

00 01 07 DESIGN PROFESSIONAL SEALS

New Braunfels Utilities
S. Union Ave
Water Line Improvements
June 2024



Item No. 120
Utility Trenching and Backfill

120.1 Description

This item shall consist of labor, equipment and/or materials for excavating, bedding, backfilling, compacting, testing, grading and other appurtenant work, prescribed under this item and in accordance with the provisions of Chapter 213 of the Texas Administrative Code as it related to work over the Edwards Aquifer recharge zone, and New Braunfels Water and Wastewater Design Criteria Manual. This item shall include any pumping, bailing, drainage and Item No. 121, "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.

120.2 Standards

The applicable provisions of the following standards shall apply as if written here in their entirety:

A. American Society for Testing and Materials (ASTM) Standards:

ASTM C33	Standard Specification for Concrete Aggregates
ASTM C125	Terminology Relating to Concrete and Concrete Aggregates
ASTM D448	Standard Classification for Size of Aggregate for Road Bridge Construction

B. Texas Department of Transportation (TxDOT)

Tex-114-E	Laboratory Compaction Characteristics and Moisture-Density Relationship of Subgrade, Embankment Soils, and Backfill Material
Tex-115-E	Field Method For Determining In-Place Density Of Soils And Base Materials
Tex-129-E	Measuring the Resistivity of Soil Material
Tex-406-A	Material Finer than 75 μm (No. 200) Sieve in Mineral Aggregates (Decantation Test For Concrete Aggregates)
Tex-410-A	Abrasion of Coarse Aggregate Using the Los Angeles Machine

120.3 Materials

A. Standard Bedding Materials

USE / PIPE MATERIAL	Cement Stabilized Backfill	Natural or Mf'd Sand	Stone Screenings	Pea Gravel	Course Aggregate
WATER					
Service Tubing 1" to 2"		X	X	X	
WATER and WASTEWATER (PVC)					
Up to 15 Inch ID		X	X		
Larger Than 15 Inch ID			X	X	
WATER and FORCEMAINS (DUCTILE IRON)					
Up to 15 Inch ID			X	X	X
Larger Than 15 Inch ID				X	X
WASTEWATER (FRP)					
Larger Than 30 Inch ID			X		

1. General requirements and limitations governing bedding selection.
 - a. Crushed gravel or crushed stone shall not be used with polyethylene tubing or polyethylene film wrap.
 - b. Pea Gravel or bedding stone shall be used in blasted trenches.
2. 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 Engineer 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 Engineer, 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 Engineer.

B. Concrete

Concrete shall conform to TxDOT Standard Specifications Item No. 421, "Hydraulic Cement Concrete".

C. Foundation Rock

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

D. Flexible Base

Flexible base shall conform to TxDOT Standard Specifications Item No. 247, "Flexible Base".

E. Pipe Bedding**1. Coarse Aggregate**

a. Pipe bedding stone shall be clean gravel, crushed gravel or crushed limestone, free of mud, clay, vegetation or other debris, conforming to ASTM C33 for stone quality. Size gradation shall conform to Grade 6 Coarse Aggregate as defined in TxDOT Standard Specifications Item No. 421, "Hydraulic Cement Concrete".

b. Course aggregate shall not exceed 35% loss as determined by the Los Angeles Abrasion test per TxDOT Test Method Tex-410-A.

2. Fine Aggregate**a. Concrete and Mortar Sand**

Shall conform to fine aggregate as defined in TxDOT Standard Specifications Item No. 421, "Hydraulic Cement Concrete".

b. 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

c. Stone Screenings

Stone screenings shall be washed and screened natural sands or sands manufactured by crushing stones complying with the requirements and tests of ASTM C33.

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

Stone screenings shall have not more than 45 percent passing any sieve retained on the next consecutive sieve of those shown above, and its fineness modulus, as defined in ASTM C125, shall not be less than 2.3 nor more than 3.1.

3. 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

Pea Gravel shall not exceed 35% loss as determined by the Los Angeles Abrasion test per TxDOT Test Method Tex-410-A.

4. 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 6 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 Engineer.

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.

5. Cement Stabilized Backfill

When indicated or directed by the Engineer, 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 Engineer.

F. Backfill Materials

The Engineer may approve any of the following well graded materials:

1. Select trench material
2. Sand
3. Crushed rock cuttings
4. Rock cuttings
5. Foundation rock
6. Blasted material with fines and rock
7. Cement stabilized material
8. Borrow

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

120.4 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 TxDOT Standard Specifications Item No. 100, "Preparing ROW". Maintenance of environmental quality protection shall comply with all requirements of "General Conditions" and TxDOT Standard Specifications Item No. 560, "Temporary Erosion, Sedimentation, and Environmental Controls."

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 Engineer 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 Engineer 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 Engineer.

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 Engineer. When such conditions delay the Work, an extension of time for working day contracts will be allowed in accordance with "General Conditions".

B. Trench Excavation

1. General

Underground piped utilities shall be constructed in an open cut in accordance with Federal regulations, applicable State Statutes conforming to Item No. 121, "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.

2. 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.

3. 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.

Where not otherwise indicated, all water piping shall be laid to the following minimum depths:

- a. Water piping installed in natural ground in easements or undeveloped areas, which are not within existing or planned streets, roads or other traffic areas shall be laid with at least 48 inches of cover.
- b. Water piping installed in existing or proposed streets, roads or other traffic areas shall be laid with at least 48 inches of cover below finished grade.

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 48 inches of cover.
- (b) Wastewater piping installed in existing or proposed streets, roads or other traffic areas shall be laid with at least 48 inches of cover below finished grade.

4. 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.

5. 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 TxDOT Standard Specifications Item No. 421, "Hydraulic Cement Concrete", with a minimum depth of 3 inches.

6. 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:

- a. 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.
- b. 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.

7. Blasting

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

8. 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 Engineer. 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.

9. Lines and Grades

Grades, lines and levels shall be as indicated on the Construction Drawings. 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 on the Construction Drawings may be changed only by direction of the Engineer 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 Engineer 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 Engineer will forward all comments of the review to the Contractor for revision. Revisions shall be made and forwarded to the Engineer 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 Contractors procedures modified to the satisfaction of the Engineer. No additional compensation shall be paid for the removal and relaying of pipe required above.

10. Surplus Excavated Materials

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

C. 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.

D. 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.

E. Concrete Encasement, Cradles, Caps and Seals

Where called for by the Engineer, or when trench foundation is excessively wet or unstable or installation of water or wastewater pipe will result in less than 48 inches of cover, Contractor shall notify Engineer. Engineer 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 NBU Standard Detail No. 421, "Concrete Trench Cap". The pipe shall be well secured to prevent shifting or flotation while the concrete is being placed.

F. 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, TxDOT Item No. 421, "Hydraulic Cement Concrete".

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

Where called for by the Contract or as directed by the Engineer, 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 as defined in TxDOT Item No. 421, "Hydraulic Cement Concrete".

H. Backfilling and Compaction

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 be at the Contractor's expense and conform to the "General Conditions."

Backfill shall be free of debris, roots, organic matter, rock or gravel larger than 6 inches in any dimension, or any other harmful matter.

2. 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 98 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 98 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 Engineer. 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 Engineer 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 be replaced in kind to the surface removed to construct the pipe.

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

All Work within the right of way shall meet the requirements of (2.) 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.

4. 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.

5. 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 95 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 Engineer.

All soil areas disturbed by construction shall be covered with top soil and seeded conforming to TxDOT Item No. 164, "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.

I. 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.

J. 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 Engineer 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.

120.5 Measurement

Work under this item shall be considered subsidiary to the Work covered under Item 510, "Pipe" unless specified as a separate bid 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. 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.

B. Concrete Retards

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

C. 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.

D. 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.

E. Concrete Encasement

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

F. Trench Safety Systems

When called for in Bid, Trench Safety Systems shall conform to Item No. 121, "Trench Safety Systems".

120.6 Payment

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

Pay Item: Pipe Excavation, ____ Ft. Width	Per Linear Foot.
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.

End

**Item No. 121
Trench Safety Systems**

121.1 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. If special shoring requirements are needed based upon the conditions of the project, they shall be submitted to the Owner for review.

121.2 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 complete the design of the Trench Safety System Plan. 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 submittal requirements of the Trench Safety System Plan must 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 Contact 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".

121.3 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.

121.4 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.

121.5 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 121.2, "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 will require 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.

121.6 Measurement

Trench Safety Systems shall be measured by linear foot through manholes and other appurtenances along the centerline of trench conforming to the Contractor's Drawings and specifications. Special shoring requirements shall be measured by the square feet of shoring used.

121.7 Payment

Payment for Trench Safety Systems, measured as prescribed above, will be made at unit bid price per linear foot of trench as measured in Section 121.6 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 Linear Foot
Pay Item: Special Shoring	Per Square Foot

END

Item No. 505
Concrete Encasement and Encasement Pipe

505.1 Description

This item shall govern the furnishing of materials and the methods of constructing a Portland cement concrete encasement or encasement pipe.

505.2 Submittals

The submittal requirements of this specification item must include:

- A. Type, of pipe, construction methods and sequence,
- B. Aggregate types, gradations and physical characteristics for the Portland cement concrete mix,
- C. Proposed proportioning of materials for the mortar mix.

