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CONSTRUCTION SPECIFICATIONS

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CONSTRUCTION SPECIFICATIONS

ITEM 200
GENERAL

200.1 DESCRIPTION

This section of the specifications contains detail specifications and descriptions covering the major items of construction and workmanship necessary for constructing the various elements of the work.

The specifications are intended to be written so that only first class workmanship and the best grade of finish and quality will result. Meeting the minimum requirements will not be considered satisfactory. The fact that these specifications may fail to be so complete as to cover every detail of construction will not relieve the Contractor of the responsibility for providing a project of the highest quality, of first class finish and appearance and satisfactory for operation.

200.2 PROJECT MAINTENANCE

The Contractor shall maintain and keep in good repair all work specified under these Contract Documents for a period of two years. All necessary repair, reconstruction, replacement and renewal of any or all of said construction within two years will be the responsibility of the Contractor. All labor, materials and equipment necessary to make good the repair or removal of any defective construction growing out of or on account of breakage, failure of the improper function of the facilities furnished by the Contractor, shall be at the Contractor's expense.

In the event that a part of the project is accepted for use by the Owner prior to the final acceptance of the project, the Contractor shall obtain from the Engineer, a separate written acceptance for the work together with a statement that the two years of guarantee shall apply from the date of such separate written acceptance.

200.3 SALVAGING OF MATERIALS

All salvaged material shall remain the property of the Owner, and salvageable material which is destroyed or damaged in its removal by the Contractor due to his negligence shall be replaced by the Contractor with new material of equal or better quality at his expense. The Contractor shall make every reasonable effort to remove equipment, pipe, valves, fittings, etc., without damage to same and, unless required for reinstallation, shall clean same and deliver to the Owner as directed by the Engineer.

200.4 USE OF EXISTING FACILITIES

The Contractor shall not make use of any existing facilities, fire hydrants, valves, power supplies, etc., without the permission of the Owner. After permission is received, the Contractor will use only approved tools and equipment in connection with the use of existing facilities and shall make any repairs or replacements required to restore satisfactory operation to the existing facility prior to final acceptance at his expense.

200.5 MOVING AND REINSTALLING EXISTING EQUIPMENT, MATERIALS, ETC.

Where it shows on the Plans that certain items of equipment such as valves, meters, pumps, etc., are to be moved by the Contractor and reinstalled, the Contractor shall inspect the existing equipment to determine that it is in satisfactory working condition and shall notify the Engineer in writing if any equipment is not in proper operating condition prior to the start of work.

All relocated equipment which is damaged or destroyed by the Contractor shall be replaced by new equipment of equal or better quality at the Contractor's cost and expense. Relocated equipment shall be installed in a complete and workable condition and shall be readjusted or recalibrated as necessary. The Contractor shall furnish the services of a manufacturer's representative if necessary for satisfactory reinstallation and recalibration. Relocated equipment shall be cleaned and painted to match installation of comparable new equipment.

END OF ITEM

CONSTRUCTION SPECIFICATIONS

ITEM 201
EXCAVATION AND BACKFILL

201.1 GENERAL

The excavation, done in connection with the project, consists of removing all materials, structures, or parts of structures in the area. The area consists of the vicinity in or along which the structure, parts of structure, and/or pipe lines are to be located, removed, and/or relocated.

Backfilling is the restoring of excavated area to a condition which meets the Engineer's approval.

The Engineer shall have the right to limit the amount of trench that shall be open or partly open in advance of or following the pipe laying. Unless otherwise directed by the Engineer, the remaining embedment shall follow immediately the pipe laying, and all remaining backfilling shall follow within 300 feet. In the event that the Contractor fails to comply with this requirement, the Engineer and/or Owner may stop the pipe laying until the requirements are met.

All excavated material unfit for backfill shall be removed from the site by the Contractor and disposed of at his expense.

201.2 EXCAVATION - GENERAL

Trench excavation shall be to the line and grade provided by the Engineer. A profile of the existing ground surface and elevation of the pipe is shown on the Plans for all water lines and for all sewer lines.

The Contractor shall remove such trees on or along the work, as the Engineer directs, and shall carefully protect all other trees adjacent to the work. Excavation machinery shall not be allowed to damage trees; rope or guy cable connections will not be allowed on trees that are not to be removed.

201.3 EXCAVATION CLASSIFICATIONS

All excavation is "unclassified" and involves the removing of all materials necessary to permit the carrying on and completion of the work. Bidders must satisfy themselves as to the actual subsurface conditions, including but not limited to the depth, location and sizes of pipe of various kinds now in place.

201.4 METHODS OF EXCAVATION

Prior to commencing any excavation, the Contractor shall provide ample labor, equipment, and shoring material to insure that the work will be carried on safely and without interruption or damage to existing installations and to provide the least interruption of traffic.

Where traffic must cross open trenches, such as street intersections and driveways, the Contractor shall provide suitable backfill bridges. The use of machinery must be so regulated as to preclude any unnecessary interference with traffic and utilities.

A. Blasting

Blasting will not be allowed.

B. Tunneling:

At the Contractor's option he may install any portion of the pipe line scheduled for open cut construction by tunneling or jacking. Such tunneling or jacking operation shall comply with the requirements of Item 257, PIPE INSTALLED BY OTHER THAN OPEN CUT. Whenever the pipe is installed by tunneling or jacking at the Contractor's option, there will be no additional payment over the open cut installation prices contained in the proposal.

The installation of pipe under existing concrete curbs and gutters for sanitary sewer house services shall be done by tunneling under the curb and gutter. There will be no special payment for such tunneling. The cost shall be included in the price bid for installing sanitary sewer house services.

Pipe installed by tunneling or jacking where required by the Plans will be paid for at the unit price bid as shown in the proposal. Any such tunneling and jacking operation shall conform with the requirements of Item 257, PIPE INSTALLED BY OTHER THAN OPEN CUT.

C. Coffer Dam:

Where shown and/or detailed on the Plans, excavation shall be performed within a coffer dam. The Contractor shall install and securely brace the coffer dam and shall remove the excavation without damage to or displacement of the coffer dam and bracing.

D. Excavation in Rock:

In both water and sewer line construction where rock, cemented gravel, boulder or unyielding shale or marl are encountered in the trench bottom, all such material shall be removed to a depth of not less than six (6) inches below the pipe at designed grade for the full width of the trench.

E. Trench Safety:

Per Texas House Bill 1569, effective as of September 1, 1989, it shall be the responsibility of the Construction Contractor to provide and maintain a viable trench safety system at all times during construction activities. The Contractor shall provide a linear foot price for trench safety provisions meeting the requirements of the United States Department of

Labor Occupational Safety and Health Administration regulations, as contained in Subpart P, Part 1926, of the Code of Federal Regulations. The Contractor shall be responsible to provide a competent person on-site who has the authority to make modification in construction to ensure the safety of personnel working in the trench and the traveling public when working in public streets. All labor, materials and equipment required to provide for trench safety shall be included under the bid item at a per linear foot (L.F.) price, and shall include mains, service lines, all other appurtenances and removal of system. Trench safety for depths less than five (5) foot depth (to be in accordance with OSHA Standards), will be subsidiary work to the installation of the pipe. Trench depth for payment purposes for Trench Safety Systems is the vertical depth as measured from the top of the existing ground to the bottom of the pipe.

201.5 EXCAVATED MATERIAL

All excavated material shall be piled in such a manner that it will not endanger the work in progress and will avoid blocking sidewalks and driveways or obstructing traffic. Driveways must be immediately cleared to permit free access. Gutters and drainage channels shall be kept clear or other means of securing proper drainage shall be provided.

201.6 DEWATERING

Where ground water is encountered, the water table shall be lowered so that all necessary work may be carried on in the dry. The water shall be kept down until the unit or section under construction is completed. No water shall be allowed to flow through or over unset concrete or through the completed line.

201.7 USE OF WASHED GRAVEL AND BALLAST STONE

Where ground water is encountered, four (4) inches of washed gravel shall be placed along the full width of the trench in lieu of the granular embedment upon which the pipe will rest. The Engineer will direct the Contractor when and where to place washed gravel.

Ballast stone may be used only in the event that the trench bottom is of such unstable condition that normal construction will not be permitted.

201.8 EXISTING STRUCTURES

At the expense of the Contractor, all existing structures, improvements and utilities shall be adequately protected from damage that may occur due to construction operations. Where construction comes in close proximity to existing structures or utilities, or if it becomes necessary to move services, poles, guy wires, pipelines or other obstructions, the Contractor shall notify and cooperate with the utility or structure owner. The utility lines and other existing structures shown on the Plans are for information only and are not guaranteed by the Owner to be accurate as to location and/or depth. The Contractor shall be liable for damage to any utilities resulting from the operation. During construction all fire hydrants, valve boxes, fire or police call boxes and other

existing utility controls shall be left unobstructed and accessible.

Unless noted on the Plans that utilities are to be moved by others, any cost of temporarily or permanently relocating utilities shall be included in the Contractor's price bid per foot of pipe. In case damage to an existing structure or utility occurs, whether total failure or settlement, the Contractor shall restore the structure or utility to its original condition and position without extra compensation.

Whenever sanitary sewer mains, laterals or service lines are encountered by trenching operations, the sewer pipe shall be replaced with one eighteen (18) foot joint of ductile iron pipe centered in the trench. The ductile iron pipe shall have solid bearing on undisturbed earth, at least eighteen (18) inches back from the face of the trench. The jointing and connecting of the ductile iron pipe to clay or concrete pipe shall be done in accordance with the Owner's standards. Upon completion of the joints they shall be completely surrounded with thoroughly compacted moist backfill.

All long lengths of ductile iron pipe installed as directed above shall be provided with additional intermediate support or supports, as directed by the Engineer. Cuts or breaks in sewer mains and laterals or service connections shall be restored at the earliest practical moment in order to give the least possible interruption in service. The Contractor shall be responsible for notifying customers of temporary interruption of service. All replacement and/or repair to sanitary sewer lines shall be at the Contractor's expense.

Whenever water service connections are crossed, and the excavation is being done by machinery; service lines are to be repaired/replaced immediately after the excavation machine has passed the service in order to minimize interruption of water service to the customer. It shall be the Contractor's responsibility to notify each customer amply ahead of the time of the disconnecting of his service. The Contractor shall provide ample support for the services across the open ditch.

Where the trench is excavated by hand, services are not to be disconnected; however, ample support shall be provided for the services across the open ditch.

After the completion of the backfilling, services are to be reinstalled in a workmanlike manner, providing a firm support which will not settle and to the satisfaction of the Engineer.

201.9 BACKFILL - GENERAL

Backfill is divided into two major categories: granular embedment and select backfill material.

Embedment is the material upon which the pipe rests and covers sewer lines to a depth on one (1) foot and water lines to a depth of six (6) inches. Embedment shall be composed of six (6) inches of crushed limestone bedding material upon which the pipe rests and extends to the pipe springline with the remaining portion of the embedment consisting of granular material as specified in Item 101.

Select backfill material is specified in Item 101, BACKFILL. It is the material required to fill the trench from the granular embedment to ground elevation of subgrade of a street.

In areas outside of streets, drives, etc., trench backfill above embedment material may be accomplished by the use of excavated material, if the material is suitable for compaction and contains only an occasional rock up to six (6) inches in its greatest dimension.

201.10 GRANULAR EMBEDMENT INSTALLATION

The granular embedment, to receive the pipe, shall be placed to a grade slightly higher than required for the grade by tamping or the removal of the slight excess embedment under the pipe. Adjustment to grade line shall be made by scraping away or filling with embedment material. Wedging or blocking up of pipe will not be permitted. Each pipe section shall have a uniform bearing on the embedment for the length of the pipe, except for immediately at the joint. Embedment under either water or sewer line shall amount to at least four (4) inches in earth cut and six (6) inches in rock cut. Granular embedment over the pipe shall be at least six (6) inches on water line construction and twelve (12) inches on sewer lines.

Where sand of quality meeting the requirements for granular embedment material is encountered at the bottom of the trench excavation, it will be necessary to excavate below the grade of the pipe just as though the material were unsuitable. Then, this material may be replaced in the trench to receive the pipe.

Where sand of a quality meeting the requirements for granular embedment is encountered in the trench excavation, it may be hauled and used along the route of the trench. If the line is located on an easement, the Contract or must obtain the permission of the property owner before removing the material.

When excavated material is to be used a granular embedment, the material must be carefully segregated in stock piles to prevent mixing and contamination by unsuitable material.

Compaction of granular embedment by flooding will not be permitted. The procedure for jetting is outlined in Paragraph 201.11.B below.

201.11 TRENCH BACKFILL

A. General:

Compaction of backfill shall be accomplished either by jetting with water or by mechanical tamping, unless otherwise specified. Backfill material having a plasticity index (PI) greater than ten (10) may not be jetted and must be tamped.

Trench backfill in areas outside of street right-of-ways, drives, etc., shall be compacted to eighty-five percent (85%) Standard Proctor Density and the entire area left in a neat and orderly condition with excess material mounding over the trench.

After a suitable length of time to permit settling, the trench surface shall be brought to a smooth grade. Certain spoil material may not be suitable backfill material even though it contains no rock in excess of three (3) inches nor lumps larger than six (6) inches.

B. Compaction by Jetting:

After sufficient time has elapsed for the free moisture to be gone from the embedment material, the remaining backfill shall be placed in layers not exceeding three (3) feet in depth and thoroughly settled by jetting with water.

Jetting shall be done with a one (1) inch pipe of sufficient length to reach the bottom of the layer being compacted and shall be connected to a hose of sufficient size with pressure to complete the work thoroughly and promptly. The jetting pipe shall be applied to the backfill on each side of the pipe at intervals of not more than five (5) feet. The jetting pipe shall be forced to the bottom layer of backfill and slowly removed to ensure complete compaction of the material. Jetting shall be done in such a manner as not to displace the pipe from its original position.

The manner for compacting backfill in trenches will be furnished to the Contractor at the nearest available fire hydrant. All such connections shall be properly maintained to prevent leakage, damage, interference with traffic or unsightliness. The Contractor shall make arrangements to pay for this service with the Owner.

C. Compaction by Tamping:

After the free water has disappeared from the embedment material, material suitable for mechanical compaction may be used as backfill. If hand pneumatic tampers are used, the backfill shall be placed in layers not exceeding three (3) inches and thoroughly tamped in place. If heavier tampers that are operated by combustion, motor or hydraulic cylinder are used, the thickness of the layers may be increased to a maximum of thirty (30) inches, provided the required density is obtained. Such backfill shall be placed in uniform layers completely across the trench, and compaction shall progress in an orderly and uniform manner. Utmost care must be taken with tamping in this manner not to injure the pipe. If compaction by use of a tamping roller is elected, the backfill shall be placed in lifts not exceeding eight (8) inches in thickness.

201.12 BACKFILLING AROUND STRUCTURES

Excavation around structures shall be backfilled with excavated or other material to the elevation shown on the Plans. The backfill material shall be placed in layers not exceeding four (4) inches in thickness, adding sufficient water to moisten the material and shall be compacted until the material is of the same density as the undisturbed earth in the sides of the excavation.

201.13 BACKFILLING TRENCHES IN STREETS

City streets are defined as that area between the right-of-way lines as the street is dedicated. The roadway shall be defined as the area between parallel lines extending two (2) feet from the back of curb line.

Trenches within street right-of-ways shall be backfilled with select material as specified in Item 101, BACKFILL. In certain areas where designated by the Engineer or his Inspector, the entire trench above the embedment shall be backfilled and compacted with road gravel as specified in Item 101, BACKFILL.

Backfill within street roadways shall be compacted to ninety-five percent (95%) Standard Proctor Density. Backfill within streets to be paved in six (6) months or within the area from street roadway to street right-of-way shall be compacted to ninety percent (90%) Standard Proctor Density.

The Contractor shall furnish all materials, labor and equipment for taking samples and the restoration of the trench surface afterward. If tests indicate that backfill does not meet the density requirements, the Contractor shall remove the backfill material to a depth of one (1) foot above the pipe, or as required by the Engineer, and re-backfill with suitable material until the required density is obtained.

201.14 MAINTENANCE OF STREETS DURING CONSTRUCTION

The Contractor shall at all times maintain the street surfaces on streets on which he is working or has worked. The maintenance required will include the filling of holes, blading or otherwise smoothing of the street surfaces (particularly the trench area), cleaning and removal of surplus excavation material, rubbish and the elimination of interference or blocking of the street to residents. Any or all operations shall be performed upon demand of the Engineer, and the cost of such maintenance shall be included in the unit prices bid for the various items of work.

In the event the Contractor fails or refuses to properly maintain the surfaces of streets on which he is working or has worked, the Owner, after due notice to the Contractor's Superintendent, will perform the necessary maintenance, and all costs to the Owner will be deducted from any monies due or to become due to the Contractor for work performed. Notice to the Contractor shall be given by the Engineer, shall be in writing and shall be delivered to the Contractor's Superintendent or his authorized agent. Except in emergency cases where immediate action is required, the Contractor shall have twenty-four (24) hours to comply with the instructions of the Engineer, and failing to do so, the Owner will proceed with the work as set forth above.

201.15 RESTORATION OF PARKWAY STRUCTURES

Backfilling in all parkways in public streets shall be subject to the same requirements as elsewhere in public streets, but special attention shall be given to restoring the surface over trenches cut in parkways. In particular, special attention shall be given to restoring grass-covered

areas to their condition prior to commencing trenching operations. No trees shall be cut, trimmed or damaged in any way whatsoever without specific consent of the Engineer.

201.16 DEPTH OF COVER

Unless otherwise shown on profile or noted on the Plans, all water lines shall be laid with the top of the pipe a minimum of three and one-half (3.5) feet below the top of the natural ground.

Cuts for all pipe to be installed will be furnished by the Engineer. Any change in grade must be approved by the engineer prior to making such change.

201.17 MEASUREMENT AND PAYMENT

No separate payment will be made for excavation or embedment and backfill material; therefore, the costs incurred in excavation, placing, compacting, disposal of excess material, etc., shall be included in the price bid per linear foot of pipe being laid.

A. Extra Depth of Water Line:

Measurement for payment of extra depth of trench shall be made by the amount of extra depth per linear foot. However, no payment shall be made for the first foot of depth below the designated grade. When the depth exceeds one foot, measurement will be made from the finally established grade up to a point one foot below the designed grade. Payments for depths of not less than a full foot shall be in proportion to the amount per full foot. No additional payment will be made for excavation for embedment, cradle, sub-footing, timber, rock, gravel or concrete foundations.

Payment will be made on the basis of the unit price bid in the proposal for extra depth.

B. Extra Depth of Sewer Line:

No extra payment shall be made in the construction of sewer line.

END OF ITEM

CONSTRUCTION SPECIFICATIONS

ITEM 202
INSTALLATION OF DUCTILE IRON FITTINGS AND SPECIALS

202.1 DESCRIPTION

Ductile iron fittings and specials are to be installed at the line and as specified in these Contract Documents.

In the installation of water mains, the Contractor shall commence his work with a connection to an existing main carrying water at system pressure, shall carry on his work progressively from such connection, and as each section of line is completed shall introduce water into it at system pressure at the earliest practical time.

202.2 GENERAL

All of the requirements of the specifications under 201, EXCAVATION AND BACKFILL, govern the excavation of trenches for installing ductile iron fittings and specials.

202.3 PIPE HANDLING

All fittings and specials shall be lowered into the trench by derrick, tripod, crane or other suitable method. Rolling or dumping it into the trench will not be permitted. Pipe fitting shall be handled in such a manner as not to damage the coating. All dirt and trash shall be removed from the barrel and the ends of the pipe while it is suspended. Slings shall be used to handle all pipe and fittings; no hooks will be permitted.

Where it becomes necessary to deflect the pipe to avoid obstructions, the deflection of each joint must be approved by the Engineer.

202.4 JOINT MAKING

The types of joints to be used for the various sizes of pipe will be as specified in Item 102, DUCTILE IRON FITTINGS. The methods of marking each type of joint will be as follows:

A. 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 non-toxic vegetable soap lubricant 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, with the follower bolts tightened to the following torque range:

Bolt Size in Inches	Range of Torque in Foot Lbs.
5/8	40 - 60
3/4	60 - 90
1	70 - 100
1-1/4	90 - 120

A torque indicating wrench shall be used to obtain the specified torque range. 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 indicated above, the joint shall be disassembled and reassembled after thorough cleaning. Overstressing of bolts to compensate for poor installation practice will not be permitted.

B. Slip-On Joints:

Slip-on joints, such as Tyton, Bell-Tite or Fatite, shall be made in the following manner. The gasket and the gasket seat inside the bell shall be wiped clean of all extraneous matter. Place the gasket in the bell in the position prescribed by the manufacturer. Apply a thin film of non-toxic vegetable soap lubricant to the inside of the gasket and the outside of the spigot prior to entering the spigot into the bell. Force the spigot home in the bell by use of a crow bar or a fork tool on sizes two (2) inches through eight (8) inches or by use of a jack on sizes ten (10) inches and larger. When using a field cut plain end piece of pipe, taper the outside cut end of the pipe about one-eighth (1/8) inch back at an angle thirty (30) degrees with a portable grinder or a coarse file before making joint.

C. 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.

202.5 JOINT AND PIPE TESTING

All new water mains shall be tested by the Contractor with a hydraulic test pressure of 150 pounds per square inch maximum unless otherwise specified. The pressure test shall be maintained for a continuous period of not less than four (4) hours on each section of the pipeline under test.

The Contractor shall furnish adequate and satisfactory equipment and supplies necessary to make such hydrostatic tests.

Materials and labor for the installation of corporation stops in ductile iron mains for this purpose will be furnished by the Contractor. The Contractor shall be responsible for all excavation, etc., in preparation for installation of taps.

The section of line to be tested shall be gradually filled with water, carefully expelling the air, and the specified pressure applied. The Owner will furnish water required for the testing at its nearest water line. All air shall be expelled from the pipe before applying the required test pressure.

All exposed joints shall be examined during the pressure test. All pipe, fittings and valves shall be examined while test is in progress, and 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 one hundred-fifty (150) pounds per square inch pressure shall not exceed thirty-five (35) gallons per inch of pipe diameter per mile of pipe in twenty-four (24) hours for eighteen (18) foot pipe lengths for lines that are mechanical joint or "slip-joint" ductile iron pipe.

Due allowance shall be made for additional joints and for variation in pipe lengths in computing the allowable amount of leakage. Individual sections of pipe may exceed the above amount up to ten (10) percent, but the total leakage for the entire contract shall not exceed the amount specified herein. 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 line involved have been completed.

The cost of testing and finding the leaks, repairing same, and retesting, if necessary, shall be at the expense of the Contractor and shall be included in the unit price bid for laying ductile pipe of the various sizes shown in the Special Contract Documents.

202.6 BLOCKING

Concrete blocking (Class "E" Concrete) shall be placed at bends, 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 and shall be sufficient to withstand the thrust, including water hammer which may develop. Each block shall rest on a firm, undisturbed foundation or trench bottom. When tie downs are required, concrete shall be Class "A" or "B" and constructed as specified is in the Special Contract Documents and/or noted on the Plans.

202.7 PIPE CLOSURE RINGS IS IN SLEEVES

Wherever ductile iron pipe of the various sizes is to be joined by use of sleeves, the Contractor is to cut closure rings from ductile iron pipe of the same size as that to be joined and is to set these rings into the spaces between the pipe ends so that there will be no longitudinal movement of the pipe from water pressure or other causes and so that no hemp used in yarning the sleeve can enter the pipe.

202.8 MEASUREMENT AND PAYMENT FOR DUCTILE IRON FITTINGS

Payment for ductile iron fittings will be made, unless the fitting or fittings are specifically included is in the price bid for an item of work, at the price bid per ton, which payment shall be full compensation for furnishing and installing fittings complete, including excavation, laying, jointing, backfilling, and any incidental work not specifically provided in these Specifications, all is in strict accordance with the Specifications, Plans and/or instructions of the Engineer.

END OF ITEM

CONSTRUCTION SPECIFICATIONS

ITEM 203
INSTALLATION OF CONCRETE PRESSURE PIPE

203.1 DESCRIPTION

Concrete pipe, fittings and specials are to be installed at locations shown on the Plans and as specified in these Contract Documents.

Unless otherwise indicated, pipe shall be laid to the grade shown or an even grade from point to point for which elevations are furnished.

All of the requirements of the specifications under Item 201, EXCAVATION AND BACKFILL govern for the excavation of trenches for laying concrete pressure pipe, fittings and specials, backfilling, etc.

203.2 PIPE HANDLING

All pipe, fittings and specials shall be lowered into the trench by derrick, tripod, crane or other suitable machine 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 pipe end or the outside or inside concrete coating. Before lowering into the trench, each joint of pipe shall be inspected, and any unsound or damaged pipe shall be rejected.

The pipe shall be kept clean and free of all dirt and trash during the laying operation. At the close of each day the open end of the pipe shall be effectively sealed against the entrance of all objects and especially water.

203.3 PIPE JOINTING, BELL & SPIGOT PIPE WITH RUBBER GASKET

Sections of pipe shall be carefully fitted together. The interior joint recess between the ends of the pipe sections shall have a maximum separation of three-fourths (3/4) inch, and a minimum separation of one-half (1/2) inch. The Contractor shall use spacers to insure proper joint spacing. These spacers shall be removed after the pipe has been placed in final position. Care shall be exercised to insure true alignment and grade.

Where it becomes necessary to make major deflections in the line, sections of pipe with beveled ends or fabricated fittings shall be used. Minor deflection of the line of pipe may be obtained in pipe joints; however, maximum joint opening caused by such deflections shall not exceed three-fourth (3/4) inch for sixteen through thirty-six (16-36) inch pipe and one (1) inch for larger pipe. Field cuts of pipe will not be permitted.

Before laying each joint of pipe, the bell and spigot rings shall be thoroughly cleaned by wire brushing and wiping until clean and dry. When the pipe is being laid, the gasket shall be placed

on the spigot ring, and the spigot end of the pipe shall then be entered into the bell of the adjoining pipe and forced into position. The gasket and the inside surface of the bell shall be lubricated with a suitable solution (flax soap) to facilitate the telescoping of the joint.

The exterior joint shall be made by placing a burlap diaper around the pipe. The burlap diaper, or wrapper, shall be hemmed for insertion of strapping. The metal strapping is to be made taut about the pipe through the use of a strapping machine.

The grout used for pouring the joint shall consist of one part of Portland cement and two parts of clean, fine, sharp (plaster) sand mixed to the consistency of thick cream. After the pipe surface has been dampened with water, the joint shall be filled with grout in one continuous operation. The top section shall be of the same 1:2 mix but of a stiff consistency so that it can be properly shaped around the periphery of the pipe joint. The mortar joint shall be properly cured to prevent rapid loss of water and shrinkage.

