

Item No. 509
Trench Safety Systems**509.1 Description**

This item shall govern the following:

- A. Designing, furnishing, and installing a Trench Safety System for trench excavation;
- B. Dewatering the area as specified on the Drawings and/or required; and
- C. Maintenance and removal of the trench safety systems as determined by Contractor's Trench Safety Engineer and/or Contractor's Competent Person(s).

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

509.2 Trench Safety System Plan Submittal

Prior to, or at the Pre-Construction Conference, the Contractor shall submit to the Owner a Trench Safety System Plan sealed by a registered Professional Engineer licensed in the State of Texas. Notice To Proceed with construction will not be issued by the Owner until the Contractor has submitted a Trench Safety System Plan to the Owner.

The Trench Safety System Plan at a minimum shall conform to OSHA standards for sloping of sides, utilization of trench boxes, and/or utilization of shoring, sheeting and bracing methods. The Contractor shall be responsible for obtaining the geotechnical information necessary to the design of the Trench Safety System Plan [normally acquired from borings taken at 500 foot intervals along the proposed centerline to a minimum depth of five feet below proposed flowline]. If the geotechnical information for the design of the improvements is acquired by the Owner or designated representative, it shall be provided to the Contractor for information purposes subject to the provisions of Standard Contract.

The Trench Safety System Plan submittal shall include:

- A. A Drawing or plan indicating specific designation of areas in which each type of system will be used, including the length of trench to be opened, the length of time that the trench will remain open, the means of egress, the storage of materials, allowable loads on trench walls, the methods for placing/compacting bedding/backfill within the safety of the system, any equipment restrictions and the subsequent removal of system,
- B. Drawings or manufacturer's data, as applicable, that describe the various elements of the Trench Safety System in sufficient detail that the workers can properly install the Trench Safety System,
- C. Recommendations and limitations for using systems.
- D. Sealed engineering calculations and/or equipment manufacturer's certifications, as applicable, that confirm that the system is designed to withstand the anticipated

loadings and that it can be fully installed/implemented in the designated space within the street right of way or easement provided by Owner or designated representative.

- E. A Certificate of Insurance of the Trench Safety Engineer's Professional Liability Insurance coverage meeting the requirements of the Standard Contract Documents shall be provided.
- F. Certificate of Completion of an OSHA-approved program indicating that the Contractor's Competent Person(s) has received training in "Excavation Safety".

509.3 Trench Safety System Plan Review

The review of the Trench Safety System Plan that will be conducted by the Owner or designated representative shall only relate to general conformance with OSHA standards and regulations. The Owner's failure to note exception(s) to the submittal shall not relieve the Contractor of any or all responsibility or liability for the Trench Safety System Plan. The Contractor shall remain solely and completely responsible for all trench safety systems and for the associated means, methods, procedures, and materials.

509.4 Construction Methods

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

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

509.5 Changed Conditions

When changed conditions require modifications to the Trench Safety System, the Contractor shall provide to the Owner or designated representative a new design or an alternate Trench Safety System that is proposed by the Contractor's Trench Safety Engineer to address the changed conditions encountered. Copies of the new design or alternate system shall be provided to the Owner or designated representative in accordance with the requirements of section 509.2, "Trench Safety System Plan Submittal". A copy of the most current Trench Safety System shall be maintained on site and made available to inspection and enforcement officials at all times.

Any changes to the Trench Safety System Plan that are initiated by the Contractor for operational efficiency or as a result of changed conditions, that could be reasonably

anticipated, will not be cause for contract time extension or cost adjustment. When changes to the Trench Safety System Plan are necessitated by severe and uncharacteristic natural conditions or other conditions totally out of the control of the Contractor, the Contractor may make a written request to the Owner for a Change Order to address the anticipated work. The Contractor shall notify the Owner in writing within 24 hours of the occurrence of changed conditions that the Contractor anticipates the submittal of a claim for additional compensation. Under "Changed Conditions" the work deemed immediately necessary by the Contractor to protect the safety of workers and public, equipment or materials may only be accomplished until the Owner or designated representative has a reasonable opportunity to investigate the Contractor's written request for a Change Order and respond in writing to the request.

509.6 Measurement

Trench Safety Systems shall be measured by lineal foot (meter: 1 meter equals 3.281 feet) through manholes and other appurtenances along the centerline of trench conforming to the Contractor's Drawings and specifications.

509.7 Payment

Payment for Trench Safety Systems, measured as prescribed above, will be made at unit bid price per centerline lineal foot of trench per Contractor's Drawings and specifications. The unit bid price shall include full compensation for designing, furnishing, installing the system; for dewatering, maintenance, replacement and removal of the Trench Safety Systems and for sloping, special clearing, and excavation necessary to safely implement the Trench Safety System Plan.

Payment will be made under the following:

Pay Item:	Trench Safety Systems (all depths)	Per Lineal Foot.
------------------	------------------------------------	------------------

END

**Item No. 510
Pipe****510.1 Description**

This item shall consist of furnishing and installing all pipe and/or materials for constructing pipe mains, sewers, laterals, stubs and, service connections including all applicable Work such as excavating, bedding, jointing, backfilling materials, tests, concrete trench cap, concrete cap and encasement, etc., prescribed under this item in accordance with the provisions of the Edwards Aquifer Protection Ordinance, when applicable, and New Braunfels Utilities Design Criteria Manual. The pipe shall be of the sizes, types, class and dimensions indicated or as designated by the Engineer/Architect (E/A) and shall include all joints or connections to new or existing mains, pipes, sewers, manholes, etc., as may be required to complete the Work in accordance with specifications and published standard practices of the trade associations for the material specified and to the lines and grades indicated. This item shall include any pumping, bailing, drainage and Item No. 509, "Trench Safety Systems" for trench walls, when indicated or applicable. Unless otherwise provided, this item shall consist of the removal and disposition of trees, stumps and other obstructions, old structures or portions thereof such as house foundations, old sewers, masonry or concrete walls, the plugging of the ends of abandoned piped utilities cut and left in place and the restoration of existing utilities damaged in the process of excavation, cutting and restoration of pavement and base courses, the furnishing and placing of select bedding, backfilling and cement or lime stabilized backfill, the hauling and disposition of surplus materials, bridging of trenches and other provisions for maintenance of traffic or access as indicated.

510.2 Pipe**A. General**

Fire line leads and fire hydrant leads shall be ductile iron, only. Domestic water services shall not be supplied from fire service leads, unless the domestic and fire connections are on separately valved branches with an approved backflow prevention device in the fire service branch. All wastewater force mains shall be constructed of ductile iron pipe Pressure Class 250 minimum for pipe greater than 12-inch size and Pressure Class 350 for pipe or PVC class 200 (SDR 26) for pipe 12-inch size and smaller. Wastewater pipe shall be in accordance with New Braunfels Utilities Standard Products List and shall have a corrosion resistant interior lining acceptable to the Owner.

Approved service clamps or saddles shall be used when tapping ductile iron pipe 12 inch size and smaller. All service tubing (1 inch thru 2 inches) installed in utility easements shall be 150 psi annealed seamless Type K copper tubing with no sweat or soldered joints.

For pipes 16" and larger all pipe manufacturers and suppliers shall be certified by the American National Standards Institute (ANSI) for ISO 9000 compliance. It is the intent of this certification that all appropriate tests be documented with sampling criteria, frequency of testing, date of testing and date in which every piece was manufactured. A copy of the testing data to include results shall be sent with the shipment with appropriate identification as it relates to the specific shipment.

The quality of materials, the process of manufacture and the finished pipe shall be subject to inspection and approval by the E/A at the pipe manufacturing plant and at the project site prior to and during installation. Plant inspections shall be conducted at the discretion of the City Representative and shall require only 48 hours of advance notice to the manufacturer. Only manufacturers and suppliers meeting this certification will be considered as approved providers of products as listed in the Standard Products List (SPL).

All water distribution pipe and fittings shall be listed in the Fire Protection Equipment Directory published by the Underwriter's Laboratories, Inc., or shall be Factory Mutual approved for fire service.

B. Water

1. Iron Pipe

Iron pipe shall be ductile iron pipe meeting all requirements of standards as follows:

- For push-on and mechanical joint pipe: AWWA C-151
- For flanged pipe: AWWA C-115

Barrels shall have a nominal thickness required by Table 1 of AWWA C-115, which thickness corresponds to Special Class 53 in sizes through 54 inch, and Class 350 in 60 and 64-inch sizes. Flanges shall be ductile iron (gray iron is not acceptable); they shall be as shown in ANSI/AWWA C115/A21.15 and shall conform to dimensions shown in Table 2 and Figure 1 of AWWA C115. These flanges are the same in all respects as flanges shown in ANSI/AWWA C110/A21.10 for fittings and are standard for all flanges used with pipe, valve, and equipment units in the water distribution and wastewater force main systems. Flanges shall be fabricated and attached to the pipe barrels by U.S. fabricators using flanges and pipe barrels of U.S. manufacture. If fabrication is to be by other than the pipe barrel manufacturer, a complete product submittal and approval by New Braunfels Utilities will be required. Additionally, such fabricator shall furnish certification that each fabricated joint has been satisfactorily tested hydrostatically at a minimum pressure of 300 psi.

- Linings and Coating:

Interior surfaces of all iron water pipe shall be cement-mortar lined and seal coated as required by AWWA C104. Pipe exteriors shall be coated as required by the applicable pipe specification. The type and brand of interior lining shall be clearly marked on the outside of the pipe and fittings. Except as authorized by the E/A, only one type and brand of pipe lining shall be used on a given project.

Except as described above for flanged pipe (Thickness Class 53) and where not otherwise indicated, ductile iron pipe shall be minimum Class 250 as defined by ANSI/AWWA C150/A21.50-current; all ductile iron pipe and flanges shall meet the following minimum physical requirements:

Grade 60-42-10:

- Minimum tensile strength: 60,000 psi (414 mPa).
- Minimum yield strength: 42,000 psi (290 mPa).

- Minimum elongation: 10 percent.

The flanges for AWWA C115 pipe may be also be made from:

Grade 70-50-05:

- Minimum tensile strength: 70,000 psi (483 map).
- Minimum yield strength: 50,000 psi (345 mPa).
- Minimum elongation: 5 percent.

(a) Ductile Iron Fittings:

Fittings shall be push-on, flanged or mechanical joint as indicated or approved and shall meet all requirements of standards as follows:

- Sizes 4 inch through 24 inch: AWWA C-110 or AWWA C-153
- Sizes larger than 24 inch: AWWA C-110.
- Lining and Coating:

Interior surfaces of all iron water pipe fittings shall be lined with cement- mortar and seal coated as required by AWWA C104. Interior surfaces of all iron wastewater and force main fittings shall be coated with a non-corrosive lining material acceptable to Owner. Fitting exteriors shall be coated as required by the applicable pipe specification.

(b) Joint Materials

Gaskets for mechanical joints shall conform to ANSI/AWWA A21.11/C-111.

Joining of slip joint iron pipe shall, without exception, be accomplished with the natural or synthetic rubber gaskets of the manufacturer of that particular pipe being used. A joint lubricant shall be used and applicable recommendations of the manufacturer shall be followed.

Gaskets for flanged joints shall be continuous full face gaskets, of 1/8 inch minimum thickness of natural or synthetic rubber, cloth-reinforced rubber or neoprene material, preferably of deformed cross section design and shall meet all applicable requirements of ANSI/AWWA A21.11/C-111 for gaskets. They shall be manufactured by, or satisfy all recommendations of, the manufacturer of the pipe/fittings being used and be fabricated for use with Class 125 ANSI B16.1 flanges.

Tee-head bolts, nuts and washers for mechanical joints shall be high strength, low alloy, corrosion resistant steel stock equal to "COR-TEN A" having UNC Class 2 rolled threads or alloyed ductile iron conforming to ASTM A 536; either shall be fabricated in accordance with ANSI/AWWA A21.11/C-111.

Hex head bolts and nuts shall satisfy the chemical and mechanical requirements of ASTM A449 SAE Grade 5 plain, and shall be fabricated in accordance with ASTM B 18.2 with UNC Class 2 rolled threads.

Either Tee-Head or Hex-Head bolts, nuts and washers as required, shall be protected with bonded fluoro-polymer corrosion resistant coating where specifically required by the E/A.

All threaded fasteners shall be marked with a readily visible symbol cast, forged or stamped on each nut and bolt, which will identify the fastener material and grade. The producer and the supplier shall provide adequate literature to facilitate such identification; painted markings are not acceptable.

(c) Polyethylene Film Wrap

All iron pipe, fittings and accessories shall be wrapped with standard 8 mil (minimum) low density polyethylene film or 4-mil (minimum) cross laminated high-density polyethylene conforming to AWWA C-105, with all edges overlapped and taped securely with duct tape to provide a continuous wrap to prevent contact between the piping and the surrounding backfill. Repair all punctures of the polyethylene, including those caused in the placement of bedding aggregates, with duct tape to restore the continuous protective wrap before backfilling.

(d) Marking

Each pipe joint and fitting shall be marked as required by the applicable AWWA specification. This includes in all cases: Manufacturer's identification, Country where cast, year of casting, and "DUCTILE" or "DI". Barrels of flanged pipe shall show thickness class; others shall show pressure class. The flanges of pipe sections shall be stamped with the fabricators identification; fittings shall show pressure rating, the nominal diameter of openings and the number of degrees for bends. Painted markings are not acceptable.