505.3 Materials

A. Portland Cement Concrete

The Portland cement concrete shall conform to Class B Concrete per the requirements of TXDOT Standard Specification Item No. 421, "Hydraulic Cement Concrete"

B. Steel Encasement Pipe

1. Steel Pipe shall conform to ASTM A53, Schedule 40. Extra Heavy Weight shall meet the requirements of ASTM A53, Schedule 80. Casing pipes shall have a minimum thickness as indicated below or as otherwise required by the authority having jurisdiction, and shall be considered the minimum thickness acceptable.
2. Pipe used as casing of a separate carrier pipe shall be new, smooth bore, steel pipe, with a coal-tar protective coating in accordance with the requirements of C203 both inside and outside. Joints shall be welded to form a true alignment of each pipe length.

Nominal Diameter of Steel Casing Pipe (Inches)	Minimum Wall Thickness of Steel Casing Pipe (Inches)	
	Roadway/Highway Crossing	Railway Crossing
16	0.250	0.282
18	0.250	0.313
24	0.375	0.375
30	0.4375	0.469
36	0.500	0.532
42	0.500	0.625
48	0.500	0.688

C. End Seals

1. End seals shall be designed to seal the annular space between the casing pipe and the carrier pipe at the ends of the casing pipe.

2. Approved Manufacturers:
 - a. Advance Products & Systems, LLC
 - b. Cascade Waterworks Manufacturing Company
 - c. CCI Piping Systems
 - d. Approved equal.
- D. Grout

Grout shall consist of not less than 6 sacks Portland cement per cubic yard and clean washed sand mixed with water. The grout shall have a consistency such that the grout will flow into and completely fill all voids. If allowed by the Engineer or designated representative, an air entraining admixture may be added to facilitate placement.

505.4 Construction Methods

- A. When indicated on the Drawings or acceptable to Engineer or designated representative, concrete encasement shall be placed to protect the pipe. Pipe or bedding shall not be placed where:
 1. the top of the pipe would have less than 48 inches of cover,
 2. the ground water invades the trench, or
 3. the trench bottom is of unstable material.
- B. If either of these conditions is encountered, the Engineer or designated representative shall be notified and may direct the Contractor to:
 1. encase the pipe with concrete,
 2. change pipe material, or
 3. use a higher strength class of pipe.
- C. Concrete encasement shall extend from 6 inches below to 6 inches above the outer projections of the pipe over the entire width of the trench in accordance with Standard Detail 310, "Concrete Encasement".

505.5 Measurement and Payment

- A. Concrete encasement will be measured by the lineal foot, for size of pipe being encased, complete in place. The measurement will be made between ends of the encasement, along the central axis as installed.
- B. Encasement pipe will be measured by size of encasement installed, complete in place. The measurement will be made between the ends of the pipe, along the central axis as installed.

505.6 Payment

- A. Work performed and materials furnished as prescribed by this item will be subsidiary to Item No. 510, "Pipe" unless included as a separate pay item in the contract. When included for payment, it shall be measured as provided under "Measurement" and will be paid at the unit

bid price per lineal foot for "Concrete Encasement" of the size indicated on the Drawings. The unit bid price shall include full compensation for furnishing all materials, pipe for all preparation, hauling, installation and for all labor, tools, equipment and incidentals necessary to complete the work, including bench excavation and disposal of surplus material.

Payment, when included as a contract Pay Item, will be made under one of the following:

Pay Item: Concrete Encasement for Dia. Pipe

Per Linear Foot.

Pay Item: Dia. Steel Encasement Pipe

Per Linear Foot

End

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

This item shall consist of furnishing and installing all pipe and/or materials for constructing water mains, force mains, sanitary sewers, laterals, stubs, and service connections including all applicable Work such as jointing, 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 on the plans. This item shall include any pumping, bailing, drainage and Item No. 121, "Trench Safety Systems" for trench walls, when indicated or applicable. Trenching and back fill shall be covered under Item No. 120, "Utility Trenching and Backfill." Acceptance testing shall be covered under Item No. 515, "Testing and Acceptance."

510.2 Submittals

- A. Furnish Shop Drawings, product data, design calculations and test reports as described below:
 1. 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.
 2. 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.
 3. Product data to show compliance of all couplings, supports, fittings, coatings and related items.

510.3 Standards

- A. The applicable provisions of the following standards shall apply as if written here in their entirety:
 1. American Water Works Association (AWWA):

AWWA C104	Cement-Mortar Lining for Ductile Iron Pipe and Fittings
AWWA C105	Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110	Ductile-Iron and Gray-Iron Fittings
AWWA C111	Rubber Gasket Joints for Ductile-Iron
AWWA C115	Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron

AWWA C150	Thickness Design of Ductile-Iron Pipe
AWWA C151	Ductile-Iron Pipe, Centrifugally Cast, Sizes 3 inches through 64 inches
AWWA C153	Ductile-Iron Compact Fittings
AWWA C600	Installation of Ductile Iron Mains and their Appurtenances
AWWA C602	Cement-Mortar Lining of Water Pipelines, 4 inches and larger in Place.
AWWA C605	Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.
AWWA C800	Underground Service Line Valves and Fittings
AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 inches through 60 inches
AWWA M23	PVC Pipe – Design and Installation.
AWWA M41	Ductile – Iron Pipe and Fittings

2. ASTM international (ASTM):

ASTM D1784	Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D2241	Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated PVC Pipe (SDR) Series
ASTM D3034	Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3139	Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D3212	“Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals”
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F679 & Annex	Standard Specification for Poly(Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F1674	Standard Test Method for Joint Restraint Products for Use with PVC Pipe

3. NSF International

NSF 61	Drinking Water System Components – Health Effects
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510.4 Materials

A. Fire Lines

Fire line leads and fire hydrant leads shall be ductile iron, only.

B. Force Mains

All wastewater force mains shall be constructed of the following pipe materials:

- a. Ductile iron pipe of pressure class 250 minimum for pipe greater than 12-inch size, and ductile iron pipe pressure class 350 for pipe 12-inch size and smaller,
- b. D2241 PVC Pressure Class 200 (SDR 21) for pipe 12-inch size and smaller, integrally colored green,
- c. PE4710 HDPE DR-9 with a minimum diameter of four (4) inches,
- d. Polyvinyl Chloride Pipe meeting all requirements of section 510.4.D, integrally colored green,
- e. Ductile iron 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.

C. Ductile Iron Water Mains

- a. 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. Ductile Iron Pipe - Pipe shall be ductile iron pipe meeting all requirements of standards as follows:
 - i. For push-on and mechanical joint pipe: AWWA C151
 - ii. For flanged pipe: AWWA C115

Barrels shall have a nominal thickness required by Table 1 of AWWA C115, 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.

- iii. 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:
 1. Grade 60-42-10:
 - a. Minimum tensile strength: 60,000 psi (414 mPa).

- b. Minimum yield strength: 42,000 psi (290 mPa).
 - c. Minimum elongation: 10 percent.
- 2. Grade 70-50-05 (for AWWA C115 pipe):
 - a. Minimum tensile strength: 70,000 psi (483 mpa).
 - b. Minimum yield strength: 50,000 psi (345 mPa).
 - c. Minimum elongation: 5 percent.
- c. Ductile Iron Fittings:
 - i. Fittings shall be push-on, flanged or mechanical joint as indicated or approved and shall meet all requirements of standards as follows:
 - 1. Sizes 4 inch through 24 inch: AWWA C110 or AWWA C153
 - 2. Sizes larger than 24 inch: AWWA C110.
- 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.
- e. Linings and Coating:
 - i. Interior surfaces of all ductile iron water pipe shall have cement-mortar lining in accordance with AWWA C104 and bituminous seal coat.
 - ii. Interior surfaces of all ductile iron wastewater and force main fittings shall be coated with Protecto 401. Lining primers, applications, and thicknesses shall be in accordance with manufacturer's recommendations for sanitary sewer applications, but shall not be less than 40 mils.
 - iii. Exterior surfaces for buried pipe and fittings shall be coated with a 1 mil bituminous coating in accordance with AWWA C110 and C151, unless specified otherwise.
 - iv. Exterior surfaces for pipe and fittings installed above grade or within vaults shall be coated as required by the applicable coating specification.
- f. Joint Materials
 - i. Gaskets for mechanical joints shall conform to ANSI/AWWA A21.11/C111.
 - ii. 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.

- iii. 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/C111 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.
- iv. 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/C111.
- v. 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.
- vi. 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.
- vii. 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.

g. 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 C105, 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. Polyvinyl Chloride (PVC) 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 305 psi (DR-14) or 235 psi (DR-18) as indicated. All pipe 4 inches and larger must be approved Underwriter's Laboratories for use in buried water supply and fire protection systems.

b. 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 when required by the E/A. 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.

c. Applicable Specifications

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

- i. AWWA C900, DR 18 or DR 14 for PVC Pressure Pipe, in 4, 6, 8, 12, 16, and 24 inch nominal sizes, having Cast Iron Pipe size outside diameters.
- ii. Fittings used with PVC Pressure pipe shall be AWWA C110 or AWWA C153 compact ductile iron fittings.

d. 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 C900.

e. Marking

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

- i. Nominal pipe size and OD base (e.g., 4 CIPS).
- ii. Type of plastic material (e.g., PVC 12454B).
- iii. Dimension Ratio (e.g., DR 18).
- iv. Pressure Class (e.g., PC 235).
- v. AWWA designation with which the pipe complies (e.g., AWWA C900-16).
- vi. Manufacturer's name or trademark and production run record
- vii. The National Sanitation Foundation (NSF) mark.