Upon completion of the backfilling of the trench, the inside joint recess shall be filled with a stiff cement mortar consisting of one part Portland cement to two parts of sand. The joint space shall be moistened by brushing, and the joint shall be leveled to conform with the interior surfaces of the pipe. Joints in small pipe shall be made in accordance with the manufacturer's recommendations.

Where concrete pipe or fittings are to enter into cast iron pipe bells, the joints shall be of cement as specified for laying cast iron pipe; where concrete pipe or fittings enter into the hub ends of valves, the joints shall be of lead as specified for laying cast iron pipe.

Any cuts on the inside surface of the pipe or any chipped areas at the ends of the pipe shall be patched with a mortar of one (1) part clean, sharp sand; all measurements to be by weight. Pipe thus patched shall not be installed until the patch has been properly and adequately cured and until approved for laying by the pipe manufacturer's inspector and by the Engineer.

The Contractor shall furnish the services of a factory trained, job experienced inspector for full time inspection of the pipe installation. This inspector must be on the job whenever pipe is being laid. The inspector shall be satisfactory to the Engineer and to the manufacturer of the pipe and, if unsatisfactory to either, is to be replaced immediately with an inspector who is satisfactory to both parties.

203.4 WELDED PIPE JOINTS

Where indicated on the Plans or specified in the Special Contract Documents, the concrete line cylinder pipe shall have welded joints. Pipe furnished for this type installation shall have joints trimmed or prepared, as recommended by the manufacturer and approved by the Engineer, for joint welding. Before laying, the bell and spigot rings shall be thoroughly cleaned for welding by wire brushing and wiping. In placing the pipe, the sections shall be fitted together with care being taken to secure thorough alignment and grade as shown on the Plans.

203.5 CONCRETE CYLINDER PIPE IN TUNNEL SECTION

Where the Contractor installs concrete cylinder pipe through the tunnel section, the bottom of casing pipe shall be made true with either metal or "Wolmanized" timber skids. The casing invert shall provide for uniform alignment and bearing along the entire length of the tunnel. The cylinder pipe shall be provided with skid rings and standard cement mortar filled inside joints. An approved flexible mastic sealer shall be applied to the exterior of the joint prior to joint engagement. To prevent undue motion of the carrier pipe, each length of pipe shall be restrained in place by a hold-down jack. After the installation of the carrier pipe in the casing, each end of the casing pipe shall be sealed with brick and mortar. All procedures and materials shall be in complete accord with Detail Plans and Specifications.

203.6 JOINT AND PIPE TESTING

All pipe laid under this contract shall be tested by the Contractor with a hydraulic test pressure of 150 pounds per square inch at the lowest elevation. The pressure test shall be maintained for a continuous period of not less than four (4) hours on each section of pipe line under test. The section of pipe to be tested shall be gradually filled with water. After the line or section has been completely filled, it shall be allowed to stand under line pressure for a sufficient length of time to allow the concrete to absorb what water it will and to allow the escape of entrapped air. All air shall be expelled before applying the required test pressure. Water required for testing shall be furnished by the Owner at the nearest line.

At intervals during the test, the route of the main shall be inspected to locate any leaks or breaks. Any defective joints, cracked or defective pipe, fittings or valves discovered shall be removed and replaced at the Contractor's expense.

In order to determine the quantity of water lost through leakage in a section of pipe with rubber gasket joints under the required test pressure, the Contractor will be required to make the leakage test, measuring by use of an approved meter all water used in the test specified herein. The maximum leakage permitted shall not exceed twenty-five (25) gallons per inch of pipe diameter per mile of pipe in twenty-four (24) hours for sixteen (16) foot pipe lengths, for pipe with rubber gasket joints.

For pipe with rubber gasket joints due allowance in computing the allowable amount of leakage shall be made for longer lengths of pipe if used, for additional joints, and for variation in pipe lengths. Individual sections of pipe may exceed the above amount up to ten (10) percent, but the total leakage for the entire contract shall not exceed the amount specified herein. The Contractor will be required to correct the defects and bring the leakage within the specified limits before the contract is accepted by the Owner.

For pipe with welded joints, after due time is allowed for absorption of water by the pipes, no leakage will be allowed.

Permanent pavement shall not be placed over any pipe until all leakage tests of the section of pipe line involved have been completed.

The cost of testing and finding the leaks and repairing defects, and retesting if necessary, shall be at the expense of the Contractor, and shall be included in the unit price bid for laying pipe of the various sizes shown in the Contract Documents.

After testing is completed, lines shall be chlorinated in accordance with Item 237, DISINFECTION OF MAINS.

203.7 MEASUREMENT, CONCRETE PRESSURE PIPE

The length of installed pipe of the various sizes and classes will be measured along the surface of the ground or street along the major axis of pipe from center of fitting to center of fitting or end of pipe without any deduction for the length of intermediate fittings or valves. For pipe laid at a grade greater than three (3) percent, measurement will be made horizontally along the major axis of the pipe.

203.8 PAYMENT, CONCRETE PRESSURE PIPE

Payment for concrete pipe will be made at the price bid per foot of pipe installed for the various pipe sizes and classes, which bid price shall include furnishing and laying the pipe, trench excavation and backfill, cleaning up, maintenance and any other work in accordance with the specifications, drawings and/or instructions of the Engineer.

203.9 MEASUREMENT AND PAYMENT, CONCRETE FITTINGS AND SPECIALS

Concrete pressure pipe fittings and specials installed will be measured and paid for on a lump sum basis for all items shown on the Plans to be made of concrete. In general, this will include all branches for blow-offs and other proposed cast iron connections and for the connection of existing cast iron lines. Where required, taps shall be made with no additional payment.

END OF ITEM

MATERIAL SPECIFICATIONS

ITEM 204
INSTALLATION OF HIGH DENSITY POLYETHYLENE (HDPE) PIPE

204.1 GENERAL

The work in this section consists of the installation of HDPE pipe and fittings.

204.2 HAULING, UNLOADING AND DISTRIBUTING PIPE

During loading, transportation and unloading, every precaution shall be taken to prevent injury to the pipe. No pipe shall be dropped from cars or trucks, or allowed to roll down slides without proper retaining ropes. During transportation each pipe shall rest on suitable pads, strips, skids or blocks securely wedged or tied in place. Any pipe damaged shall be replaced at Contractor's expense.

204.3 FUSION

- A. Sections of polyethylene pipe should be joined into continuous lengths on the jobsite above ground. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 400 degrees Fahrenheit, alignment, and an interfacial fusion pressure of 75 PSI. The butt fusion joining will produce a joint weld strength equal to or greater than the tensile strength of the pipe itself. All welds will be made using a Data Logger to record temperature, fusion pressure, with a graphic representation of the fusion cycle shall be part of the Quality Control records.
- B. Sidewall fusions for connections to outlet piping shall be performed in accordance with HDPE pipe and fitting manufacturer's specifications. The heating irons used for sidewall fusion shall have an inside diameter equal to the outside diameter of the HDPE pipe being fused. The size of the heating iron shall be ¼ inch larger than the size of the outlet branch being fused.
- C. Mechanical joining will be used where the butt fusion method can not be used. Mechanical joining will be accomplished by either using a HDPE flange adapter with a Ductile Iron back-up ring or HDPE Mechanical Joint adapter with a Ductile Iron back-up ring.
- D. Socket fusion, hot gas fusion, threading, solvents, and epoxies will not be used to join HDPE pipe.

204.4 INSPECTION

Inspect the pipe for defects before installation and fusion. Defective, damaged or unsound pipe will be rejected. All joints shall be made available for inspection by the BWSA Inspector before installation if requested.

204.5 TESTING

Pressure testing shall be conducted in accordance with ASTM F2164, Field Leak Testing of Polyethylene Pressure Piping Systems Using Hydrostatic Pressure. The HDPE pipe shall be filled with water, raised to test pressure and allowed to stabilize. The test pressure shall be 1.5 times the operating pressure at the lowest point in the system. In accordance with section 9.8, the pipe shall pass if the final pressure is within 5% of the test pressure for 1 hour. For safety reasons, hydrostatic testing only will be used.

204.6 DISINFECTION

This is only applicable to water applications. Disinfection of water lines shall be as specified in these standard specifications or as directed by the BWSA inspector.

204.7 MEASURE AND PAYMENT

HDPE PIPE, FITTINGS AND ACCESSORIES: Payment will be included under the bid item to which the work relates.

END OF ITEM

CONSTRUCTION SPECIFICATIONS

ITEM 205
INSTALLATION OF DUCTILE IRON PIPE

205.1 DESCRIPTION

Ductile iron pipe, fittings, specials and valves furnished under this contract are to be installed at locations shown on the Plans and specified in these Contract Documents.

Unless otherwise indicated, pipe in trenches shall be laid to the grade shown or an even grade from point to point for which elevations are furnished.

All of the requirements of the specifications under Item 201, EXCAVATION AND BACKFILL, shall govern for the excavation of trenches for laying pipe, fittings and specials, backfilling, etc.

205.2 PIPE HANDLING

All pipe, fittings, specials and gate valves shall be lowered into the trench by derrick, tripod, crane or other suitable machine; and they shall not be rolled or dumped into the trench. Pipe and fittings shall be handled in such a manner as not to damage the pipe. Before being lowered into the trench each joint of pipe shall be inspected, and any unsound or damaged pipe shall be rejected.

The pipe shall be kept clean and free of all sticks, dirt and trash during the laying operation. At the close of each operating day, the open end of the pipe is to be effectively sealed against the entrance of all objects, especially water.

The use of hooks for handling pipe and fittings will not be permitted.

The pipe and fittings to be installed under this contract shall be stored in such a manner that surface water will not enter the pipe. If space is not available along the right-of-way for storing the pipe in a satisfactory location, the pipe shall be properly stacked and hauled to the job only when ready for laying.

When it becomes necessary to deflect the pipe to avoid obstructions, the deflection of each joint must be approved by the Engineer. The deflection shall not exceed the allowable recommended by the manufacturer.

205.3 JOINT AND PIPE TESTING

All pipe laid under this contract shall be tested by the Contractor with a hydraulic test pressure of 150 pounds per square inch unless otherwise specified. If the line is uncovered, the pressure test shall be maintained for a continuous period of not less than four (4) hours on each section of the pipe line under test. If the pipe is covered, the duration of the test shall be six (6) hours.

The Contractor will be required to furnish adequate and satisfactory equipment and supplies necessary to make such hydrostatic tests.

The section of pipe to be tested shall be gradually filled with water, carefully expelling the air, and the specified pressure applied. The Owner will furnish water for the testing at its nearest water line. All air shall be expelled from the pipe before applying the required test pressure.

All joints shall be examined during the pressure test. All pipe, fittings and valves shall be examined while the test is in progress; and any items found to be defective shall be removed, 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 with rubber gasket joints under the required test pressure, the Contractor will be required to perform the leakage test, measuring by use of an approved meter all water used in the test specified herein.

The maximum leakage permitted shall not exceed ten (10) gallons per inch of pipe diameter per mile of pipe in twenty-four (24) hours for pipe with rubber gasket joints and eighteen (18) foot pipe lengths. Due allowance in computing the allowable leakage shall be made for additional joints and for variations in pipe lengths.

Permanent pavement shall not be placed over any pipe until all leakage tests on the section of pipe line involved have been completed.

The cost of testing, locating leaks, repairing defects and retesting, if necessary, shall be at the expense of the Contractor and shall be included in the unit price bid for laying pipe of the various sizes shown in the Contract Documents.

205.4 FINE GRANULAR EMBEDMENT

Except as otherwise indicated on the Plans, all ductile iron pipe shall be laid with an embedment of fine granular material in accordance with the standard detail shown on the Plans. For trench in earth, the excavation shall be made to a depth of four (4) inches below the grade of the outside of the pipe and filled to the depth indicated on the Plans with fine granular material. For trench in rock, excavation shall be made to a depth of six (6) inches below the grade of the pipe.

In all other respects, the pipe shall be installed in accordance with the applicable standard details prepared for this project.

205.5 MEASUREMENT AND PAYMENT

Unless otherwise covered in the Special Provisions and/or the Bid Proposal, the payment for ductile iron pipe will be made at the price bid per linear foot of pipe installed for the various ductile iron pipe sizes. Price shall include necessary furnishing, laying, hauling and handling, excavation and backfill, testing, etc., in accordance with applicable specifications, drawings and/or instruction from the Engineer.

END OF ITEM

CONSTRUCTION SPECIFICATIONS

ITEM 206
INSTALLATION OF STEEL PIPE

206.1 DESCRIPTION

The work to be performed under this section of the specifications shall consist of the furnishing and laying of steel pressure pipeline, complete, including pipe, fittings and specials, clearing and grubbing, excavation, dewatering, pipe laying, backfilling, jointing, testing and any other work that is required to complete the pipeline as shown on the Plans as specified.

The installation of outlets, including blind flanges, flexible couplings and other appurtenances which are shown on the Plans or described elsewhere in these Specifications and for which there is no specific item included on the bid schedule shall be considered a part of the work to be performed and paid for under this section of the specifications.

206.2 STEEL PRESSURE PIPE

All fifty-four inch (54") diameter and smaller diameter steel pressure pipe shown on the Plans and specified herein shall be Welded Steel Pipe, coal-tar coated, wrapped and lined, manufactured and installed in accordance with AWWA Standards C 200-80, C 203-78, C 205-80, C 206-82, C 207-78, C 208-83, C 209-84, and C 214-83, and as further set forth herein.

206.3 GENERAL REQUIREMENTS

- A. The Contractor shall furnish an affidavit that the pipe specials, fittings and appurtenances furnished will comply with all provisions of this and the standard specifications.
- B. The Contractor shall submit to the Engineer for approval the manner in which he intends to deliver and store the pipe and appurtenances to be used.
- C. The Contractor shall submit drawings and schedules showing full details of fabrication of pipe, fittings, specials and appurtenances, coatings to be applied, dimensions, layouts, joint details, and other data pertinent to the manufacture and fabrication of the pipe, fittings, specials and appurtenances.

All drawings and schedules shall be submitted (6 copies) for approval. Two copies shall be returned to the Contractor after approval. No pipe or other materials shall be manufactured until the drawings have been approved.

The Contractor shall submit, along with other required data, a tabulated layout schedule, with reference to the stationing and grade lines as shown on the drawings.

- D. Each pipe length, fitting and special shall have, plainly marked on the bell end of the pipe, the head or loading condition for which it is designed. In addition, marking will be required to indicate the location of each pipe length or special in the line, and such marking will be referenced to the layout schedules and drawings submitted for approval.
- E. Manufacturer's design calculations will be submitted along with other submittal data.
- F. The Contractor shall submit the specific details and methods to be used in welding for approval. Welding operators assigned to field welding of joints shall have been tested under the American Welding Society "Standard Qualification Procedure". The Contractor shall provide certification of the qualification of welders to perform this type of work prior to the welding of the joints. Only welders so certified shall be allowed to do the field welding.
- G. All tests required by this and the referenced specifications shall be made in accordance with standard recognized test procedures and methods. Laboratories performing tests and issuing test certificates shall be subject to the approval of the Engineer. It shall be the responsibility of the Contractor and/or manufacturer to schedule and arrange for tests required, and submit such schedule and arrangements to the Engineer, at no additional cost to the Owner.

206.4 PIPE COATING AND LINING

The complete exterior surfaces of the pipe shall be cleaned and blasted, primed, coated with coal tar enamel, and wrapped with fibrous glass mat, and bonded asbestos felt wrappers. At joints to be welded in the field, the coating shall be left off the ends a distance sufficient to permit making the field joints without injury to the coating. These areas shall be coated in the field. All materials and applications shall be in accordance with applicable provisions of AWWA Standards C 203-78, together with Section A1.5 of the appendix of those specifications.

Primer shall be Type B (fast drying).

Pipe coating shall be such to adequately protect the pipe against extremes in temperatures that have been previously witnessed in the area in which the pipe is to be installed.

All field coating work shall be thoroughly inspected by the Contractor in the presence of the Engineer with an approved electrical flaw detector, and any flaws or holidays shall be promptly repaired by the Contractor to the satisfaction of the Engineer.

The complete interior surface of all steel pipe shall be cleaned, primed and lined with coal-tar enamel. All such materials and applications shall be in accordance with applicable provisions of AWWA Standard C 203-78,

The coal-tar enamel shall be listed in Table 1 of AWWA Standard C 203-78.

At the point of manufacture, all flexible couplings shall be cleaned and primed with material which is compatible with the priming material used on the pipe. The couplings and exposed pipe ends shall be reprimed in the field. When the primer is dry, these surfaces shall be coated with the AWWA coal-tar enamel coating by the method approved in AWWA Standard C 203-78. The areas, where jumper cables have been thermite welded, shall be reprimed and coal-tar enamel coated.

All work shall be done in a thorough and workmanlike manner to the satisfaction of the Engineer. The entire operation of priming, heating and applying coal-tar enamel shall be performed by personnel experienced in this type of work.

The Contractor shall be responsible for adequate ventilation in the pipe during the time of applying coatings and shall take every necessary safety precaution to avoid injury to the personnel.

206.5 FITTINGS AND SPECIALS

The manufacturer shall furnish all fittings and special pieces required for closures, bends, branches, manholes, air valves, blowoffs, and connections to main line valves and other fittings as shown on the drawings, or as set out in the specifications.

Fittings and specials shall be manufactured in accordance with the applicable provisions of AWWA Standards C 201-80, C 207-78, C 208-83, and applicable provisions of other Standards referenced in this specification.

All fittings shall be coated and lined as specified herein for the pipeline.

The type of fittings and details covering the design of fittings and specials shall be furnished by the manufacturer and shall be subject to the approval of the Engineer.

Hydrostatic testing of fittings will not be required.

206.6 PIPE HANDLING AND TRANSPORTING

The manner in which pipe is to be transported, stored, and handled shall be subject to the approval of the Engineer.

Extreme care shall be exercised in all operations to prevent damage to the pipe exterior and interior coating, and to the pipe metal. All equipment to be used in handling the pipe shall be padded. Pipe shall be braced with interior spiders or supports during hauling, shoring and handling. Pipe sections shall not bear against each other.

Rubber belting, canvas or similar materials shall be used for slings and harnesses. Direct contact of the pipe with steel cables or chains will not be allowed.

No metal tools or heavy objects shall come into contact with the pipe. Workmen shall not walk on the finished coating, unless they are wearing rubber or composition soles and heels.

Pipe shall not be unloaded in a manner allowing any portion of the pipe to fall. When pipe is strung along the right-of-way, it shall not be placed on rocks or uneven ground. Suitable methods of support include plaining the ends on padded blocks or mounds of sandy, rock-free dirt.

Particular care shall be exercised in handling pipe at extremely high or low temperatures.

If, in the opinion of the Engineer, the pipe is mishandled, the operations shall be immediately corrected by the Contractor.

206.7 PIPE LAYING

- A. Clearing: Clearing for laying the pipeline shall be within the limits of the right-of-way shown on the Plans, and as specified in these Specifications.
- B. Excavation: All excavation is unclassified and shall include, as required, clearing the work area in the right-of-way, removing buildings, pavement, or other obstructions, excavating for pipe, appurtenances, and other structures along the pipeline, constructing and maintaining detours, installing sheeting, shoring, bracing, protection of work from surface and seepage water and other work necessary to complete the excavation.

There will be no classification of excavation as required by this section of the specification.

- C. Pipe Trenches: The width of trenches for the pipe shall be as shown on the Plans, or as required at fittings, outlets, anchorages, etc.

The depth of trenches shall be as shown on the Plans. Generally the cover of the pipe as shown on the Plans shall be four feet (4') minimum above the outside top of the pipe.

The minimum width of trench excavation at the top of the pipe shall conform to the widths as shown on the Plans.

Where necessary to place sheeting, shoring or bracing, the above minimum trench width at top of pipe shall be maintained between sheeting.

If the trench widths shown on the Plans are exceeded, the Contractor shall cradle the pipe in Class "C" concrete as shown on the Plans, or as directed by the Engineer. This additional embedment required for overcutting the width of trench will be at the expense of the Contractor.

- D. Laying Pipe: Pipe shall not be laid when the subgrade is in a condition unsatisfactory to the Engineer. If subgrade is soft, spongy or disintegrated, the material shall be removed until a firm, stable and uniform bearing is reached and the subgrade brought back to grade with rock foundation thoroughly compacted in place. Rock shall be crushed stone, limestone rock or coarse gravel, free from loam, soil, clay, and vegetable matter, graded in size one inch (1") to three inches (3").

If, in the opinion of the Engineer, the condition was not the result of the Contractor's negligence to make proper provisions for adequate drainage of the excavation, this over-excavation and refill will be paid for in accordance with Gravel Backfill.

If the Contractor elects to undercut the trench and use gravel, or gravel and tile pipe, as an underdrain in lieu of or in conjunction with pumping, bailing, draining or well pointing, the additional work will be considered as incidental work and additional compensation will not be allowed. If the Contractor neglects to provide proper drainage at the proper time, the providing of a proper foundation will be at the Contractor's expense. Embedment for the pipe, or pipe itself, shall not be laid in water.

Unless otherwise approved by the Engineer, the pipe shall be assembled in the trench.

Pipe shall be carefully handled while it is being placed in the excavated trench. All precautions described previously herein shall be exercised. Dragging or pulling the pipe in the trench will not be permitted. Pipe underside shall be carefully inspected while suspended, and any damage thereto repaired before the pipe is lowered into the trench.

Pipe shall be carefully laid on the prepared embedment. Use of wood blocks or other supports in the trench will not be allowed. A space shall be cleared for the joint, pipe lowered into place, and brought to grade by tamping under pipe or removing excess concrete under pipe. After the joint is made, the remainder of the embedment may then be placed and thoroughly tamped to fill any voids created in preparation of the joint. Care must be exercised in tamping to prevent lifting the pipe out of alignment or grade, damage to the coating, or excessive deflection of the pipe.

Pipe shall be laid from a line carefully set for line and grade and approved by the Engineer.

Each pipe section shall have a uniform bearing on the sub-grade for the full length of the pipe barrel. Suitable excavation, or provision, shall be made to receive the pipe joint and allow adequate room for proper workmanship in making the joint. Adjustments to line and grade shall be made by scraping away or filling in with gravel or concrete and not by wedging or blocking up the pipe end.

Pipe ends shall be clean and free from dirt at the time of jointing. Joints shall be made by welding as described herein.

Pipe shall be laid so that the contact in the joint between two lengths of pipe shall be uniform throughout the circumference of the joint.

Changes in vertical and horizontal pipe alignment shall be constructed as curved sections by use of standard pipe with unsymmetrical joint closure, beveled joints, or special fabricated bends or angles, as approved by the Engineer.

The maximum deflection at an unsymmetrical joint closure will be three degrees (3°). All curves or deflections greater than three degrees (3°) shall be constructed by use of special fabricated bends, or a series of uniformly deflected joint enclosures.

Openings at end of days work, openings in wyes, deep cut connections, laterals, cleanouts, etc., shall be capped and sealed watertight.

- E. Welded Joints: Unless otherwise shown, field joints shall be lap joints for fillet welding, as shown on the Plans and as specified.

Pipe fabricated in the shop shall be left uncoated a sufficient distance from the pipe end to allow for field welding without damaging the coating.

All fillet welds shall be full thickness welds.

Where welded joints are to be made on pipe laid on long slopes, adequate anchors shall be provided to prevent the pipe from creeping, and introducing high joint stresses from temperature movement and weight of the pipeline.

Welding procedures will be in strict compliance with the requirements set forth in AWWA Standard C 206-82. Any X-ray testing of welded joints called for by the Owner shall be done at the Owner's expense. Repair of openings made by cutting out specimens for testing shall be done by the Contractor at no additional expense to the Owner.

- F. Flanged Joints: Where indicated on the plans, pipe joints shall be flanged. Flanges shall be faced and drilled at ASA Class 125 pounds standard, suitable for connection with valves or fittings shown on the Plans.

Flanged joints required for the transmission line where it connects with fittings, valves or other pipe shall not be paid for separately, but shall be included in the unit bid price for pipe in the Bid Proposal.

206.8 BACKFILLING

- A. General: After pipe is laid, and sufficient time has elapsed, to prevent damage to welded and coated joints or concrete embedment, the pipeline shall be backfilled as shown on the Plans and as specified herein.

No backfill shall be made, however, until it is authorized by the Engineer. All debris from the trench shall be removed. Sheeting, shoring, and bracing shall be pulled and removed during the progress of the backfilling in a manner satisfactory to the Engineer.

- B. Material: Backfill of the pipeline to a point at least twelve inches (12") above the top outside of the pipe shall be with an approved granular material.

Granular material for backfill is defined as well graded concrete sand or other suitable granular material. The material shall be free-flowing, and devoid of binder, large rocks, lumps, organic material, clay or other undesirable material.

Rock cuttings from the excavation will be acceptable provided they meet the above requirements and provided the largest chips have an average dimension in place less than one-half inch.

- C. Placing: After concrete embedment, if specified on the Plans, has been placed, joints made and inspected, and sufficient time, in the opinion of the Engineer, has elapsed to prevent damage to the embedment or joints, good sound earth shall be brought up in tamped layers not exceeding six inches (6") in thickness of loose fill approximately equal on each side of the pipe, to a height of twelve inches (12") over the top of the pipe.

Material shall not be deposited on top of the pipe.

The first layer shall not extend above the spring line of the pipe. The tamping shall be carefully and thoroughly done in such a manner as not to displace the pipe from its original position. When necessary, in the opinion of the Engineer, backfill materials shall be moistened to facilitate compaction by tamping.

Final backfilling operation is as follows:

1. The remainder of the backfill may be placed in uniformly compacted layers not exceeding one foot in loose depth and hand or mechanically tamped in a manner approved by the Engineer, or:
2. The backfill material may be placed loosely in the trench, mounded up over the trench slightly above the original ground elevation, without tamping, and the trench jetted with water until all settlement has ceased. The jets shall be placed not over six feet apart on alternate sides of the pipe, and care exercised not to float the pipe or disturb it from its true line and grade. Attention is directed to the requirements set forth elsewhere in these specifications for method of backfilling State, County or City right-of-way.

Excavated material which is unsuitable for backfill and excess excavation shall be disposed of as directed by the Engineer, either by removing from the site, or spreading over the right-of-way. The material may be spread over the work area

in neat and sightly condition and in a manner so as to restore the original drainage of the land to its original condition. Where ordered by the Engineer, desirable top soil shall be handled separately and replaced in its original position.