2. Copper Tubing

All copper service tubing shall be annealed seamless Type K water tube meeting ASTM B88 and rated at 150 psi working pressure. The tubing shall be homogenous throughout and free from cracks, holes, crimping, foreign inclusions or other defects. It shall be uniform in density and other physical properties.

Nominal Tube Size, inches	Outside Diameter, inches		Wall Thickness, inches	
	Average	Tolerance	Average	Tolerance
3/4	0.875	± 0.003	0.065	± 0.0045
1	1.125	± 0.0035	0.065	± 0.0045
1 1/4	1.375	± 0.004	0.065	± 0.0045
1 1/2	1.625	± 0.0045	0.072	± 0.005
2	2.125	± 0.005	0.083	± 0.007

3. Service Connection Fittings

All fittings used in customer service connection - tapping mains, connecting meters, etc. - must be currently listed on the Standard Products List, or called for in the New Braunfels Utilities Standard Details.

4. Brass Goods

All brass valves, couplings, bends, connections, nipples and miscellaneous brass pipe fittings and accessories used in meter connections, service lines, air release piping assemblies, and wherever needed in the water distribution system, shall

conform to the detail Standards, Standard Products Lists, and AWWA C-800, except as herein modified or supplemented.

Unless otherwise noted, the goods described herein shall be fabricated of standard Red Brass (Waterworks Brass) meeting ASTM B62 or B584, alloy 83600, consisting of 85 percent copper and 5 percent each of tin, lead and zinc.

Exposed threads shall be covered with plastic caps or sheeting to protect the threads.

Brass goods of each type and class shall be compatible with other fittings in common usage for similar purposes. Where not otherwise indicated, all such materials shall meet the following requirements:

Inlet threads of corporation valves shall be AWWA iron pipe (IP) thread (male); outlets of service saddles shall be tapped with AWWA IP thread (female). AWWA IP threads shall conform to ANSI/ASME B1.20.1 as required by AWWA C800 for "General Purpose (Inch) Pipe Threads". For 3/4" and 1" sizes only, corporation valve inlet threads, and the internal threads of saddles may be the AWWA taper thread conforming to AWWA C800 Figure 1 and Table 6. External threads of corporation valve inlet must be compatible with internal threads of the service saddle.

Connections of all new tubing, and of tubing repairs wherever possible, shall be by flared fittings. Flare connections - and compression connections when permitted - shall be designed to provide a seal and to retain the tubing, without slippage, at a working water pressure of 150 psig.

Flanges shall conform to ANSI B16.1, Class 125, as to dimensions, drillings, etc. Copper tubing, when used, shall be Type K tubing having dimensions and weights given in Table A.1 of AWWA C800.

Brass pipe shall conform to the weights and dimensions for Extra Strong pipe given in Table A.2 of AWWA C800.

All fittings shall be suitable for use at hydrostatic working pressures up to 150 psig (hydrostatic testing of installed systems is at 200 psig).

5. Polyvinyl Chloride Water Pipe

(a) General

All polyvinyl chloride (PVC) water pipe shall be of the rigid (unplasticized) type and must bear the National Sanitation Foundation seal of approval for potable water pipe. Each joint of pipe shall consist of single continuous extrusion; bells or other components attached by solvent welding are not acceptable. Pipe shall be pressure rated at 200 psi (DR-14) or 150 psi (DR-18) as indicated.

Pipe shall have push-on, rubber gasket joints of the bell and spigot type with thickened integral bells with rubber gasket joints. The wall thickness of each pipe bell and joint coupling must be greater than the standard pipe barrel thickness. Clearance must be provided in every gasket joint for both lateral pipe deflection and for linear expansion and contraction. Concrete thrust blocking shall be placed behind bends and tees. Concrete support cradles or blocking shall be required for support of all fire hydrants, valves and AWWA C110 fittings; such support shall be provided for AWWA C153 fittings when required by the E/A.

(b) Applicable Specifications

Except as modified or supplemented herein, PVC pipe shall meet the following standards:

AWWA C-900, DR 18 or DR 14 for PVC Pressure Pipe, in 4, 6, 8 and 12 inch nominal sizes, having Cast Iron Pipe size outside diameters.

Fittings used with PVC Pressure pipe shall be AWWA C-110 or AWWA C-153 compact ductile iron fittings.

Standard sizes, dimensions and tolerances shall be as follows:

Nominal Size (inches)	Outside Diameter, inches		DR-18		DR-14	
			Wall Thickness, inches		Wall Thickness, inches	
	Avg.	Tolerance	Min.	Tolerance	Min.	Tolerance
4	4.800	+ 0.009	0.267	+ 0.032	0.343	+ 0.041
6	6.900	+ 0.011	0.383	+ 0.046	0.493	+ 0.059
8	9.050	+ 0.015	0.503	+ 0.060	0.646	+ 0.078
12	13.200	+ 0.015	0.733	+ 0.088	0.943	+ 0.113

All pipe 4 inches and larger must be approved Underwriter's Laboratories for use in buried water supply and fire protection systems.

(c) Material Requirements

All pipe and fittings shall be made from clean, virgin, NSF approved, Class 12454B PVC. Clean reworked materials generated from the manufacturers own production may be used within the current limits of the referenced AWWA C-900.

(d) Marking

Permanent marking on each joint of pipe shall include the following at intervals of not more than 5 feet:

- Nominal pipe size and OD base (e.g., 4 CIPS).
- Type of plastic material (e.g., PVC 12454B).
- Dimension Ratio and the pressure rating in psi for water at 73° F (e.g., DR 18, 150 psi).
- AWWA designation with which the pipe complies (e.g., AWWA C-900).
- Manufacturer's name or code and the National Sanitation Foundation (NSF) mark.

(e) Tracer Wire

Tracer wire shall be installed on all non-ductile iron water mains. The wire shall be installed in such a manner as to be able to properly trace all water mains without loss or deterioration of signal or without the transmittal signal migrating off the tracer wire. Tracer wire shall be placed as per specifications in 512, "Conductive Trace Wire for Non-Metallic Pipe Installation".

6. Steel Pipe

- (a) Standard Weight
ASTM A 53, Schedule 40.
 - (b) Extra Heavy Weight
Seamless ASTM A 53, Schedule 80.
 - (c) Encasement Pipe
Welded or Seamless pipe piles ASTM A-252, Grade 2. Pipe used as casing for insertion of ductile iron carrier pipe, shall be new, smooth bore, steel pipe, with bituminous coating both inside and outside and a minimum of ¼ inch thickness. Joints shall be welded to form a true alignment of each pipe length. Encasement pipe ends shall be sealed with boot or sealed wrap on each end.
 - (d) Fittings
Nipples and fittings extra strong Federal Specification WW-N 351 or WW-P 521.
 - (e) Coatings
Black or galvanized as indicated.
7. Welded Steel Pipe and Fittings for Water-Pipe
- (a) General Reference Standards Specification.
Specifications of the American Water Works Association (AWWA) listed below shall apply to this Section.
 - C – 200 Steel Water Pipe 6 inches and larger.
 - C – 205 Cement-Mortar Protective Lining and Coating for Steel Water Pipe, 4 inches and larger, Shop Applied.
 - C – 206 Field Welding of Steel Water Pipe.
 - C – 207 Steel Pipe Flanges for Waterworks Services, Sizes 4 inches through 144 inches.
 - C – 208 Dimensions for Steel Water Pipe Fittings.
 - C – 602 Cement-Mortar Lining of Water Pipelines, 4 inches and larger in Place.
 - (b) Submittals
Furnish Shop Drawings, product data, design calculations and test reports as described below:
 - (i) Certified copies of mill tests confirming the type of materials used in steel plates, mill pipe flanges and bolts and nuts to show compliance with the requirements of the applicable standards.
 - (ii) Complete and dimensional working drawings of all pipe layouts. Shop Drawings shall include the grade of material, size, wall thickness of the pipe and fittings, type and location of fittings and the type and limits of the lining and coating systems of the pipe and fittings.
 - (iii) Product data to show compliance of all couplings, supports, fittings, coatings and related items.
 - (c) Job Conditions

- (i) The internal design pressure of all steel pipe and fittings shall be as indicated.
- (ii) The interior of all steel pipe for potable water, 4 inches and larger, shall be cement-mortar lined.
- (d) Manufacturing
 - (i) Description

Pipe shall comply with AWWA C-200.

 - 1) Circumferential deflection of all pipe in-place shall not exceed 2.0 percent of pipe diameter.
 - 2) Diameter

Nominal pipe diameter shall be the inside diameter of lining or pipe barrel, unless otherwise designated in Job Conditions.
 - (ii) Wall Thickness

Steel pipe wall thickness shall be designed for the internal and external loads specified in this section. The cylinder thickness needed to resist internal pressure shall be based on an allowable stress in the steel equal to 1/2 the minimum yield stress of the material used.
- (e) Fittings
 - (i) Welded

Fabricated steel fittings shall be of the same material as pipe and shall comply with AWWA C-208.
- (f) Flanges
 - (i) Flanges shall comply with the requirements of AWWA C-207, Class D or Class E. The class shall be based on operating conditions and mating flanges of valves and equipment.
 - (ii) Gaskets shall be cloth-inserted rubber, 1/8 inch thick.
 - (iii) Flanges shall be flat faced with a serrated finish.
- (g) Pipe Joints
 - (i) Lap Joints for Field Welding
 - 1) Lap joints for field welding shall conform to AWWA C-206. This item applies only to pipes 72 inches in diameter and larger.
 - 2) The bell ends shall be formed by pressing on a hydraulic expander or a plug die. After forming, the minimum radius of curvature of the bell end at any point shall not be less than 15 times the thickness of the steel shell. Bell ends shall be formed in a manner to avoid impairment of the physical properties of the steel shell. Joints shall permit a lap at least 1 1/2 inches when assembled. The longitudinal or spiral weld on the inside of the bell end and the outside of the spigot end on each section of pipe shall be ground flush with the plate surface. The inside edge of the bell and the outside edge of the spigot shall be scarfed or lightly ground to remove the sharp edges or burrs.
 - (ii) Bell and Spigot Joints with O-Ring Gasket
 - 1) Bell and spigot joints with rubber gasket shall conform to AWWA C-200.

- 2) The bell and spigot ends shall be so designed that when the joint is assembled, it will be self-centered and the gasket will be confined to an annular space in such manner that movement of the pipe or hydrostatic pressure cannot displace it. Compression of the gasket when the joint is completed shall not be dependent upon water pressure in the pipe and shall be adequate to ensure a watertight seal when subjected to the specified conditions of service. Bell and spigot ends shall be welded on preformed shapes. The bell and spigot ends shall conform to the reviewed Shop Drawings.
- (h) Interior and Exterior Protective Surface Coatings
 - (i) Exterior Surface to be mortar coated shall conform to AWWA C-205 for shop application and AWWA C-602 for field application. Pipe materials shall be the product of an organization, which has had not less than 5 years successful experience manufacturing pipe materials, and the design and manufacture of the pipe, including all materials, shall be the product of one company.
 - (ii) All surfaces except as noted in (iii) and (iv) below shall receive shop application of mortar lining and coating.
 - (iii) Field Welded Joints. After installation, clean, line and coat unlined or uncoated ends adjacent to welded field joints, including the weld proper, as specified for pipe adjacent to the weld.
 - (iv) Machined Surfaces. Shop coat machined surfaces with a rust preventative compound. After jointing surfaces, remaining exposed surfaces shall be coated per (i) and (ii) above.

C. Wastewater

1. Polyvinyl Chloride (PVC) Pipe (Nonpressure) and Fittings

(a) General

Where PVC sewer or wastewater pipe is indicated, it shall conform to ASTM D 3034. Cell Class shall be as required by applicable ASTM pipe specification; pipe stiffness shall be 115 psi minimum for pipe to 15" size, or 72 psi minimum for larger pipe.

(b) Joint Material

PVC pipe and fitting shall have elastomeric gasket joints conforming to ASTM D 3212; gaskets to ASTM F 477.

(c) Pipe Markings

Permanent marking on the pipe shall include the following at intervals of not more than 5 feet:

- Manufacturer's name and/or trademark
- Nominal pipe size
- PVC cell classification per ASTM D 1784

ASTM designation and legend:

- For pipe 6 inch to 15-inch size: ASTM D 3034, type PSM, SDR-26 PVC Sewer Pipe.

- For pipe 18 inches and larger: ASTM F 679. T-1 wall PVC sewer pipe.

(d) Fitting Markings

Fittings shall be clearly marked as follows:

- Manufacturer's name or trademark,
- Nominal size,
- The material designation "PVC",
- PSM, and
- The designation, "Specification D3034".

(e) Tracer Wire and Tape

Tracer wire shall be installed on all non-ductile iron force mains. The wire shall be installed in such a manner as to be able to properly trace all force mains without loss or deterioration of signal or without the transmittal signal migrating off the tracer wire. Tracer wire shall be placed as per specifications in 512, "Conductive Trace Wire for Non-Metallic Pipe Installation".

Tracer tape shall be installed on all force mains in accordance to TCEQ §217.66 rules. The tape should be a minimum of 12 inches below subgrade, or a minimum of 18 inches below finished grade on areas outside the limits of pavement. The tape shall be encased in a protective, inert, plastic jacket and color-coded in accordance with APWA Uniform Color Code.

