

## SECTION 9

### SANITARY SEWER

#### 9.1 DESCRIPTION

**A. General:** This work consists of furnishing and installing sanitary sewer mains, manholes, service lines, and appurtenances. This includes all equipment, tools, materials, labor, and other incidentals to provide sewer mains and service lines complete and ready for use. The work also includes, but is not limited to, all necessary excavation, backfilling, compaction, testing, clean up, and restoration. All connections to the City sanitary sewer system, directly or indirectly, need to be designed and constructed in accordance with City Criteria.

**B. Related Work:**

Section 7	General Conditions
Section 8A	Water
Section 8B	Corrosion Protection – Plastic Pipe Systems
Section 11	Utility Excavation and Backfill
Section 18	Erosion, Sediment, and Water Pollution Control
Section 19	Incidental Work
Section 41	Utility Trench Resurfacing
Section 56	Class M6 Concrete for Curb & Gutter and Flatwork
Section 92	Temporary Traffic Control
Section 112	Select Granular Backfill
Section 200	Controlled Low Strength Material
Section 203	Submittals
Section 205	Televising

**C. Submittals:** Shall be required unless otherwise specified in the detailed specifications or special provisions. The term "Submittals" includes, but is not necessarily limited to, manufacturer's product data sheets of pipe, manholes, appurtenances, and fittings. Submittals shall be submitted for the materials used on the project in accordance with the specifications and plans. All items included in Section 9.2 of this specification that are to be incorporated into the work shall be submitted to the Engineer for review.

All Submittals shall be made in accordance with Section 203.

Resubmittals shall be made in the same manner as Submittals, with changes clearly shown.

#### 9.2 MATERIALS

**A. Pipe:** Sanitary sewer pipe up to and including 24 inches in diameter shall be Polyvinyl Chloride (PVC). Sanitary sewer pipe larger than 24 inches in diameter shall be

Reinforced Concrete Pipe (RCP) or Fiberglass Pipe (FRP). The use of materials other than those indicated requires the prior written approval of the Engineer.

1. **PVC Pipe and Fittings:** 4 inches through 15 inches diameter, shall conform to the requirements of ASTM D-3034, Type PSM, SDR-35 minimum. PVC pipe 18 inches through 24 inches diameter shall conform to the requirements of ASTM F679, minimum wall thickness T-1. PVC pipe shall be manufactured in a continuous extrusion process employing a prime grade of un-plasticized PVC plastic material that meets the requirements for this product as specified in ASTM D1784. The pipe shall be made of PVC plastic having a cell classification of 12454-B, 12454-C, 12364-C, or 13364-B. SDR-35 is a minimum and the design engineer shall determine if depths and soil conditions require additional wall thickness.

PVC Sewer Pipe shall have a flexible elastomeric seal (O-ring or rubber sealing elastomeric gasket joint), and conform to the latest revisions of ASTM D3212. Solvent cement joints are not allowed for sewer pipe and fittings.

Nominal laying lengths shall not be less than 12.5 feet, except shorter lengths may be used adjacent to manholes and for the installation of inline wyes and tees. Each length of pipe shall be marked, as a minimum, with size, SDR, "Sewer Pipe" and ASTM number.

2. **Reinforced Concrete Pipe (RCP) and Fittings:** In sizes 27 inches through 108 inches in diameter, shall conform to the requirements of ASTM C-76 and shall be manufactured using TYPE II cement. The pipe and fittings shall be manufactured at a precast facility that is certified by the American Concrete Pipe Association, is approved for supplying products to the South Dakota Department of Transportation, or as approved by the Engineer. Class of pipe shall be as shown on the plans or specified in the detailed specifications. Joints for RCP pipe shall meet the requirements of ASTM C-361 for concrete joints and confined rubber profile gaskets.
3. **Fiberglass Pipe (FRP):** The use of FRP pipe requires the design engineer to prepare a detailed specification for the material and requires the prior written approval of the Engineer to use the material specification.

**4. Sanitary Sewer Force Main:**

- a) **Polyvinyl Chloride (PVC) Pipe and Fittings 4 Inch and larger** - Shall conform to Section 8A Water Piping Systems, subsection 8A.2 Materials and Section 8B – Corrosion Protection – Plastic Pipe Systems. PVC force main shall utilize a green dye resin for color in order to represent wastewater or a green locator ribbon with the word “sewer” stenciled shall be used.
- b) **Ductile Iron Fittings 4 Inch and larger** - Shall conform to Section 8A Water Piping Systems, subsection 8A.2 Materials and Section 8B – Corrosion Protection – Plastic Pipe Systems and requires the prior written approval of the Engineer to use. A green locator ribbon with the word “sewer” stenciled shall be used.