206.9 TESTING AND ALLOWABLE LEAKAGE

After the pipe has been laid for at least seven (7) days the line shall be tested in such sections as are convenient for the Contractor and approved by the Engineer. The Contractor shall furnish all labor, materials, tools and equipment required to bulkhead and seal off the line for testing, fill it with water, raise the filled line to test pressure and measure both pressure and leakage over the test period.

The entire length of the installed line shall be field tested for water tightness in the following manner: The section of the line to be tested shall be filled with water. During the filling of the line care shall be exercised to see that all air vents are open, and all bulkheads, valves, manholes, connections, etc., in the section undergoing test shall be carefully examined for leakage. All known leaks shall be stopped, regardless of these test requirements.

The test shall consist of raising and holding the hydrostatic pressure in the test section to 150 percent of the working pressure for which the pipe was designed, which pressure shall be the highest occurring in the section being tested. Such test pressure shall be maintained for a period of four (4) hours, during which time the water pumped into the line to maintain the test pressure shall be accurately measured in a manner satisfactory to the Engineer.

Leakage during the above test shall not exceed a rate equal to fifty (50) gallons per inch of internal pipe diameter per mile per twenty-four (24) hours.

In the event any section of the line tested fails to meet the above specified requirements for water tightness, the cause of the excessive leakage shall be determined and remedied to the satisfaction of the Engineer, at the expense of the Contractor, including retesting if required.

206.10 CONCRETE BLOCKING

Class "C" concrete shall be placed, as directed by the Engineer, for blocking at each change in direction of the pipe line in a manner which will substantially brace the pipe against undisturbed trench walls. Class "C" concrete shall be placed, as directed by the Engineer, for blocking at vertical changes in direction of the pipe line which will substantially protect the pipe from movement due to internal or external pressures and vertical thrust.

Concrete blocking shall have been in place four (4) days prior to testing the pipe line as herein specified.

Concrete blocking, vertical or horizontal, will be measured and paid for as separate items. The cost thereof shall be included in the appropriate pay items listed in the Bid Proposal and Bid Schedule and measurement will be by the cubic yard computed to the limits outlined in the

appropriate blocking and tie-down details.

206.11 GUARANTEE

All pipe, fittings and appurtenances furnished and installed according to the requirements of these Specifications and the Plans shall be guaranteed for a period of two years after acceptance of the work by the Owner against defective workmanship and materials.

206.12 MEASUREMENT AND PAYMENT

Steel pressure pipe as required by this section of the Specifications will be measured for payment for the pipe (of various sizes) actually installed, measured to the nearest foot. Payment will be made at the unit bid price per linear foot in the Bid Proposal, and such payment shall be full compensation for all clearing, excavation, trenching, pipe, laying, jointing, lining, coating, backfilling, fittings, flanged outlets with blind flanges, and other items necessary to furnishing and installing the pipeline.

Clearing, excavation, trenching, jointing, lining, coating, sheeting, shoring, dewatering, backfilling and jettings as required by this section of the specifications will be considered incidental to other portions of the work and no separate measurement or payment will be allowed.

Measurement of pipe shall be through all fittings, specials, valves, etc., and no deduction in length shall be made for such appurtenances.

Payment of the unit contract price for steel pipe shall be the total compensation for furnishing all labor, pipe and fittings, tools, equipment and incidentals and performing all work that is necessary for the installation in accordance with the Plans and the provisions of these Specifications.

END OF ITEM

CONSTRUCTION SPECIFICATIONS

ITEM 207
INSTALLATION OF PVC WATER PIPE

207.1 DESCRIPTION

The required excavation, trenching and backfilling shall be in accordance with Item 201, EXCAVATION AND BACKFILL.

The following installation practices shall be used in conjunction with the manufacturer's recommendation.

A. Storage

Store pipe away from sunlight and heat. Store all pipe on a flat surface. Do not stock bundles. Pipe left outdoors for prolonged periods (greater than 6 months) should be covered with tarps.

B. Salvage or Damaged Pipe

Pipe with deep scratches or gouges (penetration of more than 10% of wall thickness) running full length of pipe shall be rejected. Localized damage may be cut out and balance of length used.

C. Cutting

Use a medium tooth saw and miter box. Fine emery cloth or sandpaper may be used to remove burrs. Tubing cutters, wheel-type cutters and snap-type cutters are not recommended.

207.2 JOINTS

Unless otherwise specified on the Plans, all pipe joints smaller than two (2") inches shall be solvent weld, all pipe joints two (2") inches and larger shall be slip-on joints.

A. Solvent Weld Method

1. Clean and dry pipe and fitting socket.
2. Make "dry run" by inserting pipe into socket to check for proper fit. Interference should take place between 1/3 and 2/3 of socket depth. Reject all fittings not meeting this requirement. Solvent cement should be furnished in a sealed container.
3. Paint on a coat of Solvent Cement on the pipe end. The length covered should equal the fitting socket depth less one-eighth (1/8") inch. Use a flat brush with natural hair bristles.

4. Paint a thin coat of Solvent Cement to fitting socket surface.
5. Reapply second coat to pipe end.
6. Insert pipe end with twisting motion into fitting socket giving an approximate one fourth (1/4) turn to spread cement. Be sure pipe bottoms are in socket.
7. Hold pipe and fitting together firmly 15 seconds.
8. Wipe off excess cement that appears on pipe surface immediately after making up joint.
9. Allow joint to set before handling. Normally joints will require 5 to 10 minutes to set. During periods of cold weather or high humidity, longer setting times will be required.
10. Pipe may be pressure tested after joints have fully "set up".

A curing period of eight (8) hours is recommended prior to applying pressures up to 50 psi and forty-eight (48) hours is recommended prior to applying test pressures.

B. Slip-on Joint Method

1. Clean and dry pipe and fitting socket.
2. Firmly set gasket in bell according to manufacturer's recommendations.
3. Lubricate pipe ends with lubricant furnished by manufacturer.
4. Push pipe end into position so that the reference mark on the pipe end is in the proper position.

207.3 FITTINGS

All fittings for pipe three (3") inches and smaller shall be polyvinyl chloride pipe material. All fittings for four (4") inch and larger shall be ductile iron in conformance with Material Specification Item 102 and Construction Specification Item 202.

207.4 WATER SERVICE CONNECTIONS

Water service connections shall be in conformance with Material Specification Item 108, Construction Specification 208 and the Plan detail.

207.5 LAYING PLASTIC PIPE

A. Trenching and Laying

1. Trenching shall conform to Construction Specification Item 201, Excavation and Backfill and to the Standard Trench Details, or as shown on the Plans.
2. Pipe shall be placed along ditch line opposite from where backfill is piled.
3. Pipe may be jointed on top of ground and lowered into trench.
4. Pipe should be laid on a smooth trench bottom. PVC lines shall be laid to grades shown in the Plans.

B. Supporting and Backfilling

1. Pipe shall be supported uniformly and continuously. All rocks and sharp objects must be removed from trench bottom. In rock excavation, place a six (6") inch thick layer of selected backfill material on trench bottom upon which pipe will rest.
2. Embedment material shall be placed in accordance with Material Specification Item 10, Construction Specification Item 201, and the Trench Detail contained in the Plans.
3. All joints shall be left well exposed.
4. The line shall be filled with water and the joints examined for leaks.
5. Joints shall then be backfilled by hand.
6. Complete backfilling shall be placed in accordance with Material Specification Item 101, Construction Specification Item 201, and the Trench Detail in the Plans.

207.6 WATER LINES IN VICINITY OF SANITARY SEWERS

Water pipes shall be laid, so far as possible, nine (9') feet above the elevation of nearby sewers at cross-over points and at least nine (9') feet laterally from sanitary sewers. Where this requirement cannot be met because of physical conditions, the sewer shall be replaced with PVC or ductile iron water pipe with a pressure rating of 150 psi for a minimum distance of nine (9') feet on either side of the water main. The minimum vertical separation shall be two (2') feet between the outside diameters and the horizontal separation shall be a minimum of four (4') feet between outside diameters. The sewer shall be located below the water line.

207.7 PVC PIPE CONTRACTION

All PVC pipe expands and contracts at a rate substantially greater than asbestos-cement or cast iron pipe. Therefore, special precautions must be taken to minimize the build-up of stresses due to thermal contraction. The most effective method to prevent excessive contraction is to fill the pipe with water prior to backfilling and to backfill the pipe in the morning while the pipe and soil are approximately the same temperature.

207.8 THRUST BLOCKS

- A. Class "A" Concrete thrust blocking shall be placed in accordance with the standard thrust blocking detail.
- B. Supporting Valves: Valves shall be independently and fully supported. Valves shall be supported with concrete thrust blocking according to the standard details.
- C. Deflecting Pipe: Bending pipe induces stresses. However, gradual curves can be made safely. Minimum radius of curvature shall be 500 feet or greater on sizes through two (2") inches and two hundred (200') feet or greater on larger sizes. Deflection shall

be at pipe joints.

207.9 TESTING AND ALLOWABLE LEAKAGE

After the pipe has been laid for at least seven (7) days, the line shall be tested in such sections as are convenient for the Contractor and approved by the Engineer. The Contractor shall furnish all labor, materials, tools and equipment required to bulkhead and seal off the line for testing, fill it with water, raise the filled line to test pressure and measure both pressure and leakage over the test period.

The entire length of the installed line shall be field tested for water tightness in the following manner: The section of the line to be tested shall be filled with water. During the filling of the line, care shall be exercised to see that all air vents are open, and all bulkheads, valves, manholes, connections, etc., in the section undergoing test shall be carefully examined for leakage. All known leaks shall be stopped, regardless of these test requirements.

The test shall consist of raising and holding the hydrostatic pressure in the test section to 150 psi. Such test pressure shall be maintained for a period of four (4) hours, during which time the water pumped into the line to maintain the test pressure shall be accurately measured in a manner satisfactory to the Engineer.

Leakage during the above test shall not exceed a rate equal to 10 gallons per inch of internal pipe diameter per mile per twenty-four (24) hours.

In the event any section of the line tested fails to meet the above specified requirements for water tightness, the cause of the excessive leakage shall be determined and remedied to the satisfaction of the Engineer, at the expense of the Contractor, including retesting if required.

208.10 CHLORINATION

Each unit of completed water supply line and water distribution system shall be sterilized with chlorine before acceptance for domestic operation.

- A. Materials: The chlorinating material shall conform to the requirements of AWWA Standard C601 and Item 237, Disinfection of Mains.
- B. Method: The amount of chlorine applied shall be such as to provide a dosage of not less than 50 parts per million. The chlorinating material shall be introduced to the water lines and distribution systems in a manner approved by the Engineer. If possible to do so, the lines shall be thoroughly flushed before introduction of the chlorinating materials. After a contact period of not less than twenty-four (24) hours, the system shall be flushed with clean water until the residual chlorine content is not greater than the residual chloring content of the water supplied. All valves in the lines being sterilized shall be opened and closed several times during the contact period. State Health

Department Bacteriological test is required, and approval of lines is subject to results.

- C. Caution should be observed in disinfecting PVC plastic pipe. Explosions have occurred when granular calcium hyperchlorite reacted with the solvent weld materials under certain field conditions. When solvent welded PVC pipe is used, the granular calcium hyperchlorite must not be used in the system until it has been dissolved in water. When chlorinated water is pumped into lines to sterilize the system, these explosions will not occur.

207.11 CLEAN UP

Upon completion of the installation of the water lines, distribution systems and appurtenances, all debris and surplus materials resulting from the work shall be removed.

207.12 MEASUREMENT AND PAYMENT

Measurement and payment will be based on completed work performed in strict accordance with the drawings and specifications. Measurement and payment shall be along the center line to include all valves and fittings. All trenching, backfill and PVC fittings shall be included in the per linear foot price of pipe. Drilled crossings or encased crossings shall be paid for separately in addition to the payment for the pipe. All ductile iron fittings, valves, specials and blocking shall be paid for at the unit price bid in the Bid Proposal.

END OF ITEM

CONSTRUCTION SPECIFICATIONS

ITEM 208
INSTALLATION OF TAPS IN WATER MAINS AND WATER SERVICE LINES

208.1 SCOPE

This Construction Standard applies to the installation of taps and/or tap assemblies in water mains and water service lines as specified on the Plans or as directed by the Engineer.

208.2 TAPS

Taps and/or tap assemblies of the specified size will be installed as indicated on the Plans or as specified by the Engineer. Taps may be made on a water system which is either uncharged or under pressure.

A. Taps are defined as:

1. Installations made by utilizing a bronze service double strap clamp equipped with a sealed, threaded port through which the pipe wall is drilled to complete a service port.

B. Tap Assemblies are defined as:

1. A corporate stop and an iron-to-copper connection attached to a hard copper (Type K) tubing terminating approximately one (1) foot below grade with a brass gate valve as shown on the Plans to serve as air release.
2. Tap assemblies may be required adjacent to gate valves. When so required, payment will be included in the unit price bid for furnishing and installing the gate valve complete.
3. Taps required for chlorination and testing shall be installed in accordance with the Plans or as directed by the Engineer. No separate payment will be made for taps required for testing and chlorination.

208.3 TAPPING CAST IRON OR DUCTILE IRON PIPE

Service taps, unless otherwise specified, shall be made in cast iron and/or ductile iron pipe with a bronze double strap tapping saddle by direct tapping of the pipe wall for tap sizes relative to pipe diameters as follows:

<u>Pipe Diameter</u>	<u>Tap Size</u>
4" through 10"	1"

12" and larger

1-1/2" and 2"

When direct tapping cannot be made within these limits, taps shall be made as specified in Item 108, utilizing bronze service clamps.

208.4 TAPPING CONCRETE PIPE

Tap locations, when available, shall be provided by the pipe manufacturer and taps shall be made during the pipe fabrication. Taps that are required to be made in the field shall be made in accordance with the pipe manufacturers recommended procedure and to the Engineer's satisfaction. Taps through one (1) inch shall be provided with nylon sleeve inserts. Taps one and one-half (1-1/2) inches through three (3) inches shall be provided as flanged outlets with flange to thread insulator adaptor kits.

208.5 TAPPING PVC PIPE

Service connection shall be made utilizing service clamps or saddles.

208.6 SERVICE LINE INSTALLATION

Water service lines shall be installed at the locations shown on the Plans or as otherwise directed by the Engineer, and three (3) feet below existing or proposed top of curb when not otherwise specified on the Plans or in the Special Contract Documents. Installation shall include leak tests as required for the main to which the service line is connected.

A. Installation Procedure:

Water services shall be installed in two separate operations:

1. Tap, service line, and meter box shall be installed as shown on the Standard Details for one (1) inch services or as detailed herein for one and one-half (1-1/2) inches and two (2) inch services.
2. The meter is to be furnished by the Owner.

B. Trench:

Trenching for water service lines may be excavated with a "Ditch-Witch" or similar device provided that ensuing trench width is sufficiently wide to provide for a minimum of two (2) inches of granular embedment on either side of the service line.

C. Depth of Cover:

The depth of cover for service lines shall be as detailed on the Plans, or specified in the Special Contract Documents. When the depth of the service line is not shown, the

installation shall be made three (3) feet below the top of existing or proposed curb grade.

D. Arrangement:

The arrangements of corporation stops, branches, curb stops, meter spuds, meter boxes, etc., will be as shown in the applicable detail, and to the approval of the Engineer.

E. Service Marker:

1. In the event that the meter box is not to be installed by the Contractor immediately subsequent to service installation, the curb stop shall be marked with a strip of blue vinyl tape at least three (3) inches wide and ten (10) mil. thick, fastened to the end of the service and extending through the backfill and approximately six (6) inches above ground at the meter box location.
2. On projects where service taps are to be made only, the tap shall be marked with blue vinyl tape, as above, attached to the corporation stop or plug and extending upward and normal to the main through the backfill at the adjacent trench edge to at least six (6) inches above ground to flag the tap location.

F. Corporation Stops:

On water service line installation each corporation stop shall be fully opened prior to backfill.

208.7 TESTS

Each water service line shall be checked for leaks and full flow through the curb stop at the time that the main is tested.

208.8 MEASUREMENT AND PAYMENT

A. Measurement:

Unless specified otherwise, measurement shall be based on diameter only.

B. Payment:

Payment for the installation of services shall be made at the unit price bid for furnishing and installing the services which shall include tapping the main, corporation stop, pipe, fittings, curb stop, trench excavation, embedment, backfill, and meter boxes.

END OF ITEM

CONSTRUCTION SPECIFICATIONS

ITEM 209
INSTALLATION OF REINFORCED CONCRETE PIPE

209.1 GENERAL

Reinforced concrete pipe and specials for storm drains and pipe culverts shall be installed at locations shown on the Plans and specified in these Contract Documents. Unless otherwise specified in the Special Contract Documents, the requirements of Item 303, TRENCH EXCAVATION AND BACKFILL, shall govern in the installation of reinforced concrete pipe storm drains and/or pipe culverts.

209.2 PIPE HANDLING

All pipe shall be lowered into the trench by suitable mechanical equipment, no pipe shall be rolled or dumped into the trench. All dirt and trash shall be removed from the pipe while suspended.

209.3 REINFORCED CONCRETE PIPE

Prior to being lowered into the trench, each length of pipe shall be carefully inspected, and those not meeting specifications shall be rejected and either destroyed or removed from the job. All lumps or excrescences on the ends of the pipe shall be removed before it is lowered into the trench. The Engineer may order the removal of and relaying of any pipe not laid in accordance with these specifications. Pipe having any defects which do not cause their rejection shall be so laid as to bring those defects to the top half of the sewer.

- A. The pipe and specials shall be so laid in the trench that after the project is completed the interior surface shall conform accurately to the grade and alignment indicated on the Plans. All pipe shall be carefully adjusted to fit snugly in cradling or embedment so that the entire length bears on cradling or embedment material. Pipe shall be laid with the groove end up grade unless otherwise approved by the Engineer.
- B. Before laying, the interior of the groove shall be carefully wiped smooth and clean and the annular space shall be kept free from dirt, stones or water. All water must be kept out of the bell-hole during laying.
- C. 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 or as herein after specified.

209.4 STRING OF PIPE

Stringing of pipe in advance of the laying operation shall be restricted to one (1) week's laying and shall be done in such a manner as to create no hazard to, or interference with, traffic. Ready access shall be provided to all streets, alleys and driveways. The pipe shall be protected with barricades and warning signs at all times. Any damage to the pipe shall be corrected at the expense of the Contractor.

209.5 BY-PASSING OF SEWAGE

Before any sewage may be bypassed from an existing sanitary sewer to accomplish any of the work required on the project, written permission to make such bypass must be obtained from the Owner's Engineer. A request for permission to effect such bypass shall be made in writing at least two (2) days prior to the time needed. The request shall contain full details as to the manner in which bypassing is to be accomplished and the minimum and maximum time bypass is to remain in service. In general, bypassing will not be approved unless it is absolutely essential to accomplish the work, and all costs incurred by the Owner in taking proper health and sanitation precautions as a result of an approved bypass shall be paid by the Contractor.

209.6 LAYING AND JOINTING OF REINFORCED CONCRETE PIPE

A. Excavation and Embedment:

Prior to the commencement of the laying of the pipe, the trench shall have been excavated to the required width and depth, and the specified embedment shall have been placed in the bottom of the trench; all as specified under Item 303, STORM DRAIN TRENCH EXCAVATION AND BACKFILL. Necessary batter boards and lines shall be provided as required for the proper alignment and grading of the pipe line.

B. Pipe Installation:

The pipe shall be carefully lowered into the prepared trench by crane or other mechanical means, and under no conditions shall pipe be rolled or dropped into the trench.

C. Jointing:

Joints using Cold Applied Preformed Plastic Gaskets shall be made as follows:

A suitable primer of the type recommended by the manufacturer of the gasket joint sealer shall be brush applied to the tongue and groove joint surfaces and the end surfaces and allowed to dry and harden. No primer shall be applied over mud, sand or dirt, or sharp cement protrusions. The surface to be primed must be clean and dry when primer is applied.

Before laying the pipe in the trench, attach the plastic gasket sealer around the tapered tongue or tapered groove near the shoulder or hub of each pipe joint. Remove the paper wrapper from only one side of the two piece wrapper on the gasket and press it firmly to the clean, dry pipe joint surface. The outside wrapper is not removed until immediately before pushing the pipe into its final position.

When the tongue is correctly aligned with the flare of the groove, remove the outside wrapper on the gasket and pull or push the pipe home with sufficient force and power (backhoe shovel, chain hoist, ratchet hoist, or winch) to cause the evidence of squeeze-out of the gasket material on the inside or outside around the complete pipe joint circumference. The use of backhoe buckets and similar pieces of equipment will not be allowed for pushing pipe joints on pipe greater than thirty (30) inches in diameter. Remove any joint material that pushed out into the interior of the pipe that would tend to obstruct the flow. Pipe shall be pulled home in a straight line with all parts of the pipe on line and grade at all times. Backfilling of pipe laid with plastic gasket joints may proceed as soon as the joint has been inspected and approved by the Engineer. Special precautions shall be taken in placing and compacting backfill to avoid damage to the joints.

When the atmospheric temperature is below sixty degrees Fahrenheit (60°F), plastic joint seal gaskets shall either be stored in a area warmed to above seventy degrees Fahrenheit (70°F), or artificially warmed to this temperature in a manner satisfactory to the Engineer. Gaskets shall then be applied to pipe joints immediately prior to placing the pipe in the trench, followed by connection to previously laid pipe.

D. Backfill:

All backfill of pipe trenches shall be in accordance with Specification Item 303, STORM DRAIN TRENCH EXCAVATION AND BACKFILL.

E. Fittings for Concrete Pipe:

1. Poured Concrete Pipe Collars

At all changes in pipe sizes in the conduit line, except at manholes, a pipe collar, as shown in detail in the Plans, shall be provided.

2. Shop and Field Fabricated Wyes, Tees, Crosses, and Bends

Shop or field fabricated wyes, tees, crosses, or bends shall be furnished and installed where indicated on the Plans or required by the Engineer. Fittings in which the largest pipe is less than twenty-four (24) inches in diameter shall be shop fabricated. Fittings in which the larger pipe is twenty-four (24) inches in diameter, and increasingly larger sizes, may be field fabricated. Care shall be taken in the fabrication that the concrete walls of the pipe are broken back only

enough to provide the required finished opening. The reinforcing mesh or bars in each pipe shall be joined by bending, twisting, or spot welded which shall provide a rigid connection. Concrete or mortar shall be wiped over the reinforcing wires connecting the two pipe joints, compacted by light blows, shaped to the contour of the pipe barrels, lightly brushed for finish and cured under wet burlap.

3. Poured Concrete Pipe Plugs

When conduit lines terminate at locations which do not include connection to drainage structures the end of the pipe shall be plugged with a field-cast unit as shown on the Plan-Profile Sheets and the costs thereof are to be included in the price bid to furnish and install reinforced concrete pipe. No extra payment will be made for the installation of concrete pipe plugs as shown on the Plan-Profile Sheets.

209.7 SPACING OF PARALLEL DRAIN LINES

Multiple installation of reinforced concrete pipe shall be laid with the center lines of individual pipes parallel. When not otherwise indicated on the Plans, the following clear distances between outer surfaces of adjacent pipe shall be as follows:

Pipe Diameter (Inches)	Clear Distance (Inches)	Pipe Diameter (Inches)	Clear Distance (Inches)
18	9	42	17
24	11	48	19
30	13	54	23
36	15	60 - 84	24

209.8 PROTECTION OF SANITARY LINES

Existing sanitary sewer lines where the top of the sewer line is one foot or less below the bottom of the reinforced concrete pipe shall be excavated and encased with Class "E" concrete; the encasement to extend six (6) inches below the bottom of the sanitary sewer pipe and three (3) inches below the bottom of the reinforced concrete pipe and to extend laterally six (6) inches below the side of the outside of the sewer pipe. Concrete for encasement shall be mixed with the minimum amount of water required for workability and shall be tamped or packed around the sewer pipe.

Existing sanitary sewer lines extending across the trench through the reinforced concrete pipe or above it shall be replaced with Class 150 ductile iron pipe. The ductile iron pipe shall be of

such length as will provide three (3) feet of bearing on undisturbed soil in each side of the trench.

Where sanitary sewer line passes through the reinforced concrete pipe, the ductile iron pipe shall be grouted in with mortar as specified for the jointing of the pipe to form a tight closure for the reinforced concrete pipe.

209.9 MEASUREMENT

Trench excavation will be measured as provided in Item 303, STORM DRAIN TRENCH EXCAVATION AND BACKFILL.

Gravel backfill required or authorized by the Engineer to stabilize the trench bottom will be measured by the cubic yard delivered to the job.

Reinforced concrete pipe will be measured by the linear feet of pipe laid, measured along the center line axis of the pipe.

209.10 PAYMENT

Reinforced concrete pipe will be paid for at the unit prices bid for the respective sizes of pipe. The price bid shall include all costs in connection with the furnishing and installation of the pipe and fittings including the protection of sanitary sewer line and all subsidiary work required in the installation of the reinforced concrete pipe. No extra payment will be made for reinforced concrete pipe fittings, including concrete collars, wyes, tees, crosses, bends and plugs. The price bid does not include the cost of replacement of permanent pavement or street surfacing.

Gravel backfill authorized by the Engineer to stabilize trench bottom will be paid at the invoice cost of the gravel delivered to the job site.

END OF ITEM

CONSTRUCTION SPECIFICATIONS

ITEM 210
INSTALLATION OF GRAVITY SEWER PIPE

210.1 GENERAL

Gravity sewer pipe shall be installed at locations shown on the Plans and specified in these Contract Documents. Pipe shall be laid to line and grade shown on the Plans. Unless otherwise specified in the Special Contract Documents, the requirements of Item 201, EXCAVATION AND BACKFILL, shall be applied to this section.

Flexible and Semi-rigid Sewer Pipe shall be installed in accordance with the most current revision of ASTM Standard D 2321, "Standard Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe", available from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania, 19103. In addition, written recommendations of the pipe manufacturer shall be followed, where these recommendations do not conflict with ASTM D 2321.

210.2 PIPE HANDLING

All pipe shall be lowered into the trench by suitable mechanical equipment; no pipe shall be rolled or dumped into trench. All dirt and trash shall be removed from the pipe while suspended.

210.3 SEWER PIPE

Prior to being lowered into the trench, each pipe shall be carefully inspected, and those not meeting specifications shall be rejected, and either destroyed or removed from the job. All lumps or excrescences on the ends of sewer pipe shall be removed before it is lowered into the trench. Sewer pipe having any defects which do not cause their rejection shall be so laid as to bring those defects to the top half of the sewer.