510.3 Construction Methods

A. General

Prior to commencing this Work, all erosion control and tree protection measures required shall be in place and all utilities located and protected as set forth in "General Conditions". Clearing the site shall conform to Item No. 102, "Clearing and Grubbing". Maintenance of environmental quality protection shall comply with all requirements of "General Conditions" and Item No. 601, "Salvaging and Placing Topsoil".

The Contractor shall conduct his Work such that a reasonable minimum of disturbance to existing utilities will result. Particular care shall be exercised to avoid the cutting or breakage of all existing utilities. If at any time the Contractor damages the utilities in place through his operations, the Contractor shall immediately notify the owner of the utility to make the necessary repairs. When active wastewater sewer lines are cut in the trenching operations, temporary flumes shall be provided across the trench while open and the lines shall be restored when the backfilling has progressed to the original bedding lines of the sewer so cut.

The Contractor shall inform utility owners sufficiently in advance of the Contractor's operations to enable such utility owners to reroute, provide temporary detours or to make other adjustments to utility lines in order that the Contractor may proceed with his Work with a minimum of delay and expense. The Contractor shall cooperate with all utility owners concerned in effecting any utility adjustments necessary and shall

not hold New Braunfels Utilities liable for any expense due to delay or additional Work because of conflicts arising from existing utilities.

The Contractor shall do all trenching in accordance with the provisions and the directions of the E/A as to the amount of trench left unfilled at any time. All excavation and backfilling shall be accomplished as indicated and in compliance with State Statutes.

Where excavation for a pipe line is required in an existing City street, a street cut permit is required and control of traffic shall be as indicated in accordance with the Texas Manual on Uniform Traffic Control Devices.

Wherever existing utility branch connections, sewers, drains, conduits, ducts, pipes or structures present obstructions to the grade and alignment of the pipe, they shall be permanently supported, removed, relocated or reconstructed by the Contractor through cooperation with the owner of the utility, structure or obstruction involved. In those instances where their relocation or reconstruction is impractical, a deviation from line and grade will be ordered by the E/A and the change shall be made in the manner directed.

Adequate temporary support, protection and maintenance of all underground and surface utility structures, drains, sewers and other obstructions encountered in the progress of the Work shall be furnished by the Contractor, at his expense and as approved by the E/A.

Where traffic must cross open trenches, the Contractor shall provide suitable bridges. For trenches less than 2 feet in width, sheet steel plates having a minimum thickness of 1/2 inch shall be used. For trenches up to 4 feet in width, sheet steel plates having a minimum thickness of 3/4 inches shall be used. In all cases, the plates shall overlay the top of the trench a minimum of 18 inches on both sides and secured by asphalt. Adequate provisions shall be made for the flow of sewers; drains and watercourses encountered during construction and any structures, which may have been disturbed, shall be satisfactorily restored upon completion of Work.

When rainfall or runoff is occurring or is forecast by the U.S. Weather Service, the Contractor shall not perform or attempt any excavation or other earth moving Work in or near the flood plain of any stream or watercourse or on slopes subject to erosion or runoff, unless given specific approval by the E/A. When such conditions delay the Work, an extension of time for working day contracts will be allowed in accordance with "General Conditions".

B. Water Line/New Wastewater Line Separation

Installation of new water or wastewater lines shall conform to the following:

Where feasible, water and wastewater lines shall be no closer to each other than 9 feet between outside diameters in all directions and shall be in separate trenches.

If the 9 foot separation cannot be achieved, any portion of a new gravity wastewater line within 9 feet in any direction (between OD's) of a potable water line, shall be in a separate trench and constructed of ductile iron, AWWA C-900 (DR-18) 150 psi rated PVC in sizes up to 12 inch, or AWWA C-905 (DR-25) 165 psi rated PVC in sizes larger than 12 inches.

If the lines are parallel, they shall not be closer than 4 feet horizontally or 2 feet vertically between OD's with the wastewater lower than the water line. If the lines cross, they may be no closer than 6 inches vertically between OD's with the sewer

below the water line and one standard 20 foot length of ductile iron, AWWA C-900 (DR-18) 150 psi rated PVC in sizes to 12 inch, or AWWA C-905 (DR-25) 165 psi rated PVC in sizes larger than 12 inches shall be centered at the point of crossing the water line.

Unless wastewater manholes and the connection to the sewer can be made completely watertight and tested for no leakage, they must be installed so as to provide a minimum of 9 feet of horizontal clearance from an existing or proposed water line.

C. Utility and Storm Sewer Crossings

When the Contractor installs a pipe that crosses under a utility structure or storm sewer and the top of the pipe is within 18 inches of the bottom of the utility structure, the pipe shall be encased as specified in Item No. 505, "Concrete Encasement and Encasement Pipe", for a distance of at least 1 foot on either side of the ditch line of the utility structure or the storm sewer. Unless otherwise specified by the E/A, concrete encasement will not be required for ductile iron, AWWA C-900 (DR-18) 150 psi rated PVC in sizes to 12 inch, or AWWA C-905 (DR-25) 165 psi rated PVC in sizes larger than 12 inches. When the Contractor installs a pipe that crosses over a utility structure or storm sewer and the top of the utility structure or storm sewer is within 18 inches of the bottom of the pipe, the pipe shall be either ductile iron, AWWA C-900 (DR-18) 150 psi rated PVC in sizes to 12 inch, or AWWA C-905 (DR-25) 165 psi rated PVC in sizes larger than 12 inches, unless otherwise specified by the E/A.

Where trenches wider than 12 inches cross under existing wastewater lines, the sewer lines shall be replaced with one 20 foot joint of ductile iron, AWWA C-900 (DR-18) 150 psi rated PVC in sizes to 12 inch, or AWWA C-905 (DR-25) 165 psi rated PVC in sizes larger than 12 inches, centered over the trench.

D. Trench Excavation

Underground piped utilities shall be constructed in an open cut in accordance with Federal regulations, applicable State Statutes conforming to Item No. 509, "Trench Safety Systems" and with a trench width and depth described below. When pipe is to be constructed in fill above the natural ground, Contractor shall construct embankment to an elevation not less than one foot above the top of the pipe, after which trench is excavated. Required vertical sides shall be sheeted and braced as indicated to maintain the sides of the required vertical excavation throughout the construction period. Adequacy of the design of sheeting and bracing shall be the responsibility of the Contractor's design professional. The Contractor shall be responsible for installation as indicated. After the pipe has been laid and the backfill placed and compacted to 12 inches above the top of the pipe, any sheeting, shoring and bracing required may be removed with special care to insure that the pipe is not disturbed. As each piece of sheeting is removed, the space left by its removal must be thoroughly filled and compacted with suitable material and provisions made to prevent the sides of the trench from caving until the backfill has been completed. Any sheeting left in place will not be paid for and shall be considered subsidiary to the pipe item bid.

E. Trench Width

Trenches for water and wastewater lines shall have a clear width on each side beyond the outside surfaces of the pipe bell or coupling of not less than 6 inches nor more than 12 inches.

If the trench width within the pipe zone exceeds this maximum, the entire pipe zone shall be refilled with approved backfill material, thoroughly compacted to a minimum of 95 percent of maximum density as determined by TxDOT Test Method Tex-114-E and then re-excavated to the proper grade and dimensions. Excavation along curves and bends shall be so oriented that the trench and pipe are approximately centered on the centerline of the curve, using short lengths of pipe and/or bend fittings if necessary.

For all utilities to be constructed in fill above natural ground, the embankment shall first be constructed to an elevation not less than 1 foot above the top of the utility after which excavation for the utility shall be made.

F. Trench Depth and Depth of Cover

All pipe and in-line appurtenances shall be laid to the grades indicated. The depth of cover shall be measured from the established finish grade, natural ground surface, subgrade for staged construction, street or other permanent surface to the top or uppermost projection of the pipe.

1. Where not otherwise indicated, all water piping shall be laid to the following minimum depths:
 - (a) Water piping installed in undisturbed ground in easements of undeveloped areas, which are not within existing or planned streets, roads or other traffic areas shall be laid with at least 42 inches of cover.
 - (b) Water piping installed in existing streets, roads or other traffic areas shall be laid with at least 42 inches of cover below finish grade.
 - (c) Unless approved by the E/A, installation of water piping in proposed new streets will not be accepted by NBU, unless approved otherwise, with all parkways and sidewalk areas graded according to any applicable provisions of the drainage plans or sloped upward from the curb line to the right of way line at a minimum slope of 1/4 inch per foot.
2. Where not otherwise indicated, all wastewater piping shall be laid to the following minimum depths:
 - (a) Wastewater piping installed in natural ground in easements or other undeveloped areas, which are not within existing or planned streets, roads or other traffic areas shall be laid with at least 36 inches of cover for wastewater service.
 - (b) Wastewater piping installed in existing streets, roads or other traffic areas shall be laid with at least 60 inches of cover.
 - (c) Wastewater piping installed in such proposed streets shall be laid with at least 42 inches of cover below the actual subgrade.

G. Classification of Excavation

Excavation will not be considered or paid for as a separate item of Work, so excavated material will not be classified as to type or measured as to quantity. Full payment for all excavation required for the construction shall be included in the various unit or lump sum Contract prices for the various items of Work installed, complete in place. No extra compensation, special treatment or other consideration

will be allowed due to rock, pavement, caving, sheeting and bracing, falling or rising water, working under and in the proximity of trees or any other handicaps to excavation.

H. Dewatering Excavation

Underground piped utilities shall not be constructed or the pipe laid in the presence of water. All water shall be removed from the excavation prior to the pipe placing operation to insure a dry firm granular bed on which to place the underground piped utilities and shall be maintained in such unwatered condition until all concrete and mortar is set. Removal of water may be accomplished by bailing, pumping or by a well-point installation as conditions warrant.

In the event that the excavation cannot be dewatered to the point where the pipe bedding is free of mud, a seal shall be used in the bottom of the excavation. Such seal shall consist of Class B concrete, conforming to Item No. 403, "Concrete for Structures", with a minimum depth of 3 inches.

I. Trench Conditions

Before attempting to lay pipe, all water, slush, debris, loose material, etc., encountered in the trench must be pumped or bailed out and the trench must be kept clean and dry while the pipe is laid and backfilled. Where needed, sump pits shall be dug adjoining the trench and pumped as necessary to keep the excavation dewatered.

Backfilling shall closely follow pipe laying so that no pipe is left exposed and unattended after initial assembly. All open ends, outlets or other openings in the pipe shall be protected from damage and shall be properly plugged and blocked watertight to prevent the entrance of trench water, dirt, etc. The interior of the pipeline shall at all times be kept clean, dry and unobstructed.

Where the soil encountered at established footing grade is a quicksand, saturated or unstable material, the following procedure shall be used unless other methods are indicated:

All unstable soils shall be removed to a depth of a minimum 2 feet below bottom of piped utility or as required to stabilize the trench foundation. Such excavation shall be carried out for the entire trench width.

All unstable soil so removed shall be replaced with a concrete seal, foundation rock or coarse aggregate materials placed across the entire trench width in uniform layers not to exceed 6 inches, loose measure and compacted by mechanical tamping or other means which shall provide a stable foundation for the utility.

Forms, sheathing and bracing, pumping, additional excavation and backfill required in unstable trench conditions shall be subsidiary to pipe bid.

J. Blasting

All blasting shall conform to the provisions of the "General Conditions" and/or "Public Safety and Convenience".

K. Removing Old Structures

When out of service masonry structures or foundations are encountered in the excavation, such obstructions shall be removed for the full width of the trench and to a depth of 1 foot below the bottom of the trench. When abandoned inlets or

manholes are encountered and no plan provision is made for adjustment or connection to the new sewers, such manholes and inlets within the construction limits shall be removed completely to a depth 1 foot below the bottom of the trench. In each instance, the bottom of the trench shall be restored to grade by backfilling and compacting by the methods provided above. Where the trench cuts through storm or wastewater sewers which are known to be abandoned, these sewers shall be cut flush with the sides of the trench and blocked with a concrete plug in a manner satisfactory to the E/A. When old structures are encountered, which are not visible from the existing surface and are still in service, they shall be protected and adjusted as required to the finished grade.

L. Lines and Grades

Grades, lines and levels shall conform to the General Conditions and/or "Grades, Lines and Levels". Any damage to the above by the Contractor shall be re-established at the Contractor's expense. The Contractor shall furnish copies of all field notes and "cut sheets" to New Braunfels Utilities.

The location of the lines and grades indicated may be changed only by direction of the E/A and it is understood that the Contractor will be paid on the basis of his unit Contract prices bid for such Work actually performed and shall make no claim for damages or loss of anticipated profits due to the change of location or grade.

The Contractor shall furnish, at his expense, all necessary batter boards or electronic devices for controlling the Work. Batter boards shall be of adequate size material and shall be supported substantially. The boards and all location stakes must be protected from possible damage or change of location. The Contractor shall furnish good, sound twilled lines for use in achieving lines and grades and the necessary plummets and graduated poles.

The Contractor shall submit to the E/A at least 6 copies of any layout Drawings from the pipe manufacturer for review and approval. The Contractor shall submit the layout Drawings at least 30 days in advance of any actual construction of the project. The E/A will forward all comments of the review to the Contractor for revision. Revisions shall be made and forwarded to the E/A for his acceptance. Prior to commencement of the Project, reviewed layout Drawings will be sent to the Contractor marked for construction.