E. Service Lines

a. Clamps or Saddles

Approved service clamps or saddles shall be used when tapping ductile iron pipe and PVC pipe 16 inch size and smaller. Outlets of service saddles shall be tapped with AWWA IP thread (female). External threads of corporation valve inlet must be compatible with internal threads of the service saddle.

b. Service Line Materials

1 inch service lines shall be annealed copper tubing meeting the requirements of paragraph 510.4.E.e. High Density Polyethylene (HDPE) meeting the requirements of paragraph 501.4.E.c may be allowed for 1 inch diameter service lines with approval from NBU. 2 inch diameter service lines shall be High Density Polyethylene (HDPE) meeting the requirements of paragraph 510.4.E.c and in no case shall copper tubing be allowed.

c. HDPE Tubing

- i. HDPE pipe with 1" to 2" diameter shall be PE 4710 conforming to the latest edition of AWWA C901 and ANSI/NSF Standard 61. PE 4710 shall conform to ASTM D3350 minimum cell classification PE 445574C-CC3.
- ii. Pipe shall have a minimum pressure class of 250 psi. The outside diameter of the pipe shall be based upon the CTS sizing system.
- iii. The pipe shall be marked in accordance with the standards to which it is manufactured. Markings shall include nominal size, outside diameter base (e.g. CTS), dimension ratio (e.g. DR 9), manufacturer's name or trademark, standard materials designation code (PE 4710), cell classification (e.g. PE 445574C), PE compound oxidative resistance for potable water (CC3), pressure class (e.g. PC 250), standard's designation (AWWA C901), manufacturer's production code, date of manufacture, mark of the certifying agency for potable water (such as NSF).
- iv. Color of exterior pipe product (pipe with color code E) shall be blue for potable water.
- v. Tracer wire shall be required on all HDPE Service Lines and in accordance with Paragraph 510.4.J of this Section and Item No. 512 "Conductive Trace Wire for Non-Metallic Pipe Installation".

d. HDPE Fittings

- i. Butt Fusion Fittings – HDPE Fittings shall be made of PE4710 and with a minimum Cell Classification of PE 445574C-CC3. All HDPE fittings shall meet the requirements of AWWA C901 and shall have a pressure rating equal to the pressure rating of the pipe to which the fitting is joined.
 1. Molded fittings shall be manufactured, tested and marked per ASTM D3261.
 2. Fabricated fittings shall be manufactured, tested and marked per ASTM F2206, or individual fittings standards.
 3. Socket fittings shall meet ASTM D2683. Fittings shall be butt fusion welded, made of PE 4710 material with the same minimum cell classification used for the service line.
- ii. Electrofusion Fittings - Fittings shall be PE4710, with a minimum Cell Classification of PE 445574C-CC3. Electrofusion Fittings shall have a manufacturing standard of ASTM F1055. Fittings shall have a pressure rating equal to the pipe unless otherwise specified on the plans.
- iii. Flanges and Mechanical Joint adapters (MJ adapters) shall be PE4710, with a minimum Cell Classification of PE 445574C-CC3. Flanged and MJ adapters can

be made to ASTM D3261 or if machined, must meet the requirements of ASTM F2206. Flanges and MJ adapters shall have a pressure rating equal to the pipe unless otherwise specified on the plans. Markings for molded or machined flange adapters or MJ adapters shall be per ASTM D3261. Fabricated (including machined) flange adapters shall be per ASTM F2206.

- iv. Mechanical Fittings for service pipes - Three primary mechanical fittings or connections can be used, which are: Stab or insert type; compression type; and clamp ring. Per MAB-4, "Internal stiffeners should be used for all mechanical fittings".
- v. Mechanical fittings shall be designed to restrain and to prevent pull-out or rotation.

e. Copper Tubing

All copper service tubing shall be 1" diameter 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
1	1.125	± 0.0035	0.065	± 0.0045

f. 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.

g. Brass Fittings

- i. 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 C800, except as herein modified or supplemented.
- ii. Unless otherwise noted, the goods described herein shall be fabricated of Waterworks No-Lead Brass meeting the requirements of ASTM B584, UNS Copper Alloy C89833 or C89836, having not more than one fifth of one percent (0.2%) total lead content by weight.
- iii. Exposed threads shall be covered with plastic caps or sheeting to protect the threads.
- iv. Brass goods of each type and class shall be compatible with other fittings in common usage for similar purposes.
- v. Brass pipe shall conform to the weights and dimensions for Extra Strong pipe given in Table A.2 of AWWA C800.

h. Corporation Valves

- i. Inlet threads of corporation valves shall be AWWA iron pipe (IP) thread (male). AWWA IP threads shall conform to ANSI/ASME B1.20.1 as required by AWWA C800 for "General Purpose (Inch) Pipe Threads". For 1" size 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.
- ii. Connections of all new copper 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.
- iii. Connections of all new polyethylene tubing or pipe shall be by compression fittings. PE tubing or piping must have a stainless steel insert stiffener at the compression connections per manufacturer's recommendations.
- iv. 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.
- v. All fittings shall be suitable for use at hydrostatic working pressures up to 150 psig (hydrostatic testing of installed systems is at 200 psig).

F. Certification

For pipes 16-inches 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).

G. Polyvinyl Chloride (PVC) Pipe (Non-pressure) and Fittings for Gravity Wastewater Mains

a. General

Where PVC gravity wastewater pipe is indicated, it shall conform to ASTM D3034 for pipe sizes 4 inch to 15 inch or ASTM F679 for pipe sizes 18 inch to 48 inch. Cell Class shall be as required by applicable ASTM pipe specification; pipe stiffness shall be 115 psi minimum.

Where pressure rated PVC gravity wastewater pipe is indicated, it shall conform to ASTM D2241 SDR 26 or meet the requirements of paragraph 510.4.D.

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 manufacturer's name and/or trademark, nominal pipe size, PVC cell classification per ASTM D1784, and be marked at intervals of not more than 5 feet:

d. Fitting Markings

Fittings shall include the manufacturer's name or trademark, nominal size, material designation "PVC", PSM, and the designation, "Specification D3034".

e. Pipe Color

Pipe shall be integrally colored green by the manufacturer.

H. Fiberglass Reinforced Plastic (FRP) Pipe (Non-pressure) and Fittings for Gravity Wastewater Mains

a. General

FRP shall conform to Item No. 320 "Fiberglass Gravity Sewer Pipe".

I. Tracer Wire

Tracer wire shall be installed on all non-ferrous water mains, water services and force mains. The wire shall be installed in such a manner as to be able to properly trace all 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".

J. Tracer Tape

Tracer tape shall be installed on all force mains in accordance with 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.

K. Concrete

Concrete shall conform to TxDOT Item No. 421, "Hydraulic Cement Concrete".

L. Material Approval

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.

510.5 Construction Methods

A. Water Line/New Wastewater Line Separation

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

1. 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.
2. 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 AWWA C900 (DR-18) 150 psi rated PVC or ASTM D 2241 (SDR-26) 160 PSI rated PVC.
3. 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 AWWA C900 (DR-18) 150 psi rated PVC or ASTM D 2241 (SDR-26) 160 PSI rated PVC shall be centered at the point of crossing the water line.
4. 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.

B. Utility and Storm Sewer Crossings

1. When the Contractor installs a pipe that crosses under a utility structure or storm sewer and the top of the pipe is within 24 inches of the bottom of the utility structure, the pipe shall be encased in concrete 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 or AWWA C900 (DR-18) 150 psi rated PVC in sizes to 12 inch. 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 C900 (DR-18) 150 psi rated PVC in sizes to 12 inch, unless otherwise specified by the E/A.
2. Steel casing must be used when water mains cross under box culverts, large storm drain pipes (48 inches or greater in diameter), or multiple barrel storm drains of any size. Casing sizes shall be in accordance with NBU Construction Specifications. Casing must extend 5' beyond the OD of the storm drain crossing.

3. Where trenches wider than 12 inches cross under existing wastewater lines, the sewer lines shall be replaced with one 20-foot joint of AWWA C900 (DR-18) 150 psi rated PVC or ASTM D 2241 (SDR-26) 160 PSI rated PVC centered over the trench.

C. Laying Pipe

1. 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.
2. 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.
3. The interior of all pipeline components shall be clean, dry and unobstructed when installed.
4. 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.
5. 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.

D. Assembling of Pipe

1. 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.
2. Orientation marks, when applicable, shall be in their proper position before pipe is seated.
3. 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.
4. 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.