- A. The pipe and specials shall be so laid in the trench that after the project is completed, the interior surface shall conform accurately to the grade and alignment indicated on the Plans. All pipe shall be carefully adjusted to fit snugly in cradling or embedment so that the entire length bears on cradling or embedment materials. Pipe shall be laid with the bell (or groove) end upstream, unless otherwise approved by the Engineer.
- B. Before laying, the interior of the bell shall be carefully wiped smooth and clean and the annular space shall be kept free from dirt, stones, or water. All water must be kept out of the bell-hole during installation.
- C. Pipe shall be installed on joints made up in complete conformance with the instructions and recommendations regarding proper installation and assembly furnished by the manufacturer.

- D. When work is suspended on the line for any reason, the end of the line shall be properly plugged to prevent water, trash, dirt or rodents from entering the line. When sewer services are installed, the end of the services shall be plugged with a precast plug or other suitable means, meeting the approval of the Engineer.
- E. A four (4) inch sewer service line will be constructed as required and shown on the Plans or when designated by the Engineer, subject to the following conditions:
1. The 4" tap on main for service line shall be a 90 degree "T".
 2. Service lines shall extend from the sanitary sewer lateral in the street to a point at least four feet behind the curb, unless otherwise shown elsewhere.
 3. Sewer services shall be subject to the same exfiltration test as specified in 210.6 of these specifications.
 4. Inspection of these services will be made by the Engineer; no sanitary sewer application is required.

210.4 STRINGING OF PIPE

Stringing of pipe in advance of the laying operation shall be restricted to one (1) day laying and shall be done in such a manner as to create no hazard to, or interference with, traffic. Ready access shall be provided to all streets, alleys and driveways. The pipe shall be protected with barricades and warning signs at all times. Any damage to the pipe shall be corrected at the expense of the Contractor.

210.5 BY-PASSING OF SEWAGE

Before any sewage may be bypassed from an existing sanitary sewer to accomplish any of the work required on the project, written permission to make such bypass must be obtained from the Owner's Engineer. A request for permission to effect such bypass shall be made in writing at least 2 days prior to the time needed. The request shall contain full details as to the manner in which bypassing is to be accomplished, and the minimum and maximum time bypass is to remain in service. In general, bypassing will not be approved unless it is absolutely essential to accomplish the work, and all costs incurred by the Owner in taking proper health and sanitation precautions as a result of an approved bypass shall be paid by the Contractor.

210.6 TESTING

All sewer pipe shall be so installed that the completed sewer will have a maximum exfiltration of 200 gallons per inch of internal diameter, per mile of pipe, per 24 (twenty-four) hours, where the maximum hydrostatic head at the center line of the pipe does not exceed twenty-five (25) feet. In addition, all flexible and semi-rigid sewer pipe shall be tested for deflections.

Infiltration shall not exceed the above specified rates for exfiltration.

- A. The Contractor shall, under the direction of the Engineer, perform an infiltration or exfiltration test as described hereafter on completed line. Manholes shall be vacuumed tested. Sewer lines shall require mandrel test and closed circuit television inspection.
- B. An infiltration test will be performed in lieu of exfiltration test when, in the judgment of the Engineer, this would be acceptable and accurate. Ordinarily this method will be used when the sewer line is under hydrostatic water pressure. This would occur in areas with a high water table or when a trench is wet as a result of rain or runoff. In performing infiltration tests, the length of line to be tested shall be isolated. This shall be accomplished by plugging the effluent of the upstream manhole with an inflatable rubber pipe stopper. Also, all open ends (services, clean-outs, etc.) shall be plugged. Flow measurements shall then be made in the downstream manhole with a Leopold-Lagco fiberglass flume as manufactured by F. B. Leopold Company, Inc. , V-Notch Weir as manufactured by N. B. Products or approved equal. The measuring device shall be self-reading and the Engineer shall be provided with manufacturer's bulletins describing the characteristics of the device.
- C. The tests described herein may be performed with any tools or equipment that will produce results as outlined. The method of testing, tools, and equipment shall be approved by the Engineer.
- D. The deflection test for flexible and semi-rigid sewer pipe shall consist of passing a prefabricated plug designed for deflection testing through the pipe a minimum of 30 days after installation but no later than a year. The prefabricated plug shall have an outside diameter of ninety-five (95) percent of the inside diameter of the pipe being tested. If during the test the plug hangs and cannot be pulled completely through a section of the deflected line between two points, i.e., two manholes or a manhole and a cleanout, all or part of that section of pipe shall be removed and replaced and the deflection test shall be performed on the replaced section of pipe in the prescribed time range as stated above. A completed section of sewer line will not be accepted until it has passed the deflection test.
- E. Exfiltration Test Pneumatic Method: Air Test
 - 1. Where specified, in accordance with the stipulated requirements on the project plans or specifications, air tests shall be made on sanitary sewer systems. Such air tests shall be made by the pressure drop versus time method.
 - 2. On sanitary sewer systems requiring air tests, the Contractor shall furnish all material, equipment and labor. The air gauges will be dead weight tested and approved by the Owner. Owner personnel shall judge the results of the tests. The test shall be performed using the equipment stated below according to stated procedures.

3. The equipment shall meet the following minimum requirements:
 - a. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected.
 - b. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.
 - c. All air used shall pass through a single control panel.
 - d. Air compressor of adequate capacity for charging the system.
4. All pneumatic plugs shall be seal-tested before being used in the actual test installation. The plugs shall hold without bracing and without movement of the plugs within the pipe.

After a manhole-to-manhole reach of pipe has been backfilled and the pneumatic plugs have been checked, the plugs shall be placed in the line at each manhole and inflated to 25 psig. Low pressure air shall be introduced into this sealed line until the internal air pressure reaches 4 psig. Allow at least two (2) minutes for the air temperature to stabilize. If the pipe to be tested is submerged in ground water, insert a pipe probe into the backfill material adjacent to the center of the pipe, and determine the pressure in the probe when the air passes slowly through it. This is back pressure due to ground water submergence over the end of the probe. All gauge pressure in the test should be increased by this amount. After the stabilization period (3.5 psig of minimum pressure in the pipe) start stop watch. Determine time in seconds that is required for the internal air pressure to reach 2.5 psig. Minimum permissible pressure holding time runs of single pipe diameter are indicated in the following table.

Should the sanitary sewer system fail air tests, the Contractor shall find and repair the leaks and retest. Water test shall be performed on the manhole even though the pipe is air tested. Concrete sewer pipe shall be water filled in advance of test for a period of twenty-four (24) hours before air testing.

Cost of material, equipment, labor, etc., required in testing shall be included in the price bid per foot of pipe in place.

210.7 CONNECTION TO EXISTING LINES

Connection to an existing line shall be made without interruption of flow of sewage in the existing line.

210.8 MEASUREMENT AND PAYMENT

- A. Service Lines: Measurement shall be along a horizontal line beginning at the centerline of the sanitary sewer lateral to which it is connected and ending four (4) feet behind the curb.
- B. Sewer Pipe: Measurement shall be made along the main axis of the pipe line in place with no deduction for pipe laid through manholes and shall include Trenching and Backfilling.

Payment for pipe in place will be made at the respective unit prices bid for the various depth trenches measured from the surface of the ground to the flowline of the pipe.

- C. Connection of Existing Lines: There will be no extra pay for connection of existing lines. The cost of such connections shall be included in the unit price bid for pipe in place.

END OF ITEM

MATERIAL SPECIFICATIONS

ITEM 211
INSTALLATION OF CURED-IN-PLACE PIPE

211.1 GENERAL

Cured-in-place pipe consists of a resin impregnated flexible tube, coated with an elastomeric coating, when inverted into an existing sewer pipe through existing access manholes, and which, under proper hydrostatic and thermal conditions, is cured-in-place, becoming a structurally sound cured-in-place pipe. Depending on the deterioration level of the existing pipe, the thickness of the cured-in-place pipe will be dictated by the required structural strength. The pipe will be impermeable to water, provide corrosion resistance, and an optimum friction factor for the sewer flow.

211.2 EXECUTION

Thoroughly clean sewers as required for the installation of the resin-impregnated tube. Locate and identify all service connections by closed circuit color television. Cut out all service connections by remote cutters. Notify the BWSA at least 48 hours prior to service interruption. Install the resin-impregnated tube of the correct thickness as specified.

Cut out all service connections by remote cutters and restore service within 18 hours.

Re-inspect by CCTV to verify satisfactory completion of work at time of lateral reinstatement. Cost subsidiary to Post-Construction TV Inspection.

Pump around all dry and wet weather flows to accommodate the process at each separate installation, as required.

Comply with all appropriate governmental agencies' regulations regarding traffic, safety procedures and permits, the cost of which is the responsibility of the Contractor.

MATERIALS: The fiber felt tube shall be fabricated to a size that when installed will tightly fit the internal circumference of the conduit specified by the Owner. Allowance for circumferential stretching during inversion shall be made and shall meet ASTM-1216.

The minimum length shall be that deemed necessary by the Contractor to effectively span the distance from the inlet to the outlet of the respective manholes, unless otherwise specified. The Contractor shall verify the lengths in the field before impregnation. Individual inversion may be made over one or more manhole sections, as determined in the field by the Contractor.

Unless otherwise specified, the Contractor shall furnish a general purpose unsaturated polyester resin and catalyst system that meets ASTM standards and the finished cured physical strengths specified.

REQUIRED THICKNESS OF CURED-IN-PLACE PIPE: The thickness of the pipe will be determined from information supplied or manufacture’s recommendation for the condition of the existing pipe. Should pre-installation inspections reveal the sewers to be in substantially different conditions than those in the design considerations, the Contractor can request such changes in pipe thickness, supporting such request with design data in accordance with the pipe manufacturer’s standard design criteria as follows:

211.3 LINER THICKNESS

Sewer Diameter	Pipe Invert Depth up to 10’ (also the minimum)	Pipe Invert Depth 10’-15’	Pipe Invert Depth Over 15’
6”	4.5mm	4.5mm	4.5mm
8”	6.0mm	6.0mm	6.0mm
10”	6.0mm	6.0mm	7.5mm
12”	6.0mm	7.5mm	9.0mm
15”	7.5mm	9.0mm	10.5mm
18”	9.0mm	12.0mm	13.5mm
21”	10.5mm	13.5mm	15.0mm
24”	12.0mm	15.0mm	16.5mm
30”	15.0mm	18.0mm	21.0mm
36”	16.5mm	21.0mm	24.0mm
42”	19.5mm	24.0mm	28.5mm
48”	22.5mm	28.5mm	33.0mm
54”	25.5mm	30.0mm	36.0mm
60”	28.5mm	34.5mm	39.0mm

211.4 PREPARATORY WORK: The installation procedures shall be as follows unless otherwise approved by the Benbrook Water & Sewer Authority.

Safety - The contractor shall carry out his operations in strict accordance with all safety requirements. Particular attention is drawn to those safety requirements that involve working with scaffolding and entering confined spaces.

All easements shall be cleaned up after use and restored to their original conditions or better. In the event additional work room or access is required by the Contractor, it shall be the Contractor’s responsibility to obtain written permission from the Property Owners involved for the use of additional property required. No additional payment will be allowed for this item. If a

street must be closed to traffic because of the orientation of the sewer, the City of Benbrook shall institute the actions necessary to do this for the mutually agreed upon time period.

Before using any water from the Benbrook Water and Sewer Authority, the Contractor shall be responsible for the water meter and related charges for the set up, including the water usage bill. All expenses shall be considered incidental to cleaning.

Cleaning of Sewer Line - It shall be the responsibility of the Contractor to remove all internal debris out of the sewer lines and flush the sewer lines clean, disposing of debris off-site. Debris is not to be washed downstream into other sewers. All solids or semisolids resulting from the cleaning operations shall be removed from the site and disposed of at no additional cost to BWSA. It is the responsibility of the Contractor to secure a legal dump site for the disposal of this material. All materials shall be removed from the site no less often than at the end of each work day. All cost for the above-described work shall be paid for by the price bid per linear foot for installation of CIP pipe.

Inspection of Pipelines - Inspection of pipelines shall be performed by experienced personnel trained in locating breaks, obstacles, and service connections by closed circuit color television. Television inspection shall be in accordance with the specifications contained herewith for "Pre- and Post-Construction Television Inspection of Sanitary Sewer Lines".

211.5 INSTALLATION OF THE RESIN IMPREGNATED TUBE

The Contractor shall designate a location where the uncured resin in the original containers and the unimpregnated fiber-felt tube will be vacuum impregnated prior to installation. The Contractor shall allow the Owner to inspect the materials and "wet-out" procedure. A resin and catalyst system compatible with requirements of this method shall be used. The quantities of the liquid thermosetting materials shall be per manufacturer's standards to provide the wall thickness specified. All felt shall be impregnated under vacuum.

The wet-out fiber felt tube shall be installed through an existing manhole or other approved access by means of an inversion process and the application of a hydrostatic head sufficient to fully extend it to the next designated manhole. The impregnated tube shall generally be inserted into the vertical inversion standpipe with the impermeable plastic membrane side out. At the lower end of the inversion standpipe, the felt tube shall be turned inside out and attached to the standpipe so that a leak-proof seal is created. The inversion head will be adjusted to be of sufficient height to cause the impregnated tube to invert from manhole to manhole and hold the tube tight to the pipe wall and produce dimples at the side connections. A lubricant, if used, shall be as approved by manufacturer's standards. Manufacturer's standards shall be closely followed during the elevated temperature curing so as not to over-stress the felt fiber and cause damage or failure prior to cure. In certain cases, the Contractor may elect to use a top inversion.

Curing: After inversion is complete, the Contractor shall supply a suitable heat source and water or steam recirculation equipment. The equipment shall be capable of delivering hot water

or steam throughout the section by means of a pre-strung hose, which has been perforated per manufacturer's recommendations, to uniformly raise the water temperature above the temperature required to affect a cure of the resin. This temperature shall be determined by the resin/catalyst system employed and shall be per manufacturer's standards.

The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water or steam supply. Another such gauge shall be placed at the remote manholes to determine the temperatures during cure. Initial cure shall be deemed to be completed when inspection of the exposed portions of the cured-in-place pipe appear to be hard and sound. The cure period shall be of a duration recommended by the resin manufacturer, as modified for the inversion process, during which time the recirculation of the water and/or steam and cycling of the heat exchanger to maintain the temperature continues.

Cool-down: The Contractor shall cool the hardened cured-in-place pipe to a temperature below 100 F before relieving the static head in the inversion standpipe. Cool-down may be accomplished by introducing cool water into the inversion standpipe to replace water or steam being drained from a small hole made in the downstream end. Care shall be taken in the release of the static head so that a vacuum will not be developed that could damage the newly installed cured-in-place pipe.

SERVICE CONNECTIONS: After the pipe has been installed, the Contractor shall reconnect the active service connections. This shall generally be done without excavation, and, in the case of non-man entry pipes, from the interior of the pipeline by means of a television camera and a cutting device that re-established them to not less than 90 percent capacity. Existing services shall be reinstated within 18 hours of installation. Should internal reinstatement not be possible, the services must be reconnected externally by excavation immediately. Service saddles acceptable to the Engineer shall be utilized. Backfill at service connections shall be cement stabilized (2 sacks per cubic yard) to a point 12 inches above the service lateral to trench intersection and shall be in accordance with these specifications. Each reconnection shall be paid for separately. Six inch sewer lines shall have service connections completed by external means. Contractor may re-connect the 6" sewer line connections by internal means in special cases with the approval of the Engineer.

211.6 ACCEPTANCE

The finished cured-in-place pipe shall be continuous over the entire length of an inversion run between manholes and be smooth and free from substantial wrinkles, as well as defects, and improper house connections. Should any of these defects occur, the line shall be excavated, repaired and/or replaced and complete restoration made to the satisfaction of the Benbrook Water & Sewer Authority at no additional cost.

The watertightness of the pipe shall be tested for leaks under a positive head during cure with allowances being made for end leakage and temperature effects.

CLEAN-UP: Upon acceptance of the installation work and testing, the Contractor shall restore

the project area affected by his operations to original or better conditions.

PATENTS: The Contractor shall warrant and save harmless the Benbrook Water & Sewer Authority and all of its officers, agents, and employees against all claims for patent infringement and any loss thereof.

SPECIAL NOTES: The Contractor shall be liable for damages to the homes or basements from backups which may result during the installation of new pipe.

211.7 MEASUREMENT AND PAYMENT

Cured-in-Place Pipe (CIPP) Installation: CIPP installation will be measured for payment by the linear foot of CIPP actually installed in the various diameters of sewers measured along the centerline of the sewer from centerline to centerline of manholes. Payment will be made for the quantities measured at the unit price per linear foot for the various sewer diameters listed.

Service Reconnection: Payment will be made for the quantities measured at the unit price per each listed in the bid proposal. Payment shall include all labor, materials, and the lateral connection, including all necessary pipe and fittings to connect the existing service line. Payment shall not include pavement replacement, which if required, shall be paid separately.

Television Inspection and Cleaning: Special Condition for Post-Construction Television Inspection applies.

Sewer Cleaning by Bucket Machine: Heavy cleaning requiring more than hydraulic jet cleaning shall be performed by bucket machines. The payment for such cleaning shall be included in the bid item for CIP Pipe installation.

By-Pass Pumping: The Contractor shall provide diversion for the flow of sewage around the section or sections of pipe designated for the inversion of the resin-impregnated tube. The pumps and by-pass lines shall be of adequate capacity and size to handle all flows. All costs for by-pass pumping required during installation of the pipe shall be subsidiary to the pipe reconstruction item.

Point Repairs: Point repairs shall be made before or after a cured-in-place pipe installation at the Contractor's option. Point repairs shall be conducted only if mutually agreed to by the Benbrook Water & Sewer Authority and the Contractor prior to acceptance of the line for reconstruction. Before any excavation is done for any purpose, it will be the responsibility of the Contractor to check with various utility companies and determine the location of their facilities. Point repairs shall be measured and paid for by the linear foot for the appropriate depth of cut. Payment shall include all labor, material and equipment for pipe replacement according to standards.

Subsidiary Work: Any damage resulting to utilities and property, resulting repairs, temporary service costs, etc., shall be borne by Contractor. Repair and/or replacement of fences, sprinkler system piping and other such restoration work resulting from Contractor activities shall be considered subsidiary to the cost of the project and no additional payment will be allowed.

END OF ITEM

MATERIAL SPECIFICATIONS

ITEM 212 PIPE ENLARGEMENT SYSTEM

212.1 GENERAL

Description: This specification includes requirements to rehabilitate existing sanitary sewers by the pipe enlargement system, herein called Pipe Bursting or Pipe Crushing (Pipe Bursting/Crushing). This system includes splitting or bursting the existing pipe to install a new polyethylene pipe and reconnect existing sewer service connections.

212.2 METHODS

This section specifies the approved system method or process to include all labor, materials, tools, equipment and incidentals necessary to provide for the complete rehabilitation of deteriorated gravity sewer lines by the Pipe Bursting/Crushing systems. Approved methods include: the PIM Corporation (PIM System), Piscata Way, New Jersey; McLat Construction (McConnell System for Pipe Crushing), Houston, Texas; and Trenchless Replacement Systems, (TRS System), Calgary, Canada.

Definition: The Pipe Bursting/Crushing system is defined as the reconstruction of gravity sewer pipe by installing an approved pipe material, by means of one of the pre-approved methods set forth in Section 212.2 of this specification. The process involves the use of a static, hydraulic or pneumatic hammer "moling" device, suitably sized to break out the old pipe or using modified boring "knife" with a flared plug that implodes and crushes the existing sewer pipe. Forward progress of the "mole" or the "knife" may be aided by the use of hydraulic equipment or other apparatus, as specified in the approved methods. The replacement pipe is either pulled or pushed into the bore. The method allows for replacement of pipe sizes from 8" through 21" and/or upsizing in varying increments up to 21". This specification is based on the precedent that the Pipe Bursting/Crushing system used has been pre-approved by the Engineer and BWSA.

212.3 QUALITY ASSURANCE

The Contractor shall be certified by the particular Pipe Bursting/Crushing system manufacturer that such firm is a licensed installer of their system. No other Pipe Bursting/Crushing system other than those listed in Section 212.2 of these specifications is acceptable.

Personnel directly involved with installing the new pipe shall receive training in the proper methods for joint fusing, handling, and installing the polyethylene pipe. Training shall be performed by a qualified representative as determined by the pipe manufacturer.

Personnel directly involved with installing the new pipe shall receive training in the proper methods for joint fusing, handling, and installing the polyethylene pipe. Training shall be

performed by a qualified representative as determined by the pipe manufacturer.

212.4 SUBMITTALS

Submit for review and acceptance, the following Contractor's Work Plan and Drawings to the Engineer for review and approval:

- 1) Shop drawings, catalog data, and manufacturer's technical data showing complete information on material composition, physical properties, and dimensions of new pipe and fittings. Include manufacturer's recommendation for handling, storage, and repair of pipe and fittings if damaged.
- 2) Location and number of insertion or access pits shall be planned by Contractor and submitted in writing prior to excavation for approval by Engineer.
- 3) Method of construction and restoration of existing sewer service connections. This shall include:
 - i) Detail drawings and written description of the entire construction procedure to install pipe, bypass sewage flow and reconnection of sewer service connections.
 - ii) Working drawings for information only showing sewage flow bypass, and maintenance of traffic. Contractor shall provide for continuous sewerage flow. Dewatering shall be the Contractor's responsibility.
 - iii) Certification of workmen training for installing pipe.
 - iv) Television inspection reports and videotapes made after new pipe installation.

212.5 DELIVERY, STORAGE, AND HANDLING:

Transport, handle, and store pipe and fittings as recommended by manufacturer.

If new pipe and fittings become damaged before or during installation, it shall be repaired as recommended by the manufacturer or replaced as required by the Project Manager at the Contractor's expense, before proceeding further.

Deliver, store and handle other materials as required to prevent damage.

212.6 MATERIALS

- 1) Polyethylene Piping Material: The pipe and fitting material shall be high density, extra molecular weight (EHMW) polyethylene pipe material conforming to ASTM D1248, Type III, Class C, Category 5, Grade P34, and have a PPI (Plastic Pipe Institute) recommended designation of PE3408 and cell classification 345434C per ASTM D3350. The molecular

weight category shall be extra high (250,000 to 1,500,000) as per the Gel Permeation Chromatography determination procedure with a typical value of 330,000.

- a) The interior of the pipe shall be a light reflective color to facilitate closed circuit television inspection.
 - b) The pipe material shall be listed by the Plastic Pipe Institute (PPI) in PPI TR-4. The pipe material shall have as hydrostatic design basis of 1600 psi at 73 F and 800 psi at 140 F.
 - c) The manufacturer's certification shall state that the pipe was manufactured from one specific resin and shall state the resin used and its source. All pipe shall be made of virgin material. No rework, except that obtained from the manufacturer's own production of the same formulation, shall be used.
 - d) Pipe supplied under this specification shall have a nominal Ductile Iron Pipe Size inside diameter. The Standard Dimension Ratio (SDR) and minimum pressure rating of the pipe shall be SDR 17 - 100 psi. Pipe with a lower SDR ratio and higher pressure rating may be used in lieu of the minimum specified.
- 2) Tests: The Contractor shall be required to send submittals to the BWSA on the production material.
- a) The pipe manufacturer shall provide certification that samples of the production product meets these specifications. The certification will state that production product has been tested in accordance with ASTM D2837, and validated in accordance with the latest revision of PPI TR-3.
 - b) The pipe manufacturer shall provide certification that stress regression testing has been performed on the specific product. Certification shall include a stress life curve per ASTM D2837 and testing shall have been performed in accordance with ASTM D2837.
 - c) Rejection: Polyethylene plastic pipe and fittings may be rejected for failure to meet any of the requirements of this specification.

212.7 SEWER SERVICE CONNECTIONS

- 1) Sewer Service Connections: Sewer service connections shall be connected to the new pipe by mechanical or fusion methods. Once the saddle is secured, a hole shall be drilled in the pipe the full inside diameter of saddle outlet.
- 2) Pipe Saddles: Mechanical saddles shall be made of polyethylene pipe compound that meets the requirements of ASTM D1248, Class C, have stainless steel straps and fasteners, neoprene gasket and backup plate. Mechanical saddles shall be Strap-on-Saddle Type as manufactured by Driscopipe or Tapping Saddle manufactured by DuPont, or approved equal. Fusion saddles shall be electrofusion branch saddles as manufactured by Central

Plastics Company, or approved equal.

- 3) Connection to Existing Service: Connections to the existing sewer service connections pipe shall be made using flexible couplings. All flexible couplings shall conform to ASTM C425 and shall be as manufactured by Fernco Joint Sealer Co., DFW Plastics, Inc. or approved equal. Backfill at service connections shall be cement stabilized sand (2 sacks per cubic yard) to a point 12 inches above the service lateral to trench intersection and shall be in accordance with these specifications.

The Contractor shall, upon request, permit the Engineer to take elevations on both the existing and new portions of the service connection pole to determine final grade and invert elevations. Elevation changes greater than 0.10 foot from the house lateral piping and shall be reconnected as directed by the Engineer.

- 4) Service Interruptions: Service interruptions to homes shall not exceed 18 hours.

212.8 PREPARATION

- 1) Bypassing Sewage:

- a) The Contractor shall bypass the sewage around the section or sections of sewer to be rehabilitated. The bypass shall be made by plugging existing upstream manhole and pumping the sewage into a downstream manhole or adjacent system or other method as may be approved by the Engineer. The pump and bypass lines shall be of adequate capacity and size to handle the flow without sewage backup occurring to facilities connected to the sewer.
- b) The Contractor shall be responsible for continuity of sanitary sewer service to each facility connected to the section of sewer during the execution of the work.

If sewage backup occurs and enters buildings, the Contractor shall be responsible for clean-up, repair, property damage costs and claims.

- 2) Line Obstructions: If pre-installation (TV) inspection reveals an obstruction in the existing sewer (heavy solids, dropped joints, protruding service taps or collapsed pipe) which will prevent completion of the pipe bursting/crushing process, and cannot be removed by conventional sewer cleaning equipment, then an obstruction removal shall be made by the Contractor, with the approval of the Engineer.
- 3) Sags in Sewer Line: ALL SAGS AND GRADE PROBLEMS IN EXISTING SEWER LINES SHALL BE CORRECTED AS PART OF THIS CONTRACT. If the pre-construction television inspection reveals a sag in the sewer line, the Contractor shall be responsible for bringing the proposed sewer pipe to an acceptable grade without a sag. A sag is defined as any sewer line segment more than 3 feet in length which ponds water in the absence of sewage flow. The contractor shall take the necessary measures to eliminate the sag by the

method of: pipe replacement, digging a sag elimination pit and bringing the bottom of the pipe trench to a uniform grade in line with the existing pipe invert or by other measures that shall be acceptable to the Engineer and BWSA.