Should the Contractor's procedures not produce a finished pipe placed to grade and alignment, the pipe shall be removed and relayed and the Contractor's procedures modified to the satisfaction of the E/A. No additional compensation shall be paid for the removal and relaying of pipe required above.

M. Surplus Excavated Materials

Excess material or material which cannot be made suitable for use in embankments will be declared surplus by the E/A and shall become the property of the Contractor to dispose of off site at a permitted fill site, without liability to the City or any individual. Such surplus material shall be removed from the Work site promptly following the completion of the portion of the utility involved.

N. Pipe Bedding Envelope

Pipe shall be installed in a continuous bedding envelope of the type shown on the drawings or as described herein. The envelope shall extend the full trench width, to

a depth of 6 inches below the pipe and to 12 inches above water and wastewater pipe.

1. Standard Bedding Materials

USE / PIPE MATERIAL	Cement Stabilized Backfill	Natural or Mfd Sand	Pea Gravel	PIPE BEDDING STONE	
				Uncrushed Gravel	Stone Screenings
WATER					
Welded Steel	X				
Service Tubing 3/4" to 2-1/2"		X	X		X
WATER and WASTEWATER					
Up to 15 Inch ID		X	X	X	X
Larger Than 15 Inch ID			X	X	

2. General requirements and limitations governing bedding selection.

- (a) Crushed gravel or crushed stone shall not be used.
- (b) Uncrushed gravel may be used with polyethylene film wrap in trenches up to 6 feet deep and in deeper trenches where ample trench width, a tremmie, or conditions will allow controlled placement of the gravel without damaging the polyethylene wrap.
- (c) Pea Gravel or bedding stone shall be used in blasted trenches.

3. Requirements to prevent particle migration.

Bedding material shall be compatible with the materials in the trench bottom, walls and backfill so that particle migration from, into or through the bedding is minimized. The E/A may require one or more of the following measures to minimize particle migration: use of impervious cut-off collars; selected bedding materials, such as pea gravel or bedding stone mixed with sand; filter fabric envelopment of the bedding; cement stabilized backfill; or other approved materials or methods. Measures to minimize particle migration will be shown on the Drawings or designated by the E/A, and, unless provisions for payment are provided in the contract documents, the cost of these measures shall be agreed by change order. The following limitations shall apply.

- (a) Sand, alone, shall not be used in watercourses, in trenches where groundwater is present, or in trenches with grades greater than 5 percent.
- (b) Pea gravel or bedding stone, alone, shall not be used in the street right-of-way within 5 feet of subgrade elevation in trenches that are 3 feet or wider.
- (c) Each gravel or bedding stone, alone, shall not be used where the trench bottom, sides, or backfill is composed of non-cementitious, silty or sandy soils having plasticity indices less than 20, as determined by the E/A.

O. Laying Pipe

No pipe shall be installed in the trench until excavation has been completed, the bottom of the trench graded and the trench completed as indicated.

All recommendations of the manufacturer shall be carefully observed during handling and installation of each material. Unless otherwise indicated, all materials shall be delivered to the project by the manufacturer or agent and unloaded as directed by the Contractor. Each piece shall be placed facing the proper direction near to where it will be installed.

The interior of all pipe, fittings and other accessories shall be kept free from dirt and foreign matter at all times and stored in a manner that will protect them from damage. Stockpiled materials shall be stacked so as to minimize entrance of foreign matter.

The interior of all pipeline components shall be clean, dry and unobstructed when installed.

Piping materials shall not be skidded or rolled against other pipe, etc. and under no circumstances shall pipe, fittings or other accessories be dropped or jolted.

During handling and placement, materials shall be carefully observed and inspected and any damaged, defective or unsound materials shall be marked, rejected and removed from the job site. Minor damage shall be marked and repaired in a manner satisfactory to the E/A. Joints, which have been placed, but not joined, backfilled, etc., shall be protected in a manner satisfactory to the E/A.

P. Assembling of Pipe

Angular spacing of all joints shall meet the manufacturer's recommendations for the pipe and accessories being used. Side outlets shall be rotated so that the operating stems of valves shall be vertical when the valves are installed. Pressure pipe shall be laid with bell ends facing the direction of pipe installation. Pipe end bells shall be placed upgrade for all wastewater lines.

Orientation marks, when applicable, shall be in their proper position before pipe is seated.

Before joining any pipe, all foreign matter, lumps, blisters, excess coal tar coating, oil or grease shall be removed from the ends of each pipe and the pipe ends shall then be wire brushed and wiped clean and dry. Pipe ends shall be kept clean until joints are made.

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

Q. Joints

1. O-Ring and Push-on Joints

Just before making a joint the ends of the pipe shall be clean, dry, free of any foreign matter, lump blisters, excessive coal tar coating and grease or oil and shall be wire brushed. The gasket and the inside surface of the bell shall be lubricated with a light film of soft vegetable soap compound (Flax Soap) to facilitate telescoping the joints. The rubber gasket if not factory installed shall be stretched uniformly as it is placed in the spigot groove to insure a uniform volume of rubber around the circumference of the groove. The spigot shall be centered in the bell, the pipe pushed home uniformly and brought into true alignment. Bedding material shall be placed and tamped against pipe to secure

the joint. Care should be taken to prevent dirt or foreign matter from entering the joint space.

2. Bolted Joints

All flanged, mechanical or other bolted joints shall be joined with nuts and bolts and be coated as indicated above in Iron Pipe.

R. Placing Pipe in Tunnels

Piping installed as a carrier pipe in a tunnel, encasement pipe, etc., shall have uniform alignment, grade, bearing and conform to the reviewed Shop Drawings. All necessary casing spacers, bedding material, grout cradle or paving, bracing, blocking, etc., as stipulated by the Contract or as may be required to provide and maintain the required pipe alignment and grade, shall be provided by the Contractor at no cost except as provided by the Bid Items. This shall include casing spacers acceptable to the Owner attached to the carrier pipe in accordance with the manufacturer's recommendations. The insertion pushing forces shall not exceed the pipe manufacturer's recommendation. Such carrier piping shall have flexible bolted or gasketed push-on joints installed as follows:

1. 21 Inch Pipe and Smaller

Prior to placing the pipe in the tunnel, the inside joint recess at the bell shall be buttered with cement mortar.

After the joint is engaged, the excess mortar shall be smoothed by pulling a tight fitting swab through the joint. Cement mortar protection shall then be placed in the normal manner to the exterior of the joint and allowed to harden sufficiently to avoid dislodgment during installation. If time is of the essence, a quick setting compound may be used.

2. 24 Inch Pipe and Larger

Each length of pipe shall be pushed into the tunnel as single units. A flexible mastic sealer shall be applied to the exterior of the joint prior to joint engagement. The surfaces receiving the mastic sealer shall be cleaned and primed in accordance with the manufacturer's recommendation. Sufficient quantities of the mastic sealer shall be applied to assure complete protection of all steel in the joint area. The interior of the joint shall be filled with cement mortar in the normal manner after the pipe is in its final position within the tunnel.

S. Temporary Pipe Plugs, Caps, Bulkheads and Trench Caps

Temporary plugs, caps or plywood bulkheads shall be installed to close all openings of the pipe and fittings when pipeline construction is not in progress.

All temporary end plugs or caps shall be secured to the pipe as provided under Item No. 507, "Bulkheads".

Trench caps shall be reinforced Class D concrete as indicated.

T. Corrosion Control

1. Protective Covering

Unless otherwise indicated, all flanges, nuts, bolts, threaded outlets and all other iron or steel components buried and in contact with earth or backfill shall be

wrapped with 8-mil (minimum) polyethylene film meeting ANSI/AWWA C-105 to provide a continuous wrap.

U. Pipe Anchorage, Support and Protection

Pressure pipeline tees, plugs, caps and bends exceeding 22-1/2 degrees; other bends as directed shall be securely anchored by suitable concrete thrust blocking or by approved metal harness. Unless otherwise indicated, on 24 inch or larger piping, all bends greater than 11 1/4 degrees shall be anchored as described herein.

1. Concrete Thrust Blocking

Concrete for use as reaction or thrust blocking shall be Class B conforming to Item No. 403, "Concrete for Structures".

Concrete blocking shall be placed between solid ground and the fitting to be anchored. The area of bearing on the pipe and on the ground shall be as indicated or directed by the E/A. The blocking shall, unless otherwise indicated, be so placed that the pipe, fittings and joints will be accessible for repair.

The trench shall be excavated at least 6 inches outside the outermost projections of the pipe or appurtenance and the trench walls shaped or undercut according to the detail Drawings or as required to provide adequate space and bearing area for the concrete.

The pipe and fittings shall be adequately weighted and laterally braced to prevent floating, shifting or straining of the pipeline while the concrete is being placed and taking initial set. The Contractor shall be solely responsible for the sufficiency of such restraints.

2. Metal Thrust Restraint

Fabricated thrust restraint systems such as those described below may be approved for use instead of concrete blocking. To obtain approval, the project Drawings must include sufficient drawings, notes, schedules, etc., to assure that the proposed restraints as installed will be adequate to prevent undesirable movement of the piping components. Such restraint systems may only be used where and as specifically detailed and scheduled on approved Project Drawings.

(a) Thrust Harness

A metal thrust harness of tie rods, pipe clamps or lugs, turnbuckles, etc., may be approved. All carbon steel components of such systems, including nuts and washers, shall be hot-dip galvanized; all other members shall be cast ductile iron. After installation, the entire assembly shall be wrapped with 8-mil polyethylene film, overlapped and taped in place with duct tape to form a continuous protective wrap.

(b) Restrained Joints

Piping or fitting systems utilizing integral mechanically restrained joints may be approved. All components of such systems shall be standard manufactured products fabricated from cast ductile iron, hot-dip galvanized steel, brass or other corrosion resistant materials and the entire assembly shall be protected with a continuous film wrap as described for (a) above.

Location, configuration and description of such products shall be specifically detailed on the Drawings. (Add-on attachments such as retainer glands, all-thread rods, etc., are not acceptable.)

3. Concrete Encasement, Cradles, Caps and Seals

When trench foundation is excessively wet or unstable or installation of water or wastewater pipe will result in less than 36 inches of cover, Contractor shall notify E/A. E/A may require Contractor to install a concrete seal, cradle, cap, encasement or other appropriate action.

All concrete cap, etc., shall be continuous and begin and end within 6 inches of pipe joints. Concrete cap, cradle and encasement shall conform to Standard No. 421, "Concrete Trench Cap". The pipe shall be well secured to prevent shifting or flotation while the concrete is being placed.

4. Anchorage Bulkheads

Concrete bulkheads keyed into the undisturbed earth shall be placed as indicated to support and anchor the pipe and/or backfill against end thrust, slippage on slopes, etc. Concrete material and placement shall be Class A, Item No. 403, "Concrete for Structures".

5. Trench Caps, Concrete Rip-Rap and Shaped Retards

Where called for by the Contract or as directed by the E/A, concrete trench caps, concrete rip-rap and/or shaped retards shall be placed as detailed by the Drawings as protection against erosion. Concrete material and placement shall be Class B, Item No. 403, "Concrete for Structures".

- V. Wastewater Connections

1. Connections to Mains 12 Inches and Smaller

All branch connections of new main lines shall be made by use of manholes.

Service stubs shall be installed as indicated. Minimum grade shall be 1 percent downward to main and minimum cover shall be 4 1/2 feet at the curb. Standard plugs shall be installed in the dead end before backfilling.

Where a service connection to a main 12 inches or smaller is indicated, a wye, tee or double wye shall be installed.

Where a service connection to a main 15 inches or larger is indicated, a field tap may be made with the pipes installed crown to crown. The tap should be made conforming to the pipe manufacturer's recommendations with the E/A's approval.

Where not otherwise indicated, (wastewater) service connections shall be installed so that the outlet is at an angle of not more than 45 degrees above horizontal at the main line.

2. Connections to the Existing System

Unless otherwise specified by the E/A, all connections made to existing mains shall be made at manholes with the crown of the inlet pipe installed at the same elevation as the crown of the existing pipe. Service stubs installed on the existing system shall be installed by use of tapping saddles unless otherwise approved by the E/A. Extreme care shall be exercised to prevent material from depositing in the existing pipe as the taps are being made.

When connections to existing mains are made, a temporary plug approved by the E/A must be installed downstream in the manhole to prevent water and debris from entering the existing system before Final Completion. These plugs

shall be removed after the castings are adjusted to finish grade or prior to Final Completion.

W. Water System Connections

The Contractor shall, at his expense, make all necessary connections of new piping or accessories to the existing water system. To minimize any inconvenience from outages, the Contractor shall schedule all such connections in advance and such schedule must be approved by the E/A before beginning any Work.

1. Line Stoppers

NBU will require contractors to use line stoppers to take an outage during construction if system valves are not available or existing valves do not function. Line stoppers will be required based on the following criteria.

- (a) If the number of residential customers affected is greater than 20 and expected to last more than 4 hours.
- (b) If any commercial customers are affected by the outage then the use of line stoppers will be determined on a case by case basis.
- (c) If any critical care customers are affected by the outage then the use of line stoppers will be determined on a case by case basis.
- (d) System conditions may require a line stopper and may not be known until construction commences.

