

SECTION 520—WATER AND SANITARY SEWER FACILITIES

520.01—Description

This work shall consist of furnishing and installing necessary materials for water distribution systems and sanitary systems in accordance with these specifications and in conformity to the dimensions, lines, and grades shown on the plans or as established by the Engineer.

520.02—Materials

- (a) **Pipe, fittings, and flanges** shall conform to the requirements of Section 232.
- (b) **Gaskets and joint materials** shall conform to the requirements of Section 212.
- (c) **Casing pipe** shall be 14-gage corrugated metal half-circle pipe conforming to the requirements of Section 232 except as modified for securing interlocked or nested connections.
- (d) **Concrete blocks** shall conform to the requirements of Section 222.
- (e) **Bricks** shall conform to the requirements of Section 222.
- (f) **Hydraulic cement mortar** shall conform to the requirements of Section 218.
- (g) **Concrete** shall conform to the requirements of Section 217 and shall be Class A3.
- (h) **Reinforcing steel** shall conform to the requirements of Section 223.
- (i) **Curing material for concrete** shall conform to the requirements of Section 220.
- (j) **Timber skids** shall conform to the requirements of Section 236, and the preservative and treatment shall conform to the requirements of Section 236.
- (k) **Valves** shall conform to the requirements of AWWA C500, C504, C506, C507, C508, or C509 for the types and features specified.
- (l) **Fire hydrants** shall conform to the requirements of AWWA C502 or C503 with the various features specified.
- (m) **Water meters** shall conform to the requirements of AWWA C700, C701, C702, C703, C704, C706, C707, C708, or C710 for the type and features specified. Each meter shall be furnished with a meter box.
- (n) **Corporation stops** shall be made of bronze or red brass conforming to the requirements of ASTM B62. The fitting design and thread dimension shall conform to the requirements of AWWA C800. The working pressure of the corporation stop shall be equal to that of the water main to which it is attached.
- (o) **Castings** shall conform to the requirements of Section 224.
- (p) **Nonshrink waterproof grout** shall conform to the requirements of Section 218.
- (q) **Aggregate** shall conform to the requirements of Section 203. Aggregate for drain fields shall be No. 5.

520.03—Procedures

The Contractor shall be responsible for anticipating and locating underground utilities and obstructions in accordance with the requirements of Section 105.08.

When construction appears to be in close proximity to existing utilities, the trench(es) shall be opened a sufficient distance ahead of the work or test pits made to verify the exact locations and inverts of the utility to allow for changes in line or grade.

Connections to existing lines shall be made only after the proposed line is completed and approved by the Engineer. Connections shall be made in the minimum time possible with minimum interruption of service. Work and interruptions in existing service shall be scheduled with the utility owner.

Existing water and sewer lines and appurtenances and manholes not required in the completed system shall be abandoned as directed by the Engineer. Abandoned materials shall become the property of the Contractor, unless otherwise noted on the plans, upon satisfactory replacement with the new installation. Abandoned pipe that is not removed shall be cleaned of debris and plugged at open ends with Class A3 concrete.

Existing manholes that are not required in the completed system shall be removed to at least 2 feet below the proposed subgrade or natural ground line and shall be filled with approved backfill in accordance with the requirements of Section 302.03 (a)2.g.

Disturbed property shall be restored prior to final acceptance. Restoration shall include, but not be limited to, replacing shrubbery, sod, or topsoil, including lime, fertilizer, seed, and mulch; replacing paved or finished

surfaces with similar materials; and performing other work in accordance with the requirements of Section 107.08.

Sidewalks and streets shall be kept open for passage. The Contractor shall provide and maintain adequate and safe passage over excavations to accommodate pedestrians or vehicles as directed by the Engineer.