- a) Identification of Sags: Sags shall be identified by television inspection in the absence of sewage flow. If available, the Contractor shall be furnished television tapes from the BWSA identifying the sag location. Flow shall be blocked at an upstream manhole and diverted to another sewer line or downstream manhole below the segment of pipe to be inspected. TV inspection shall be performed in accordance with television inspection of sanitary sewer lines. Videotapes shall be submitted to the Engineer for review.
- b) Correction of Sags: Sags shall be corrected by open cut and by adding additional bedding material to bring the sag back to grade where access is available. For pipe enlargement methods, all sags identified on the pre-construction videotapes shall be corrected prior to commencing with pipe enlargement.

In instances where sags are located under existing structures, the existing sewer line may be relocated using open cut or boring methods. The Engineer shall specifically review potential relocation's and evaluate the constructability, economics and engineering feasibility prior to construction work.

- c) Measurement and Payment: Measurement and payment to correct sags shall be per linear foot of pipe construction to correct the sag. For pipe bursting methods, open-cut or bore construction, the applicable bid prices in the proposal section shall apply.
- 4) Television Inspection: Inspection of the pipelines shall be performed by experienced personnel trained in locating breaks, obstacles and service connections by closed circuit color television. Television inspection shall be in accordance with the specifications contained herewith for "Pre- and Post-Construction Television Inspection of Sanitary Sewer Lines", Special Conditions SC-46 and SC-49, respectively.

212.9 PIPE ENLARGEMENT SYSTEM AND PIPE INSTALLATION

- 1) Site Organization:
 - a) Insertion or access pits shall be located such that their total number shall be minimized and the length of replacement pipe installed in a single pull shall be maximized.
 - b) Existing manholes shall be utilized wherever practical. Manhole inverts and bottoms may be removed to permit access for installation equipment.
 - c) Equipment used to perform the work shall be located away from buildings so as not to create a noise impact. Provide silencers or other devices to reduce machine noise as needed to meet requirements.

- d) The actual pipe enlargement procedure shall commence prior to 11:00 AM in order to afford the contractor ample time to complete all related work within the allotted workday, which is defined as the hours between 7:00 AM and 6:00 PM, so as not to impose on the peace and comfort of persons in the immediate vicinity. No actual pipebursting work shall be started after 11:00 AM; all actual pipebursting activity shall cease at 6:00 PM. Other activities other than the actual pipebursting may continue after 6:00 PM.
- 2) **Finished Pipe:** The installed replacement pipe shall be continuous over the entire length of each pipe segment from manhole to manhole and shall be free from visual defects such as foreign inclusions, concentrated ridges, discoloration, pitting, varying wall thickness, pipe separation, other deformities. Replacement pipe with gashes, nicks, abrasions, or any such physical damage which may have occurred during storage and/or handling, which are larger/deeper than 10% of the wall thickness shall not be used and shall be removed from the construction site. The replacement pipe passing through or terminating in a manhole shall be carefully cut out in a shape and manner approved by the Engineer. The invert and benches shall be streamlined and improved for smooth flow. The installed pipe shall meet the leakage requirements of the pressure test specified later.
- 3) **Pipe Jointing:**
- a) Sections of polyethylene replacement pipe shall be assembled and joined on the job site above the ground. Jointing shall be accomplished by the heating and butt-fusion system in strict conformance with the manufacturer's printed instructions.
- b) The butt-fusion system for pipe jointing shall be carried out in the field by operators with prior experience in fusing polyethylene pipe with similar equipment using proper jigs and tools per standard procedures outlined by the pipe manufacturer. These joints shall have a smooth, uniform, double rolled back bead made while applying the proper melt, pressure, and alignment. It shall be the sole responsibility of the Contractor to provide an acceptable butt-fusion joint. All joints shall be made available for inspection by the Engineer before insertion. The replacement pipe shall be joined on the site in appropriate working lengths near the insertion pit. The maximum length of continuous replacement pipe which shall be assembled above ground and pulled on the job site at any one time shall be 600 linear feet.
- c) For situations where the replacement pipe is not pulled all the way to the manhole or if it is impossible to pull the missile all the way through, the following shall apply: At the direction of the Engineer, a 12"-18" full circle steel clamp shall be utilized to connect segments of the HDPE pipe.
- 4) **New Pipe Installation:**
- a) Thread winch cable or chain and associated lines through sewer section to be rehabilitated. Keep lines away from pedestrian and vehicular traffic.

- b) Existing manholes may be used for launch and receiving access. Remove manhole invert and bottom as required. Pull winch chain through sewer section and attach to cutter and machine head. Lower into launching manhole, apply winch tension pulling the cutter and head into the sewer until the rear of the machine is flush with the manhole wall. Attach steel starter pipe and advance assembly until the rear of the steel starter pipe is flush with the manhole wall. Lower hydraulic jack into the manhole and align. Insert new pipe by simultaneous operation of the jack and winching the cutter and head forward.

5) Anchoring New Pipe and Sealing Manholes:

- a) After the new pipe has been installed in the entire length of the sewer section, anchor the pipe at manholes. The new pipe shall protrude in the manholes for enough distance to allow sealing and trimming.
- b) Sealing the new pipe at manholes shall not begin for a minimum of ten (10) hours after installation. Provide a flexible gasket connector in the manhole wall at the end of the new pipe, centered in the existing manhole wall. Grout flexible connector in the manhole, filling all voids the full thickness of the manhole wall.
- c) Restore manhole bottom and invert.

6) Field Testing:

- a) Low Pressure Air Test of Replacement Pipe: After a manhole-to-manhole section of sanitary sewer main has been pipe burst/crushed and prior to any service lines being connected to the replacement pipe, the pipe shall be plugged at each manhole with pneumatic plugs. The design of the plugs shall be such that they will hold against the test pressure without requiring external blocking or bracing. One of the plugs shall have three air hose connections; one for the inflation of the plug, one for reading the air pressure in the sealed line, and one for introducing air into the sealed line. Low pressure air shall then be introduced into the sealed line until the internal air pressure reaches 4.0 psig greater than the average back pressure resulting from any ground water that may be over the pipe. At least two minutes shall elapse to allow the pressure to stabilize. The time required for the internal pressure to decrease from 3.5 to 2.5 psig greater than the average back pressure resulting from any ground water that may be over the pipe, shall not be less than the time shown for a given pipe diameter in the following table:

Carrier Pipe Diameter (inches)	Minimum Elapsed Time (minutes)
8	4
10	5
12	6

15	7
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- b) Post-Construction Television Inspection of New Pipe: Refer to Special Condition for Post-Construction Television Inspection of Sanitary Sewer.

212.10 MEASUREMENT AND PAYMENT

- 1) Pipe Installation: Pipe installation will be measured for payment by the linear foot of pipe actually installed in the various diameters of sewers measured along the centerline of the sewer from centerline to centerline of manholes. Payment will be made for the quantities measured at the unit price per linear foot for the various sewer diameters listed.
- 2) Service Reconnections: Installation of sewer service connections will be measured for payment by each actually reconnected to the installed pipe. Payment will be made for the quantities measured at the unit price per each listed. Payment shall include required excavation and backfill, saddles, flexible connections, and all other incidentals necessary to successfully reconnect sewer service lines to the rehabilitated sewer. Payment shall not include pavement replacement, which if required, shall be paid separately.
- 3) Sewer Cleaning by Bucket Machine: Heavy cleaning requiring more than hydraulic jet cleaning shall be performed by bucket machines. The payment for such cleaning shall be included in the bid item for pipe installation.
- 4) By-pass Pumping: The Contractor shall provide diversion for the flow of sewage around the section or sections of pipe designated for rehabilitation. The pumps and by-pass lines shall be of adequate capacity and size to handle all flows. All costs for by-pass pumping required during installation of the pipe shall be subsidiary to pipe enlargement.
- 5) Subsidiary Work: Any damage to utilities and property, resulting repairs, temporary service costs, etc. shall be borne by Contractor. Repair and/or replacement of fences, sprinkler system piping and other such restoration work resulting from Contractor activities shall be considered subsidiary to the cost of the project and no additional payment will be allowed.
- 6) Testing: All cost for testing the replacement pipe by a pressure method will be incidental to pipe installation.

END OF ITEM

MATERIAL SPECIFICATIONS

ITEM 213
CONCRETE CONSTRUCTION

213.1 EXAMINATION

- A. Contractor shall give the Engineer at least twenty-four (24) hours advance notice that he intends to pour concrete in any unit of the structure to permit the inspection of forms and placement of reinforcing steel.
- B. Verify site conditions prior to construction.
- C. Verify requirements for concrete cover over reinforcement.
- D. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely and will not cause hardship in placing concrete.
- E. Pumps for the removal of ground or surplus water shall be demonstrated to be adequate for the drying up of the work area.

213.2 PREPARATION

- A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.
- B. In locations where new concrete is to be doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout, unless capsule anchors or other form of fastening is shown on Plans.
- C. All preparation shall be approved by the Engineer before any placement of concrete.

213.3 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304.
- B. Notify OWNER minimum 24 hours prior to commencement of operation.
- C. Ensure that reinforcement, inserts, embedded parts, formed joint fillers, joint devices and water stops are not disturbed during concrete placement.
- D. Install joint fillers, primer and sealant in accordance with manufacturer's instructions.

- E. Separate slabs on grade from vertical surfaces with 1-inch thick joint filler where shown on the Plans.
- F. Extend joint filler from bottom of slab to within 1/4 inch of the finished slab surface.
- G. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken.
- H. Place concrete continuously between predetermined expansion, control, and construction joints.
- I. Do not interrupt successive placement; do not permit cold joints to occur.
- J. Place floor slabs in checkerboard pattern indicated.
- K. Screed floors and slabs on grade level to required level, maintaining surface flatness of maximum 1/4 inch to 10 feet.

213.4 CONCRETE FINISHING

- A. Provide formed concrete surfaces to be left exposed with smooth rubbed finish.
- B. Apply non-slip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as shown on the Plans or in the schedules. Immediately after trowel finishing, slightly roughen the concrete surface by brooming in the direction perpendicular to the main traffic route. Use fiber-bristle broom unless otherwise directed. Coordinate the required final finish with the ENGINEER before application.
- C. Steel trowel surfaces which are scheduled to be exposed.
- D. In areas with floor drains, maintain floor elevation at walls. Pitch surfaces uniformly to drains at nominal slope indicated on the Plans.

213.5 CURING AND PROTECTION

- A. Curing shall conform to the requirements of ACI 308.
- B. Curing operations shall follow finishing operations within 2 hours and shall continue for 7 days.
- C. Curing shall be accomplished by one of the following methods:
 - 1. Ponding or continuously sprinkling.
 - 2. Absorptive mats or fabrics kept continuously wet.

3. Use of approved curing compounds. Curing compounds shall not be used on any surface which will receive additional concrete or where concrete hardeners or terrazzo floors are scheduled to be installed. Remove the compound film from all exposed surfaces at the end of the curing period.

213.6 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed in accordance with ACI 301 and under the provisions of the General Conditions.
- B. CONTRACTOR shall provide free access to the Work and cooperate with the appointed testing firm.
- C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.
- D. Tests of cement and aggregates may be performed to ensure conformance with specified requirements.
- E. Four concrete test cylinders will be taken for every 75 or less cubic yards or each class of concrete placed.
- F. One additional test cylinder will be taken during cold weather concreting, cured on job site under same conditions as concrete it represents.
- G. One slump test will be taken for each set of test cylinders taken.
- H. One air content test for each load of concrete at point of discharge when indication of change requires.

213.7 PATCHING

- A. Allow OWNER or ENGINEER to inspect concrete surfaces immediately upon removal of forms.
- B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify OWNER or ENGINEER upon discovery.
- C. Patch imperfections in accordance with ACI 301 and as directed by the OWNER or ENGINEER.

13.8 DEFECTIVE CONCRETE

- A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- B. Repair or replacement of defective concrete will be as determined by the OWNER or ENGINEER.
- C. Do not patch, fill, touch-up, repair or replace defective concrete except upon express direction of OWNER or ENGINEER for each individual area.

213.9 SCHEDULE - CONCRETE TYPES

- A. Class "A" concrete shall be steel reinforced and shall include the following:
 - 1. Foundations
 - 2. Walls
 - 3. Slabs
 - 4. Beams
 - 5. Girders
 - 6. Columns
 - 7. Drilled piers.
- B. Class "B" concrete shall be placed without forms or with simple forms, with little or no reinforcing, and shall include the following:
 - 1. Equipment Bases
 - 2. Standard pipe supports
 - 3. Curbs and gutters
 - 4. Sidewalks
 - 5. Ductbanks
 - 6. Manhole bases
 - 7. Street paving
 - 8. Thrust blocks
 - 9. Pipe encasements.
- C. Class "C" concrete shall be placed with or without forms and shall be unreinforced. It is intended for use in the following applications:
 - 1. Concrete fill
 - 2. Working slab.
- D. Class "D" concrete shall be steel reinforced and shall be placed where high early strength cement is specified.

13.10 SCHEDULE - CONCRETE FINISHES

- A. Provide smooth-rubbed finish, rubbing concrete with a carborundum brick no later than one day after form removal, for the following locations:
1. Interior exposed walls and other interior vertical surfaces.
 2. Exterior exposed walls and other vertical surfaces down to two feet below finished grade.
 3. Exposed beams and undersides of elevated slabs.
 4. Interior vertical surfaces of liquid containing structures down to one foot below liquid level.
- B. At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to the formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue the final surface treatment of formed surfaces uniformly across the adjacent unformed surfaces unless otherwise shown.
- C. Provide rough-form finish with tie-holes and imperfections repaired and with fins and other projections exceeding 1/4 inch rubbed down or shipped off at the following locations:
1. Exterior vertical surfaces up to two feet below finished grade.
 2. Interior vertical surfaces of liquid containing structures up to one foot below liquid level.
- D. Chemical-Hardener Finish: Apply chemical-hardener finish to interior concrete floors where shown on the Plans or in schedules.
1. Floor Hardener: Hardening agent for exposed concrete floors shall be a colorless aqueous solution of zinc and/or magnesium flosilicate, or of sodium silicate. Each gallon of the flosilicate solution shall contain not less than two pounds of crystals. The sodium silicate solution shall be 32 percent by volume of 42 degree Baume sodium silicate. A proprietary hardener may be used provided the solution is delivered ready for use in the manufacturer's original containers. No combination chlorinated rubber curing-hardening material will be considered in lieu of the material specified for chemical floor hardener.

Chemical floor hardener shall be applied to interior concrete floors where shown on Plans or in schedules. The floors shall be thoroughly cured, cleaned, and perfectly dry with all work above them completed. Zinc and/or magnesium flosilicate shall be applied evenly, using 3 coats, allowing 24 hours between coats. The first coat shall be 1/4 strength, the second coat 1/2 strength, and the third coat 2/3 strength. Each coat shall be applied so as to remain wet on the concrete surface for 15 minutes. Sodium silicate shall be applied full strength at the rate of 1/3 gallon per 100 square feet. Proprietary hardeners shall be applied in accordance

with manufacturer's instructions. After the final coat is completed, the dry surplus hardener shall be removed from the surfaces by scrubbing and mopping with water.

2. Foundation Waterproofing: The exterior of all concrete walls not exposed to view and placed below ground level shall be given a waterproofing application of Thoroseal Foundation Coating as manufactured by Thoro System Products. A compatible bonding agent shall be added to or included in the mix per bonding agent manufacturer's recommendations.

END OF ITEM

MATERIAL SPECIFICATIONS

ITEM 214
FOLD AND FORM PIPE

214.1 GENERAL

Description: The Contractor shall utilize the installation of polyethylene or PVC sewer lines to restore the watertight condition of sanitary sewer lines.

214.2 MATERIALS

1. Polyethylene Liner Material: The polyethylene liner material shall be a high density polyethylene pipe compound which conforms to ASTM D-1248. The polyethylene pipe liner shall meet manufacturer's standards. The lining shall be a hard impermeable pipe, which shall conform to the minimum structural standards applicable, including ASTM D-368 for 3,300 psi tensile stress, ASTM D-638 for 4,500 psi for flexural stress, and ASTM D-790 for 145,000 psi for modulus of elasticity. The finished liner shall incorporate materials, which will withstand the corrosive effects of normal sewage. The Contractor shall provide a written guarantee of his compliance with these standards. The liner shall be light in color to facilitate closed circuit television inspection.
2. Polyvinyl Chloride (PVC) Liner Material: Polyvinyl pipe shall conform to ASTM D3034. The PVC compound used for the folded pipe shall conform to ASTM D1784 classification 12334-B, 12344B or 12454B or C. Compounds that have different cell classifications which are superior to those of the specified compounds are also acceptable. The lining shall conform to the minimum structural standards applicable including ASTM D-790 for 6,000 psi flexural stress and 350,000 psi modulus of elasticity.
3. Sizing of the Liner. The liner diameter, length and wall thickness shall be appropriate for each designated location. The Contractor shall verify the actual sewer lengths and diameters in the field prior to cutting the liner to length and sizing the diameter.
 - a. The liner shall be fabricated to a size that when installed will neatly fit the internal circumference of the sewer to be lined. Allowance for circumferential stretching of the liner during insertion shall be made as per manufacturer's standards.
 - b. The length of liner shall be that deemed necessary by the Contractor to effectively carry out the insertion and seal the liner at the inlet and outlet points. When reformed, the hardened liner should extend from end to end of the sewer segment being lined in a continuous tight fitting watertight pipe-within-a-pipe.
 - c. The wall thickness of the folded pipe liner shall conform to the design criteria of the manufacturer or the licensee; however, the minimum wall thickness shall conform to the following table:

Existing Pipe I.D. (inches)	Minimum Wall Thickness (inches)
6	0.236
8	0.265
10	0.331
12	0.392

214.3 EXECUTION

1. General: Liner installation shall be accomplished by pulling the liner through the existing sanitary sewer pipeline utilizing a power winch and steel cable with an appropriate pulling head at the end of the liner. Rounding of the liner shall be accomplished by utilizing a heat source such as water or steam with a rounding device to reform the folded pipe into a hard, impermeable round pipe.
2. Preliminary Cleaning and Inspection:
 - a. Prior to any lining of designated sanitary sewer line segments, the Contractor shall remove internal deposits as necessary to assure proper liner installation.
 - b. Inspection of pipelines shall be performed by experienced personnel trained in locating breaks, obstacles, and service connections by closed circuit television. The interior of the pipeline shall be carefully inspected to determine the location and extent of any structural failures, which may prevent proper installation of lining materials into the pipelines and location of service laterals.
 - c. It shall be the responsibility of the Contractor to clear the line of obstructions such as solids, roots, dropped joints, protruding branch connections or broken pipe that will prevent the insertion of the liner. If inspection reveals an obstruction not indicated in these specifications that cannot be removed by conventional cleaning equipment, then the Contractor shall notify the Engineer. The Engineer may authorize an excavation in order to remove such obstruction.
3. Documentation: Special Conditions for Pre- and Post-Construction Television inspection apply, items SC-46 and SC-49, respectively.
4. Flow Bypassing: The Contractor, when required, shall provide for the transfer of flow around the section or sections of pipe that are to be lined. The bypass shall be made by diversion of the flow at an existing upstream access point and pumping the flow into a downstream access point or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle the flow. The proposed bypassing system shall be approved in advance by the Owner. All costs of flow bypassing shall be considered incidental to cost of rehabilitating the pipe.

5. Notification of the Public: The Contractor shall notify all Property Owners affected by the liner installation work at least 48 hours prior to commencement of the work which will temporarily plug the sanitary services of the Property Owners connected to the sewer line segment being lined. Notification shall be by written notice and, when possible, shall be verbal, also. Customer complaints during installation shall be resolved by the Contractor.
6. Liner Installation:
 - a. The liner shall be inserted into the existing sewer line with a power winch and steel cable connected to the end of the liner by use of an appropriate pulling head. A second pulling head may be attached to the other end of the liner for attachment of a tag line to pull the liner back out of the sewer line, if necessary. Precautions should be taken during insertion to protect the liner pipes to prevent scoring the outside of the liner as it is being pulled into the sewer.
 - b. Prior to reforming the liner, "O" Ring gaskets shall be installed on the liner at each manhole connection.
 - c. After insertion is completed, the installer shall supply a suitable heat/pressure source and water re-circulation equipment. The equipment shall be capable of delivering water/pressure throughout the section to uniformly raise the water temperature above the temperature required to reform the liner.
 - d. The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water supply.
 - e. The installer shall cool the liner to a temperature below 100 F before relieving the reforming pressure. Cool down may be accomplished by the introduction of cool water or other approved method into the re-circulation network.
 - f. The finished lining shall be continuous over the entire length of an insertion run and be free from visual defects such as foreign inclusions and pinholes. The lining shall be impervious and free of any leakage from the pipe to the surrounding ground or from the ground to the inside of the lined pipe. Any defects which will affect, in the foreseeable future, or warranty period, the integrity or strength of the linings, shall be repaired at the Contractor's expense, in a manner mutually agreed by the Owner and the Contractor.
7. Completion of Lining:
 - a. After the liner has been reformed, the Contractor shall reconnect the existing active service connections. This shall be done from the interior of the pipeline by means of a television camera and a cutting device that re-establishes their operability or by excavation. Any bypass pumping that is required shall be

provided at no additional cost for sewer lines where lining is being performed. Service interruptions to any homes tributary to this sewer line shall not exceed 18 hours. Connection of the service lateral by excavation shall be made with a Neoprene Gasket Saddle, which inserts into the lined pipe for a watertight fit. Backfill at service connections shall be cement-stabilized sand (2 sacks per cubic yard) to a point 12 inches above the service lateral to trench intersection and shall be in accordance with these specifications.

- b. Excavation pits for externally reinstated service laterals shall remain open for 24 hours after reinstatement of the service. The Contractor shall be responsible for verifying that shrinkage of the polyethylene sewer liner has not occurred.
 - c. The water tightness of the liner shall be gauged while the liner is curing, and under a positive head. After the work is completed, the Contractor will provide the Owner with a video tape showing both the before lined and after lined conditions, including the restored connections. Upon completion of the installation work after required testing indicates the lining is acceptable, the Contractor shall reinstate the project area affected by his operations and perform any surface restoration in accordance with these Specifications.
8. Special Notes: The installer shall be liable for damages to the homes or basement from backups, which may result during the installation of the liner. Installer will be allowed to open clean outs.

214.4 MEASURE & PAYMENT

1. Liner Installation: Liner installation will be measured for payment by the linear foot of liner actually installed in the various diameters of sewers measured along the centerline of the sewer from centerline to centerline of manholes. Payment will be made for the quantities measured at the unit price per linear foot for the various sewer diameters listed.
2. Service Reconnection: Payment will be made for the quantities measured at the unit price per each listed in the bid proposal. Payment shall include all labor, materials, and the lateral connection, including all necessary pipe and fittings to connect the existing service line. Payment shall not include pavement replacement, which if required, shall be paid separately.
3. Television Inspection and Cleaning: Special Conditions for Pre- and Post-Construction Television Inspection apply, Special Conditions SC-46 and SC-49, respectively.
4. Sewer Cleaning by Bucket Machine: Heavy cleaning requiring more than hydraulic jet cleaning shall be performed by bucket machines. The payment for such cleaning shall be included in the bid item for installation of Fold and Form Pipe.

5. By-Pass Pumping: The Contractor shall provide diversion for the flow of sewage around the section or sections of pipe designated for rehabilitation. The pumps and by-pass lines shall be of adequate capacity and size to handle all flows. All costs for by-pass pumping required during installation of the pipe shall be subsidiary to the pipe reconstruction item.
6. Point Repairs: Point repairs shall be made before or after liner installation at the Contractor's option. Point repairs are available for payment only if mutually agreed by the BWSA and the Contractor prior to acceptance of the line for reconstruction. Before any excavation is done for any purpose, it will be the responsibility of the Contractor to check with various utility companies and determine the location of their facilities. Point repairs shall be measured and paid for by the linear foot for the appropriate depth of cut. Payment shall include all labor, materials, and equipment for pipe replacement according to BWSA standards.
7. Subsidiary Work: Any damage resulting to utilities and property, resulting repairs, temporary service costs, etc., shall be borne by Contractor. Repair and/or replacement of fences, sprinkler system piping and other such restoration work resulting from Contractor activities shall be considered subsidiary to the cost of the project and no additional payment will be allowed.

END OF ITEM

MATERIAL SPECIFICATIONS

ITEM 215
SLIPLINING

215.1 GENERAL

This section includes requirements to rehabilitate existing sanitary sewers by sliplining with polyethylene pipe.

215.2 MATERIALS

1. Polyethylene Slipline Pipe:

- a. The properties of the material shall be determined in accordance with ASTM D638. ASTM D638 shall be used to determine that the thermal butt-fusion joints are stronger than the materials joined.
- b. The melt index of the polyethylene resin shall be determined in accordance with ASTM D1238, Condition E, and shall be equal to, or between 0.05 g/10 min. and 1.00 g/10 min.
- c. The density of the base polyethylene resin shall be determined in accordance with ASTM D1505 and be equal to, or between, 0.941 g/cc and 0.955 g/cc.
- d. The material shall be tested in accordance with ASTM D1693, Condition C.
- e. Polyethylene pipe and fittings may be rejected for failure to meet any of the requirements of this specification.
- f. The sewer liner pipe and fittings shall be made of a polyethylene pipe compound that meets the requirements for Type III, Class C, Grade P-34, Category 5, polyethylene material as defined in ASTM D1248 or ASTM D3350, and having a PPI rating of PE3408, and cell classification 345434D or E per ASTM D3350. A higher numbered cell classification limit which gives a desirable higher primary property, per ASTM 3350, may also be accepted by the Engineer at no additional cost to the City. The molecular weight category shall be extra high (250,000 to 1,500,000) as per the Gel Permeation Chromatography determination procedure with a typical value of 330,000.
- g. Before beginning work, the Contractor shall submit for approval, the vendor's specific technical data with the complete information on resin, physical properties of pipe and pipe dimensions pertinent to this job. A certificate of "Compliance With Specification" shall be furnished for all materials to be supplied. The manufacturer's certificate shall state the pipe was manufactured from one

specific resin and shall state the resins used and its source. All pipe shall be made of virgin material. No rework except that obtained from the manufacturer's own production of the same formulation shall be used.

The BWSA will run tests on field samples per applicable ASTM specifications at an independent laboratory for verification of the required physical properties and characteristics. The number of samples taken shall be at the BWSA's discretion.

All samples shall be provided by the Contractor at no charge to the BWSA. The BWSA shall pay all charges for all testing of the liner material if they are found to meet specification. All retesting of materials not initially meeting these specifications shall be at the Contractor's expense.