2. Shutoffs

New Braunfels Utilities will make all shutoffs on existing water mains. The Contractor shall be required to notify the E/A's field representative on the job at least 72 hours prior to the desired time for any shutoff. The E/A's field representative will notify any affected utility customers at least 24 hours prior to the shutoff. The Utility will make the shutoff after ensuring that all appropriate measures have been taken to protect the water system, customers and employees.

New Braunfels Utilities will operate all valves to fill existing mains. Where a newly constructed main has not been placed in service and has only one connection to the public water supply, the Contractor may operate one valve to fill the main after approval has been obtained from the Utility. The operation of the valve is to be conducted under the immediate supervision of the E/A's field representative.

Water for the Work shall be metered and furnished by the Contractor in accordance with of the Standard Contract Documents.

3. Wet Connections to Existing Water System

The Contractor shall make all wet connections called for by the Contract or required to complete the Work. Two connections to an existing line performed during the same shutout, at the same time and at a distance less than 50 linear feet apart, will be considered one wet connection. Two connections to an existing line performed during the same shutout, at the same time and at a distance equal to, or greater than 50 linear feet will be considered two wet connections. A wet connection shall include draining and cutting into existing piping and connecting a new pipeline or other extension into the existing pressure piping, forming an addition to the water transmission and distribution network.

The Contract price for wet connections shall be full payment for all necessary shutoffs, excavation, removing plugs and fittings, pumping water to drain the lines, cutting in new fittings, blocking and anchoring piping, bedding and backfilling, placing the lines and service and all site cleanup.

No water containing detectable amounts of chlorine may be drained, released or discharged until specific planning and appropriate preparations to handle, dilute and dispose of such chlorinated water are approved in advance by the Utility and the disposal operations will be witnessed by an authorized representative from the Utility.

4. Pressure Taps to Existing Water System

(Note: Only Contractors / Subcontractors on an NBU approved list may make such taps)

The Contractor shall make all pressure taps called for by the Contract Documents or required to complete the Work. A pressure tap shall consist of connecting new piping to the existing water system by drilling into the existing pipe while it is carrying water under normal pressure without taking the existing piping out of service.

Unless otherwise provided by the Contract, the Contractor shall, at his expense, perform all necessary excavation, furnish and install the tapping sleeve, valve and accessories, provide the tapping machine, drill the tap and shall block, anchor and backfill the piping, valve and all accessories, place the new piping in service and perform all site cleanup. When NBU makes the tap, NBU crews will tap the main and install the service to the property line. In this case, the Contractor will need to pay for the tap in advance at NBU's Service Center located at 355 FM 306.

If a private Contractor makes the tap, a Utility Inspector must be present. "Size on size" taps will not be permitted, unless made by use of an approved full circle gasket tapping sleeve. Concrete blocking shall be placed behind and under all tap sleeves 24 hours prior to making the wet tap.

5. Service Connections

Service connection taps into PVC or AC pipe or into CI or DI pipe 12 inches or smaller shall be made using either a service clamp or saddle or a tapping sleeve as recommended by the pipe manufacturer and as approved by the E/A. Direct tapping of these pipes will not be permitted.

All water service connections shall be installed so that the outlet is at an angle of not more than 45 degrees above horizontal at the main line.

Precautions should be taken to ensure that the tapping saddle or sleeve is placed on the pipe straight to prevent any binding or deformation of the PVC pipe. The mounting chain or U-bolt strap must be tight.

Tapping shall be performed with a sharp shell type cutter so designed that it will smoothly penetrate heavy walled PVC DR14 and 200 psi AC and will retain and extract the coupon from the pipe.

X. Backfilling

1. General

Special emphasis is placed upon the need to obtain uniform density throughout the backfill material. The maximum lift of backfill shall be determined by the compaction equipment selected and in no case shall it exceed 18 inches, loose measurement.

No heavy equipment, which might damage pipe, will be allowed over the pipe until sufficient cover has been placed and compacted. All internal pipe bracing installed or recommended by the manufacturer shall be kept in place until the pipe bedding and trench backfill have been completed over the braced pipe section. Testing of the completed backfill in streets and under and around structures shall meet the specified density requirements. Initial testing shall not be at Contractor's expense and shall conform to the "General Conditions."

2. Backfill Materials

The E/A may approve any of the following well graded materials:

- (a) Select trench material
- (b) Sand
- (c) Crushed rock cuttings
- (d) Rock cuttings
- (e) Foundation Rock
- (f) Blasted material with fines and rock
- (g) Cement stabilized material
- (h) Borrow

Within the 100-year flood plain, sand will not be permitted for backfilling. The E/A will approve the topsoil for areas to be seeded or sodded.

3. Backfill in Street Right of Way

Placement of backfill under existing or future pavement structures and within 2 feet of any structures shall be compacted to the required density using any method, type and size of equipment, which will give the required compaction without damaging the pipe or bedding. Placement of backfill greater than 2 feet beyond structures in Right of Way shall be conform to (6.) below. The depth of layers, prior to compaction, shall depend upon the type of sprinkling and compacting equipment used and the test results thereby obtained. Prior to and in conjunction with the compaction operation, each layer shall be brought to the moisture content necessary to obtain the required density and shall be kept level to insure uniform compaction over the entire layer. Testing for density shall be in accordance with Test Method Tex-114-E and Test Method Tex-115-E.

Each layer of backfill must provide the density as required herein. Swelling soils (soils with plasticity index of 20 or more) shall be sprinkled as required to provide not less than optimum moisture nor more than 2 percent over optimum moisture content and compacted to the extent necessary to provide not less than 95 percent nor more than 102 percent of the density as determined in accordance with Test Method Tex-114-E. Non-swelling soils (soils with plasticity index less than 20) shall be sprinkled as required and compacted to the extent necessary to provide not less than 95 percent of the density as determined in accordance with Test Method Tex-114-E.

After each layer of backfill is complete, tests may be made by the E/A. If the material fails to meet the density indicated, the course shall be reworked as

necessary to obtain the indicated compaction and the compaction method shall be altered on subsequent Work to obtain indicated density.

At any time, the E/A may order proof rolling to test the uniformity of compaction of the backfill layers. All irregularities, depressions, weak or soft spots that develop shall be corrected immediately by the Contractor.

Should the backfill, due to any reason, lose the required stability, density or finish before the pavement structure is placed, it shall be recompacted and refinished at the sole expense of the Contractor. Excessive loss of moisture in the subgrade shall be prevented by sprinkling, sealing or covering with a subsequent backfill layer or granular material. Excessive loss of moisture shall be construed to exist when the subgrade soil moisture content is more than 4 percent below the optimum of compaction ratio density. Backfill shall be placed from the top of the bedding material to the existing grade, base course, subgrade or as indicated. The remainder of the street backfill shall be Flexible Base, Concrete or Hot Mix Asphalt Concrete as indicated or to be replaced in kind to the surface removed to construct the pipe.

4. Backfill in County Street or State Highway Right of Way

All Work within the right of way shall meet the requirements of (3.) above, as a minimum and shall meet the requirements of the permit issued by the County when their requirements are more stringent. Prior to the start of construction, the Contractor shall be responsible for contacting the appropriate TxDOT office or County Commissioner's Precinct Office and for coordinating his activities with the operating procedures in effect for utility cut permits and pavement repair under their jurisdiction. Approval for all completed Work in the State or County right of way shall be obtained from the appropriate Official prior to final payment by the Owner.

5. Backfill in Railroad Right of Way

All Work within the railroad right of way shall meet the requirements of (3.) above, as a minimum and shall meet the requirements of the permit issued by the Railroad Owner when their requirements are more stringent. Approval for all completed Work in the railroad right of way shall be obtained from the Railroad prior to Final Completion.

6. Backfill in Easements

Where not otherwise indicated, Contractor may select whatever methods and procedures may be necessary to restore entire Work area to a safe, useful and geologically stable condition with a minimum density of 85 percent or a density superior to that prior to construction.

In and near flood plain of all streams and watercourses, under or adjacent to utilities, structures, etc. all backfill shall be compacted to a density of not less than 95 percent conforming to TxDOT Test Method Tex-114-E, unless otherwise directed by E/A.

All soil areas disturbed by construction shall be covered with top soil and seeded conforming to Item No. 604, "Seeding for Erosion Control". All turf, drainways and drainage structures shall be constructed or replaced to their original condition or better. No debris shall remain in the drainways or drainage structures.

Quality Control Testing. The Contractor shall be responsible for compaction in accordance with the appropriate Specification. Compaction tests may be done at one location point randomly selected or as indicated by the NBU Inspector, per each 12 inch loose lift per 400 linear feet. These tests shall be performed by a nationally-accredited, independent testing laboratory. Payment for such tests shall be the responsibility of the Contractor, including the material proctor tests and density tests.

Any failed test shall require the Contractor to remove and replace that layer of backfill to 50 feet from either side from the failed test location. The Contractor will also be required at no cost to NBU to provide two additional tests at the replaced location where the initial test failed and at one location point, randomly selected or as indicated by the NBU Inspector.

Y. Wastewater Pipe Acceptance Testing

Wastewater pipe installed in the New Braunfels Utility System shall be tested for exfiltration or infiltration as described below in "Exfiltration Test" and "Infiltration Test" or by acceptable low pressure air test, as described below. At the conclusion of either test series, the Work shall be further tested for pipeline settlement and also for deflection as described below. Finally, the pipe shall be inspected with closed circuit television (CCTV) camera. The Contractor shall be solely responsible for making proper repairs to those elements which do not pass these test requirements.

1. Wastewater Exfiltration Test

Water for the Work shall be metered and furnished by the Contractor in accordance with of the Standard Contract Documents.

The pipeline shall be completely filled with water for its complete length or by sections as determined by the E/A. If tested for its complete length, the maximum head at any point shall not exceed 25 feet unless otherwise indicated. If tested in sections, the manholes in the test section shall be completely filled with water. After the pipeline has been filled and allowed to stand for 24 hours, the amount of exfiltration shall be calculated. Any amount in excess of 200 gallons per inch of inside pipe diameter per mile per day shall be cause for rejection.

For portions of lines located within the Edwards Aquifer Recharge Zone or within any recharge area or recharge feature within the Edwards Aquifer Transition Zone, the minimum head during testing shall not be less than 2 feet and the leakage rate shall not exceed 50 gallons per inch of inside pipe diameter per mile per day. This rate shall apply for the entire portion of the line extending up to the first manhole located outside the recharge zone, recharge area, or recharge features indicated on Drawings and shall also be applicable for any recharge areas or recharge features which may be identified during construction. For construction within the 25-year flood plain, the exfiltration rate shall not exceed 10 gallons per inch diameter per mile of pipe per 24 hours at the same minimum test head.

2. Wastewater Infiltration Test

When the pipe placed in easements is completed, the upper portion of the trench backfill shall be removed to a depth of not less than 18 inches below the finished surface and width equal to the original trench width. The trench shall then be flooded with water until it is completely saturated and water stands in the ditch a minimum of 12 inches deep. In cases of steep terrain, earthen dikes shall be

used to assure that water will stand over the trench. After it is apparent that the trench is completely saturated, the main shall then be inspected with closed-circuit television for infiltration. Any section of the main or any service stub that indicates infiltration above the maximum quantity specified shall be cause for rejection.

This procedure shall not be used for pipes installed in areas where the Plasticity Index (P.I.) of the surrounding material is 20 or higher or where the backfill material has a P.I. of 20 or more.

For portions of lines located within the Edwards Aquifer Recharge Zone or within any recharge area or recharge feature within the Edwards Aquifer Transition Zone, the total infiltration as determined by water test, must be at a rate not greater than 50 gallons per inch of pipe diameter per mile of pipe per 24 hours at a minimum test head of two feet. This rate shall apply for the entire portion of the line extending up to the first manhole located outside the recharge zone, recharge area, or recharge features indicated on Drawings and shall also be applicable for any recharge areas or recharge features which may be identified during construction. For construction within the 25-year flood plain, the infiltration rate shall not exceed 10 gallons per inch diameter per mile of pipe per 24 hours at the same minimum test head.

If the quantity of infiltration exceeds the maximum quantity specified, remedial action must be undertaken in order to reduce the infiltration to an amount within the limits specified.

3. Wastewater Pipeline Settlement Test

During the infiltration test or after the exfiltration test, the pipe will be TV inspected for possible settlement. When air testing has been used, water shall be flushed into the pipe to permit meaningful observations. Prior to flushing, the manholes and pipes should be cleared of all debris. Any pipe settlement which causes excessive ponding of water in the pipe shall be cause for rejection. Excessive ponding shall be defined as a golf ball (1-5/8" dia.) submerged at any point along the line.

4. Low Pressure Air Test of Plastic Gravity Flow Wastewater Lines

(a) General

Wastewater lines, at the discretion of the E/A, shall be air tested between manholes. Backfilling to grade shall be completed before the test and all laterals and stubs shall be capped or plugged by the Contractor so as not to allow air losses, which could cause an erroneous, test result. Manholes shall be plugged so they are isolated from the pipe and cannot be included in the test.

All plugs used to close the sewer for the air test shall be capable of resisting the internal pressures and must be securely braced. Place all air testing equipment above ground and allow no one to enter a manhole or trench where a plugged sewer is under pressure. Release all pressure before the plugs are removed. The testing equipment used must include a pressure relief device designed to relieve pressure in the sewer under test at 10 psi or less and must allow continuous monitoring of the test pressures in order to avoid excessive pressure. Use care to avoid the flooding of the air inlet by infiltrated ground water. (Inject the air at the upper plug if possible.) Use only qualified personnel to conduct the test.