E. Joints

1. O-Ring and Push-on Joints
 - i. 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.

F. HDPE Service Line Joints

1. The pipe and fittings shall be joined by butt fusion or electrofusion couplings, mechanical joint (MJ) adapters, or by flange connections in accordance with manufacturer's recommendations and as required in this document. Unless otherwise shown on Drawings and except for connections to existing utilities, all joints shall be fused.

a. Butt Fusion: The pipe shall be joined by heat fusion of the ends. Prior to fusion the pipe shall be clean and the ends shall be cut square. Butt-fusion joining is applicable to pipes that have the same nominal outside diameter and wall thickness, within one SDR. Field site butt-fusion system operators shall be trained in the use of the high-quality butt-fusion equipment that secure and precisely align the pipe ends for the fusion process. Operators shall be trained by the pipe supplier or manufacturer of the fusing machine and be experienced in the operation of the equipment. Fusion quality shall be recorded, the recording of the information must be provided to the Owner. The Owner will review documents within 7 days and identify any fusion records that might indicate the need to replace an existing fused connection. The recorded fusion information must meet the standard requirements of ASTM F3124. All fusions failing to meet these requirements shall be removed and refused. Refer to ASTM F2620, ASTM F3124, ASTM F3183 and ASTM F3190.

b. Electrofusion: Electrofusion joining shall be done in accordance with the manufacturers recommended procedure and ASTM F1055, ASTM F1290, MAB-01 and MAB-02. Qualification of the fusion technician shall be demonstrated by evidence of electrofusion training within the past year on the equipment and pipe sizes to be utilized for this project. Installers shall follow the guidance shown in the previous documents to fabricate EF assemblies. The installer must remove oxidation from the pipe and maintain a clean surface on both pipe and fitting to ensure acceptable joint quality.

c. Mechanical:

i. Mechanical connection of HDPE to auxiliary equipment such as valves, pumps, and fittings shall use flanges or mechanical joint adapters and other devices in conformance with the AWWA Manual of Practice M55, Chapter 6. Mechanical connections shall be manufactured for HDPE pipe and approved by the connection manufacturer for use with polyethylene pipe. Uncontrolled tapering or hand-beveling in the field is not allowed.

- ii. Mechanical connections on pipe 3" and smaller are available to connect HDPE pipe to other HDPE pipe, or a fittings, or to a transition to another material. The use of stab fit style couplings is allowed, along with the use of metallic couplings of brass and other materials. All mechanical and compression fittings shall be recommended by the manufacturer for use with HDPE and with potable water.
- iii. Mechanical couplings that wrap around the pipe and act as saddles are made by several manufacturers specifically for HDPE pipe. All such saddles, tapping saddles, couplings and clamps shall be recommended by the manufacturer as being designed for use with HDPE pipe at the required pressure class; all mechanical couplings shall be fully restrained either by themselves or by an alternate means.
- d. Mechanical Joint/Flange: A flange assembly consists of a metal back-up flange or bolt-ring and a polyethylene flange adapter. MJ assembly consists of a MJ adaptor with gland ring, gasket and bolt kit. Both MJ adapters and flange adapters are fused onto the plain end of the pipe main. Bolting guidance for MJ connections is provided in AWWA C600 and guidance for flanges and gaskets is provided in PPI-TN38. Note that an HDPE flange adapter acts as both a flange and a gasket, and as such, no 'gasket' is required. For further information, refer to PPI TN38

G. Placing Pipe in Tunnels

Piping installed as a carrier pipe in a tunnel, encasement pipe, etc., shall have uniform alignment, grade, bearing, meet all requirements of the carrier pipe as specified, and conform to the reviewed Shop Drawings. All necessary casing spacers, joint restraints, 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. Carrier pipe may be pulled into place inside the encasement or tunnel using lubricants to ease pipe installation. Lubricants such as flax soap or drilling mud may be used for this purpose. Use of petroleum products such as oil or grease for this purpose shall not be permitted.

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

1. 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.
2. All temporary end plugs or caps shall be secured to the pipe as provided under Item No. 507, "Bulkheads".
3. Trench caps shall be reinforced Class D concrete as indicated.

I. 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 C105 to provide a continuous wrap.

J. Pipe Anchorage, Support and Protection

Pressure pipeline tees, plugs, caps and shall be secured with thrust restraints. Joint restraints lengths shall be determined by the Engineer. Concrete thrust blocking may be approved on a case-by-case basis for connections to existing mains or other situations where restraint lengths cannot be achieved.

1. Concrete Thrust Blocking

- a. Concrete for use as reaction or thrust blocking shall be Class B conforming to TxDOT Item No. 421, "Hydraulic Cement Concrete".
- b. 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.
- c. 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.
- d. 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.

3. 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.

4. 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.)

K. Wastewater Connections

1. Connections to Mains 12 Inches and Smaller
 - a. All branch connections of new main lines shall be made by use of manholes.
 - b. Service stubs shall be installed as indicated. Minimum grade shall be 2 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.
 - c. Where a service connection to a main 12 inches or smaller is indicated, a wye, tee or double wye shall be installed.
 - d. 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.
 - e. 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
 - a. 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.
 - b. 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.

L. Water System Connections

1. 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.
2. 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.

3. Shutoffs

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

4. Wet Connections to Existing Water System

- a. 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.
- b. 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.
- c. 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.

5. Pressure Taps to Existing Water System **(Note: Pressure taps can only be performed by NBU pre-approved Contractors.)**

- a. 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.

- b. 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 must pay for the tap in advance at NBU's Service Center located at 355 FM 306.
- c. 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.

6. Service Connections

- a. Service connection taps into PVC, AC, CI, or DI pipe 16 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.
- b. 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.
- c. 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.
- d. 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.

7. Cleanup and Restoration

- a. 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.
- b. 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.

M. Water Main Abandonment

1. Water mains to be abandoned shall be disconnected from pipes that are to remain in service and entirely filled with pumpable grout. All connections to existing mains to remain in service shall be cut or plugged as appropriate and thrust blocks installed as necessary. All valves on the water main shall be abandoned as per the section below. Contractor is responsible for all labor, equipment, and materials required to complete the work.
2. Service lines to be abandoned shall be disconnected at the corporation stop at the main, and all other valves and appurtenances, including the water meter, shall be removed. All meters to be removed shall be returned to NBU.

N. Valve Abandonment

1. Valves to be abandoned shall only occur when an abandoned valve is left on an abandoned water main that is no longer in service. A valve to be abandoned shall have the valve box, casing, and valve stem extension (if present) removed to a minimum of 18-inches below grade. The remaining casing shall be filled with non-shrink grout to the top of the casing.

O. Wastewater Main Abandonment

1. Wastewater mains to be abandoned shall be cleaned and televised per Item No. 315 "CCTV Inspection" to verify all existing laterals have been transferred to another wastewater main.
2. Wastewater mains to be abandoned shall be disconnected from pipes or manholes that are to remain in service and entirely filled with pumpable grout. All connections to existing mains to remain in service shall be cut or plugged as appropriate. Contractor is responsible for all labor, equipment, and materials required to complete the work.
3. Wastewater manholes to be abandoned shall be abandoned per NBU Standard No. 340 "Abandoned Manhole."

510.6 Measurement

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

Pipe to be abandoned shall be measured by the cubic yard of pumpable grout required to completely fill the pipe.

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 iron fittings 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. These will be subsidiary to the bid item Pipe.

Excavation and backfill, when included under 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.

510.7 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.

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:

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

B. No separate payment will be made for thrust restraint measures.

C. 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.

D. 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 C153 for all fittings 4-inch through-24 inch sizes, regardless of whether AWWA C110 or AWWA C153 fittings are furnished or the type of end connections supplied.
2. AWWA C110 for all fittings larger than 24-inch size.

E. 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.

F. Trench Safety Systems

When called for in Bid, Trench Safety Systems shall conform to Item No. 121, "Trench Safety Systems".

G. Water Main Abandonment

Water main abandonment shall be paid for at the unit price bid, complete in place, according to the size of the main to be abandoned, and shall be full payment for furnishing all labor, equipment, and materials necessary to fill the existing main with pumpable grout. Unless otherwise provided herein, as separate pay item(s), subsidiary items to the bid price shall include:

1. All excavation required to access the existing main
2. Installation of plugs or caps
3. Installation of thrust blocks
4. Backfill, compaction, and restoration
5. Temporary and permanent pavement repairs and maintenance
6. Disposal of surplus or unusable excavated material

7. Removal and legal disposal of existing water main
8. Temporary and permanent removal and replacement of pavement, curb, drainage structures, driveways, sidewalks and any other improvements damaged or removed during construction
9. Cleanup

H. Water Service Abandonment

Water service abandonment shall be paid for at the unit price bid, complete in place, according to the size of the service to be abandoned, and shall be full payment for furnishing all labor, equipment, and materials necessary to plug or cap the connection to the existing main and remove all existing valves and appurtenances. Unless otherwise provided herein, as separate pay item(s), subsidiary items to the bid price shall include:

1. All excavation required to access the existing main
2. Installation of plugs or caps
3. Backfill, compaction, and restoration
4. Temporary and permanent pavement repairs and maintenance
5. Disposal of surplus or unusable excavated material
6. Removal and legal disposal of existing service materials
7. Delivery of water meters to NBU storage facilities or inspection personnel, as directed
8. Temporary and permanent removal and replacement of pavement, curb, drainage structures, driveways, sidewalks and any other improvements damaged or removed during construction

I. Wastewater Line Abandonment

Wastewater line abandonment shall be paid for at the unit price bid, complete in place, according to the size of the main to be abandoned, and shall be full payment for furnishing all labor, equipment, and materials necessary fill the existing line with pumpable grout. Unless otherwise provided herein, as separate pay item(s), subsidiary items to the bid price shall include:

1. Cleaning and televising the existing main
2. All excavation required to access the existing main
3. Installation of plugs or caps
4. Installation of thrust blocks
5. Backfill, compaction, and restoration any required excavation
6. Temporary and permanent pavement repairs and maintenance
7. Removal and legal disposal of surplus or unusable excavated material
8. Removal and legal disposal of existing sewer materials
9. Temporary and permanent removal and replacement of pavement, curb, drainage structures, driveways, sidewalks and any other improvements damaged or removed during construction
10. Cleanup

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: 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
Pay Item: Abandon and Grout Fill, ____ Dia. Water Main	Per CY
Pay Item: Abandon and Grout Fill, ____ Dia. Wastewater Main	Per CY

End

Item No. 511
Water Valves & Fire Hydrants

511.1 Description

This item shall govern the valves furnished and installed as indicated on the Drawings. Unless otherwise indicated on the Drawings, all valves 4 inches and larger shall be AWWA-type valves of suitable design and fully equipped for service buried in the earth, without need for further modification and shall be wrapped with 8-mil polyethylene film with all edges and laps securely taped to provide a continuous wrap. Where not indicated, the Contractor may use valves with any type end-joint allowed for fittings of the pipe class being used. Unless otherwise indicated on the Drawings, all valve stems shall be adjusted to situate the operating nut not more than 24 inches below the proposed ground or paving surface of the finished project.