- h. All polyethylene sliplining pipe shall conform to the sizes and Standard Dimension Ratio (SDR) requirements shown on the drawings.
 - i. Lengths: Standard lengths shall be used whenever possible, (40 foot sections). Where construction difficulties prevent the use of standard pipe sizes, other pipe sizes may be specified.
 - j. Pipes shall be joined to one another and to polyethylene fittings by thermal butt-fusion in accordance with ASTM D2657 and ASTM D3350. Butt-fusion joining and site location, joining shall be performed within or outside the excavation. Joints between pipe sections shall be smooth on the inside and internal projection beads shall not be greater than 3/16 inch.
 - k. The tensile strength at yield of the butt-fusion joints shall not be less that of the pipe.
2. Sewer Service Connections: Mechanical and fusion-bonded saddles shall be made of polyethylene pipe compound that meets the requirements of ASTM D-2448, Type IV, Class C. Mechanical saddles shall have stainless steel straps and fasteners and neoprene gaskets. Mechanical saddles shall be Strap-on-Saddle Type as manufactured by Drisco Pipe or Tapping Saddle as manufactured by DuPont, or approved equal. Fusion saddles shall be electrofusion branch saddles as manufactured by Central Plastics Company, or approved equal.

Saddles for use on PVC pipe shall be molded fittings as recommended by the PVC pipe manufacturer, and shall conform to the requirements of ASTM D3034, SDR 35.

215.3 EXECUTION

- 1. Cleaning and Television Inspection of Sanitary Sewers: Cleaning and television inspection of sanitary sewers to be sliplined shall be completed per the requirements of Special Condition for pre-construction television inspection. All material encountered in the existing sewers shall be removed and disposed of by the Contractor. All video tapes

shall be delivered to the BWSA's representatives for evaluation prior to any sliplining operations.

2. Obstruction Removal: The Engineer shall determine where obstruction removal (due to dropped joints, collapsed pipe, roots, rocks, obstructions in the pipe which cannot be removed by the cleaning equipment or other reasons) will be required. The Contractor shall locate the insertion pits at these obstruction locations whenever possible, and no additional payment will be authorized to the Contractor. When obstruction removal is required at locations other than insertion pits, payment for the obstruction excavation at the appropriate Contract unit price will be authorized.
3. Sewer Cleaning by Bucket Machine and Root Cutting: Heavy cleaning requiring more than hydraulic jet cleaning shall be performed by bucket machines or root cutting, as required. No additional payment for such cleaning and/or root cutting shall be made.
4. Insertion or Access Pits: The location and number of insertion or access pits shall be planned by the Contractor and submitted in writing for approval by the Engineer prior to excavation. The pits shall be located such that their total number shall be minimized, and the footage of liner pipe installed in a single pull shall be maximized.

Before excavation is begun, it will be the responsibility of the Contractor to check with the various utility companies and determine the location of the utilities in the vicinity of the work area.

Damage done to utilities and the resulting repair, temporary service cost, etc., shall be borne by the Contractor.

All excavations shall be properly sheeted/shored in accordance with OSHA specifications for trench safety systems. Any damage resulting from improperly shored excavations shall be corrected to the satisfaction of the Engineer with no compensation to the Contractor.

All open excavations shall be kept secure at all times by the use of barricades with appropriate lights and signs, construction tape, covering with steel plates, etc., or as directed by the Engineer.

The cost for bypass pumping if required around an insertion pit, from a manhole upstream to a mnhole downstream, shall be included in the Unit Price Bid for sliplining.

Excavation for insertion pits shall not be paid for separately, but shall be included in the Unit Price Bid for sliplining.

5. Insertion of Polyethylene Liner Pipe into Carrier Pipe: The existing sewer will remain in operation during the sliplining process whenever possible. Obstructions such as roots, large joint offsets, rocks or other debris, etc., that would prevent passage or damage to

the other pipe sections must be removed or repaired prior to installing the new pipe. After completing the insertion pit excavation, the top of the existing sanitary sewer line shall be removed, where required, down to the spring line. A power winch cable shall then be connected to the end of the liner by use of a suitable pulling head, equal to the outside diameter of the liner. The pulling head shall be adequately secured to the liner and then attached to the power winch cable so that the liner can be satisfactorily fed and pulled through the sanitary sewer main. Proper bumpers shall be provided in the insertion pit in order to prevent the ragged edges of the existing pipe from scarring the outside of the liner as it is pulled into the existing sewer.

Precautions shall be taken not to damage the liner or break or separate any of the butt-fused joints. Sufficient time (a minimum of 24 hours) shall be allowed for the liner to return to its normal length assuming the over-elongation is due to a higher temperature at the time of installation) based upon the average temperature in the sewer. The length of the liner pulled in any one segment shall be limited to prevent any backup of service lines, which may result due to restricted flow through the annular space. Maximum Allowable Pulling Force. In order to ensure the integrity of the polyethylene liner, the pulling force exerted on the liner shall be limited to that indicated on the following table for the appropriate outside diameter of the polyethylene liner:

POLYETHYLENE LINE OUTSIDE DIAMETER (INCHES)	MAXIMUM PULLING FORCE (TONS)
5.375	3.5
7.125	4.0
8.625	7.5
10.750	10.5
14.000	12.0
18.000	21.5
21.000	35.0
24.000	52.0

The Contractor shall use a suitable pulling head so that the pulling head and liner will separate from each other when the pulling force exerted on the liner reaches the amount indicated above. The pulling head design (including calculations) shall be approved by the Engineer prior to its use.

As an alternative, the Contractor may be permitted to use a measuring device (spring, gauge, etc.) connected to the pulling cable which shall register the pulling force being exerted on the liner. The pulling force shall not exceed those values indicated above for the applicable outside diameter of the polyethylene liner. The measuring device shall be approved by the Engineer prior to its use.

The Contractor may be allowed to push the liner subject to the Engineer's approval. Care shall be taken to avoid any buckling of the liner by limiting the stroke of the

backhoe. Any portion of the liner damaged during this insertion process shall be cut out and the liner rejected. In certain cases, the Contractor may be permitted to use a combination of pulling and pushing to enhance the insertion of the liner. A liner that is permitted to be pushed shall not have an open end which can allow sand or other debris to be pushed into the liner.

A pipe manufacturer's representative shall be onsite to assist the Contractor for the first full day of slipline pipe installation.

6. Use of Clamps and Encasement for Polyethylene Pipe: Where excavations for the insertion of the liner are made between two manholes, the ends of the liner will be cut smooth, square to the axis of the liner, so that it can be joined in a workman-like manner. The liner shall be joined with a JCM Industries Type 108 or equal, all stainless steel (including bolts and lugs), full circle, Universal Clamp Coupling with a 1/4-inch minimum thickness grid type gasket. Clamps shall be selected to fit the outside diameter of the liner pipe. Minimum clamp widths shall be selected from the following table:

OUTSIDE DIAMETER OF LINER PIPE (Inches)	MINIMUM WIDTH OF CLAMP (Inches)
5.375	12
7.125	15
8.625	18
10.750 or Greater	30

In all excavations where the liner is not within the existing sanitary sewer line (carrier pipe) cement stabilized sand bedding shall be installed. Visual inspection is required for approval of bedding before backfill is completed.

7. Testing of the Liner: Testing will be required after the liner has been installed in the existing sanitary sewer main. The first is a low pressure air test of the liner before it has been sealed in place at the manholes and before any service reconnections have been made to the liner. The purpose of this test is to check the integrity of the joints that have been made and to verify that the liner has not been damaged by inserting it into the sanitary sewer.
 - a. Low Pressure Air Test Procedure: After a manhole-to-manhole section of sanitary sewer main has been sliplined and prior to any service lines being connected to the new liner, the liner shall be plugged at each manhole with pneumatic plugs. The design of the plugs shall be such that they will hold against the test pressure without requiring external blocking or bracing.

One of the plugs shall have three (3) air hose connections; one for the inflation of the plug, one for reading the air-pressure in the sealed line, and one for introducing air into the sealed line.

Low pressure air shall then be introduced into the sealed line until the internal air pressure reaches 4.0 psig greater than the average back pressure resulting from any groundwater that may be over the pipe. At least two (2) minutes shall elapse to allow the pressure to stabilize.

The time required for the internal pressure to decrease from 3.5 to 2.5 psig greater than the average back pressure resulting from any ground water that may be over the pipe, shall not be less than the time shown for a given pipe diameter in the following table:

CARRIER PIPE OUTSIDE DIAMETER (Inches)	MINIMUM ELAPSED TIME (Minutes)
5.375	3
7.125	4
8.625	5
10.750	6
14.000	7
18.000	8

Lines over 18 inches shall be approved for payment by Visual and T.V. Inspection in accordance with Special Condition SC-49.

8. Sealing Liner in Manholes: After the pipe has reached equilibrium the annular space between the liner and the existing sanitary sewer main must be sealed at each manhole with a chemical seal and nonshrink grout. Oakum soaked in Scotchseal 5600 or equal shall be placed in a band to form an effective water-tight gasket in the annular space between the liner and the existing pipes in the manholes. The width of the band shall be a minimum of 12" or one-half the diameter of the pipe, whichever is greater. It shall be finished off with a non-shrink grout placed around the annular space from inside the manhole and shall not be less than 6" wide. The chosen method, including chemicals and materials, must be approved by the Engineer. The Contractor shall cut the liner so that it extends 4" into the manhole. The Contractor shall make a smooth, vertical cut and slope the area over the top of the exposed liner using non-shrink grout. The Contractor shall also use cementitious grout to form a smooth transition with a reshaped invert and a raised manhole bench such that neither the shape edges of the liner pipe, nor the concrete bench, nor the channeled invert shall exist to catch debris and create a stoppage. The invert of the manhole shall also be reworked (smoothed and built-up) to match the flow line of the new liner.

The liner pipe shall be allowed to normalize to ambient temperatures, as well as recover from any imposed stretch, a minimum of 24 hours in the case of polyethylene, before

being cut to fit between manholes and proceeding with reshaping and/or smoothing the manhole invert.

9. Sewer Service Connections:

- a. Sewer service connections shall be connected to the new pipe by mechanical or fusion methods. Once the saddle is secured, a hole shall be drilled in the pipe, the full inside diameter of the saddle outlet.
- b. Connections to the existing sewer service connection pipe shall be made using flexible Fernco sewer connectors, or approved equal. Backfill at service connections shall be cement stabilized sand (2 sacks per cubic yard) to a point 12 inches above the service lateral to trench intersection and shall be in accordance with these Specifications.
- c. The Contractor shall upon request, permit the Engineer to take elevations on both the existing and new portions of the service connections pipe to determine final grade and invert elevations. Elevation changes greater than 0.10 feet from the house lateral piping shall be reconnected as directed by the Engineer.
- d. Service interruptions to homes shall not exceed 18 hours.

215.4 MEASURE & PAYMENT

1. Pipe Installation: Pipe installation will be measured for payment by the linear foot of pipe actually installed in the various diameters of sewers measured along the centerline of the sewer from centerline of manholes. Payment will be made for the quantities measured at the unit price per linear foot for the various sewer diameters listed.
2. Service Reconnections:
 - a. Installation of sewer service connections will be measured for payment by each actually reconnected to the installed pipe. Payment will be made for the quantities measured at the unit price per each listed.
 - b. Payment includes all required excavation and backfill, surface restoration, saddles, flexible couplers, up to 5' of service line, and all appurtenant work.
 - c. Payment for additional service line (over 5' at each service reconnection) will be paid for at the appropriate Contract Unit Price. Payment includes all required additional excavation, backfill, surface restoration, and all appurtenant work.
3. Television Inspection and Cleaning: Television inspection shall include necessary cleaning (hydraulic jet or mechanical cleaner) to provide video image required for line analysis. The quantity of TV inspection shall be measured as the total length of pipe

actually cleaned and televised. This contract requires the Contractor to TV inspect the sewer lines twice, once before and once after construction. Pre-Cleaning and Television Inspection shall be paid at the Contract Unit Price for all pipe successfully cleaned and television inspected. The amount paid to the Contractor for Post Construction Television Inspection shall be the Unit cost times the length of pipe lined.

4. Obstructions: Obstructions such as roots, large offset joints, rocks, or other debris, that would prevent passage or cause damage to pipe and must be removed or repaired before installing the pipe will be subsidiary to unit cost of sliplining pipe.
5. Subsidiary Work: Any damage resulting to utilities and property, resulting repairs, temporary service costs, etc. shall be borne by Contractor. Repair and/or replacement fences, sprinkler system piping, and other such restoration work resulting from Contractor activities shall be considered subsidiary to the cost of the project and no additional payment will be allowed.
6. Testing: All cost for testing the replacement pipe by a pressure method will be incidental to the installation.

END OF ITEM

CONSTRUCTION SPECIFICATIONS

ITEM 226
RIGID FIBERGLASS MANHOLE LINERS

226.1 GENERAL

This item shall govern the furnishing and installation of rigid fiberglass liners in existing brick or concrete manholes. The manholes to be rehabilitated using fiberglass liners, and the interior diameter and depth of the liner are listed in the Manhole Rehabilitation Schedule. The locations of these manholes are shown on the drawings. Rigid Fiberglass Liners shall be as manufactured by Containment Solutions of Conroe, Texas; L.F. Manufacturing, Inc., of Giddings, Texas; Associated Fiberglass Engineers, of Fort Worth, Texas; or approved equal. The installation at each manhole shall include the preparation of the existing manhole to receive the fiberglass liner, installation of the liner, grouting the annular space between the existing structure and the liner, and backfilling around the new fiberglass corbel section.

226.2 MATERIALS

1. General. Fiberglass reinforced polyester manhole liners shall be manufactured from commercial grade polyester resin or vinyl ester resin, with fiberglass reinforcements. All liners shall meet the requirements of ASTM D3753 and this specification. Fillers, when used, shall be inert to the environment. The fiberglass shall be suitable for atmospheres containing hydrogen sulfide and dilute sulfuric acid as well as other gasses associated with wastewater collection systems.
2. Reinforcing. The reinforcing materials shall be commercial grade E type glass in the form of continuous roving and chop roving. The coupling agent will provide a suitable bond between the glass reinforcements and the resin.

226.3 DESIGN REQUIREMENTS

1. Manholes shall have sufficient strength to withstand an AASHTO H-20 dynamic loading. This shall be verified by acceptable test results performed in accordance with the reference standard.
2. The manhole cylinder and the hemispherical reducer (corbel) shall be preassembled at the factory into a monolithic unit by overlaying the joint with fiberglass reinforced resin to a thickness equal to or greater than the wall thickness of the cylinder. Field jointing is not permitted. Corbel section shall be concentric with respect to the larger cylinder, unless otherwise approved by the Engineer.

3. The manhole cylinder shall have the minimum pipe stiffness values shown in the table below when tested in accordance with the reference standard:

Length - Ft.	F/AY - Psi
3.0 - 6.5	0.75
7.0 - 12.5	1.26
13.0 - 20.5	2.01
21.0 - 25.5	3.02
26.0 - 35.0	5.24

4. Diameter tolerance. Inside diameter tolerances shall be +/- 1% of the required inside diameter.
5. UV Inhibitor. The exterior surface of the manhole liner shall be UV-protected using grey pigments in the resin.
6. Interior Surfacing Material. The inner surface exposed to the sewer environment shall be a resin-rich layer 0.010 to 0.020 inch thick followed by a minimum of two passes of chopped roving of minimum length 0.5 inch to maximum length of 2.0 inch, applied uniformly to an equivalent weight of 3 oz./ft². 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
7. The entire fiberglass assembly at each manhole shall be fabricated so that no more than twelve inches of concrete adjusting rings will be required to bring the top of the manhole frame/cover to the required elevation.

226.4 CLEANING

1. Covers (screens) shall be placed over the pipe inverts to prevent extraneous material from entering the sewer system.
2. Existing roots and manhole steps shall be removed by cutting them flush with the manhole wall.
3. All foreign materials shall be removed from the manhole wall using high pressure water spray (3500 - 4000 psi). Cleaning equipment shall have a pressure gauge that indicates the water pressure being used.

226.5 PRELIMINARY REPAIRS

1. Active leaks shall be stopped using BWSA-approved products specifically formulated for that purpose and according to manufacturer's recommendation. Some leaks may require

exterior grouting to stop the inflow. Grouting shall be performed in accordance with ITEM 259 - PRESSURE GROUTING.

2. After all repairs have been completed, all loose materials shall be removed from the manhole. No material shall be allowed to enter the sewer system.

226.6 INSTALLATION PROCEDURES

Excavate around the top of the existing manhole and remove the manhole frame and cover, brick or concrete adjustments, and corbel section. If the existing manhole is poured concrete, the corbel section shall be removed using methods, which will not damage the lower manhole barrel. Brick and precast concrete corbels shall be removed to the top of the manhole barrel section

After cleaning and preliminary repairs are completed on the existing manhole, the rigid fiberglass liner shall be installed in accordance with the construction drawings.

The bottom of the manhole liner shall be cut to fit the existing manhole base and pipe entrances. Cuts shall be accurately made with a suitable power saw.

The existing bench shall be dug out and a new concrete bench poured. Extend the gravity sewer by adding short lengths of PVC Pipe. The manhole liner shall be lowered into the existing manhole and set into wet, Class D concrete mix on the benches. A good bottom seal shall be obtained in order to prevent loss of grout from the annular space between the outside of the manhole liner and the interior of the existing manhole. A 6-inch lift of quick-setting grout shall be placed above the initial bottom seal to ensure adequacy of the bottom seal.

The annular void between the manhole liner and the existing manhole shall be filled with a 4,000 psi at 28-days strength cementitious grout mixture. The grout mixture shall consist of Portland cement and sand. The actual design mix showing the proportions of each component and admixtures, if any, shall be submitted to the Engineer for approval.

After the annulus and perimeter of the manhole liner is grouted, concrete adjustment rings shall be placed on top of the liner corbel section to bring the frame and cover to finish grade.

The manhole corbel section shall be backfilled with sand or granular material as recommended by the manufacturer and approved by the BWSA. The remaining excavation shall be backfilled as required in ITEM 201, EXCAVATION AND BACKFILL.

226.7 TESTING

After the manhole liner installation is complete and all adjustment rings and the frame and cover are installed, the manhole shall be vacuum tested as required by Section SC -47, VACUUM TESTING OF NEW AND REHABILITATED MANHOLES. Any leakage into the manhole shall be stopped.

226.8 MEASURE AND PAYMENT

1. The Contract Unit Price for rigid fiberglass manhole inserts shall include all labor, equipment, and materials necessary for the complete construction of the manhole insert, including backfilling. The pay quantity shall be measured from the bottom of the fiberglass barrel section to the top of the fiberglass corbel.
2. Payment for exterior grouting of manhole walls necessary to stop infiltration will be at the Contract Unit Price for manhole grouting.
3. Payment for step removal, furnishing and sealing concrete adjusting rings and the ring and cover, and concrete collar, will be at the applicable Contract Unit Prices.

END OF ITEM

226.7 TESTING

After the manhole liner installation is complete and all adjustment rings and the frame and cover are installed, the manhole shall be vacuum tested as required by Section SC -47, VACUUM TESTING OF NEW AND REHABILITATED MANHOLES. Any leakage into the manhole shall be stopped.

226.8 MEASURE AND PAYMENT

1. The Contract Unit Price for rigid fiberglass manhole inserts shall include all labor, equipment, and materials necessary for the complete construction of the manhole insert, including backfilling. The pay quantity shall be measured from the bottom of the fiberglass barrel section to the top of the fiberglass corbel.
2. Payment for exterior grouting of manhole walls necessary to stop infiltration will be at the Contract Unit Price for manhole grouting.
3. Payment for step removal, furnishing and sealing concrete adjusting rings and the ring and cover, and concrete collar, will be at the applicable Contract Unit Prices.

END OF ITEM

CONSTRUCTION SPECIFICATIONS

ITEM 227
VAULT AND MANHOLE CONSTRUCTION

227.1 WATER LINE VAULTS

This section of the specifications covers the construction of vaults for water valves or other control devices, large meters, etc., and sanitary sewer manholes. Vaults may be of reinforced concrete or precast reinforced concrete culvert pipe or as detailed on the Plans.

Concrete shall conform to Item 113, CONCRETE and Item 213, CONCRETE CONSTRUCTION.

227.2 STANDARD SANITARY SEWER MANHOLES

Sewer line manholes shall be constructed in accordance with the Plans and Specifications and approval of the Engineer. They shall be provided with cast iron manhole ring and cover. Manhole steps will not be furnished.

Sewer pipe shall be laid through the manhole where possible, prior to concreting floor slab, so that full depth of pipe is embedded in concrete to form the flow channel. Where pipe cannot be used through manholes due to direction of flow, the flow channel to top of pipe shall be formed with concrete and troweled with a steel trowel to a smooth, even finish. The slab shall be sloped one (1) inch per foot to flow channel and troweled to a smooth, even finish. After concrete has set, the top half of pipe between the walls of the manhole shall be broken out and the edges pointed up.

A. Cast-in-Place Manholes:

The walls and base of cast-in-place manholes shall be poured monolithically using Class "A" Concrete. The earthen pit shall be widened and deepened at the bottom to allow a sufficient spread of base concrete matching the dimensions shown on the detail in the Plans. The walls shall be constructed using form sections which can be disconnected and removed both inside and outside after the concrete has cured. Forms shall provide a minimum wall thickness of six inches (6") and inside diameter at the base of four feet (4'). Inside diameter at the top of the barrel shall not be less than twenty-six inches (26"). Precast cover grade rings shall be used to bring the manhole to finish grade. The grade rings and cast iron frame and cover shall be mortared around the outside flush with the outside wall of the cast-in-place section.

B. Precast Manholes:

Precast reinforced concrete manhole section shall comply with ASTM C478 "Precast Reinforced Manhole Sections", with the following additions:

1. All pipe shall be machine made by a process which will provide for uniform placement of zero (0) slump concrete in the form and compaction by mechanical devices which will assure a dense concrete in the finished product. However, reducer cones may be wet-cast.
2. Aggregates shall comply with ASTM C33 except that aggregate shall have a minimum of fifty percent (50%) calcium carbonate equivalent.
3. Minimum wall thickness shall be as specified for Wall B in the "Class Tables" of ASTM C76.
4. Water containment manholes shall use precast sections of the bell and spigot or tongue and groove design with trapped type preformed O-ring rubber gaskets conforming to ASTM C443. Non-water containment structure such as valve vaults may use an approved preformed mastic joint material in lieu of O-rings.
5. Risers shall be available in standard lengths on one foot (1') through six feet (6') in increments of one foot (1').
6. Manhole steps will not be furnished.

The Class "A" concrete base shall be poured around the sewer pipe to the shape and dimensions shown on the Plans. The first section of reinforced precast concrete pipe shall be set on the base and grouted in place. The required sections of precast pipe shall be placed to bring the manhole up to grade. Precast pipe joints shall be "O" ring. The last section of precast pipe shall be a concentric manhole ring. Precast concrete grade rings shall be used to bring the manhole to finished grade. The grade rings and cast iron frame and cover shall be mortared around the outside flush with the outside wall of the precast manhole cone.

C. Fiberglass Manholes

See Specification 128 and 228 herein.

227.3 DROP MANHOLES

Drop Manholes shall be constructed as detailed on the Plans, in locations as specified.

227.4 MEASUREMENT AND PAYMENT

If vaults are not included in the price bid for the valve (or other installation) they shall be paid for at the unit price bid for the vault complete in place.

Sewer manholes shall be measured and paid for by the unit complete in place, including all

excavation, castings, reinforcing steel, backfill, concrete and all appurtenances for a complete unit.

The price bid for a standard sewer manhole is for a depth of six (6) feet or less measured from the invert to the top of the manhole casting. Payment for extra depth of manholes in excess of six (6) feet will be made at the unit price bid per foot of extra depth, measured to the nearest one-tenth (1/10) foot.

The lump sum bid for drop manholes shall be in addition to payment for standard sewer manhole. Bid price shall include all material, labor and equipment required for the installation complete and ready for service.

END OF ITEM

CONSTRUCTION SPECIFICATIONS

ITEM 228
INSTALLATION OF FIBERGLASS MANHOLES

228.1 GENERAL

Fiberglass manholes shall be installed at locations shown on the Plans and specified in these Contract Documents. Manholes shall meet or exceed ASTM D-3753 and specification Material Specification 128.

228.2 SHIPPING AND HANDLING

The fiberglass manholes shall not be dropped or struck. They may be lifted by inserting a 4" x 4" x 30" timber into the top of manhole with cable attached or by a sling or "choker" connection around center of manhole, lift as required. Use of chains or cables in contact with the manhole surface is prohibited.

228.3 CONCRETE

Fiberglass Bottom: Class F Concrete shall be used to form bench area and invert. Class E Concrete shall be used on top of anti-flotation ring and around the reduce section as required for buoyancy and as shown on the drawings.

Concrete Bottom: Lower manhole into wet concrete until it rests at the proper elevation, with a minimum of 4 inches of fiberglass manhole inserted into the wet concrete below flow line, then move manhole to plumb. The concrete shall extend a minimum of one foot from the outside wall of the manhole and a minimum of 6 inches above incoming lines. On the inside concrete shall form the bench and invert area and rise a minimum of 4 inches above incoming lines. Concrete collars shall be constructed around reducer section at locations shown on the drawings.

228.4 BACKFILL

Backfill Material: Unless shown otherwise on drawings and approved by the Engineer, sand, crushed stone, or pea gravel shall be 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. Suitable material chosen from the excavation may be used for the remainder of the backfill. The material chosen shall be free of large lumps or clods, which will not readily break down under compaction. This material will be subject to approval by Engineer.

Backfill shall be placed in layers of not more than 12 loose measure inches and mechanically tamped to 95% Standard Proctor Density, unless otherwise approved by 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.

228.5 MARKING AND IDENTIFICATION

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

Manufacturer's name or trademark
Manufacturer's factory location
Manufacturer's serial number
Total height
Complies with ASTM D-3753

228.6 MEASUREMENT AND PAYMENT

The price bid for new/ replacement manhole installations shall include all labor, equipment and materials necessary for construction of the manhole including but not limited to joint sealing, lift hole sealing and exterior surface coating, concrete base, concrete invert, connections to sewer pipes, castings, backfill, unpaved surface restoration, and all appurtenant work. Payment shall not include pavement replacement, which if required, will be made separately, based on the appropriate bid items.

Payment for concrete collars and watertight manhole inserts, if required, will be made separately, based on the appropriate bid items.

END OF ITEM

CONSTRUCTION SPECIFICATIONS

ITEM 229
INSTALLATION OF POLYETHYLENE WRAPPING

229.1 POLYETHYLENE WRAPPING, INSTALLATION OF

This specification is intended to set forth the general requirements for the installation of polyethylene wrapping material conforming to material specification Item 129, POLYETHYLENE WRAP FOR METAL PIPE AND FITTINGS.