(b) Ground Water

Since the presence of ground water will affect the test results, test holes shall be dug to the pipe zone at intervals of not more than 100 feet and the average height of ground water above the pipe (if any) shall be determined before starting the test.

(c) Test Procedure

The E/A may, at any time, require a calibration check of the instrumentation used. Use a pressure gauge having minimum divisions of 0.10 psi and an accuracy of 0.0625 psi. (One ounce per square inch.) All air used shall pass through a single control panel. Clean the sewer to be tested and remove all debris where indicated. Wet the sewer prior to testing. The average back pressure of any groundwater shall be determined (0.433 psi) for each foot of average water depth (if any) above the sewer.

Add air slowly to the section of sewer being tested until the internal air pressure is raised to 4.0 psig greater than the average back pressure of any ground water that may submerge the pipe. After the internal test pressure is reached, allow at least 2 minutes for the air temperature to stabilize, adding only the amount of air required to maintain pressure. After the temperature stabilization period, disconnect the air supply. Determine and record the time in seconds that is required for the internal air pressure to drop from 3.5 psig to 2.5 psig greater than the average backpressure of any ground water that may submerge the pipe. Compare the time recorded with the specification time for the size and length of pipe as given in the following table:

Table for Low Pressure Air Testing of Plastic Pipe:

Minimum Specified Time Required For 1.0 psig Pressure Drop For Size and Length of Pipe Indicated								
Diameter of Pipe, (in.)	Specification Time (min: sec) for length shown							
	100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

NOTES: 1. Specification times are as given in UNI-B-6 RECOMMENDED PRACTICE FOR LOW-PRESSURE TESTING OF INSTALLED PIPE -- by Uni-Bell PVC Pipe Association, 2655 Villa Creek Dr., Ste. 155, Dallas Texas 75234.

Any drop in pressure, from 3.5 psig to 2.5 psig (adjusted for groundwater level), in a time less than that required by the above table shall be cause for rejection. When the line tested includes more than one size pipe, the minimum time shall be that given for the largest size pipe included.

Test procedure for wastewater pipe located in the Edwards Aquifer Recharge Zone or identified recharge areas or recharge features within the Edwards Aquifer Transition Zone:

Low-pressure air tests must conform to the procedure described in ASTM C-924 or other equivalent procedures. For safety reasons, air testing of pipe sections will be limited to line sizes of 36 inches inside diameter or less. Lines that are 36 inches or larger inside diameter may be air tested at each joint. The minimum time allowable for the pressure to drop from 3.5 pounds per square inch to 2.5 pounds per square inch gauge during a joint test, regardless of pipe size, shall be twenty (20) seconds.

For sections of pipe less than 36-inch inside diameter, the minimum time allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge must be computed by the following equation:

$$T = 0.0850 (D)(K)/(Q), \text{ where}$$

T = time for pressure to drop 1.0 pounds per square inch gauge in seconds;

K = $0.000419(D)(L)$, but not less than 1.0

D = nominal inside diameter in inches;

L = length of line of same pipe size in feet; and

Q = rate of loss, assume 0.0015 cubic feet per minute per square foot ($\text{ft}^3/\text{min}/\text{ft sq}$) of internal surface area.

Any drop in pressure, from 3.5 psig to 2.5 psig, in a time less than that required by the above formula shall be cause for rejection. When the line tested includes more than one size of pipe, the minimum time shall be that calculated for the largest size pipe included.

Manholes must be tested separately and independently. All manholes must be hydrostatically tested with a maximum loss allowance of 0.025 gallon per foot diameter per foot of head per hour.

When lines are air tested, manholes are to be tested separately by exfiltration or vacuum method (see Standard Specification Item No. 506, "Manholes").

5. Wastewater Deflection Test

Deflection tests shall be performed by the Contractor on all flexible and semi-rigid wastewater pipes. The tests shall be conducted after the final backfill has been in place at least 30 days. Testing for in-place deflection shall be with a pipe

mandrel or rigid ball sized at 95% of the inside diameter of the pipe. A second test of flexible and semi-rigid wastewater pipes 18 inch size and larger, also with a pipe mandrel or ball sized at 95% of the inside diameter of the pipe, shall be conducted by the Contractor 30 days prior to expiration of his warranty on the Work.

Contractor shall submit his proposed pipe mandrels or testing balls to the E/A or his designated representative for concurrence prior to testing the line.

Test(s) must be performed without mechanical pulling devices and must be witnessed by the E/A or his designated representative.

Any deficiencies noted shall be corrected by the Contractor and the test(s) shall be redone.

6. Closed Circuit Television (CCTV) Inspection

(a) General

(i) Description of Work

Furnish all labor, tools, test equipment and materials, including any and all permits required to televise, inspect, video, still photograph and document the gravity wastewater collection systems.

(ii) Quality Assurance

- 1) Equipment used shall be in good working order and provide continuous operation during TV/video inspection.
- 2) CD / DVD disks shall be of good visual quality capable of slow motion and pausing without significant reduction of visual quality.
- 3) Inspector(s) must be NASSCO / PACP certified and certification number submitted to NBU prior to commencement of work.
- 4) Video image shall be calibrated using a Marconi Resolution Chart No. 1 or equivalent.

(iii) Submittals

Submit to NBU a PACP Report and Top View Report and CD / DVD disks completed.

(b) Materials

(i) General

Equipment used shall be designed for use in gravity wastewater collection systems. Contractor has the option of an approved equal device or other material than that which is specified. Submittals are required prior to commencement of work.

(ii) Television Camera

Camera used shall be 360 degree COLOR RVC camera. Camera shall be operative in 100% relative humidity and be specifically designed for the environment. Camera shall have an integral lighting system capable of producing clearly focused, well-defined images of the entire periphery of the pipe. The quality of video picture and definition provided shall be to the satisfaction of NBU and, if unsatisfactory, equipment shall be removed and replaced with satisfactory equipment.

(iii) Video Recording Equipment

Furnish video equipment to provide a visual and audio recording of all areas in the pipe. Video recording system at the site shall be capable of rewind, play back, slow motion and stop motion. The video shall be recorded on a CD, DVD, or equal portable storage device whose format is compatible with Windows XP Pro. Also, an audio channel for clearly recording the camera locations and operator observations (cracks, leaks, service connections, etc.). The system shall continuously indicate distance, in feet, from manhole to manhole and the manhole-to-manhole run numbers on the video recording.

(iv) Power Supply

Power supply shall be continuous. If night operations occur, supply all labor, power and lighting equipment for operations, traffic safety, permits, etc.

(c) Execution

(i) General

1) a. New Mains: Recommended Cleaning

All mains and manholes should be clean of debris prior to televising. The sanitary sewer main shall be flushed within 72 hours of televising and recording. This will assure the main is clean of debris as well as identify any potential sags within the main

b. New Mains: All sanitary sewer gravity lines shall be televised at the Contractor’s expense; and a video recording of the subject mains provided prior to preliminary acceptance and at the 1-year warranty inspection by NBU. Televiewing may only occur after the stabilized subgrade has been installed and satisfactory density tests have been submitted to the City of New Braunfels. An NBU authorized representative must be present during the televising, unless otherwise approved by NBU. The sewer video inspection shall include rotating the camera lens to inspect the interior of each sewer lateral.

c. Existing Mains: Cleaning

i. Recommended Cleaning

Purpose of Inspection	Recommended Cleaning
To determine the serviceability of the pipe, e.g. is the pipe silting up	Do not clean prior to CCTV inspection only clean if the camera cannot travel through the pipeline.
Inspection of structurally suspect pipelines	Do not clean prior to CCTV inspection. Cleaning may damage the pipeline.
To identify the general structural condition of the pipeline. Identification of small severity faults is not a concern.	Light cleaning to remove slime and spider webs.
To identify all faults in the pipeline, including small severity faults, e.g. in order to determine whether the pipeline is suitable of grouting.	Full cleaning of the pipeline to remove all foreign material.

ii. Cleaning Method – Cleaning is normally completed by hydraulic jetting. Equipment capable of delivering 2000 psi pressure and volume rating of 45 gpm is normally used for

- light cleaning. Jetting units that have been specifically set up for root cutting and removal of heavy debris may be required to fully clean the pipeline.
- iii. Cleaning Considerations – Consideration needs to be given to ensure that:
 - a) Adjacent properties are not damaged or flooded.
 - b) Sewer overflows do not occur.
 - c) The sewer being cleaned is not damaged.
 - d) All debris from the cleaning is collected and removed from the sewer system.
 - iv. Cleaning Direction – Cleaning should generally be carried out from a downstream manhole, in a downstream direction. Upstream cleaning should be avoided wherever possible because it increases the possibility of water being blown up lateral and causing p-traps or toilets at adjacent buildings to overflow.
 - v. Inspection after Cleaning – The pipeline should be inspected as soon as possible after it has been cleaned. In any case the inspection should be completed within seven days of cleaning. For pipes that have material with high levels of debris or grease flowing through them seven days may be too long and re-cleaning may be required.
- 2) Demonstrate the ability of the TV/video equipment (camera/light/video/audio/photograph system) to the satisfaction of NBU. Distance meter shall be furnished on the digital video recording. Meter shall be checked using distances between manholes. Meter distances and actual distances shall be consistent.
- (ii) Televising / Inspection
- 1) Inspection shall be done one manhole section at a time.
 - 2) Locate video vehicle on upstream side of manhole. Recording shall begin during the lowering of the camera into the manhole opening. Video in the downstream direction such that camera movement is with the flow. Camera lens shall be positioned looking along the axis of the sewer. The camera axis should be within $\pm 10\%$ of the vertical sewer centerline of the pipe. For oval shaped pipes, the camera shall be positioned vertically above the invert at a height $\frac{2}{3}$ of the vertical dimension of the pipe.
 - 3) Insert the camera in the upstream manhole after flow restrictions required have been accomplished. Flow into the system being inspected shall be stopped, with the exception of service laterals into the system being inspected. Move camera through the pipe lines at a moderate speed not exceeding 30 feet per minute. Excessive use of the pan and tilt features should be avoided. Stop camera at locations where one or more of the following conditions is observed:
 - a. Infiltration/inflow sources.
 - b. Service Laterals.

- c. Structural defects including broken pipe; collapsed or collapsing pipe, cracks, deterioration, punctures, etc.
 - d. Abnormal joint conditions such as misalignments, open joints and joints not sealed.
 - e. Unusual conditions such as root intrusion, protruding pipes, in-line pipe size changes, mineral deposits, grease and obstructions.
- 4) Stop camera long enough for a thorough visual inspection of the conditions. All such conditions as specified above, along with the corresponding PACP code for each condition, shall be audio recorded on video and the inspection log sheet. Move the camera and rotate to obtain optimum view of the conditions. Each condition should be framed as to provide a full perspective. If requested by an NBU representative, view problem areas in the opposite direction by pulling the TV camera from the opposite direction at no additional cost to the NBU.
 - 5) While the camera is stopped at each service connection, rotate the camera so as to be able to view the service connection for a length of time that enables a good visual inspection of the service connection for damage and infiltration. Be responsible for measurements such as service lateral locations, if used for subsequent rehabilitation work.
 - 6) When, during the inspection operation, the television camera will not pass through the entire manhole-to-manhole section, set up equipment so that the inspection can be performed from the opposite manhole at no additional cost to NBU. All reasonable effort should be given to video the entire segment including the removal of obstructions, reversals, location/exposure of buried manholes, use of more versatile equipment, etc.
 - 7) Any defects or anomalies detected on new construction that does not meet NBU requirements shall be corrected by the Contractor prior to NBU acceptance. Once corrected, the portion(s) shall be videoed, again, to assure the modification(s) was made correctly.
- (iii) Documentation
- 1) Furnish a detailed report and digital video of the system inspected. The minimum information supplied shall be the following:
 - a. Name and address of Contractor and the Developer.
 - b. Name of Project, system(s) inspected, and Project's representative involved.
 - c. Log reports:
 - i. PACP Report and Top View Report for each section of pipe using NASSCO's PACP Standards unless otherwise instructed by NBU.
 - ii. Separate line for each deficiency and location
 - iii. Corresponding video and location of each section of pipe and deficiencies on digital video.
 - 2) Video shall be labeled with the following information:

- a. System that is video (street name and manhole to manhole numbers) and log report number corresponding to video
 - b. Date video was recorded
 - c. Contractor's name and representative
 - d. Project's name, if applicable
- 3) All recordings shall be rendered unable to be copied over after they are completed.
- (iv) Maintenance of Traffic
- 1) Be responsible for all maintenance of traffic around work site. Contractor shall maintain traffic in accordance to all federal, state and local regulations. At no additional cost to NBU, submit a Maintenance of Traffic Plan, for review and approval by NBU as necessary, prior to commencing work. Obtain all necessary permits prior to commencing work, at no additional cost to NBU.
 - 2) Maintenance of Traffic shall also include construction and maintenance of any necessary detour facilities, furnishings, installing and maintaining of traffic control and safety devices during construction, control of dust, and any other special requirements for safe and expeditious movement of traffic around or through the work site.
 - 3) Be responsible for coordination with all affected agencies when roadways will be closed or traffic will be detoured. No detours or roadway closings shall be permitted unless specifically approved in writing by the City of New Braunfels and NBU.