This item shall govern the furnishing of labor, materials, equipment and incidentals necessary to install fire hydrant and appurtenances, operators, bolts, nuts and gaskets.

511.2 Submittals

The submittal requirements of this specification item must include:

- A. Test Data.
- B. Product Catalog Data.
- C. Shop Drawings.
- D. Operation and Maintenance Manuals.
- E. Hydrant cut sheets and Certification of Compliance with AWWA C502 as record data.
- F. Hydrant and flow results from hydrant flow testing in section 511.7 for approval.

511.3 Standards

The applicable provisions of the following standards shall apply as if written here in their entirety:

- A. American National Standards Institute (ANSI) Standards:

ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings
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- B. American Society for Testing and Materials (ASTM) Standards:

ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A307	Carbon Steel Bolts and Studs, 60,000-psi Tensile Strength
ASTM A325	Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM D2000	Classification System for Rubber Products in Automotive Applications

- C. American Water Works Association (AWWA) Standards:

AWWA C105	Polyethylene Encasement for Ductile-Iron Pipe System
AWWA C111	Standard for Rubber-Gasket Joints
AWWA C500	Metal-Seated Gate Valves For Water Supply Service
AWWA C502	Standard for Dry-Barrel Fire Hydrants
AWWA C504, Class 150B	Rubber-Seated Butterfly Valves
AWWA C507	Ball Valves, 6 in. Through 60 in.
AWWA C509	Resilient Seated Gate Valves for Water and Sewerage Systems
AWWA C512	Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service
AWWA C514	Air Valve and Vent Inflow Preventer Assemblies for Potable Water Distribution System and Storage Facilities
AWWA C515	Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
AWWA C530	Standard Specification for Pilot-Operated Control Valves
AWWA C540	Standard for Power-Actuating Devices for Valves And Slide Gates
AWWA C550	Standard for Protective Interior Coatings for Valves and Hydrants
AWWA M51	Air Valves: Air-Release, Air/Vacuum, and Combination

D. NSF International

NSF 61	Drinking Water System Components – Health Effects
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511.4 Materials

The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation in the Work is of the kind and quality that satisfies the specified functions and quality. New Braunfels Utilities' Standard Products Lists (SPL) are considered to form a part of these Specifications. Contractors may, when appropriate, elect to use products from the SPL; however, submittal to the Engineer/Architect (E/A) is still required. If the Contractor elects 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 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. Samples, Inspection and Testing Requirements:

All tests and inspections called for by the applicable standards shall be performed by the manufacturer. Upon request, results of these tests shall be made available to the purchaser.

B. Other Requirements:

Each submittal shall be accompanied by:

1. Complete data covering:
 - a. the operator, including type and size, model number, etc.,
 - b. the manufacturer's name and address of his nearest service facility,
 - c. the number of turns to fully open or close the valve
2. Detailed instructions for calibrating the limit stops for open and closed positions, and
3. Any other information that may be necessary to operate and maintain the operator.
4. Complete dimensional data and installation instructions for the valve assembly as it is to be installed, including the operator.
5. Complete replacement parts lists and drawings, identifying every part for both the valve and operator.

511.5 Valves

A. All valves shall be of the close right type.

B. Gate Valves

Gate Valves 4" through 36", including Tapping Valves, shall be resilient wedge type with non-rising stem in strict conformance with AWWA C509/C515 unless otherwise indicated. All valves for potable water service must comply with NSF 61 standards.

Gate Valves larger than 36", including Tapping Valves, shall be double disc, parallel seat internal wedging type valves meeting the requirements of AWWA C500.

1. Quality Assurance

- a. Acceptable Manufacturers
 - i. American Flow Control.
 - ii. M&H.
 - iii. Mueller.
 - iv. Clow.
 - v. U.S. Pipe.
 - vi. Kennedy Valve
- b. Experience Requirements: The manufacturer shall have at least 10 years of experience in the manufacture of valves used in the water and wastewater treatment environment. References and installation list shall be provided on request.

2. Functional Requirements

- a. Stem Seals: All valves shall have approved O-ring type stem seals. At least two O-rings shall be in contact with the valve stem where it penetrates the valve body.
- b. Operation: All valves shall have non-rising stems with a 2" square operating nut, or with a spoke type handwheel when so ordered, turning clockwise to close.
- c. Gearing: Gate valves in 16 inch and larger sizes shall be geared and, when necessary for proper bury depth and cover, shall be the horizontal bevel-geared type enclosed in a lubricated gear case.
- d. Bypass: Unless otherwise indicated, 36 inch and larger gate valves shall be equipped with a bypass of the non-rising stem type which meets the same AWWA standard required for the main valve.
- e. Valve Ends: Valve ends shall be push-on, flanged, mechanical joint, ALPHA restrained joint, as indicated or approved.
- f. Tapping valves shall have inlet flanges conforming to MSS SP-60, with bolt holes drilled per ANSI B16.1 Class 125. Seat rings and body casting shall be over-sized as required to accommodate full size cutters; the outlet end shall be constructed and drilled to allow the drilling machine adapter to be attached directly to the valve.
- g. Gear Case: All geared valves shall have enclosed gear cases of the extended type, attached to the valve bonnet in a manner that makes it possible to replace the stem seal without disassembly and without disturbing the gears, bearing or gear lubricant. Gear cases shall be designed and fabricated with an opening to atmosphere so that water leakage past the stem seal does not enter the gear case.
- h. Valve Body: Double disc gate valves in 36 inch and larger sizes installed in the horizontal position shall have bronze rollers, tracks, scrapers, etc.
- i. Gate: Gate for resilient wedge gate valves shall be ductile iron with rubber-seat compound bonded to the valve gate. Gate for double disc valves shall be ductile iron with bronze mounted wedges and seats.

C. Butterfly Valves:

Unless otherwise indicated, all valves shall conform AWWA C-504 and AWWA C-550 and comply with NSF61 standards, except as modified or supplemented herein.

1. Quality Assurance:

- a. Acceptable Manufacturers
 - i. DeZurik.
 - ii. M&H.
 - iii. CMB/K-Flo.
 - iv. Pratt.
- b. Experience Requirements: The Manufacturer shall have had successful experience in manufacturing tight-closing, rubber-seated butterfly valves for this type service in the sizes indicated. The Manufacturer shall have at least 10 year's experience in the manufacture of valves.
- c. Manufacturer's Representative for Startup and Testing: The Valve Vendor or Manufacturer shall provide the services of a competent manufacturer's representative for an indefinite period of time as required to insure proper adjustment, installation, and operation of the valve.

2. Functional Requirements

- a. Valve Bodies: Valves shall be the short body design and shall have flanged connections on both ends unless otherwise called for. Valve bodies shall be constructed of cast iron ASTM A126, Class B or ASTM A48, Class 40 or ductile iron in accordance with ASTM A536, Grade 65/45/12. Valve class shall be suitable for the pressure class of the adjacent pipe in which it is installed or as shown in the valve list herein.
- b. Valve Discs: Valves shall be of such design that the valve discs will not vibrate or flutter when operated in a throttled position. Valve discs shall be secured to the shafts by means of keys or pins so arranged that the valve discs can be readily removed without damage thereto. All keys and pins used in securing valve discs to shafts shall be stainless steel or monel. Valve discs shall be stainless steel or ductile iron, ASTM A536, Grade 65-45-12 (448-310-12); seating edge shall be stainless steel or other corrosion resistant material.
- c. Valve Shafts: Valve shafts shall be constructed of wrought stainless steel conforming to ASTM A276 or monel. The ends of the shaft shall be permanently marked to indicate the position of the disc on the shaft.
- d. All buried valves shall have approved manufacturer's O-ring type or split V type "Chevron" shaft seals. When O-ring seals are used, there shall be at least two O-rings in contact with the valve shaft where it penetrates the valve body.
- e. On 24 inch and larger valves, the seat shall be completely replaceable and/or adjustable with common hand tools without disassembling the valve from the pipeline. Rubber seats located on the valve disc shall be mechanically secured with stainless steel retainer rings and fasteners.
- f. Unless otherwise indicated, valves shall be provided with manual operators with vertical stems and 2 inches square operating nut turning clockwise to close and equipped with a valve disc position indicator. All keys or pins shall be stainless steel or monel. Buried valves shall have the valve stems extended or adjusted to locate the top of the operating nut no more than 24 inches below finish grade.
- g. Unless otherwise indicated, motorized butterfly valves shall be equipped with 460/230 VAC, 3-phase reversing motor operators, extended as required to locate

the center line of the operator shaft approximately 4 feet to 4 feet, 6 inches above finish grade. Operators shall be equipped with cast iron or malleable iron manual override hand wheel with a valve position indicator, local push button controls, lighted status/position indicator, torque and travel limit switches and all switches, relays and controls (except external power and signal wiring) necessary for both local and remote operation.

