

5.46.2.2 Payment

a) Hourly Site Clean-up: Payment will be for all manpower, materials, equipment and resources required to clean up the site and remove all excess material and debris at the hourly rate bid in the contract for the hours determined above.

b) Trench Spoil Removal: Payment will be for the cubic feet of material removed at the unit price bid in the contract.

5.47 - Removal and Replacement of Driveways and Turnouts

5.47.0 General

5.47.0.1 Scope

This Item shall govern for the construction of new driveways and turnouts or the removal and replacement of driveways and turnouts. Driveways and turnouts shall be concrete of the design type specified and shall be constructed according to the Typical Sections and Details.

5.47.1 Materials

Base, stabilized base, asphalt surfacing, concrete pavement, reinforcing steel and other materials shall conform to the material requirements of the pertinent items.

5.47.2 Construction Methods

The driveways and turnouts shall be constructed according to the Typical Sections and Details. Unless otherwise directed by the OWNER, the CONTRACTOR shall provide uninterrupted access to the adjacent property.

Stabilization of subgrade will be required where specified on the plans in accordance with the construction methods of the pertinent stabilization items.

Base material shall be placed on the subgrade, sprinkled, bladed compacted and shaped to conform to the typical sections shown on the plans and specified in the construction methods of the pertinent base item.

The subgrade, foundation, or pavement surface shall be shaped to line, grade and cross sections and constructed in accordance with the details shown on the plans.

When concrete pavement is specified on the plans it shall be in accordance with the construction methods of the “Cast in Place Concrete” specification. Reinforcing steel shall be placed as shown on the detail drawings. Care shall be exercised to keep all steel in its proper location during concrete placement. Hand finishing will be permitted.

5.47.3 Payment

The work performed and materials furnished in accordance with this Item shall be measured and paid under the Rigid Pavement bid item and shall be full compensation for furnishing all materials required; all labor, tools, equipment, all excavation and hauling of excavated material, all removal, hauling and disposal of concrete driveways, curbs, and debris and all sprinkling, compacting and incidentals necessary to complete the work.