229.2 GENERAL

The polyethylene wrapping is to be installed over ductile iron pipe, fittings and specials, to provide a dielectric barrier against the electrolytic action encountered in highly active soils.

229.3 INSTALLATION OF DUCTILE IRON PIPE

To install polyethylene wrapping on ductile iron pipe, the following procedures shall be followed:

A. Place Wrapping on Ductile Iron Pipe:

Using either a sling or pipe tongs, raise the pipe a suitable working distance off the ground. Slip a polyethylene tube over the spigot end of the pipe so that the excess length is gathered near the hoisting sling. Tape a smooth, unwrinkled end of the wrapping one (1) foot from the spigot end.

B. Lower the Pipe Into Place:

Lower the pipe into the trench to a point just above grade, seat the spigot end in the bell of the adjacent installed pipe, then lower to grade and alignment.

C. Joint:

Complete the pipe joint in the normal manner, then gauge the joint to assure the proper position of the seal.

D. Complete the Wrapping Installation:

Reposition the sling to raise the bell on the adjoining pipe three (3) or four (4) inches. Draw the polyethylene wrapping on the up-stream pipe over and past the tape wrap on the down-stream pipe to the extremity of the tape, which shall be a minimum of two (2) feet past the taped end of the down-stream pipe. DO NOT tape this end. Lower the pipe to grade and alignment.

E. Successive Pipe Runs:

Repeat "A" through "D" successively along the line.

F. Backfill:

Complete backfill operations in the normal manner, except limit operation to a point which will not restrict the above installation phases.

229.4 INSTALLATION ON FITTINGS AND SPECIALS

Fittings such as bends and reducers shall be covered similarly to steps "A" through "F" above. Specials such as valves, hydrants, crosses, etc., shall be wrapped by splitting, tucking and overlapping the polyethylene tube, then closing the field-made splices with the required tape.

Polyethylene tubing required to connect valves may be obtained from overlapping the excess tube on the adjacent pipe lengths. The tubing should be drawn over the bell of pipe on either side and insulated with field-made seams as described above.

Hydrants shall be encased with the Polyethylene tubing slipped over the hydrant and extended to a point two (2) to three (3) inches above the ground line. The wrap shall be excluded from the drain region to allow normal drain function of the hydrant.

All fittings and specials that require concrete blocking shall be completely wrapped prior to pouring the concrete block.

229.5 MEASUREMENT AND PAYMENT

Measurement shall be on the basis of the amount of pipe in place. Payment shall be made for polyethylene wrapped pipe complete in place measured on a per linear foot basis as above defined and the price bid per linear foot of the particular size pipe involved. No special payment will be made for wrapping of gate valves, fire hydrants and similar appurtenances.

END OF ITEM

CONSTRUCTION SPECIFICATIONS

ITEM 230
CORROSION PROTECTION OF NEW CONCRETE MANHOLES
AND UNDERGROUND STRUCTURES

230.1 OVERVIEW

This specification covers work, materials and equipment required for protecting and/or rehabilitating concrete and masonry manholes and other underground structures by monolithic spray-application of a high-build, solvent-free epoxy coating to eliminate infiltration, provide corrosion protection, repair voids and enhance structural integrity. Procedures for surface preparation, cleaning, application and testing are described herein.

230.2 GENERAL

1. SECTION INCLUDES

- A. Requirements for surface preparation, repairs and solvent-free epoxy coating application to specified surfaces.

2. REFERENCES

- A. ASTM D638 - Tensile Properties of Plastics.
- B. ASTM D790 - Flexural Properties of Unreinforced and Reinforced Plastics.
- C. ASTM D695 - Compressive Properties of Rigid Plastics.
- D. ASTM D4541 - Pull-off Strength of Coatings Using a Portable Adhesion Tester.
- E. ASTM D2584 - Volatile Matter Content.
- F. ASTM D2240 - Durometer Hardness, Type D.
- G. ASTM D543 - Resistance of Plastics to Chemical Reagents.
- H. ASTM C109 - Compressive Strength Hydraulic Cement Mortars.
- I. ACI 506.2-77 - Specifications for Materials, Proportioning, and Application of Shotcrete.
- J. ASTM C579 - Compressive Strength of Chemically Setting Silicate and

Silica Chemical Resistant Mortars.

- K. ASTM - The published standards of the American Society for Testing and Materials, West Conshohocken, PA.
- L. NACE - The published standards of National Association of Corrosion Engineers (NACE International), Houston, TX.
- M. SSPC - The published standards of the Society of Protective Coatings, Pittsburgh, PA.
- N. Los Angeles County Sanitation District – Evaluation of Protective Coatings for Concrete
- O. SSPWC 210-2.3.3 - Chemical resistance testing published in the Standard Specifications for Public Works Construction, 1997 edition (otherwise known as “The Greenbook”)

3. SUBMITTALS

- A. The following items shall be submitted:
 - 1. Technical data sheet on each product used, including ASTM test results indicating the product conforms to and is suitable for its intended use per these specifications.
 - 2. Material Safety Data Sheets (MSDS) for each product used.
 - 3. Project specific guidelines and recommendations.
 - 4. Applicator Qualifications:
 - a. Manufacturer certification that Applicator has been trained and approved in the handling, mixing and application of the products to be used.
 - b. Certification that the equipment to be used for applying the products has been manufactured or approved by the epoxy coating manufacturer and Applicator personnel have been trained and certified for proper use of the equipment.
 - c. Two (2) years experience and five (5) recent references of projects of similar size and scope and Applicator must provide references indicating successful application on underground concrete or masonry substrates of a minimum 10,000 vf of the specified 100% solids, high-build solvent-free epoxy coating by heated, plural

component spray application.

- d. Proof of any required federal, state or local permits or licenses necessary for the project.
5. Or Equal Submittal: In order to be considered as an equal product, said product will have to meet the minimum physical properties of the approved products as referenced in paragraph 2.04 as measured by the applicable ASTM standards referenced in paragraph 1.03. Testing results must be performed and presented by a third-party testing laboratory.

Equal products must be submitted to Owner a minimum of two (2) weeks prior to bid date. In order for a product to be considered equal the submitted product must provide proof of successfully passing the Los Angeles County Sanitation Districts Coating Evaluation Study or evidence from the City of Los Angeles Department of General Services Standards Division indicating the Department tested and the product "passed" SSPWC Section 210-2.3 Chemical Resistance Test. An applicator that has been trained and certified by the manufacturer must install all products.

Product pre-approval is required to determine if the prospective product may be bid on this project. A product may be rejected as unacceptable should submittal to Owner not be received a minimum of two (2) weeks prior to bid date.

4. QUALITY ASSURANCE

- A. Applicator shall initiate and enforce quality control procedures consistent with applicable ASTM, NACE and SSPC standards and the epoxy coating manufacturer's recommendations.
- B. A NACE certified coating inspector ("Inspector") shall be provided by Owner. The Inspector will observe surface preparation, application and material handling procedures to ensure adherence to the specifications.

5. STORAGE AND HANDLING

- A. Products are to be kept dry, protected from weather and stored under cover.
- B. Products are to be stored and handled according to their material safety data sheets.

6. SITE CONDITIONS

- A. Applicator shall conform with all local, state and federal regulations including those set forth by OSHA, RCRA and the EPA and any other applicable authorities.

7. WARRANTY

- A. Applicator shall warrant all work against defects in materials and workmanship for a period of one (1) year, unless otherwise noted, from the date of final acceptance of the project. Applicator shall, within a reasonable time after receipt of written notice thereof, repair defects in materials or workmanship which may develop during said one (1) year period, and any damage to other work caused by such defects or the repairing of same, at his own expense and without cost to the Owner.

230.3 PRODUCTS

1. EXISTING PRODUCTS

- A. Standard Portland cement or new concrete (not quick setting high strength cement) must be well cured prior to application of the epoxy coating.
- B. Cementitious patching and repair materials should not be used unless proof of suitability and procedures for topcoating with an epoxy coating are approved by the epoxy coating manufacturer. Project specific submittals should be provided including application, cure time and surface preparation procedures which permit optimum bond strength with the epoxy coating.
- C. Remove existing coatings prior to application of the new epoxy coating. Applicator is to maintain strict adherence to applicable NACE and SSPC recommendations with regard to proper surface preparation and compatibility with existing coatings.

2. EPOXY COATING MANUFACTURER

- A. Raven Lining Systems, Inc., Tulsa, Oklahoma 800-324-2810 or 918-584-2810 or FAX 918-582-4311.
- B. Or approved equal.

3. REPAIR MATERIALS

- A. Repair materials shall be used to fill voids, structurally reinforce and/or rebuild surfaces, etc. as determined necessary by the Owner and epoxy coating applicator. Repair materials must be compatible with the specified epoxy coating and shall be applied in accordance with the manufacturer's recommendations.
- B. The following products may be accepted and approved as compatible repair basecoat materials for epoxy topcoating for use within the specifications:
 - 1. 100% solids, solvent-free epoxy grout specifically formulated for epoxy topcoating compatibility. The epoxy grout manufacturer shall provide

instructions for trowel or spray application and for epoxy topcoating procedures.

2. Factory blended, rapid setting, high early strength, fiber reinforced, non-shrink repair mortar that can be trowelled or pneumatically spray applied may be approved if specifically formulated to be suitable for epoxy topcoating.

4. EPOXY COATING

- A. Raven Lining Systems' Raven 405 epoxy coating system - a 100% solids, solvent-free two-component epoxy resin system thixotropic in nature and filled with select fillers to minimize permeability and provide sag resistance acceptable to these specifications.

Product type	Amine cured epoxy
Color	Light Blue
Solids Content (vol %)	100
Mix Ratio	3:1
Compressive Strength, psi	18,000
Tensile Strength, psi	7,600
Tensile Elongation, %	1.50
Flexural Modulus, psi	600,000
Hardness, Type D	88
Bond Strength - Concrete	>Tensile Strength of Concrete
Chemical Resistance:	
Severe Municipal Sewer:	All types of service
Successful Pass:	Sanitation District of L.A. County Coating Evaluation Study or SSPWC 210.2.3.3

5. EPOXY COATING APPLICATION EQUIPMENT

- A. Manufacturer approved heated plural component spray equipment shall be used in the application of the specified epoxy coating.

6. REPAIR MATERIAL SPRAY APPLICATION EQUIPMENT (if spray applied)

- A. Spray applied repair materials shall be applied with manufacturer approved equipment.

230.4 EXECUTION

1. ACCEPTABLE APPLICATORS

- A. Repair material applicators shall be trained to properly apply the cementitious mortar according to manufacturer's recommendations.

- B. Epoxy coating must be applied by a Certified Applicator of the epoxy coating manufacturer and according to manufacturer specifications.

2. EXAMINATION

- A. All structures to be coated shall be readily accessible to Applicator.
- B. Appropriate actions shall be taken to comply with local, state and federal regulatory and other applicable agencies with regard to environment, health and safety.
- C. Any active flows shall be dammed, plugged or diverted as required to ensure that the liquid flow is maintained below the surfaces to be coated. Flows should be totally plugged and/or diverted when coating the invert. All extraneous flows into the manhole or vaults at or above the area coated shall be plugged and/or diverted until the epoxy has set hard to the touch.
- D. Installation of the epoxy coating shall not commence until the concrete substrate has properly cured in accordance with these specifications.
- E. Temperature of the surface to be coated should be maintained between 40 deg F and 120 deg F during application. Prior to and during application, care should be taken to avoid exposure of direct sunlight or other intense heat source to the structure being coated.

3. SURFACE PREPARATION

- A. Applicator shall inspect all specified surfaces prior to surface preparation. Applicator shall notify Owner of any noticeable disparity in the surfaces which may interfere with the proper preparation or application of the repair material and/or epoxy coating.
- B. Applicator shall perform all surface preparation and epoxy coating installation.
- C. All contaminants including: oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants shall be removed. All concrete or mortar that is not sound or has been damaged by chemical exposure shall be removed to a sound concrete surface or replaced.
- D. Surface preparation method(s) should be based upon the conditions of the substrate, service environment and the requirements of the repair materials and/or epoxy coating to be applied. Surfaces to receive repair materials and/or epoxy coating shall be cleaned and abraded to produce a sound surface with adequate profile and porosity to provide a strong bond between the repair materials and/or epoxy coating and the substrate.

- E. Infiltration shall be stopped by using a material which is compatible with the repair materials and is suitable for topcoating with the epoxy coating.
- F. All surfaces should be inspected by the Inspector during and after preparation and before the repair material is applied.

4. APPLICATION OF REPAIR MATERIALS

- A. Areas where structural steel has been exposed or removed shall be repaired in accordance with the Owner's recommendations.
- B. Repair materials shall meet the specifications herein. The materials shall be trowel or spray applied utilizing proper equipment on to specified surfaces. The material thickness shall be specified by the Owner according to the projects' requirements and manufacturer's recommendations.
- C. Cementitious repair materials shall be trowelled to provide a smooth surface with an average profile equivalent to coarse sandpaper to optimally receive the epoxy coating. No bugholes or honeycomb surfaces should remain.
- D. The repair materials shall be permitted to cure according to manufacturer recommendations. Curing compounds should not be used unless approved for compatibility with the specified epoxy coating.
- E. After abrasive blast and leak repair is performed, all surfaces shall be inspected for remaining laitance prior to epoxy coating application. Any evidence of remaining contamination or laitance shall be removed by additional abrasive blast, shotblast or other approved method. If repair materials are used, refer to these specifications for surface preparation. Areas to be coated must also be prepared in accordance with these specifications after receiving a cementitious repair material and prior to application of the epoxy coating.
- F. All surfaces should be inspected by Inspector during and after preparation and before the epoxy coating is applied.

5. APPLICATION OF EPOXY COATING

- A. Application procedures shall conform to the recommendations of the epoxy coating manufacturer, including material handling, mixing, environmental controls during application, safety, and spray equipment.
- B. The spray equipment shall be specifically designed to accurately ratio and apply the specified epoxy coating materials and shall be regularly maintained and in proper working order.
- C. The epoxy coating material must be spray applied by a Certified Applicator of the

epoxy coating manufacturer.

- D. Specified surfaces shall be coated by spray application of a moisture tolerant, solvent-free, 100% solids, epoxy coating as further described herein. Spray application shall be to a minimum wet and dry film thickness as defined below:

Concrete, New/Smooth Manholes: 80-100 mils average for immersion, 60-80 mils average for atmospheric, splash and spill service

Concrete, New/Smooth Lift Stations 125 mils average, thicker coating
Wet Wells or Junction Boxes: may be required based upon prepared surface profile

Concrete, New/Smooth Deep 125 mils average, thicker coating
Tunnel Shafts: may be required based upon prepared surface profile.

(Thicknesses shown above are for general purposes only, each project should be evaluated independently and thickness of system determined upon product, service environment, protection and restoration requirements.)

- F. If necessary, subsequent topcoating or additional coats of the epoxy coating should occur as soon as the basecoat becomes tack free, but no later than the recoat window for the specified products. Additional surface preparation procedures will be required if this recoat window is exceeded.
- G. (Optional) Fiberglass woven-roving fabric may be rolled into the resin or chopped glass spray applied with the resin for added tensile and flexural strength where desired. Sloped surfaces of the floor may be made non-skid by broadcasting aluminum oxide or silica sand into the surface prior to gelation.
- H. (Optional) Depending on flow levels and how long flow can be stopped, inverts may be lined with an approved 100% solids, fast setting epoxy coating.

6. TESTING AND INSPECTION

- A. During application, Applicator shall regularly perform and record epoxy coating thickness readings with a wet film thickness gage, such as those available through Paul N. Gardner Company, Inc. meeting ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, to ensure a monolithic coating and uniform thickness during application. A minimum of three readings per 200 square foot area shall be recorded. Applicator will submit all documentation on thickness readings to Inspector on a daily basis when coating application occurs.
- B. Applicator may perform holiday detection on all surfaces coated with the epoxy coating in the presence of Inspector. After the epoxy coating has set hard to the touch, surfaces shall first be dried, an induced holiday may then be made on to the

coated concrete surface and shall serve to determine the minimum/maximum voltage to be used to test the coating for holidays at that particular area. The spark tester shall be initially set at 100 volts per 1 mil (25 microns) of film thickness applied but may be adjusted as necessary to detect the induced holiday (refer to NACE RPO188-99). All detected holidays shall be marked and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional epoxy coating material can be hand applied to the repair area. All touch-up/repair procedures shall follow the epoxy coating manufacturer's recommendations. (Note: This procedure is sometimes difficult or impossible to perform in tight manhole or vault structures or may provide unreliable readings when testing coatings applied to concrete.)

- C. A minimum of 10% of the total surface area or structures coated may be subjected to adhesion (bond) testing per this section at the option of the Owner. Measurement of bond strength of the epoxy coating to the substrate may be examined in accordance with ASTM D4541. Any areas detected to have inadequate bond strength shall be evaluated by the Owner. Further bond tests may be performed in that area to determine the extent of potentially deficient bonded area and repairs shall be made by Applicator in strict accordance with manufacturer's recommendations.

- D. (Optional) Manholes coated in their entirety may be vacuum tested. All pipes entering the manhole should be plugged, taking care to securely place the plug from being drawn into the manhole. The test head shall be placed and the seal inflated in accordance with the manufacturer's recommendations. A vacuum pump of ten (10) inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to nine (9) inches. Following are minimum allowable test times for manhole acceptance at the specified vacuum drop:

DEPTH (FEET)	TIME (SECONDS)		
	<u>48" diameter</u>	<u>60" diameter</u>	<u>72" diameter</u>
4	10	13	16
8	20	26	33
12	30	39	49
16	40	52	67
20	50	65	81
24	59	78	97

Add for 2ft. more depth: 5 6.66 8

Note: These numbers have been taken from ASTM C 1244-93 (reapproved 2000).

If the manhole fails the initial test, repairs and adjustments necessary due to extenuating circumstances (ie. pipe joint, liner, plug sealing) should be made.

Retesting shall proceed until a satisfactory test is obtained.

- E. A final visual inspection shall be made by the Inspector and Applicator. Any deficiencies in the finished coating shall be marked and repaired by Applicator according to the procedures set forth herein.
- F. The municipal sewer system may be put back into non-severe operational service as soon as the final inspection has taken place. Consult epoxy coating manufacturer for further recommendations.

230.5 MEASUREMENT AND PAYMENT

Measurement and payment will be based on the total vertical feet of applied coating.

END OF ITEM

CONSTRUCTION SPECIFICATIONS

ITEM 233
DEWATERING OF WATER LINES

233.1 GENERAL

At the locations shown and detailed on the Plans, there shall be constructed standard blow-offs and drains and special dewatering facilities to permit the blowing off and/or the dewatering of lines or sections of lines.

233.2 STANDARD BLOW OFF DRAIN

Where shown on the Plans, standard blow-offs and drains connected to storm sewer, culvert or open water course with cast iron pipe provided with gate valves shall be constructed. To the extent practical, drain pipe shall have continual fall from the gate valve to the storm sewer or water course. Each blow-off and drain shall be constructed as detailed on the Plans.

233.3 MEASUREMENT AND PAYMENT

Blow-offs and drains will be measured as complete units from the blow-off branch to the storm sewer, culvert, or open water course. The measurement shall include the cutting in of the discharge line into the storm sewer or culvert and the sealing of the cut in. In the case of a drain discharging into an open water course, measurement shall include the riprap or headwall protection of the outlet and flap valve if required.

Payment will be made for blow-off and drain at the unit price bid, which shall be full compensation for the complete installation including excavation and backfill, cutting in and sealing of the discharge line into the storm sewer or culvert, blocking of valves and fittings, and furnishing of outlet protection (where the discharge is into an open watercourse). The lump sum payment will be exclusive of the blow-off fitting in the main and of the cast iron pipe, valves and fittings required, which will be paid for at the respective unit prices bid.

Payment for blow-off with dewatering sump manhole will be made on lump sum basis at unit price bid, which shall be full compensation for complete installation including excavation and backfill from blow-off fitting to manhole, furnishing and installing sump manhole, and other items needed for complete installation, exclusive of items for which there are bid items in the proposal.

END OF ITEM

CONSTRUCTION SPECIFICATIONS

ITEM 234
REMOVING EXISTING PIPE

234.1 DESCRIPTION

The work to be done under this section of the specifications consists of the necessary excavation and removal of pipe and fittings, and (unless new pipe is to be laid in the same trench at once) backfilling, grading and sodding, restoration of existing street surface, etc., as indicated on the Plans or set forth in the Special Contract Documents.

All cast iron, ductile iron, brass, copper, or other metals pipe and fittings and all other salvaged materials are the property of the Owner and shall be made available for BWSA to pick-up and salvage.

234.2 TRENCH EXCAVATION AND BACKFILL

The Contractor shall provide, before commencing any excavation, ample equipment and shoring material to insure that the work will be carried on in such a manner as to prevent damage to existing installation. The use of machinery must be so well and carefully regulated as to preclude any possible damage to existing structures or pipe lines.

The trench shall be excavated to sufficient depth and width to permit the removal of the pipe jointing material and the pipe in a convenient and safe manner. The trench walls shall be braced where necessary to prevent caving and to provide safe working conditions. All water removed from the trench shall be conducted to natural drainage ways, drains or storm sewers in such a manner as to prevent damage to property of the public.

Where excavation endangers adjacent structures or pipe lines, the Contractor shall at his own expense carefully shore, support and protect all such structures and pipe lines so that there will be no failure or settlement. In case any damage, either failure or settlement, occurs to an existing pipe line or structure, the Contractor shall restore same to its original condition and/or position without compensation from the Owner.

In those cases where a new main is not to be installed in the same trench immediately, and after the existing pipe has been removed, the trench shall be backfilled in layers not exceeding three (3) feet in depth and thoroughly compacted by and approved method.

Excess excavated material not used in backfilling shall be disposed of by the Contractor without additional compensation by the Owner.

234.3 REMOVING PIPE

Before taking up any pipe or fittings in any section of pipe line to be removed, all jointing material shall be removed from the joints. The lead from lead joints shall be kept free from dirt or trash.

The pipe shall be removed from the trench by direct lift with suitable equipment. Dragging of the pipe will not be permitted. Every care shall be taken to prevent damage to the pipe and fittings in the removing and handling. After removal from the trench the Contractor shall clean the outside surface of all pipe, fittings, etc.

If more than five (5) percent of the pipe is broken or damaged by the Contractor, a sum representing the present market value of the footage broken or damaged in excess of this percentage will be deducted from the amount otherwise due the Contractor and will be retained by the Owner as payment for the broken or damaged pipe. If the bell of any pipe is broken or damaged, the entire length of the pipe will be included in determining the footage broken or damaged.

234.4 MEASUREMENT AND PAYMENT

Pipe of the various sizes will be measured along the surface of the ground or street along the main axis of the pipe from center of fitting to center of fitting or end of pipe without any deduction for intermediate fittings or valves. Payment will be made at the price bid per foot of pipe removed for the various pipe sizes. Bid price shall include locating and uncovering pipe, removal of jointing material, lifting from trench, cleaning, loading and hauling to storage yard, and plugging of ends of pipe to remain. Payments for plug and concrete blocking are made separately.

END OF ITEM

CONSTRUCTION SPECIFICATIONS

ITEM 235
CONNECTION TO EXISTING WATER MAINS

235.1 DESCRIPTION

Where indicated on the Plans and/or specified, the Contractor shall connect the new main with existing mains. The Contractor shall furnish all labor, materials, equipment and services required for the locating and uncovering of the existing line, the making of cuts in the existing line, the removal, relocation and/or lowering of existing lines as required, dewatering of the trench, connecting of the existing line into the new main and all appurtenant work required for a complete connection. Relocated mains or lines shall be laid so that all valves shall be set vertically.

Only such connections to existing mains as are necessary to load, test and sterilized mains under construction with water from City mains will be permitted prior to the chlorination of new mains. All other connections to existing mains from the new main shall be made only after the new main has been satisfactorily disinfected and the Owner has authorized the connections. The Contractor will be required to plug and block lines, crosses, tees or other fittings installed in the new main to permit testing and chlorination prior to the making of connections. Such plugs and blocking shall be adequate to withstand a test pressure of 150 pounds per square inch.

Where cut-ins are made immediately adjacent to valves which are under pressure, the Contractor shall take all necessary precautions to brace such valves with temporary blocking and bracing which shall be of ample size and properly placed to prevent movement or blowing off of any pipe, valves or fittings due to water pressure on the main.

Connections to existing water mains shall be made at the locations shown, as specified and/or as directed by the Owner. All such connections shall be made in a most expeditious and workmanlike manner to cause the least inconvenience to water customers and to traffic. The detailed schedule of operations for making each connection shall be approved by the Owner before any work thereupon is commenced.

In the case where blow-off connections or fire hydrants are not provided for flushing, the Contractor will be required to leave one end of the new main open for flushing, and then plug and block the end for chlorination and testing.

235.2 MEASUREMENT AND PAYMENT

Wet connections to existing mains shall be measured as a lump sum for each connection listed in the proposal.

Where connections to existing mains are made substantially in the dry, that is, a connection to a line shut off by immediately adjacent valve or valves, and which does not require cutting into a main under pressure, no extra compensation will be allowed, and the Contractor will be paid only the unit price bid for the installation of the cast iron pipe, valves and/or concrete blocking installed in making the connection.

Payment for connections to existing mains will be made at unit price bid for various installations, which will include the furnishing of all labor, miscellaneous materials and services for locating the existing main or line to which connection is to be made; the uncovering of such length of line as may be necessary in the making of connection; the cutting in of a fitting, the removal of a plug and blocking, the removal raising, lowering or relocation of the existing line and appurtenances; the completion of the connection between the new and existing line; necessary backfilling and compaction of backfill, and all incidental work required for a complete connection.

All new materials incorporated into the connection will be paid for at the unit prices bid, and the lump sum bid for each connection shall not include the furnishing and installation of such materials.

END OF ITEM

CONSTRUCTION SPECIFICATIONS

ITEM 237
CLEANING AND STERILIZATION OF WATER MAINS

237.1 GENERAL

During the construction operations workmen shall be required to use utmost care to see that parts of the structures, inside of pipes, fittings, jointing materials, valves, etc., the surfaces of which come in contact with the water system, are maintained in a sanitary condition.

Every effort must be made to keep the inside of the pipe, fittings and valves free of all foreign matter, sticks, dirt, rocks, etc. As each joint of pipe is being laid, it must be effectively swabbed so that all foreign matter is removed. All fittings and exposed open ends of pipe must be blocked or capped until the line is completed.

Under no circumstances shall any part of a new line be placed in service prior to sterilization.