- (a) **Protecting Water Supplies:** During the course of construction, the Contractor shall protect water supply facilities within the construction limits from contamination by sewage. The Contractor shall use the following criteria to govern the installation of water and sewer facilities in proximity of each other:

- 1 **Parallel separation:** Except as specified hereinafter, water lines shall be placed at least 10 feet horizontally from existing or proposed sanitary sewer lines, combination sewer lines, and sanitary sewer manholes. Sanitary sewer lines shall be placed at least 10 feet horizontally from existing and proposed water lines. This distance shall be measured from edge to edge. If local conditions prevent a lateral separation of 10 feet, a water line may be placed closer than 10 feet to a sewer or a sewer line may be placed closer than 10 feet to a water line if the top of the sewer pipe is at least 18 inches below the bottom of the water line. Where the vertical separation cannot be obtained, the sewer shall be constructed of mechanical joint water pipe. Gravity sewers shall be pressure tested, in place, to 50 pounds per square inch without leakage prior to backfilling. Force main sanitary sewer shall be pressure tested in accordance with the requirements of Section 520.04(c).
- 2 **Crossings:** Water and sewer lines that cross shall be placed to provide a separation of at least 18 inches between the bottom of the water line and the top of the sewer line. Where this vertical separation cannot be obtained, the sewer shall be constructed of mechanical joint or other approved water pipe for at least 10 feet on each side of the crossing.

Sanitary sewers and combined sewers crossing over a water line shall have a vertical separation of at least 18 inches between the bottom of the sewer and the top of the water line. The support shall be adequate to prevent excessive deflection of joints and the settling on and breaking of the water line. The water or sewer line shall be centered at the point of the crossing so that joints will be equidistant and as far from each other as practicable.

Water lines shall not pass through or come in contact with any part of a sanitary sewer, combined sewer, or sanitary sewer manhole.

The Contractor shall immediately notify the Engineer if he becomes aware that the work will result in the violation of these criteria. Upon such notification, the Engineer will issue instructions concerning remedial measures.

- (b) **Excavation:** Excavation, backfill, and compaction shall be performed in accordance with the requirements of Section 302 except that stone larger than 1 inch in diameter shall not be used in backfill until the pipe has a cover of at least 1 foot. The remainder of backfill to the original ground or to within 12 inches of the finished subgrade shall not include stone larger than 10 inches in its greatest dimension. Pipelines installed outside the roadway shall be backfilled in 8-inch layers and compacted to approximately 85 percent of the theoretical maximum density.

Trenches for pipelines shall be excavated generally along straight lines, and bottoms shall be uniformly graded as required. Bedding material shall be placed in accordance with the plans. Where the trench bottom is in rock, it shall be excavated to at least 8 inches below the bottom of the pipe and backfilled with approved local or commercial bedding material. Pipe shall have a uniform bearing on a solid foundation for its entire length. Where pipe foundations are yielding, pipe shall be bedded on at least 8 inches of approved local or commercial bedding material. Bell holes, where applicable, shall be of sufficient size to ensure the making of proper joints.

Trenches below the grade line of the pipe shall be dewatered during installation of pipelines.

When work is not in progress for any reason, lines shall be securely closed.

Where adjacent pavements are to be retained, pavement removed for pipeline trenches shall be replaced in kind with equal or better material or as otherwise specified. After backfilling, the Contractor shall maintain a smooth riding surface until pavement repairs are completed.

- (c) **Inspecting Pipe and Fittings:** Pipe and fittings shall be inspected for cracks and defects before they are lowered into the trench. Faulty pipe and fittings shall be removed from the site.
- (d) **Placing Pipe:** Water mains shall have a cover of at least 36 inches, and water service lines shall have a cover of at least 24 inches. Pipe, fittings, valves, hydrants, and accessories shall be carefully lowered

into the trench to prevent damage to materials, protective coatings, and linings. Materials shall not be dropped or dumped into the trench.

If pipe, fittings, valves, hydrants, or accessories are damaged during handling, the damage shall be immediately brought to the Engineer's attention. The Contractor shall then submit to the Engineer, for approval, a method for repairing the damaged item. Damaged items shall be repaired as approved by the Engineer or shall be removed from the project.

Lumps, blisters, and excess coating shall be removed from ends of pipes that are to be joined. The inside of the bell and the outside of the spigot shall be wire brushed, wiped clean, dry, and free from oil and grease before pipe is placed. Foreign material shall be kept from entering pipe during placement.

As each length of pipe is placed in the trench, the spigot end shall be centered in the bell and the pipe forced home and brought to the correct line and grade. Pipe shall be secured in place with approved backfill material tamped under it except at bells. Precautions shall be taken to prevent dirt from entering the joint space. If it becomes necessary to deflect water main pipe during construction, the amount of deflection shall not exceed the manufacturer's recommendation.