3. Performance Requirements

- a. Unless otherwise indicated, valve operators shall be sized to seat, unseat, open and close the valve with 150 psi shutoff pressure differential across the disk and allow a flow velocity of 16 fps past the disc in either direction.
- b. Motorized valve motors shall be capable of producing at least 140% of the torque required to operate the valves under conditions of maximum non-shock shutoff pressure without exceeding a permissible temperature rise of 131°F over 104°F ambient (55 degrees Celsius over 40 degrees Celsius ambient); they shall have a duty rating of not less than 15 minutes and shall be capable of operating the valve through 4 1/2 cycles against full unbalanced pressure without exceeding the permissible temperature rise. Motors shall be suitable for operating the valve under maximum differential pressure when voltage to motor terminals is 80% of nominal voltage. Motor bearings shall be permanently lubricated and sealed.

D. Ball Valves:

Unless otherwise indicated, Ball Valves, shall conform to AWWA C507.

Ball valves shall be brass, bronze, stainless steel or PVC as indicated on the Drawings or Details or as approved by the Engineer or designated representative.

E. Air-Vacuum Release Valves:

Unless otherwise indicated, Air-Vacuum Release Valves, Combination Air Valves, shall conform to AWWA C512 and C514. Valves in potable water applications must adhere to NSF 61 requirements.

1. Quality Assurance

- a. Acceptable Manufacturers:
 - i. Vent-O-Mat
 - ii. Vent-Tech
 - iii. A.R.I. Flow Control

2. Air-Vacuum Release Valves

- a. Shall be air-vacuum units having small and large orifice units contained and operating within a single body or assembled unit.
- b. The small orifice system shall automatically release small volumes of air while the pipe is operating under normal conditions. The large air-vacuum orifice system shall automatically exhaust large volumes of air while the pipe is being filled and shall permit immediate re-entry of air while being drained.
- c. Valve body, float, and assembly shall be designed for the pipeline's overall maximum working pressure and shall seat at the minimum pressure.

3. Combination Air Valves

- a. Shall be designed to exhaust large volumes of air as the pipeline is being filled; permit large volumes of air to enter the pipeline during pipeline drainage; release accumulated pockets of air while the pipeline is in operation and under pressure; and dampen surge pressures caused by water column separation or rapid air discharge.
- b. Combination air valves shall be heavy-duty, single-chamber air and vacuum valves with disc floats. Floats shall include discs drilled with the small and large orifices, and an anti-surge float. Internal clearances around the floats shall be equal to the inlet/outlet area. The anti-surge float should be normally opened and have drilled orifices to throttle water flow.
- c. Combination air valve inlet/outlet cross-sectional area shall be equal to the nominal size of the valve. CAV outlet for raw water use shall be fitted with a cover or with a vent pipe where indicated on the Drawings. Combination air valves outlets for treated water use shall be connected to piping to vent air out of the manhole. The vent piping shall extend to 4 feet above the ground or as indicated on the Drawings.

4. Material Requirements

- a. Interior components should be stainless steel. Interior components that are not stainless steel shall be coated in accordance with Specification Item No. 530 "High Performance Coatings."
- b. Valve exterior bodies and covers shall be 316 stainless steel.
- c. Internal bushings, hinge pins, float guide and retaining screws, pins, etc., shall be stainless steel.
- d. Orifice seats shall be Buna-N rubber.
- e. Floats shall be stainless steel, rated at 1000 psi.
- f. Unless otherwise indicated, these valves shall be as included in the Standard Products List.

F. Control Valves:

All control valves to regulate pressure, flow, pump, etc., in New Braunfels Utilities' lines shall be models listed in the Standard Products List (SPL).

511.6 Fire Hydrants

All fire hydrants shall be Dry Barrel, Traffic Model (break-away), Post Type having Compression Type Main Valves with 5 1/4" or 6" opening, closing with line pressure. Approved models are listed on Standard Products List.

New Braunfels Utilities reserves the right to limit purchases of fire hydrants to traffic models equipped with safety flange on the hydrant barrel and stem, manufactured by the following manufacturers providing such products conform to the provisions contained here in:

- A. Mueller Company (Mueller A423 Super Centurion 200)
- B. American-Darling Valve and Manufacturing Company (American-Darling 6-inch B-84-B)
- C. Clow Valve Company (Clow Medallion)

D. EJ (East Jordan Iron Works)

All fire hydrants shall be provided with (1) 5" Harrington Integral Hydrant Storz, "HIHS" or equivalent (approved by NBU engineer).

- A. Mueller – Harrington # HIHS-MLR-50-45 (or Mueller's 5" Quick Disconnect, part # 287304)
- B. American Darling – Harrington # HIHS-WAT-50-45
- C. Clow – Harrington # HIHS-Clow-50-45
- D. EJ (East Jordan Iron Works) – Harrington # HIHS-EJIW-50-45

Applicable Specifications

- A. AWWA C-502 current: "AWWA Standard for Dry-Barrel Fire Hydrants".
- B. NFPA 1963: "Standard for Fire Hose Connections".
- C. ANSI A-21.11 current: "American National Standard for Rubber Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings".

Functional Requirements

- A. Design Working Pressure shall be 250 psi or greater.
- B. Inlet shall be side connection hub end for mechanical joint (ANSI A-21.11-current). Shoe shall be rigidly designed to prevent breakage.
- C. Lower Barrel shall be rigid to assure above ground break at traffic feature. Bury length of hydrant shall be four (4) feet minimum, five (5) feet maximum (hydrant lead pipe may be elbowed up from main using restrained joints; flanged joints in lead pipes are not allowed). Flange type connections between hydrant shoe, barrel sections and bonnet shall have minimum of 6 corrosion resistant bolts. Barrel shall have an inside diameter of not less than 7 inches. Hydrant shall have non-rising stem.
- D. Hydrant Main Valve shall be 5 1/4 or 6-inch I.D. Valve stem design shall meet requirements of AWWA C502, with Operating Nut turning clockwise to close. Operating Nut shall be pentagonal, 1 1/2-inch point to flat at base, and 1 7/16 inches at top and 1-inch minimum height. Seat ring shall be bronze (bronze to bronze threading) and shall be removable with light weight stem wrench. Valve mechanisms shall be flushed with each operation of valve; there shall be a minimum of two (2) drain ports.
- E. Traffic Feature shall have replaceable breakaway ferrous metal stem coupling held to stem by readily removable type 302 or 304 stainless steel fastenings. Breakaway flange or frangible lugs shall be designed to assure aboveground break. Breakaway or frangible bolts will not be acceptable.
- F. Outlet Nozzles shall be located approximately 18 inches above ground. Each hydrant shall have two (2) 2 1/2 inch nozzles 180 degrees apart with National (American) Standard Fire Hose Coupling Screw Thread NFPA 1963 and one (1) 5-inch Harrington Integral Hydrant Storz Nozzle, Harrington, Inc. model "HIHS" or equivalent (approved by NBU engineer). Nozzles shall be threaded or cam-locked, O-ring sealed, and shall have type 302 or 304 stainless steel locking devices. Nozzle caps (without chains) and cap gaskets shall be

furnished on the hydrant. The cap nut shall have the same configuration as the operating nut, with exception to the Storz Cap, which shall not have a pentagon-operating nut and shall be attached by cable to the hydrant.

- G. Hydrants shall be Dry-Top Construction, factory lubricated oil or grease with the lubricant plug readily accessible.
- H. Hydrant shall have double O-ring seals in a bronze stem sheath housing to assure separation of lubricant from water and shall have a weather cap or seal, or both, as approved by the Owner, to provide complete weather protection.

Material Requirements

- A. All below ground bolts shall be corrosion resistant. The hydrant valve shall be Neoprene, 90 durometer minimum. The seat ring, drain ring, operating nut and nozzles shall be bronze, AWWA C-502 current, containing not over 16 percent zinc. Break-away stem coupling shall be of ferrous material; its retaining pins, bolts, nuts, etc. of type 302 or 304 stainless steel.
- B. Coatings shall be durable and applied to clean surfaces. Exterior surfaces above ground shall receive a coating of Sherwin Williams' silver metallic paint or approved equal. The coating shall be applied according to coating manufacturer's specifications. Other exposed ferrous metal shall receive asphalt-based varnish, or approved equal, applied according to the coating manufacturer's specifications. Bonnets and caps shall be painted based on NFPS Standard 291 recommendations shown in Figure 1 below per flow testing results after approval by the Engineer.