237.2 PROCEDURE

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. The line shall be flushed out and filled with water from a water main.
- B. Chlorine shall be injected at one end of the line, and water released from the opposite end until the chlorine is present at the discharge end in such quantity to indicate a residual of fifty (50) ppm. All valves shall then be closed, and the solution shall remain in the line for at least twenty-four (24) hours.
- C. After twenty-four (24) hours the solution shall be discharged from the line and replaced by water direct from a water main.
- D. Contractor shall take water samples 1 per 1,000 feet of pipe (not through a fire hydrant) under the supervision of the Owner and submitted to an Independent Laboratory for analysis. If the tests show a satisfactory quality of water, the line may be placed in service. If the sample shows an unsatisfactory quality of water, the process of disinfection shall be repeated until a satisfactory sample is obtained.
- E. Unless otherwise specified in the Special Contract Documents, the Contractor will make all necessary taps into pipe to accomplish chlorination of a new line.

237.3 ADDITION OF CHLORINATED LIME

For convenience in certain locations, it may be directed by the Owner that chlorinated lime (HTH) be placed in the pipe as laid, in lieu of standard gas chlorination.

237.4 MEASUREMENT AND PAYMENT

The Contractor shall furnish all chlorination equipment, operators and chlorinating agent; all excavation and backfilling; protection of the site; and incidental labor, material and equipment required in the unit price bid per linear foot of pipe in place.

END OF ITEM

CONSTRUCTION SPECIFICATIONS

ITEM 238
SEWER SERVICE CONNECTIONS

238.1 DESCRIPTION

This item covers the construction methods required for the installation of sanitary sewer service connections as authorized by the Engineer based on applications for connections as approved by the Owner.

Standard sewer service connections shall be installed in trenches down to twelve (12) feet deep, and deep-cut service connections shall be installed in trenches greater than twelve (12) feet deep. Installation of sewer service connections will consist of such wyes, bends, tees, etc., as may be required by the Standard Details and Special Conditions. Standard sewer pipe shall be PVC SDR-35 push on joints.

Separate payment will be made for four (4) inch sewer service lines to be extended from the standard or deep-cut connections at the main to a point at least ten (10) feet behind the curb.

All service connections left for future tie-in by the property Owner shall terminate with a watertight plug. The ends of all sewer service lines designated by green locator tape at the exposed end and extending from a point in the service pipe trench at the end of the service line at least one (1) foot above natural ground surface.

Service connections as completed for payment shall conform to the details shown on the Plans.

238.2 MEASUREMENT AND PAYMENT

Measurement and payment for "Standard" or "Deep-Cut" Sewer Service Connections to the various size mains will be made at the Lump Sum price bid for each.

Payment for four (4) inch sewer service pipe will be made separately in addition to the service connections and such payment shall include trenching, furnishing and laying the pipe and backfill at the price bid per linear foot in the proposal.

No deduction will be made from the length of the sewer main for the length of the sewer wye as installed for the sewer service connection.

END OF ITEM

CONSTRUCTION SPECIFICATIONS

ITEM 257
PIPE INSTALLED BY OTHER THAN OPEN CUT

257.1 GENERAL

The casing pipe for open cut and bored or tunneled section shall be AWWA C-200 Fabricated Electrically Welded Steel Water Pipe, and shall conform to the provisions of Material Specifications, Item 106, Steel Pipe, of these standard specs. The steel casing pipe shall be supplied as follows:

For the inside and outside of casing pipe, coal-tar protective coating is required in accordance with the requirements of Sec. 2.2 and related sections in AWWA C-203.

Touch-up after field welds shall provide coating equal to those specified above.

Casing Spacers (centering style) such as manufactured by Cascade Waterworks Manufacturing Company, Advanced Products and Systems, Inc., or an approved equal shall be used on all non-concrete pipes when installed in casing. Installation shall be as recommended by the manufacturer.

257.2 EXECUTION

1. Where sewer pipe is required to be installed under railroad embankments or under highways, streets or other facilities in other than open cut, construction shall be performed in such a manner so as to not interfere with the operation of the railroad, street, highway, or other facility, and so as not to weaken or damage any embankment or structure. During construction operations, barricades and lights to safeguard traffic and pedestrians shall be furnished and maintained, until such time as the backfill has been completed and then shall be removed from the site.
2. Pits and Trenches:
 - a. If the grade of the pipe at the end is below the ground surface, suitable pits or trenches shall be excavated for the purpose of conducting the jacking or tunneling operations and for placing end joints of the pipe. Wherever end trenches are cut in the sides of the embankment or beyond it, such work shall be sheeted securely and braced in a manner to prevent earth from caving in.
 - b. The location of the pit shall meet the approval of the Engineer.
 - c. The pits of trenches excavated to facilitate these operations shall be backfilled immediately after the casing and carrier pipe installation has been completed.
3. Boring and Jacking Steel Casing Pipe: Steel casing pipe shall be installed by boring

hole with the earth auger and simultaneously jacking pipe into place.

- a. The boring shall proceed from a pit provided for the boring equipment and workmen. The holes are to be bored mechanically. The boring shall be done using a pilot hole. By this method an approximate 2-inch hole shall be bored the entire length of the crossing and shall be checked for line and grade on the opposite end of the bore from the work pit. This pilot hole shall serve as the centerline of the larger diameter hole to be bored. Other methods of maintaining line and grade on the casing may be approved if acceptable to the Engineer. Excavated material shall be placed near the top of the working pit and disposed of as required. The use of water or other fluids in connection with the boring operation will be permitted only to the extent required to lubricate cuttings. Jetting or sluicing will not be permitted.
 - b. In unconsolidated soil formations, a gel-forming colloidal drilling fluid consisting of at least 10 percent of high grade carefully processed bentonite may be used to consolidate cuttings of the bit, seal the walls of the hole, and furnish lubrication for subsequent removal of cuttings and installation of the pipe immediately thereafter.
 - c. Allowable variation from the line and grade shall be as specified under paragraph 2 of ITEM 157.1. All voids between bore and outside of casing shall be pressure grouted.
4. Installation of Carrier Pipe in Casing:
- a. Sanitary sewer pipe located within the encasement pipe shall be supported by "skids" or "bands" to prevent the pipe and bells from snagging on the inside of the casing, and to keep the installed line from resting on the bells.
 - b. All skids shall be treated with a wood preservative. Skids should extend for the full length of the pipe with the exception of the bell area and spigot area necessary for assembly unless otherwise specified.
 - c. The Contractor shall prevent over-belling the pipe while installing it through the casing. A method of restricting the movement between the assembled bell and spigot where applicable shall be provided.
 - d. At all bored, jacked, or tunneled installations, the annular space between the carrier pipe and casing shall be filled with grout. Care must be taken that not too much water is forced into the casing so as not to float the pipe. The backfill material will not be required unless specified on the plans and specified by the Engineer.
 - e. Closure of the casing after the pipe has been installed shall be plugged at the ends of the casing as shown on the drawings or as required by the Engineer.

5. Boring and Jacking Ductile Iron Pipe without Casing Pipe:
 - a. As indicated on drawings and as required and directed by the Engineer sewer shall be constructed of bore and jacked ductile iron pipe.
 - b. When a casing pipe is not designated on the drawings, the contractor shall provide a casing pipe if necessary to achieve line and grade. Casing pipe shall be provided at no additional cost and shall be subsidiary to the cost bid for installation By Other than Open Cut.
 - c. Bore and jack in accordance with paragraph C.3. above.
 - d. Short length of sewer consisting of a single pipe section may be installed by jacking without a bore hole if permitted by the Engineer and in soft soil layer. All voids outside of installed pipe shall be pressure grouted.

6. Tunneling: Where the characteristics of the soil, the size of the proposed pipe, or the use of monolithic sewer would make the use of tunneling more satisfactory than jacking or boring, or when shown on the plans, a tunneling method may be used, with the approval of the Engineer or railroad/highway officials.
 - a. When tunneling is permitted, the lining of the tunnel shall be of sufficient strength of support the overburden. The Contractor shall submit the proposed liner method to the Engineer for approval. The tunnel liner design shall bear the seal of a licensed professional engineer in the State of Texas. Approval by the Engineer shall not relieve the Contractor of the responsibility for the adequacy of the liner method.
 - b. The space between the tunnel liner and the limits of excavation shall be pressure grouted or mud-jacked.
 - c. Access holes for placing concrete shall be space at maximum intervals of 10 feet.

257.3 MEASURE AND PAYMENT

Installation of pipe by other than open cut will be measured by the linear foot of pipe, complete in place. Such measurement will be made between the ends of the pipe along the central axis as installed. The work performed and materials furnished as prescribed by this item will be paid for at the Contract Unit Price bid per linear foot for Pipe Installed by Other Than Open Cut of the type, size, and class of pipe specified as shown on plans. The furnishing of all materials, pipe, liner materials required for installation, for all preparation, hauling and installing of same, and for all labor, tools, equipment and incidentals necessary to complete the work, including excavation, backfilling and disposal of surplus material shall be included in the Contract Unit Price as shown in the Bid Proposal. Payment shall not include pavement replacement, which if

required, shall be paid separately.

END OF ITEM

CONSTRUCTION SPECIFICATIONS

ITEM 258
ELEVATED SANITARY SEWER CROSSINGS

258.1 GENERAL

This section applies to the installation of elevated crossings of sanitary sewer lines over creeks and waterways. All aerial crossing supports shall be out of the main channel flow. The aerial crossing location and design shall be approved by an ENGINEER.

258.2 FOUNDATIONS

Foundations for the elevated crossings will be drilled shafts of a diameter sufficient to carry the dead and superimposed loads. Spread footings are to be avoided.

258.3 CARRIER PIPE

Steel casing pipe shall be designed to span the full width of the channel or creek. The sanitary sewer carrier pipe shall be anchored to the drilled shaft foundation by a concrete saddle and a sanitary sewer pipe strap or concrete collar.

258.4 MEASUREMENT AND PAYMENT

Measurement for payment will be specified in the respective items in the proposal at the unit price bid. Compensation will be based on labor and materials necessary to make the installation.

END OF ITEM

CONSTRUCTION SPECIFICATIONS

ITEM 259
PRESSURE GROUTING

259.1 GENERAL

Scope. This Section governs all work, materials and testing required for the pressure grouting of manhole defects. Manholes or sections of manholes with active leaks shall be repaired as indicated in the Manhole Rehabilitation Schedule.

Description. The Contractor shall be responsible for the furnishing of all labor, supervision, materials, equipment, and testing required for the completion of pressure grouting of manhole defects in accordance with the Contract Documents.

Manufacturer's Recommendations. Materials, additives, mixture ratios, and procedures utilized for the grouting process shall be in accordance with manufacturer's recommendations.

Manholes. Manholes to be grouted are of brick, concrete, or fiberglass construction.

259.2 MATERIALS

1. Grouting Materials:

- a. Urethane Gel Grout: Urethane gel grout, such as Scotch-Seal 5610 gel or equal shall be a hydrophilic polymer. The chemical shall be mixed within the range of from 8 to 10 parts of water and shall contain a reinforcing agent supplied by the same manufacturer. The material shall gel and cure to a tough flexible elastomeric condition. When wet, the gel shall exhibit strength properties of at least 25 psi tensile at 150 percent elongation. The material shall not change in linear dimension more than eight percent when subjected to wet and dry cycles.
- b. The chemical grout shall be applied so as to have the grout material flow freely into the defects. To avoid any wastage of the material flowing through the defects, a gel control agent may be added. The following properties shall be exhibited by the grout:
 - i. Documented service of satisfactory performance in similar usage.
 - ii. Controllable reaction times and shrinkage through the use of chemicals supplied by the same manufacturer. The minimum gel set time shall be established so that adequate grout travel is achieved.
 - iii. Resistance to chemicals; resistant to most organic solvents, mild acids

- and alkali.
 - iv. Compressive recovery return to original shape after repeated deformation.
 - v. The chemical shall be essentially non-toxic in a cured form.
 - vi. Sealing material shall not be rigid or brittle when subjected to dry atmosphere. The material shall be able to withstand freeze/thaw and moving load conditions.
 - vii. Sealing material shall be noncorrosive.
- c. A reinforcing agent such as Scotch-Seal Brand 5612 reinforcing agent or equivalent shall be utilized in accordance with manufacturer's recommendations. Any 5612 reinforcing agent which contains lumps must be discarded. Care must be taken to be sure that the pH of the water in the tank is from 5 to 9. As a precaution against the possibility of the pH being outside this range, take a small amount of water from the tank to which Gel Reinforcing Agent 5612 is to be added. Add a few drops of 5612 to this test sample. Scotch-Seal Brand Gel Reinforcing Agent 5612 should disperse readily. If precipitation occurs, drain the tank and retest. Repeat as necessary until dispersion occurs. If dispersion does not occur, do not use the water source.
 - d. A filler material such as Celite 292 (diatomaceous earth) from Johns Mansville or equivalent shall be utilized. The addition of the filler material shall not exceed the quantity specified by the manufacturer, and continuous agitation of the water side of the mixture is required. The filler material may also be utilized as a reinforcing agent in accordance with the urethane gel grout manufacturer's recommendations.
2. Additives: Grout additions may be utilized for catalyzing the gel reaction, inhibiting the gel reaction, buffering the solution, lowering the freezing temperature of the solution, acting as a filler, providing strength or for inhibition of root growth.
 3. Root Control: A root inhibiting chemical such as dichlobenil shall be added to the chemical grout mixture at a safe level of concentration and shall have the ability to remain active within the grout for a minimum of 12 months.
 4. Material Identification: Contractor shall completely identify the types of grout, mortar, sealant, and/or root control chemicals used and provide case histories of successful use or defend the choice of grouting materials based on chemical and physical properties, ease of application, and expected performance, to the satisfaction of the Engineer.
 5. Mixing and Handling: Mixing and handling of chemical grout and forming constituents, which may be toxic under certain conditions shall be in accordance with the

recommendations of the manufacturer and in such a manner as to minimize hazard to personnel. It is the responsibility of the Contractor to provide appropriate protective measures to ensure that chemicals or gels produced by the chemicals are under control at all times and are not available to unauthorized personnel or animals. All equipment shall be subject to the approval of the Engineer. Only personnel thoroughly familiar with the handling of the grout material and additives shall perform the grouting operations.

259.3 EXECUTION

1. General. Manhole grouting shall not be performed until sealing of manhole frame and grade adjustments, partial manhole replacement, or manhole repairs are complete.
2. Preliminary Repairs:
 - a. Seal all unsealed lifting holes, unsealed step holes, voids larger than approximately one-half (1/2) inch in thickness. All cracked or deteriorated material shall be removed from the area to be patched and replaced with Octocrete, as manufactured by IPS Systems, Inc. or equal, in accordance with manufacturer's specifications.
 - b. Cut and trim all roots within the manhole.
3. Temperature. Normal grouting operations including application of interior coating shall be performed in accordance with manufacturer's recommendations.
4. Grouting Material Usage. Grouting of the manhole may include corbel, wall, pipe seals, manhole joints, wall to flattop joint, and/or bench/trough. Areas of the manhole designated to be grouted will be directed by the Engineer. If entire manhole is scheduled for grouting, grouting shall include the entire manhole including corbel, wall, pipe seals and bench/trough. Pipe seal grouting shall include all pipe seals in the specified manhole and grouting of the specified manhole including the bench/trough to the maximum height of 18 inches from the crown.
5. Drilling and Injection:
 - a. Injection holes shall be drilled through the manhole wall at locations indicated in the appropriate detail(s).
 - b. Grout shall be injected through the holes under pressure with a suitable probe. Injection pressure shall not cause damage to the manhole structure or surrounding surface features. Grout shall be injected through the lowest holes first. The procedure shall be repeated until the manhole is externally sealed with grout.
 - c. Grouting from the ground surface shall not be allowed.

- d. Grout travel shall be verified by observation of grout to defects or adjacent injection holes. Provide additional injection holes, if necessary, to ensure grout travel.
 - e. Injection holes shall be cleaned with a drill and patched with a waterproof quick setting mortar for brick and concrete manholes.
6. Testing of Rehabilitated Manholes. Testing of rehabilitated manholes for water tightness shall be performed by the Contractor in the presence of the Engineer in accordance with the requirement of Section SC-47, VACUUM TESTING OF SANITARY SEWER MANHOLES of these specifications.

259.4 MEASUREMENT AND PAYMENT

If the entire manhole is grouted, the Contract Unit Price shall be per vertical foot grouted as indicated on the Manhole Rehabilitation Schedule included in these specifications or as required by the Engineer.

Payment for grouting pipe seals, bench and trough, and 18 inches above crown of pipe, and grouting flattop to wall joint, shall be based on the Contract Unit Price per each manhole rehabilitated as indicated on the Manhole Rehabilitation Schedule. The Contract Unit Price shall be payment in full for performing the work and for furnishing all labor, supervision, materials, equipment, preliminary repairs and testing necessary to complete the work including grouting with urethane grout.

END OF ITEM

CONSTRUCTION SPECIFICATIONS

ITEM 260
ROCK RIPRAP – GROUT – FILTER FABRIC

260.1 GENERAL

General Conditions, Supplemental Conditions, applicable requirements of Division 1 - General Requirements and the North Central Texas Council of Governments (NCTCOG) Standard Specifications, are hereby made a part of this section.

This item shall govern for the installation of rock riprap of the various sizes shown on the plans.

260.2 DESIGN CRITERIA

1. The toe of the riprap revetment shall be entrenched in stable channel bottoms. If the channel bottom is not stable, the design shall incorporate other requirements needed to stabilize the revetment toe.
2. The channel side slope shall be as shown on the drawings.
3. Engineering filter fabric material shall be placed underneath the riprap.
4. Riprap shall extend up the bank to an elevation where vegetation will provide adequate protection. See cross sections.

260.3 PRODUCT

1. RIPRAP MATERIAL: Stone for riprap shall be durable and of a suitable quality to insure permanence in the structure. It shall be free from cracks, seams and other defects that would tend to increase deterioration. Rock shall be reasonably well graded between the following prescribed limits:

	<u>Sieve Size (Square Mesh)</u>	<u>Percent Passing</u>
24"	24 inch	100
Riprap	18 inch	80-90
	12 inch	45-55
	6 inch	0-20

	<u>Sieve Size (Square Mesh)</u>	<u>Percent Passing</u>
18"	18 inch	100
Riprap	12 inch	60-85
	6 inch	15-45

3 inch

0-15

2. RIPRAP WEIGHT: Weight of rock shall be one hundred fifty five pounds per solid cubic foot (min.) calculated from the bulk specific gravity (saturated surface dry).

3. FILTER FABRIC BLANKET:

Approved Manufacturer:

- Supac - Heavy Grade 8NP (UV)
- Trevira 011/280
- Amoco 4553
- or Equal Heavy Grade

4. RIPRAP GROUTING

a. FINE AGGREGATE: Fine aggregate for grouting mix shall consist of natural sand, manufactured sand, or a combination of natural and manufactured sands. The grading and uniformity of the fine aggregate shall conform to the following requirements as delivered to the mixers:

<u>Sieve Designation, U.S. Standard Square Mesh</u>	<u>Permissible Limits Percent by Weight, Passing</u>
3/8 in. (9.5 mm)	100
No. 4 (4.75 mm)	95 - 100
No. 8 (2.36 mm)	80 - 95
No. 16 (1.18 mm)	55 - 75
No. 30 (600 um)	30 - 60
No. 50 (300 um)	12 - 30
No. 100 (150 um)	2 - 10

260.4 EXECUTION

1. CONSTRUCTION:

- a. The channel side slope and the toe excavation shall be prepared to the required lines and grades.
- b. Filter fabric and riprap shall be placed in succession to the required thicknesses and elevations. Riprap shall be hand placed around structures to prevent damage to the structures.

2. INSTALLATION OF THE FILTER FABRIC (GEOTEXTILE): The geotextile shall be placed in the manner and at the locations shown on the drawings. At the time of installation, the geotextile shall be rejected if it has defects, rips, holes, flaws, deterioration or damage incurred during manufacture, transportation or storage. The surface to receive the geotextile shall be prepared to a relatively smooth condition free of obstructions, depressions, debris, and soft or low density pockets of material. Erosion

features such as rills, gullies, etc. must be graded out of the surface before geotextile placement. The geotextile shall be placed with the long dimension perpendicular to the centerline of the channel and laid smooth and free of tension, stress, folds, wrinkles, or creases. The strips shall be placed to provide a minimum width of 24-inches of overlap for each joint. Temporary pinning of the textile to help hold it in place until the rock riprap is placed. The temporary pins shall be removed as the riprap is placed to relieve high tensile stress which may occur during placement of material on the geotextile. The specified placement procedure requires that the length of the geotextile be greater than the actual slope length. The Contractor shall adjust the actual length of the geotextile used based on initial installation experience. The geotextile shall be protected at all times during construction from contamination by surface runoff and any geotextile so contaminated shall be removed and replaced with uncontaminated geotextile. Any geotextile damaged during its installation or during placement of riprap shall be replaced by the Contractor at no cost to the Owner. The work shall be scheduled so that the covering of the geotextile with a layer of the specified material is accomplished within seven (7) calendar days after placement of the geotextile. Failure to comply shall require replacement of geotextile. The geotextile shall be protected from damage prior to and during the placement of rock riprap. Before placement of gabion units, the Contractor shall demonstrate that the placement technique will prevent damage to the geotextile. In no case shall any type of equipment be allowed on the unprotected geotextile.

3. **RIPRAP PLACEMENT:** Stone for riprap shall be placed on the filter fabric blanket in such a manner as to produce a reasonably well graded mass of rock with the minimum practicable percentage of voids and shall be constructed within the specified tolerance to the lines and grades shown on the drawings. The intent of these specifications is to require placement of riprap to the thickness shown and to allow isolated stones to extend as much as six inches above grade. Riprap shall be placed to its full course thickness at one operation and in such a manner as to avoid displacing the fabric. The larger stones shall be well distributed and the entire mass of stones in their final position shall conform to the gradation specified hereinbefore. The finished riprap shall be free from objectionable pockets of small stones and clusters of larger stones. The desired distribution of the various sizes of stones throughout the mass shall be obtained by selective loading of the material at the quarry or other source, by controlled dumping of successive loads during final placing, or by other methods of placement which will produce the specified results. Rearranging of individual stones, by mechanical equipment or by hand will be required to the extent necessary to obtain a reasonably well graded distribution of stone specified above. The Contractor shall maintain the riprap protection until accepted. Any material displaced by any cause shall be replaced at his erosion to the lines and grades shown on the Drawings.
4. **GROUT PLACEMENT:** Grout shall be composed of cement, water and air-entraining admixture and sand mixed in the proportions of 1 part of Portland cement to 3 parts of sand, sufficient water to produce a workable mixture, and that amount of admixture which will entrain sufficient air to produce durable grout, as determined by the ENGINEER. Sand for grouting shall conform to the requirements of paragraph: FINE AGGREGATE. The

grout shall be mixed in a concrete mixer in the manner specified for concrete except that the time of mixing shall be increased to that necessary to produce a mixture having a consistency such as to permit gravity flow into the interstices of the riprap with the help of limited spading and brooming. The grout shall be used in the work within a period of one (1) hour after mixing. Retempering of ground will not be permitted. Riprap shall not be grouted when the ambient temperature is below 35 degree F. or above 95 degrees F. unless approved by the ENGINEER in writing; nor when the grout, without special protection, is likely to be subjected to freezing temperatures before final set has occurred. Prior to grouting, all surfaces of riprap shall be wetted. The riprap shall be grouted in successive longitudinal strips, approximately 10 feet in width, commencing at the lowest strip and working up the slope. Grout shall be brought to the place of final deposit by approved means, and in no case will grout be permitted to flow on the riprapped surface a distance in excess of 10 feet. Immediately after dumping the batch of grout, it shall be distributed over the surface of the strip by the use of brooms and the grout worked into place between stones with suitable spades, trowels, or vibrating equipment. As a final operation, the grout shall be removed from the top surfaces of the upper stones and from pockets and depressions in the surface of the stone protection. After completion of any strip as specified, no workman or any load shall be permitted on the grouted surface for a period of at least 24 hours. The grouted surface shall be protected from rain, flowing water, and mechanical injury. The surface of all grouted riprap shall be cured by keeping the surface continuously wet for a period of not less than 7 days.

260.5 MEASURE AND PAYMENT

1. FILTER FABRIC: Filter fabric will be measured by the square yard for material used including that required at toes and thickened edges of riprap. Payment for filter fabric will be made at the contract unit price per square yard which includes all plant, labor, material, and all installation costs in-place, complete.
2. STONE RIPRAP: Stone (rock) riprap will be measured by the cubic yard using actual plan dimensions. Payment for riprap will be made at the contract unit price per cubic yard which includes all plant, labor, material, and installation costs in-place, complete.
3. GROUT: Grout for rock riprap will be measured by the square yard using actual plan dimensions. Payment for grout will be made at the contract unit price per square yard which includes all plant, labor, material, and installation costs in-place, complete.

END OF ITEM

CONSTRUCTION SPECIFICATIONS

ITEM 261
CONCRETE RIPRAP

261.1 GENERAL

The following shall govern the furnishing and placing of concrete riprap as shown on the plans or as directed by the Engineer.

261.2 MATERIALS

Concrete for riprap shall be placed in accordance with the details and to the dimensions shown on the plans or as established by the Engineer. Unless otherwise shown on the plans, concrete riprap shall be reinforced using wire or bar reinforcement.

The concrete shall be 3000 PSI at 28 days, Class A.

Wire reinforcement shall be six (6) by six (6) inch No. 6 plain electric welded reinforcing fabric or its equal. A minimum lap of six (6) inches shall be used at all splices. At the edge of the riprap, the wire fabric shall not be less than one (1) inch, no more than three (3) inches from the edge of the concrete and shall have no wire projecting beyond the last member parallel to the edge of the concrete.

Reinforcement shall be supported properly throughout the placement to maintain its position equidistance from the top and bottom surface of the slab.

If the slopes and bottom of the trench for toe walls are dry and not consolidated properly, the Engineer may require the entire area to be sprinkled, or sprinkled and consolidated before the concrete is placed. All surfaces shall be moist when concrete is placed.

After the concrete has been placed, compacted, and shaped to conform to the dimensions shown on the plans, and after it has set sufficiently to avoid slumping, the surface shall be finished with a wooden float to secure a reasonably smooth surface.

261.3 PAYMENT

Payment for concrete riprap in place shall be made at the unit price bid in the Proposal multiplied by the quantity of material used. Bid price will be full compensation for placing all materials, and for all labor, tools, equipment, and incidentals necessary to complete the work.

Payment for all necessary excavation below natural ground, and bottom or slope of the excavated channel will be included in the bid price.

END OF ITEM