- (e) **Cutting Pipe:** Pipe for fittings or closure pieces shall be cut in a neat and orderly manner without damage to the pipe so as to leave a smooth end at right angles to the axis of the pipe. The lining of the pipe shall not be damaged. Flame cutting of ductile iron or cast iron pipe with an oxyacetylene torch will not be permitted.
- (f) **Joining of Pipe:** Gasket and joint lubricant for water facilities shall be a nontoxic, tasteless, and odorless substance that will not support bacteria. Gasket end joint lubricant for sewer facilities shall be as recommended by the manufacturer or as approved by the Engineer. Pipe that is not furnished with a depth mark shall be marked before assembly to ensure that the spigot end is inserted to the full depth of the joint. Field-cut pipe lengths shall be filed or ground to resemble the spigot end of such pipe as manufactured.
 - 1 **Ductile iron pipe** shall be joined in accordance with AWWA C-111 and AWWA C-600.
 - 2 **Steel pipe** shall be joined by field welding unless otherwise specified on the plans. Pipe ends shall comply with the requirements of AWWA C-206 for the type of field joint specified. Field-welded joints shall comply with the requirements of AWWA-206; flanged joints shall comply with the requirements of AWWA C-207, and rubber gasket joints shall comply with the requirements of AWWA M11.
 - 3 **Galvanized steel pipe** shall be joined by fittings in accordance with the manufacturer's recommendation.
 - 4 **Copper pipe or tubing** shall be joined by fittings in accordance with the manufacturer's recommendation.
 - 5 **PVC pipe** shall be joined by gasketed bell and socket joints in accordance with AWWA C-900.
 - 6 **Concrete pipe** for water facilities shall have joints of the round rubber gasket type, unless otherwise specified, using either a bell and spigot joint or a double spigot and sleeve joint. Either joint shall be such that when the pipe is laid and the joint completed, the gasket will be confined within a groove or by shoulders on the bell and spigot. The contact surface in the joint shall be such as not to cause cutting of the rubber gasket during installation.

Concrete pipe for sewer facilities shall be joined by using rubber gaskets. The gasket shall be continuous and fit snugly into the annular space between the overlapping surfaces of the assembled pipe joint to form a flexible watertight seal. The annular space between the gasket bearing surface of the assembled and centered joint shall be more than 75 percent of the uncompressed thickness of the applied gasket including the manufacturer's tolerances of the joint and gasket.
 - 7 **Vitrified clay pipe** shall be joined with compression joints in accordance with ASTM C-12 and manufacturer's recommendation.
 - 8 **PE pipe** shall be joined in accordance with AWWA C-901 and the manufacturer's recommendation.
 - 9 **ABS pipe** shall be joined with a solvent cement joint in which pipe solvent cements into a coupling socket to form the joint. Primer for priming solvent cement joints shall be methylethyl ketone (MEK), and the cement shall be MEK containing a minimum of 20 percent by weight of

dissolved ABS. Type OR joint is a mechanical-seal joint in which a gasket shall be compressed between the pipe and the bell coupling to form the joint closure.

- (g) **Plugs, Caps, Tees, and Bends:** Plugs, caps, tees, and bends shall be anchored with reaction backing. Backing shall be concrete reaction blocks, metal reaction harnesses, or a combination thereof. Concrete shall be placed in accordance with the requirements of Section 404 and cured in accordance with the requirements of Section 316.04(j). Metal harness tie rods and clamps shall be of adequate strength to prevent movement and shall be galvanized or rustproofed by approved means.
- (h) **Encasement Pipe:** Encasement pipe shall be installed in accordance with the requirements of Section 302.
- (i) **Casing Pipe and Concrete:** Casing pipe and concrete shall be constructed in accordance with plan details and the applicable requirements of Sections 302, 303, 316, and 406, with the half-circle sections of casing pipe nested or interlocked to obtain a satisfactory union of the two sections of pipe. Prior to installation, existing pipe to be encased shall be cleaned and foreign material removed.
- (j) **Valves, Valve Boxes, and Manholes:** The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the wrench nut of the valve with the box cover flush with the surface of the finished pavement. Manholes shall be constructed to permit minor valve repairs and protect the valve and pipe from impact where they pass through the walls.
- (k) **Fire Hydrants:** Wherever a hydrant is set in pervious soil, drainage shall be provided at the base of the hydrant by placing coarse gravel or crushed stone mixed with coarse sand from the bottom of the trench to at least 6 inches above the waste opening in the hydrant and to a distance of 1 foot around the elbow.