Z. Water Pipe Acceptance Testing

Acceptance testing for potable water pipes involves two (2) types of tests, bacteriological and hydrostatic. Both types of these testing methods are defined in the following sections.

Note: Bacteriological testing (AB.5) should be done on the pipe prior to the hydrostatic testing unless the pipe is isolated in the system such that there are no services or trunk line connected and approved by an NBU inspector.

After the pipe has been installed and backfilled and all service laterals, fire hydrants and other appurtenances installed and connected, a pressure test, followed by a leakage test, will be conducted by the Contractor. The Contractor will furnish the pump and gauges for the tests. The Utilities Representative shall be present during the tests. The specified test pressures will be based on the elevation of the lowest point of the line or section under test. Before applying the specified test pressure, all air shall be expelled from the pipe. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points.

All drain hydrant and fire hydrant leads, with the main 6-inch gate valve open, the hydrant valve seats closed and nozzle caps open, shall be included in the test.

Prior to pressure testing against an existing system valve, a bacteriological test shall be performed to determine potability of water.

1. Hydrostatic Test

A hydrostatic test will be conducted on the entire project or each valved section to test for leakage. The leakage test shall be at 150 psi for at least 4 hour.

(a) Allowable Leakage

Leakage shall be defined as the quantity of water that must be supplied into any test section of pipe to maintain the specified leakage test pressure (see above, "Pressure Pipe Leakage Test") after the air in the pipeline has been expelled and the pipe has been filled with water.

No pipe installation will be accepted if the leakage exceeds 25 gallons/24 hours/mile of pipe/inch nominal pipe diameter.

$$\frac{(25 \text{ gpd})}{(\text{in.} \cdot \text{mi.})}$$

(b) Location and Correction of Leakage

If such testing discloses leakage in excess of this specified allowable, the Contractor, at his expense, shall locate and correct all defects in the pipeline until the leakage is within the indicated allowance.

All visible leakage in pipe shall also be corrected by Contractor at his own expense.

AA. Service Charges for Testing

The Contractor shall be responsible for all expenses relating to acceptance testing.

AB. Disinfection of Potable Water Lines

1. Preventing Contamination

The Contractor shall protect all piping materials from contamination during storage, handling and installation. Prior to disinfection, the pipeline interior shall be clean, dry and unobstructed. All openings in the pipeline shall be closed with watertight plugs when pipe laying is stopped at the close of the day's work.

2. Cleaning

Prior to disinfection the Contractor shall clean the pipeline to remove foreign matter. For pipelines 16" in diameter or smaller, cleaning shall consist of flushing the pipeline. For pipelines greater than 16" in diameter, cleaning shall be performed by operating hydrants and blow-offs located at low points in the pipeline, or by mechanical means (sweeping or pigging). Water for the Work shall be metered and furnished by the Contractor in accordance with of the Standard Contract Documents.

3. Procedure and Dosage

The Contractor, at its expense, will supply the test gauges and the Sodium Hypochlorite conforming to ANSI/AWWA B300, which contains approximately five percent (5%) to fifteen percent (15%) available chlorine, and will submit for approval a written plan for the disinfection process. Calcium Hypochlorite conforming to ANSI/AWWA B300, which contains approximately 65 percent available chlorine by weight, may be used in granular form or in 5 g tablets for 16" diameter or smaller lines, if it is included as part of the written plan of disinfection that is approved by New Braunfels Utilities. The Contractor, at its

expense, shall provide all other equipment, supplies and the necessary labor to perform the disinfection under the general supervision of the Utility.

One connection to the existing system will be allowed with a valve arranged to prevent the strong disinfecting dosage from flowing back into the existing water supply piping. The valve shall be kept closed and locked in a valve box with the lid painted red. No other connection shall be made until the disinfection of the new line is complete and the water samples have met the established criteria. The valve shall remain closed at all times except when filling or flushing the line and must be manned during these operations. Backflow prevention in the form of a reduced pressure backflow assembly must be provided if the valve is left unattended. The new pipeline shall be filled completely with disinfecting solution by feeding the concentrated chlorine and approved water from the existing system uniformly into the new piping in such proportions that every part of the line has a minimum concentration of 50 mg/liter available chlorine.

The disinfecting solution shall be retained in the piping for at least 24 hours and all valves, hydrants, services, stubs, etc. shall be operated so as to disinfect all their parts. After this retention period, the water shall contain no less than 25 mg/liter chlorine throughout the treated section of the pipeline.

For pipelines larger than 16" in diameter, the Contractor may use the AWWA C-651 "Slug Method" for disinfecting the pipeline. Chlorine shall be fed at a constant rate and at a sufficient concentration at one end of the pipeline to develop a slug of chlorinated water having not less than 100 mg/liter of free chlorine. The Contractor shall move the slug through the main so that all interior surfaces are exposed to the slug for at least three (3) hours. The chlorine concentration in the slug shall be measured as it moves through the pipeline. If the chlorine concentration drops below 50 mg/liter, the Contractor shall stop the slug and feed additional chlorine to the head of the slug to restore the chlorine concentration to at least 100 mg/liter before proceeding. As the slug flows past fittings and valves, related valves and hydrants shall be operated so as to disinfect appurtenances and pipe branches.

Unless otherwise indicated, all quantities specified herein refer to measurements required by the testing procedures included in the current edition of "Standard Methods". The chlorine concentration at each step in the disinfection procedure shall be verified by chlorine residual determinations.

4. Final Flushing

The heavily chlorinated water shall then be carefully flushed from the potable water line until the chlorine concentration is no higher than the residual generally prevailing in the existing distribution system. Proper planning and appropriate preparations in handling, diluting, if necessary, and disposing of this strong chlorine solution is necessary to insure that there is no injury or damage to the public, the water system or the environment. The plans and preparations of the Contractor must be approved by Utility before flushing of the line may begin. Additionally the flushing must be witnessed by an authorized representative of the Utility.

Approval for discharge of the diluted chlorine water or heavily chlorinated water into the wastewater system must be obtained from New Braunfels Utilities. The line flushing operations shall be regulated by the Contractor so as not to overload the wastewater system or cause damage to the odor feed systems at

the lift stations. The Utility shall designate its own representative to oversee the work. Daily notice of line discharging must be reported to New Braunfels Utilities Dispatch office.

5. Bacteriological Testing

After final flushing of the strong disinfecting solution, two (2) sets of water samples from the line, that are taken at least twenty-four (24) hours apart, will be tested for bacteriological quality by the Utility and must be found free of coliform organisms before the pipeline may be placed in service. Each set shall consist of one (1) sample that is drawn from the end of the main and additional samples that are collected at intervals of not more than 1000 feet along the pipeline. All stubs shall be tested before connections are made to existing systems.

The Contractor, at its expense, shall install sufficient sampling taps at proper locations along the pipeline. Each sampling tap shall consist of a standard corporation cock installed in the line and extended with a copper tubing gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed and retained for future use.

Samples for bacteriological analysis will only be collected from suitable sampling taps in sterile bottles treated with sodium thiosulfate. Samples shall not be drawn from hoses or unregulated sources. The Utility, at its expense, will furnish the sterile sample bottles and may, at its discretion, collect the test samples with Utility personnel.

If the initial disinfection fails to produce acceptable sample test results, the disinfection procedure shall be repeated at the Contractor's expense. Before the piping may be placed in service, two (2) consecutive sets of acceptable test results must be obtained.

An acceptable test sample is one in which: (1) the chlorine level is similar to the level of the existing distribution system; (2) there is no free chlorine and (3) total coliform organisms are absent. An invalid sample is one, which has excessive free chlorine, silt or non-coliform growth as defined in the current issue of the "Standards Methods." If unacceptable sample results are obtained for any pipe, the Contractor may, with the concurrence of the Inspector, for one time only flush the lines and then collect a second series of test samples for testing by the Utility. After this flushing sequence is completed, any pipe with one or more failed samples must be disinfected again in accordance with the approved disinfection procedure followed by appropriate sampling and testing of the water.

New Braunfels Utilities Water Quality Laboratory will notify the assigned Utility Inspector in writing of all test results. The Inspector will subsequently notify the Contractor of all test results. The Water Quality Laboratory will not release test results directly to the Contractor.

AC. Cleanup and Restoration

It shall be the Contractor's responsibility to keep the construction site neat, clean and orderly at all times. Cleanup shall be vigorous and continuous to minimize traffic hazards or obstructions along the streets and to driveways. Trenching, backfill, pavement repair (as necessary), and cleanup shall be coordinated as directed by the Utility. The E/A will regulate the amount of open ditch and may halt additional trenching if cleanup is not adequate to allow for orderly traffic flow and access.

Materials at the site shall be stored in a neat and orderly manner so as not to obstruct pedestrian or vehicular traffic. All damaged material shall be removed from the construction site immediately and disposed of in a proper manner. All surplus excavated materials become the property of the Contractor for disposal at his expense. After trenching, the Contractor shall immediately remove all excavated materials unsuitable for or in excess of, backfill requirements. Immediately following the pipe laying Work as it progresses, the Contractor shall backfill, grade and compact all excavations as provided elsewhere and shall immediately clean up and remove all unused soil, waste and debris and restore all surfaces and improvements to a condition equal or superior to that before construction began and to an appearance which complements the surroundings. The Contractor shall grade and dress the top 6 inches of earth surfaces with soil or other material similar and equal to the surrounding, fill and smooth any visible tracks or ruts, replace and re-establish all damaged or disturbed turf or other vegetation and otherwise make every effort to encourage the return of the entire surface and all improvements to a pleasant appearance and useful condition appropriate and complementary to the surroundings and equal or similar to that before construction began.

Permanent pavement replacement, if necessary, shall begin immediately after all testing of each segment of piping is satisfactorily completed.

510.4 Materials

The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation into the Work is of the kind and quality that satisfies the specified functions and quality. **New Braunfels Utilities Standard Products Lists (SPL)** forms a part of the Specifications. Contractors may, when appropriate, elect to use products from the SPL; however, submittal to the E/A is still required. Should the Contractor elect to use any materials from these lists, each product shall be completely and clearly identified by its corresponding SPL number when making the product submittal. This will expedite the review process in which the E/A, decides whether the products meet the Contract requirements and the specific use foreseen by the E/A in the design of this engineered Project. The purpose of the SPL's is to expedite review, by the E/A of Contractor product submittals. The SPL's should not be interpreted as being a pre-approved list of products necessarily meeting the requirements for a given construction Project. Items contained in the SPL cannot be substituted for items shown on the Drawings, or called for in the specifications, or specified in the Bidding Requirements, Contract Forms and Conditions of Contract, unless approved by the E/A. The Standard Product List current at the time of plan approval will govern.

A. Concrete

Concrete shall conform to Item No. 403, "Concrete for Structures".

B. Coarse Aggregate

Coarse aggregate shall conform to Item No. 403, "Concrete for Structures" or one of the following:

1. Pipe Bedding Stone

Pipe bedding stone shall be clean gravel, crushed gravel or crushed limestone, free of mud, clay, vegetation or other debris, conforming to ASTM C 33 for stone

quality. Size gradation shall conform to ASTM C-33 No. 57 or No. 67 or the following Table:

SIEVE SIZE	% RETAINED BY WEIGHT
1-1/2"	0
1"	0-10
1/2"	40-85
#4	90-100
#8	95-100

2. Foundation Rock

Foundation rock shall be well graded coarse aggregate ranging in size from 2 to 8 inches.

3. Flexible Base

Flexible base shall conform to Item No. 210, "Flexible Base".

C. Fine Aggregate

1. Concrete and Mortar Sand

Fine aggregate shall conform to Item No. 403, "Concrete for Structures".

2. Bedding Sand

Sand for use as pipe bedding shall be clean, granular and homogeneous material composed mainly of mineral matter, free of mud, silt, clay lumps or clods, vegetation or debris. The material removed by decantation TxDOT Test Method Tex-406-A, plus the weight of any clay lumps, shall not exceed 4.5 percent by weight.

The resistivity shall not be less than 3000 ohms-cm as determined by TxDOT Test Method Tex-129-E. Size gradation of sand for bedding shall be as follows:

GRADATION TABLE	
SIEVE SIZE	% RETAINED BY WEIGHT
1/4"	0
#60	75-100
#100	95-100

3. Stone Screenings

Stone screenings shall be free of mud, clay, vegetation or other debris, and shall conform to the following Table:

SIEVE SIZE	% PASSING
3/8"	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60

No. 50	10 to 30
No. 100	2 to 10

All screenings shall be the result of a rock crushing operation.

D. Pea Gravel

Pea gravel bedding shall be clean washed material, hard and insoluble in water, free of mud, clay, silt, vegetation or other debris. Stone quality shall meet ASTM C 33. Size gradation shall be as follows:

SIEVE SIZE	% RETAINED BY WEIGHT
3/4"	0
1/2"	0-25
1/4"	90-100

E. Select Backfill or Borrow

This material shall consist of borrow or suitable material excavated from the trench. It shall be free of stones or rocks over 8 inches and shall have a plasticity index of less than 20. The moisture content at the time of compaction shall be within 2 percent of optimum as determined by TxDOT Test Method Tex-114-E. Sandy loam borrow will not be allowed unless shown on the Drawings or authorized by the E/A.