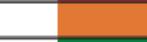
<i>Bonnet and Cap Colors</i>			
Color Name	Code	Color	Available Flow
Red	C		Less than 500 GPM
Orange	B		500-999 GPM
Green	A		1,000-1,499 GPM
Light Blue	AA		1,500 GPM & above

Figure 1: Bonnet and Cap Color Based on Flow Rate Calculated at 20 psi Residual Pressure

511.7 Water Flow Testing for Fire Hydrants

A. Guidelines

These guidelines are to be followed when a building, facility, residential subdivision, or multi-family dwelling units, within the City of New Braunfels or its Extraterritorial Jurisdiction, ETJ, is required to have a water (fire) flow test completed.

All water flow testing criteria for the purposes of these guidelines and any other guidelines shall conform to the International Fire Code as adopted by the City of New Braunfels, NFPA 291.

This guide does not replace, nor supersede any codes and/or ordinances adopted by the City of New Braunfels, or determinations and positions of the Fire Chief or Fire Marshal.

Fire flow testing is the determination of actual flow conditions within a hydrant system. A hydrant system is the system of mains, whether looped or not, capable of providing fire flow to a site. A site may have one or more hydrant systems with different flow and pressure characteristics.

Available fire flow is measured in gallons per minute (gpm) at a residual pressure of 20 psi.

The water system shall pass all construction acceptance testing (bacteriological and hydrostatic) prior to flow testing.

B. Hydrant Requirements

Following is a list of requirements for fire hydrant acceptance.

1. Water system (water mains, valves, services, hydrants and all appurtenances) must be in place and have passed all NBU acceptance testing.
2. Fire hydrant spacing must be in compliance with International Fire Code and local city ordinance for new construction.
3. All fire hydrants must have a 5-inch Storz connection with a standard Storz cap (not a pentagon nut). The cap must be tight fitting so that it cannot be turned or taken off by hand.
4. All fire hydrants must be at a level so that the center of the 5-inch (Storz) connection will be a minimum of 18 inches above the planned finished grade.
5. All fire hydrants must be flow tested following the guidelines set forth in NFPA 291. Flow testing may only be done by a fire sprinkler company (licensed by the State Fire Marshal's Office), fire protection engineer (licensed by the Texas Board of Professional Engineers), or civil engineer (licensed by the Texas Board of Professional Engineers). Flow testing costs and coordination are the responsibility of the Contractor.
6. Engineer to provide NBU with updated CAD file (preferably GPS located, at the very least geospatially located) 3 business days prior to flow testing. NBU will number the new hydrants that will be used for the numbering on the flow testing form.

C. Flow Testing Requirements

Following is a list of steps for fire flow testing.

1. All valves in open position.
2. Follow flow testing procedures listed in NFPA 291 "Recommend Practice for Water Flow Testing and Marking of Hydrants."
3. Input information using NBU's *Fire Hydrant Flow Test Form (Appendix C)*.
4. Results of the flow test will be given to the New Braunfels Fire Marshal's Office, a copy to NBU and the Engineer. (NB Fire Marshal's Office – 424 S Castell Ave; NBU – 355 FM 306)
5. A copy of the state issued engineer license or fire sprinkler license of the person/company who performed the test must be included with the results which are turned in to the Fire Marshal's Office.
6. Flow tests must be able to be duplicated prior to final acceptance by NBU or New Braunfels Fire Department (NBFD).
7. Acceptance of the constructed water system will depend upon NBFD's and NBU's approval of the fire flow(s) of the hydrant(s), among other criteria.
8. NBU field inspector should be consulted prior to testing for observation and coordination purposes. Contractor should give NBU field inspector 48-hour notice prior to any flow testing.
9. NBU field inspector must be on-site during flow testing.

511.8 Construction Methods

A. Setting Valves, Drains and Air Releases

Unless otherwise indicated, main line valves, drain valves and piping, air and vacuum release assemblies and other miscellaneous accessories shall be set and jointed in the manner described for cleaning, laying, and jointing pipe.

Unless otherwise indicated, valves shall be set at the locations shown on the Drawings and such that their location does not conflict with other appurtenances such as curb ramps. Valves shall be installed so that the tops of operating stems will be at the proper elevation required for the piping at the location indicated above. Valve boxes and valve stem casings shall be firmly supported and maintained, centered and aligned plumb over the valve or operating stem, with the top of the box or casing installed flush with the finished ground or pavement in existing streets, and installed with the top of the box or casing approximately 6 inches below the standard street subgrade in streets which are excavated for paving construction or where such excavation is scheduled or elsewhere as directed by the Engineer or designated representative.

Drainage branches or air blowoffs shall not be connected to any sanitary sewer or submerged in any stream or be installed in any other manner that will permit back siphonage into the distribution system. Every drain line and every air release line shall have a full sized independent gate valve flanged directly to the main. Flap-valves, shear gates, etc., will not be accepted.

B. Setting Fire Hydrants:

Fire hydrants shall be located in a manner to provide accessibility and in such a manner that the possibility of damage from vehicles or conflict with pedestrian travel will be minimized. Unless otherwise directed, the setting of any hydrant shall conform to the following:

Hydrants between curb and sidewalk on public streets, shall be installed as shown on standard, with outermost point of large nozzle cap 6" to 18" behind back of curb. Where walk abuts curb, and in other public areas or in commercial areas, dimension from gutter face of curb to outermost part of any nozzle cap shall be not less than 3 feet, nor more than 6 feet, except that no part of a hydrant or its nozzle caps shall be within 6 inches of any sidewalk or pedestrian ramp. Fire hydrants shall not be installed within nine feet vertically or horizontally of any sanitary sewer line regardless of construction.

All hydrants shall stand plumb; those near curbs shall have the 5-inch Storz nozzle facing the curb and perpendicular to it. Hydrants shall be placed with no obstructions within 3' of the pentagonal operating nut. The hydrant bury mark shall be located at ground or other finish grade; nozzles of all new hydrants shall be approximately 18 inches above grade. Lower barrel length shall not exceed five (5) feet. Ground to bottom of connection pipe shall be 4 feet. Barrel extensions are not permitted unless approved by the Engineer or designated representative. Each hydrant shall be connected to the main by 6-inch ductile iron pipe; a 6-inch gate valve shall be installed in the line for individual shutoff of each new hydrant.

Fire hydrants on mains under construction (or out of service) shall be securely wrapped with a poly wrap bag (5 mils or greater) or envelope taped into place. When the mains are accepted and placed in service (or hydrant repaired or replaced) the bag shall be removed.

C. Pressure Taps: Refer to Section 510.3 of Standard Specification, "Pipe".

D. Plugging Dead Ends:

Standard plugs shall be inserted into the bells of all dead ends of pipes, tees or crosses and spigot ends shall be capped. All end plugs or caps shall be secured to the pipe conforming to Section 510.3 of Standard Specification, "Pipe".

E. Protective Covering:

Unless otherwise indicated, all flanges, nuts, bolts, threaded outlets and all other steel component shall be coal tar coated and shall be wrapped with standard minimum 8-mil low density polyethylene film or a minimum 4-mil cross laminated high-density polyethylene meeting ANSI/AWWA Specification C-105-current, with all edges and laps taped securely to provide a continuous and watertight wrap. 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.

F. Valve Box, Casing and Cover:

Stems of all buried valves shall be protected by valve box assemblies. Valve box castings shall conform to ASTM A48, Class 30B. Testing shall be verified by the manufacturer at the time of shipment. Each casting shall have cast upon it a distinct mark identifying the manufacturer and the country of origin.

G. Air Release Assemblies:

Shall be installed as directed by the engineer.

H. Pressure/Flow Control Valves:

Assemblies shall be installed as indicated.

I. Connections to Existing System:

Refer to Item No. 510, "Pipe" for connections to the existing system.

J. Shutoffs:

Refer to Item No. 510, "Pipe" for shutoffs.

K. Abandonment:

Refer to Item No. 510, "Pipe" for abandonment.

511.9 Measurement

All types of valves will be measured per each. Fire hydrants and drain valves will be measured per each. Pressure/Flow control valve assemblies and both manual and automatic air release assemblies will be measured per each.

Unless indicated otherwise in the Drawings, bury depths that exceed 5.5 feet shall be considered subsidiary to the completed unit.

511.10 Payment

Payment shall include full compensation, in accordance with the pay item established in the bid, for excavation, furnishing, hauling and placing valves and barrel extensions including anchorage and all incidental and subsidiary materials and work; preparing, shaping, dewatering, shoring of trenches, bedding, placing and compacting backfill materials and for all other incidentals necessary to complete the installation, as indicated in the Drawings, complete in place.

Payment for iron fittings and for wet connections are covered in Section 510.6 of Standard Specification Item 510, "Pipe".

A. Valves: Valves will be paid for at the unit bid price for the size and type valve installed, including valve stem casing and cover, excavation and backfill, setting, adjusting to grade, anchoring in place, and other appurtenances necessary for proper operation.