Wherever a hydrant is set in clay or other impervious soil, a drainage pit 2 feet in diameter and 3 feet in depth shall be excavated below each hydrant. The pit shall be filled compactly with coarse gravel or crushed stone mixed with coarse sand under and around the elbow of the hydrant to a level 6 inches above the waste opening. The drainage pit shall not be connected to a sewer.

- (l) **Installing Corporation Stops:** Corporation stops shall be installed while the main is under pressure and at a 45-degree angle to the horizontal plane.
- (m) **Concrete Encasement:** Concrete encasement shall be constructed in accordance with the requirements of Sections 302, 303, 316.04(j), 404, and 406.
- (n) **Water Meters and Yokes:** The meter box shall not transmit shock or stress to the meter and shall be centered and plumb over the meter. The top of the box shall be flush with the surrounding surface.
- (o) **Jacked Encasement Pipe:** Jacked encasement pipe shall be installed in accordance with the requirements of Section 302.03(a)1.
- (p) **Sanitary Service Lateral Connection:** Connection shall be performed by approved methods prior to installation using wyes, bends, adapters, cleanouts, and necessary pipe. Existing service laterals shall mate with the new fitting, adapter, or pipe to produce a watertight joint.
- (q) **Sanitary Manholes and Manhole Frames and Covers:** These items shall be constructed in accordance with the requirements of Section 302.03(c). A secure bond between the pipe and manhole wall shall be obtained. Flexible insert gaskets shall be used to obtain a watertight joint. The gasket style and composition shall be subject to the approval of the Engineer. Precast wall sections shall be seated with flexible joint sealant for their full circumference. Lift holes, defects, joints between sections, and frames and covers shall be sealed with nonshrink waterproof grout.
- (r) **Sanitary Drop Connections:** Connections shall be constructed in accordance with the requirements of Sections 302, 303, 404, and 406.
- (s) **Sewer Cleanouts:** Cleanouts shall be constructed in accordance with the requirements of Sections 302, 303, 404, and 406.
- (t) **Conveying Sewage:** When it is necessary to contain or pump sewage during the adjustment of or connection to existing sewers, sewage shall be carried by a watertight conveyor to sewers or manholes approved by the Engineer or shall be disposed of in accordance with local and state health codes. Sewage shall not be allowed to flow onto or over any open surface.
- (u) **Manhole Frame and Covers, Valve Boxes, and Other Castings Located Within the Paved Roadway, Shoulder, or Sidewalk:** These shall be constructed within a tolerance of ± 0.05 foot of the finished grade.

- (v) **Reconstruct Existing Sanitary Manhole:** This shall consist of the removal of the existing manhole to the point indicated on the plans or directed by the Engineer. Reconstruction shall be accomplished by using existing units and pavement rings or new units and adjustment rings to attain the proposed finished grade.

520.04—Testing

Water and sewer mains, appurtenances, and materials shall be tested for leakage after installation. Testing shall be performed in the presence of the Engineer. The Contractor shall provide water, plugs, equipment, tools, labor, materials, and incidentals necessary to perform the testing. If any section of a main or manhole under test shows leakage in excess of that specified, the Contractor shall make necessary repairs or replacements at his own expense. Testing shall be repeated until satisfactory results are obtained. Visible leaks shall be repaired regardless of the amount of allowable leakage.

- (a) **Water Mains and Appurtenances:** New water mains and appurtenances shall be tested for leakage using the hydrostatic pressure test method in accordance with Section 4 of AWWA C600 and the following:
 - 1 The duration of each test shall be at least 2 hours. Sections of main with concrete reaction backing shall not be tested until at least 5 days after the backing is placed. If the backing is high-early-strength concrete, the test may be performed 2 days after backing is placed.
 - 2 Testing of tie-ins with existing mains shall be performed under the normal working pressure of the main involved. Visible leakage at these points will not be allowed during a period of at least 2 hours.
 - 3 The hydrostatic test pressure shall be 100 pounds per square inch or 1.5 times the working pressure, whichever is greater, based on the elevation of the lowest point in the line or section under test and shall be corrected to the elevation of the test gage. The Contractor shall ascertain the specific working pressure of the water main from the utility owner. Leakage loss shall not exceed the allowable leakage (*L*) as determined by the following formula:

$$L = \frac{ND\sqrt{P}}{7,400}$$

Where:

L = the allowable leakage in gallons per hour;

N = the number of joints in the length of pipe line tested;

D = the nominal inside diameter of the pipe in inches; and

P = the average test pressure during the leakage test in pounds per square inch.