All suitable materials from excavation operations not required for backfilling the trench may be placed in embankments, if applicable. All unsuitable materials that cannot be made suitable shall be considered surplus excavated materials as described in 510.3(M). The Contractor may, if approved by the engineer, modify unsuitable materials to make them suitable for use. Modification may include drying, removal or crushing of over-size material, and lime or cement treatment.

F. Cement Stabilized Backfill

When indicated or directed by the E/A, all backfill shall be with cement-stabilized backfill rather than the usual materials. Unless otherwise indicated, cement stabilized backfill material shall consist of a mixture of the dry constituents described for Class J Concrete. The cement and aggregates shall be thoroughly dry mixed with no water added to the mixture except as may be directed by the E/A.

510.5 Measurement

Pipe will be measured by the linear foot for the various types, sizes and classes. Parallel lines will be measured individually.

Where a line ties into an existing system, the length of the new line will be measured from the visible end of the existing system at the completed joint. Unless otherwise indicated, the length of water and wastewater lines will be measured along pipe horizontal centerline stationing through fittings, valves, manholes, and other appurtenances.

Unless otherwise provided, ductile fitting 24-inch and smaller will be measured by the ton and paid for in accordance with the schedule in Standard Product List. Unless otherwise provided, fittings larger than 24 inch sizes will be subsidiary to the pipe.

Welded steel pipe fittings will not be measured separately. These will be subsidiary to the bid item Pipe.

Excavation and backfill, when included as pipe installation will not be measured as such but shall be included in the unit price bid for constructing pipe and measured as pipe complete in place including excavation and backfill.

When pay items are provided for the other components of the system, measurement will be made as addressed hereunder.

510.6 Payment

Payment for pipe, measured as prescribed above, will be made at the unit price bid per linear foot for the various sizes of pipe, of the materials and type indicated, unless unstable material is encountered or trench excavation and backfill is bid as a separate item.

The concrete seal, foundation rock or coarse aggregate when used as directed in unstable material will be paid for at the unit price bid per cubic yard, which shall be full payment for all excavation and removal of unsuitable material and furnishing, placing and compacting the foundation rock, coarse aggregate or other approved material all complete in place. Excavation and backfill, when included as a separate pay item, will be paid for by the designated Pay Item.

A. Pipe

Payment for pipe, measured as prescribed above, will be made at the unit price bid per linear foot complete-in-place as designed and represented in the Drawings and other Contract documents. Unless otherwise provided herein, as separate pay item(s), subsidiary items to the bid price per linear foot of pipe shall include the following:

1. clearing
2. constructing any necessary embankment
3. excavation
4. disposal of surplus or unusable excavated material
5. furnishing, hauling and placing pipe
6. fittings larger than 24 inch
7. field constructed joints, collars, temporary plugs, caps or bulkheads
8. all necessary lugs, rods or braces
9. pipe coatings and protection
10. connections to existing systems or structures, concrete blocking and thrust blocks and restrained joints
11. preparing, shaping, pumping for dewatering, and shoring of trenches
12. bedding materials
13. backfill materials
14. hauling, placing and preparing bedding materials

15. particle migration measures
16. hauling, moving, placing and compacting backfill materials
17. temporary and permanent pavement repairs and maintenance
18. temporary and permanent removal and replacement of pavement, curb, drainage structures, driveways, sidewalks and any other improvements damaged or removed during construction
19. cleanup
20. vertical stack on deep wastewater services
21. all other incidentals necessary to complete the pipe installation as indicated

No separate payment will be made for thrust restraint measures.

Steel cylinder concrete pipe fittings and welded steel pipe fittings will not be paid for separately. These will be subsidiary to the bid item Pipe.

B. Concrete Cradles and Seals

When called for in the Bid, concrete cradles and seals will be paid for at the unit Contract price bid per linear foot for the size of pipe specified, complete in place.

C. Concrete Retards

When called for in the Bid, Concrete retards will be paid under respected bid Item, Concrete Retards."

D. Boring, Jacking and Tunneling

When called for in the Bid, boring, jacking and tunneling will be paid under respected bid Item, "Jacking or Boring Pipe" or "Tunneling".

E. Wet Connections to Water Mains

When called for in the bid, wet connections will be paid at the unit price bid per each, complete in place, according to the size of the main that is in service and shall be full compensation for all Work required to make the connection and place the pipe in service.

F. Fittings

Cast iron and ductile iron fittings of the class indicated, furnished in accordance with these specifications will be paid for at the unit price bid per ton, complete in place, according to scheduled weights for mechanical joint fittings furnished, including glands, bolts and gaskets, as published in the following standards:

1. AWWA C-153 for all fittings 4-inch through-24 inch sizes, regardless of whether AWWA C-110 or AWWA C-153 fittings are furnished or the type of end connections supplied.
2. AWWA C-110 for all fittings larger than 24-inch size.

G. Concrete Trench Cap and Encasement

Where the distance between the top of the concrete encasement and the top of the trench cap is less than 36 inches, the concrete cap and encasement shall be poured as one unit and paid for under this bid item at the Contract price bid per linear foot. When the distance above is greater than 36 inches or when the trench cap is placed

separately, the trench cap shall be paid for as a separate item, per linear foot, complete in place.

H. Cement-Stabilized Backfill

Cement-stabilized backfill will be paid for at the unit price bid per linear foot and shall be full payment to the Contractor for furnishing and installing the required material, mixed, placed and cured complete in place.

I. Concrete Encasement

When called for in the Bid, Concrete Pipe Encasement will be paid under respected bid Item, "Encasement and Encasement Pipe".

J. Pressure Taps

Pressure taps will be paid for at the unit price bid, complete in place, according to the size tap made and the size main tapped and shall be full payment for furnishing all necessary materials, including tapping sleeve and valve, making the tap, testing and placing the connection in service.

K. Trench Safety Systems

When called for in Bid, Trench Safety Systems shall conform to Item No. 509, "Trench Safety Systems".

L. In-Place Slip lining with or without In-Place Pipe Destruction/Replacement

As called for in the corresponding bid items, pipe slip lining with or without in-place pipe destruction/replacement will be paid for at the Contract price per linear foot for the specified liner and pipe size and type pipe, at all depths, complete in place.

Installation of new services, or reconnection of existing services, to the liner will be paid for at the Contract price per each for the specified size and type of service, at all depths, complete in place.

M. Cured Resin Pipe Lining

When called for in the bid, cured resin pipe lining will be paid for per linear foot, for the size and type of pipe lined, at all depths, complete in place including all equipment set-ups, video inspection and cleaning of existing pipe. Installation of new services or reconnection of existing services to the relined pipe will be paid for per each, for the specified size and type of service, at all depths, complete in place.

Payment, when included as a Contract pay item, will be made under one of the following:

- Pay Item:** Pipe, ___Dia. ___ (all depths), including Excavation and Backfill Per Linear Foot.
- Pay Item:** In-Place Sliplining without In-Place Pipe Destruction/Replacement
(___ Dia. ___ Pipe Lining ___ in. Dia. Existing Pipe) Per Linear Foot.
- Pay Item:** In-Place Sliplining with Pipe Destruction/Replacement
(___ Dia. ___ Replacement Pipe ___ in. Dia. Existing Pipe) Per Linear Foot.
- Pay Item:** Installing or Reconnecting Lateral Service to Existing, Relined or Replaced
Pipe (___Dia. ___ Service) in. (___Dia. ___Pipe) Per Each.
- Pay Item:** Pipe Excavation, ___Ft. Width Per Linear Foot.

New Braunfels Utilities

Specifications

Pay Item: Pipe Trench Backfill, ___Ft. Width	Per Linear Foot.
Pay Item: Concrete Seal or Cradle, ___Dia. Pipe	Per Linear Foot.
Pay Item: Concrete Trench Cap, ___Ft. Width	Per Linear Foot.
Pay Item: Concrete Cap and Encasement, ___Dia. Pipe	Per Linear Foot.
Pay Item: Cement Stabilized Backfill, ___Dia. Pipe	Per Linear Foot.
Pay Item: Cured Resin Pipe Lining (for ___ Dia. Pipe)	Per Linear Foot.
Pay Item: Installing or Reconnecting Lateral Service to Cured Resin Lined Pipe, (___Dia. ___Service for ___Dia. Main)	Per Each.
Pay Item: Pressure Taps, ___ Dia. x ___ Dia.	Per Each.
Pay Item: Wet Connections, ___ Dia. x ___ Dia.	Per Each.
Pay Item: Ductile Iron Fittings 4 inch through 24 inch	Per Ton.

A "W" after the pay item indicates the use for water.

A "WW" after the pay item indicates the use for wastewater.

End

Item No. 512
Conductive Trace Wire for
Non-Metallic Pipe Installation

512.1 Description

Install electrically continuous trace wire with access points as described herein to be used for locating non metallic pipe with an electronic pipe locator after installation.

512.2 Materials

Trace wire to be twelve (12) gauge minimum solid copper with thermoplastic insulation recommended for direct burial. Wire connectors to be 3M DBR, or approved equal and shall be watertight and provide electrical continuity.

512.3 Construction Methods

Tracer wire shall be installed on all non-ductile iron water mains and force mains. The wire shall be installed in such a manner as to be able to properly trace all water/force mains without loss or deterioration of signal or without the transmitted signal migrating off the tracer wire.

Trace wire shall be installed in the same trench and inside bored holes and casing with nonmetallic pipe during pipe installation. It shall be secured to the pipe as required to insure that the wire remains adjacent to the pipe. The trace wire shall be securely bonded together at all wire joints with an approved watertight connector to provide electrical continuity, and it shall be accessible at all new water valve boxes.

A. Wastewater – Force Mains

For access points along force mains, valve boxes should be placed at intervals of no greater than 500 feet including one at the pump station and one at the discharge point.

B. Water

Tracer wires in valve boxes should be secured to the wall of the valve box and an excess of approximately 3 feet of wire should be coiled under the valve cap. This will keep the wire from being vulnerable to being twisted around valve keys and snapped, or pushed to the bottom of the valve box where it would be out of reach and inaccessible to the locator.

C. Pipe Application

At the point of connection between cast or ductile iron water mains, with any non iron water main, the tracer wire shall be properly connected to the iron pipe with a cad weld or approved equivalent. Tracer wire welds shall be completely sealed with the use of an approved mastic type sealer specifically manufactured for underground use. Mastic shall be applied in a thick coat a minimum of 2 inches thick and shall be protected from contamination by the backfill material with the use of a plastic membrane.

Tracer wire shall be laid flat and securely affixed to the top of the pipe at 10 foot intervals. The wire shall be protected from damage during the execution of the works. No breaks or cuts in the tracer wire or tracer wire insulation shall be permitted. At water

service saddles, the tracer wire shall not be allowed to be placed between the saddle and the water main.

The tracer wire will be allowed some slack to allow for bends in laying and for future installation of joints, splices, tapping saddles, etc. The slack should also be sufficient to allow for small earth movements occurring in compacting trench fill or through natural subsidence.

At all water main end caps, a minimum, of 6 feet of tracer wire shall be extended beyond the end of the pipe, coiled and secured for future connections. The end of the tracer wire shall be spliced to the wire of a six pound zinc anode and is to be buried at the same elevations as the water main.

D. Boring

For directional drilling, auguring or boring installations, four #12 tracer wires shall be installed with the pipe and connected to the tracer wire at both ends, or cad welded to the existing iron pipe at both ends.

E. Splicing

Except for approved spliced-in connections, tracer wire shall be continuous and without splices from valve chamber to valve chamber.

Spliced connections between the main line tracer wire and branch connection tracer wire shall only be allowed at water main tees, crosses or at iron or copper water services where a portion of the branch connection water main or water service is replaced with a non iron or non copper material. The branch connection tracer wire shall be a single tracer wire properly spliced to the main line tracer wire. Where the existing branch connection is neither iron nor copper, then the new branch connection tracer wire shall be properly spliced to the existing tracer wire on the branch connection.

When tying new construction to old construction, tracer wire will not be terminated to or on another tracer wire or metallic utility line unless the two systems are demonstrably compatible. This is to reduce the potential for rapid corrosion of one system due to a 'reverse' cathodic effect.

At all repair locations where there is existing tracer wire, the tracer wire shall be properly reconnected and spliced as outlined above.

512.4 Testing Requirements

Contractor shall perform a continuity test on all trace wire in the presence of the Engineer or the Engineers' representative.

- A. All tracer wire for new utility installations will be tested before acceptance. The test will take the following form:
 - 1. A standard 5 watt generator will be used to provide an AC current on the wire.
 - 2. The frequency of the signal from the generator will be initially restricted to 33 kHz or less.
 - 3. A standard hand held detector will be used to trace the signal.
- B. The installed tracer wire will be deemed to pass the test if using this set up:
 - 1. The tracer wire is accessible at all access points.
 - 2. The tracer wire can be traced from access point to access point.

3. Widely-spaced access points can be traced out in the worst case from each 'end' to a common meeting point between them.
 4. Depth readings are consistent and accurate to within 15 to 1 depth to diameter ratio.
- C. If the trace wire is found to be not continuous after testing, Contractor shall repair or replace the failed segment of the wire.

512.5 Measurement and Payment

There is no separate payment for the supply and installation of tracer wire on any construction or installation of non-ductile iron water main or force main by the Contractor. The Contractor shall consider the supply and installation of the tracer wire incidental to all construction of non-ductile water main and force main.

End