- B. Fire Hydrants: Fire Hydrants installation (and flow testing) shall be paid for at the unit bid price for all fittings, piping, valves, between the main line and the fire hydrant; setting, adjusting to grade, anchoring in place, installing blue hydrant reflectors, and other appurtenances necessary for proper operation. Flow testing shall be coordinated and results recorded by Contractor;
- C. Pressure/Flow Control Assemblies: Pressure control and flow control valve assemblies will be paid for at the unit bid price, including box or vault, setting, adjusting to grade, anchoring in place, adjusting the control device to the required conditions, providing other appurtenances necessary for proper operation, and placing in operation.
- D. Drain Valve Assemblies: Drain valve installation shall be paid for at the unit bid price, including all fittings, piping, and valves between the main line and the drain valve; setting, adjusting to grade, anchoring in place, and other appurtenances necessary for proper operation;
- E. Manual Air Release: Manual air release installations will be paid for at the unit bid price and shall include valves, fittings, pipe, tapping the main, box and cover, and other appurtenances necessary for proper operation.
- F. Automatic Air-Vacuum Valves: Automatic air-vacuum release assemblies will be paid for at the unit bid price and will include the main line tap or outlet, all pipe, valves, fittings, box or vault and cover, and other appurtenances necessary for proper operation.

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

Pay Item: Valves, _____ Type, _____ Diameter	Per Each.
Pay Item: Fire Hydrants	Per Each.
Pay Item: Pressure or Flow Control Valve Assemblies	Per Each.
Pay Item: Drain Valve Assemblies	Per Each.
Pay Item: Manual Air Release Assemblies, _____ Diameter	Per Each.
Pay Item: Automatic Combination Air/Vacuum Release Valve Assembly, _____ Diameter	Per Each.

END8

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**A. Trace Wire**

Trace wire for direct bury applications shall be twelve (12) gauge minimum solid copper or high-strength copper-clad steel (HS-CCS) with HDPE or HMWPE insulation recommended for direct burial.

Trace wire for trenchless applications shall be twelve (12) gauge minimum extra-high-strength copper-clad steel (EHS-CCS) with HDPE or HMWPE insulation recommended for direct burial.

Trace wire for all applications shall have insulation color per the APWA Uniform Color Code for the specific utility being marked.

B. Wire Connectors

Wire connectors must be watertight, provide electrical continuity, and be filled with dielectric moisture resistant grease. Connectors shall be 3M Direct Bury Splice Kits, Copperhead Snakebite Locking Connectors, or approved equal.

C. Access Points

Access Points shall meet the requirements of NBU SPL 18.1.0.

512.3 Construction Methods

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

Tracer wire shall be installed in the same trench and inside bored holes and casing with non-metallic pipe during pipe installation. It shall be secured to the pipe as required to ensure 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 tracer wire access points installed per NBU standard details. Sections of wire shall be spliced together using approved splice caps and waterproof seals. Twisting the wires together is not acceptable. No bare tracer wire shall be accepted. Detection tape shall not be used in lieu of tracer wire.

A. Wastewater – Force Mains

For access points along force mains, tracer wire access points shall 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 wire access points are to be placed at intervals no greater than 600' and adjacent to isolation valves or fire hydrants.

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 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 handheld 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-metallic 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-metallic water main and force main.

End

Item No. 515
Pipeline Testing and Acceptance

515.1 Description

This item shall consist of the testing and acceptance of water and wastewater pipes, including hydrostatic testing for pressure pipes, low pressure air testing for gravity pipes, deflection and settlement testing.

A. Tests shall be required in accordance with the following table:

	Bacteriological Testing	Hydrostatic Testing	Exfiltration Test	Infiltration Test	Low Pressure Air Test	Settlement Testing	Deflection Testing	CCTV Inspection
Water Mains	X	X						
PVC Gravity Sewer Mains					X	X	X	X
Other Gravity Sewer Mains			X	X		X	X	X
Force Mains		X						

515.2 Submittals

A. Furnish test reports as described below:

1. Submit written plan for disinfection.
2. Submit detailed hydrostatic test procedure 10 days prior to conducting the test.
3. 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.
4. Submit Hydrostatic Pipe Test Reports.

515.3 Standards

A. The applicable provisions of the following standards shall apply as if written here in their entirety:

1. ASTM International (ASTM):

ASTM F2164	Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure
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ASTM F1417-11A	Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Line Using Low-Pressure Air
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2. American Water Works Association (AWWA):

AWWA B300	Hypochlorites
AWWA C200	Steel Water Pipe, 6 In (150 mm) and Larger
AWWA C600	Installation of Ductile-Iron Mains and Their Appurtenances
AWWA C604	Installation of Buried Steel Water Pipe – 4 In. (100 mm) and Larger
AWWA C605	Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
AWWA C651	Disinfecting Water Mains
AWWA M9	Concrete Pressure Pipe
AWWA M11	Steel Pipe – A Guide for Design and Installation
AWWA M23	PVC Pipe – Design and Installation
AWWA M41	Ductile-Iron Pipe and Fittings
AWWA M55	PE Pipe – Design and Installation

515.4 Products

A. Water for Testing

1. Obtain water for filling and testing the pipeline and provide all temporary pumps and piping necessary to fill the pipeline.
2. If chlorinated water is used, then dechlorinate it before disposal per all regulations.
3. Water for the Work shall be metered and furnished by the Contractor in accordance with of the Standard Contract Documents.

B. Test Plugs

1. Design plugs or blind flanges to withstand the test pressure on either side with only atmospheric pressure on the opposite side.
2. Provide a 30-inch access manhole in one side of the plug and a 12-inch flanged outlet on the other side of the plug unless shown differently on the Drawings.

C. Pressure Gauge

1. Use a pressure gauge having minimum divisions of 0.10 psi and an accuracy of 0.0625 psi. (One ounce per square inch.)

D. CCTV Equipment

1. General

Equipment used shall be designed for use in gravity wastewater collection systems per Specification Item No. 315 "CCTV Inspection".

515.5 EXECUTION

A. General

Perform tests in accordance with this Section, AWWA Standards, AWWA Manuals, and the supplier's recommendations.

B. Water Pipe Acceptance Testing

Acceptance testing for potable water pipes requires two tests, bacteriological and hydrostatic. Bacteriological testing should be done on the pipe after disinfection and 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 hydrostatic test will be conducted by the Contractor.

1. Disinfection of Potable Water Lines

a. 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.

b. Cleaning

Prior to disinfection the Contractor shall clean the pipeline to remove foreign matter. For pipelines 16-inches in diameter or smaller, cleaning shall consist of flushing the pipeline. For pipelines greater than 16-inches 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).

c. Procedure and Dosage

i. 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-inch 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.

ii. 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.

- iii. 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.
- iv. For pipelines larger than 16-inches 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.
- v. Unless otherwise indicated, all quantities specified herein refer to measurements required by the testing procedures included in the current edition of "Standard Methods for the Examination of Water and Wastewater," jointly published by AWWA, WEF, and AHPA. The chlorine concentration at each step in the disinfection procedure shall be verified by chlorine residual determinations.

d. 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 NBU before flushing of the line may begin. Additionally, the flushing must be witnessed by an authorized representative of NBU.

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.

2. Bacteriological Testing

After final flushing of the disinfecting solution, the system 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. All stubs shall be tested before connections are made to existing systems.

- a. Contractor must collect two (2) sets of water samples taken at least twenty-four (24) hours apart. 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.

- b. 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.
- c. 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.
- d. 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.
- e. 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 for the Examination of Water and Wastewater." 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 collects 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.
- f. 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.

3. Hydrostatic Test

- a. 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.
- b. Determine the HGL for each test section, and test such that the pressure range below is achieved (lower pressure at high point and higher pressure at low point).
 - i. Test pressure shall in no case be less than 200 psi, or more than 2X the working pressure.
- c. 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.
- d. Prior to pressure testing against an existing system valve, a bacteriological test shall be performed to determine potability of water.
- e. 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 hours.

i. 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.

(25 gpd)
(in. - mi.)

ii. 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.

C. Wastewater Pipe Acceptance Testing

Gravity sewer 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 per Specification Item No. 315 "CCTV Inspection".

Force main sewer pipe shall be tested in accordance with the hydrostatic test procedure outlined in the "Water Pipe Acceptance Testing."

The Contractor shall be solely responsible for making proper repairs to those elements which do not pass these test requirements.

1. Wastewater Exfiltration Test

- a. 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.
- b. 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

- a. 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.
- b. 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.
- c. 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.
- d. If the quantity of infiltration exceeds the maximum quantity specified, remedial action must be undertaken to reduce the infiltration to an amount within the limits specified.

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

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. Use only qualified personnel to conduct the test.

a. Plugs

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.

b. Pressure Relief Device

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.)

c. 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.

d. Test Procedure

- i. The E/A may, at any time, require a calibration check of the instrumentation used. 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.
- ii. 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:

Diameter of Pipe, (in.)	Minimum Specified Time Required For 1.0 psig Pressure Drop For Size and Length of Pipe Indicated							
	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.

- iii. 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.
- e. Edwards Aquifer Recharge/Transition Zone Test Procedure
 - i. Low-pressure air tests must conform to the procedure described in ASTM F1417-11A 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 must be air tested at each joint.
 - ii. 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.
 - iii. 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 ($\text{ft}^3/\text{min}/\text{ft}^2$) of internal surface area.

- iv. 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.

f. Manholes

- i. Manholes must be tested separately and independently in accordance with Standard Specification Item No. 304, "Manholes".

D. Settlement Testing

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.

E. Deflection Testing

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.

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

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

F. Closed Circuit Television (CCTV) Inspection

1. CCTV Televising / Inspection shall be in accordance with Specification Item No. 315 "CCTV Inspection".

510.5 Measurement and Payment

No direct measurement or payment will be made for the work to be done or the equipment to be furnished under this Item but shall be considered subsidiary to the particular items required by the bid.

End