- (b) **Gravity Sanitary Sewers:** Leakage shall be not more than 200 gallons per inch of pipe diameter per mile per day (24 hours) for pipe up to and including 24 inches in diameter and not more than 4,800 gallons per mile per day for pipe more than 24 inches in diameter for any section of the system, including manholes, when subjected to at least 4 feet of head above the line crown at the upstream manhole of the section being tested.
 - 1 **Infiltration test:** When in the opinion of the Engineer the trench or excavation is sufficiently saturated as a result of natural ground water, tests may be made on the basis of infiltration. The Contractor shall measure the flow of water at the nearest downgrade manhole. Three series of measurements shall be made at not less than 1-hour intervals, and the results shall be reduced to an average. The average for a 24-hour period shall then be computed. If the pipeline or manholes fail to meet the test requirements, leaks shall be repaired and defective pipe and manholes shall be replaced at the Contractor's expense. The test shall be repeated until satisfactory results are obtained.
 - 2 **Exfiltration test:** An exfiltration test shall be performed when the trench or excavation is dry and infiltration will not occur. The test shall be conducted as follows: The pipe shall be plugged at the lower manhole. The line and manhole shall be filled with water to a 4-foot level or to the top of the straight section if the manhole is less than 4 feet in height. The water shall stand until the pipe has reached maximum absorption and until trapped air has escaped (at least 4 hours). After maximum absorption has been reached, the manhole shall be filled to the original level. After 1 hour has elapsed, the difference in the level shall be recorded in terms of gallons. The 24-hour loss shall then be computed. If the pipe line system and manholes fail to meet test requirements,

leaks shall be repaired at the Contractor's expense. The test shall be repeated until satisfactory results are obtained.

- 3 **Air test:** In lieu of the infiltration or exfiltration test for leakage, the Contractor may test the sewers by using low air pressures. In the event low air pressure tests are used, the manholes shall be tested by exfiltration. Inflatable stoppers shall be used to plug all lines into and out of the manhole being tested. The stoppers shall be positioned in the lines far enough from the manhole to ensure testing of those portions of the lines not air tested. The manhole shall then be filled with water to the top and a 12-hour soaking period shall be allowed prior to test measurement. The manhole shall be refilled to a mark, and at the end of 1 hour, the amount of leakage shall be measured. Leakage shall not exceed ½ gallon per hour. If the manhole fails to comply with the test requirements, leaks shall be repaired at the Contractor's expense. The test shall be repeated until satisfactory results are obtained. The low air pressure test shall be conducted in accordance with the following:

- a. After backfilling and prior to air testing, the Contractor shall eliminate discernable water leaks and remove debris. Tests shall be conducted from manhole to manhole or from manhole to terminus. Personnel shall not be allowed in manholes once testing has begun.
- b. Immediately before testing, the Contractor shall provide securely braced test plugs at each manhole and a suitable means of determining the depth of the ground water level above the inverts.
- c. The Contractor shall slowly add air to the portion of the pipe being tested until the internal air pressure is at a test pressure of 4 pounds per square inch above the invert or ground water table, whichever is greater, or until the pressure is equal to the hydraulic gradient, whichever is greater. If the test plug shows leakage, as determined by the Engineer, the Contractor shall relieve the pressure for at least 2 minutes. The Contractor shall then disconnect the hose and compressor. If the pressure decreases to 3.55 pounds per square inch, the time shall be recorded for the amount of time required for the pressure to drop from 3.5 to 2.5 pounds per square inch. The minimum allowable holding times will be as specified herein. Pipes that fail to maintain minimum holding times will not be accepted. Repairs, replacement, and retesting as specified by the Engineer shall be performed at the Contractor's expense.

The minimum allowable holding time for an 8-inch sanitary sewer pipe that is required for the pressure to drop from 3.5 to 2.5 pounds per square inch is:

Line Length	Time (sec)
25	18
50	35
75	53
100	70
125	88
150	106
175	123
200	141
225	158
250	176
275	194
300	211
350	227
400	227

The minimum allowable holding time for a 12-inch sanitary sewer pipe that is required

for the pressure to drop from 3.5 to 2.5 pounds per square inch is:

Line Length	Time (sec)
25	40
50	79
75	119
100	158
125	198
150	238
175	277
200	317
225	340
250	340
275	340
300	340
350	340
400	340

- (c) **Force Main Sanitary Sewers:** Leakage shall not exceed the allowable leakage (*L*) as determined by the following formula:

$$L = \frac{ND \sqrt{P}}{1850}$$

Where:

L = the allowable leakage in gallons per hour;

N = the number of joints in the length of pipe line tested;

D = the nominal inside diameter of the pipe in inches; and

P = the average test pressure during the leakage test in pounds per square inch.

The hydrostatic test pressure shall be maintained for at least 30 minutes at 100 pounds per square inch or 1.5 times the working pressure, whichever is greater, based on the elevation of the lowest point in the line or section under test and shall be corrected to the elevation of the test gage. The Contractor shall ascertain the specific working pressure of the force main from the utility owner. Visible leaks shall be satisfactorily repaired regardless of the amount of allowable leakage.

- (d) **Offsets of Existing Pipe:** Offsets will not be subjected to hydrostatic pressure testing unless specified on the plans. After installation and connection to the existing mains, the offset shall be placed in service and left uncovered for visual inspection for at least 2 hours. Visible leaks shall be repaired to the satisfaction of the Engineer prior to acceptance of the offset. Offset of existing pipe for water mains shall be disinfected in accordance with AWWA C-651, Section 9.

520.05—Disinfecting Water Mains

New, relocated, and modified water mains and accessories shall be disinfected prior to tie-ins in accordance with AWWA C651.

If the initial disinfection fails to yield satisfactory samples, disinfection shall be repeated until satisfactory samples have been obtained. After each group of samples is taken, the Contractor shall submit a written report to the Engineer that states the results of the tests.

520.06—Measurement and Payment

Excavation and replacement of pavement removed for pipe trenches will not be measured for separate payment unless otherwise shown. However, minor structure excavation will be measured and paid for in

accordance with the requirements of Section 303.06. When excavation is required below the proposed trench bottom, necessitating additional bedding material, the bedding will be measured and paid for in accordance with the requirements of Section 302.04.

Water mains, water service lines, sanitary sewer pipe, and sanitary sewer force mains will be measured in linear feet of pipe through all valves and fittings, complete-in-place, and will be paid for at the contract unit price per linear foot. This price shall include excavating when not a specific pay item for the utility in question; testing; disinfecting; backfilling; compacting; dewatering; disposing of surplus and unsuitable material; sheeting and shoring; bedding material; installing pipe; connecting to existing lines or manholes; fittings less than 16 inches in diameter; reaction blocking; concrete anchor block; watertight welds; restrained joints; abandoning or removing lines, manholes, and other appurtenances; and restoring property. Pipe of one size, except for cast iron and ductile iron pipe, shall be combined into one contract item for the respective size of water main and sanitary sewer pipe. The salvage value of abandoned materials shall accrue to the Contractor and shall be reflected in the contract unit price for the respective replacement facility.

Encasement pipe and casing pipe and concrete will be measured in linear feet, complete-in-place, and will be paid for at the contract unit price per linear foot. This price shall include excavating, dewatering, sheeting and shoring, blocking, installing pipe, grouting, concrete encasement, reinforcing steel, masonry blocks, watertight bulkheads, backfilling, compacting, disposing of surplus and unsuitable material, and restoring property.

Jacked encasement pipe will be measured and paid for in accordance with the requirements of Section 302.04. This price shall include excavating, backfilling, disposing of surplus and unsuitable material, sheeting and shoring, blocking, bulkheads, and jacking.

Concrete encasement will be measured in linear feet of encased pipe or cubic yard of concrete, complete-in-place, and will be paid for at the contract unit price per linear foot or cubic yard. This price shall include excavating, sheeting and shoring, concrete, reinforcing steel, backfilling, compacting, and disposing of surplus and unsuitable material.

Sanitary service lateral connections will be measured in linear feet, complete-in-place, from the center line of the sewer main to the point of connection of sanitary service lateral and will be paid for at the contract unit price per linear foot. This price shall include excavating, backfilling, compacting, disposing of surplus and unsuitable material, sheeting and shoring, connecting to existing service lateral, and restoring property.

Sanitary drop connections will be measured in linear feet, vertical measure, complete-in-place, from the invert of the upper inlet pipe to the invert of the lower inlet pipe and will be paid for at the contract unit price per linear foot. This price shall include pipe and fittings, concrete, reinforcing steel, connections to sewer lines and manholes, excavating, bedding material, backfilling, compacting, disposing of surplus and unsuitable material, and restoring property.

Sanitary sewer manholes, frames and covers, and watertight frames and covers will be measured and paid for in accordance with the requirements of Section 302.04.

Sewer cleanouts (main or lateral) will be measured in units of each, complete-in-place, and will be paid for at the contract unit price per each. This price shall include fittings; riser pipe, frame, cover, and box; excavating; backfilling; compacting; disposing of surplus and unsuitable material; and restoring property.

Reconstruct existing sanitary manhole will be measured in linear feet, vertical measure, from the point of the removed section to the top of masonry on which the frame and cover is placed and will be paid for at the contract unit price per linear foot. This price shall include removing, salvaging and resetting frame and cover, reconstruction of manhole, new materials, excavation, backfilling, compaction, disposal of surplus of unsuitable material and restoring property.

Fire hydrants will be measured in units of each, complete-in-place, and will be paid for at the contract unit price per each. This price shall include excavating, dewatering, backfilling, compacting, connections, concrete blocking, pipe straps, crushed stone drain, disposing of surplus and unsuitable material, restoring property, and testing.

Water meters and boxes; water meter boxes and yokes; valves and boxes or manholes; and tapping sleeves, valves, and boxes or manholes will be measured in units of each, complete-in-place, and will be paid for at the contract unit price per each. This price shall include excavating, backfilling, and restoring property.

Bends, plugs or caps, reducers, and branches (tees, wyes, and crosses) will be measured in units of each

and will be paid for at the contract unit price per each. This price shall include restrained joints, excavating, reaction blocking, testing, backfilling, sheeting and shoring, watertight welds, abandoning or removing existing lines as noted on the plans, and restoring property.

Offsetting existing pipe will be measured in linear feet of pipe parallel to the flow line between tie-in points, complete-in-place, and will be paid for at the contract unit price per linear foot. This price shall include fittings, couplings, restrained joints, excavating, testing, disinfecting, backfilling, compacting, dewatering, disposing of surplus or unsuitable material, sheeting and shoring, bedding material, installing pipe, connecting existing lines as noted on the plans, reaction blocking, watertight welds, abandoning or removing existing lines as noted on the plans, and restoring property.

Leak detectors will be measured in units of each. This price shall include pipe, return bends, bird screens, clamps, excavating, backfilling, and restoring property.

These prices shall include containing or pumping sewage during adjusting or connecting existing sewers and providing and maintaining adequate and safe passage over excavations to accommodate pedestrians or vehicles as directed by the Engineer.

Payment will be made under:

Pay Item	Pay Unit
Water main (Size and type)	Linear foot
Water service line (Size)	Linear foot
Encasement pipe (Size and type)	Linear foot
Casing pipe and concrete (Size)	Linear foot
Leak detector (Standard)	Each
Bend (Size)	Each
Reducer (Size)	Each
Plug or cap (Size)	Each
Branch (Size)	Each
Offset existing pipe (Size)	Linear foot
Valve and (box or manhole) (Size and type)	Each
Tapping sleeve, valve, and (Box or manhole)	Each
Fire hydrant (Standard and type)	Each
Water meter and box (Size)	Each
Water meter box and yoke (Size)	Each
Jacked encasement pipe (Size and type)	Linear foot
Sanitary sewer pipe (Size and type)	Linear foot
Sanitary service lateral connection (Size)	Linear foot
Sanitary sewer force main (Size)	Linear foot
Bend-force main (Size)	Each
Reducer-force main (Size)	Each
Plug or cap-force main (Size)	Each
Branch-force main (Size)	Each
Offset existing pipe-force main (Size)	Linear foot
Sanitary sewer manhole (Standard)	Linear foot
Manhole frame and cover (Standard)	Each

Pay Item	Pay Unit
Sanitary drop connection	Linear foot
Valve and (box or manhole) (Size and type)-force main	Each
Tapping sleeve, valve, and (box or manhole) (Size)-force main	Each
Concrete encasement (Standard)	Linear foot or Cubic yard
Reconstruct existing sanitary manhole	Linear foot
Watertight manhole frame and cover (Standard)	Each