- c) **High-density Polyethylene (HDPE)** - The use of HDPE pipe is allowed however the design engineer shall prepare and submit detailed specifications for the material and installation procedures. The detailed specifications shall be reviewed and approved by the Engineer prior to plan approval. The HDPE pipe shall incorporate a green stripe to indicate “sewer”.

**5. Sewer Service Pipe and Fittings:**

- a) All gravity pipe and fittings shall conform to the requirements of ASTM D-3034, SDR-35.
- b) Service line cleanout caps shall be flush type cap. Cleanouts installed in travel surfacing shall have a frame and cover per the Standard Details.
- c) Force mains less than 4 inch diameter shall utilize HDPE. The use of HDPE requires the Contractor to submit detailed specifications for the material to the Engineer for approval of use.

**B. Miscellaneous Pipe Materials:**

- 1. **Pipe Couplings:** When coupling PVC pipe to PVC pipe a gasketed PVC repair coupling shall be used. A clamp style coupling shall generally be used when coupling dissimilar pipe materials or for coupling non-PVC pipes.

Clamp style couplings shall be Fernco-Strong back RC series repair couplings, or approved equal.

Nonshear reinforced banded style couplings shall be adjustable repair coupling with 300 series stainless steel shear ring as manufactured by Mission Rubber Company, Inc., PVC repair couplings, or approved equal shall be used on all pipe 6 inches in diameter or less. All couplings shall bear the manufacturer’s identifying mark and size.

Increasing/reducing couplings will not be allowed.

- 2. **Caps/Plugs:** PVC caps and plugs shall be the gasketed or solvent welded sewer fitting type.

Concrete caps and plugs for non-PVC pipe shall be non-shrink grout placed continuously for a one foot or one pipe diameter, whichever is greater, into the pipe.

- 3. **Sewer Main Insulation:** Refer to Section 11 Utility Excavation and Backfill.

- 4. **Sanitary Sewer Force Main Fittings, Valves, and Ancillary Items:** Shall conform to Section 8A Water Piping Systems, subsection 8A.2 Materials and

Section 8B – Corrosion Protection – Plastic Pipe Systems. Tracer wire color shall be green.

**C. Concrete Manholes:**

1. **General:** Manholes shall be pre-cast reinforced concrete, manufactured using Type II cement, and shall have diameters as shown on the plans. The manholes shall be manufactured at a precast facility that is certified by the American Concrete Pipe Association, is approved for supplying manholes to the South Dakota Department of Transportation, or has been approved by the Engineer. Manholes 48 inches in diameter shall meet the current requirements of ASTM-C-478. Manholes with diameters larger than 48 inches shall have steel reinforcing that meets the requirements of ASTM C-76, Class 2. Upon request from the Engineer, the Contractor and/or supplier shall supply a test report from an independent testing laboratory showing compliance with this Specification.
2. **Manhole Bases:** Shall be precast integral (monolithic) with the barrel section and shall be cast to a minimum thickness of 6 inches.

Cast-in-place bases shall not be allowed unless pre-approved by the Engineer. When specified in the detailed specifications or shown on the plans, cast-in-place bases shall have a minimum thickness of 8 inches with concrete conforming to the requirements of Class M6, Section 56, and manufactured using Type II cement. Cast-in-place bases shall incorporate a water stop between the base slab and manhole barrel. The water stop material shall be American Colloid “Water stop – RX”, 1 inch x  $\frac{3}{4}$  inch size or approved equal. The detailed specifications and use of this type of base shall be reviewed and approved by the Engineer.

3. **Cone Sections:** Shall be eccentric type with 27-inch opening.
4. **Flat Cover Slabs:** When shown on the plans or specified in the detailed specifications, shall be designed for H-20 loading and shall have an offset 27-inch diameter opening.
5. **Gasketed Joints:** Joints between manhole sections, and between manhole sections and flat cover slabs shall be rubber gasketed joints conforming to the requirements of ASTM C443. Gasket types shall be either the O-ring style, the profile style, or approved equal.
6. **Manhole External Joint Seals:** Shall meet the requirements of ASTM C877 Type III, and are required on all manhole joints. The wrap must provide a minimum seal width of 9 inches. Manhole external joint seal shall be Infi-Shield External Gator Wrap or approved equal. Manhole external joint seals shall be installed on all manholes where ground water is present and shall be installed in accordance with the manufacturer’s recommendations. Engineer will identify on the plans where external joint seals are required.
7. **Manhole Steps:** Shall not be provided.

- 8. Lifting Holes:** Penetrating through the manhole sidewalls are not permitted.
- 9. If an interior lift system is used:** Inserts shall be grouted flush with the interior of the manhole after placement, grouted with a non-shrink grout.

- 10. Non-Shrink Grout:** Shall conform to the following requirements:

Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7000 psi in 28 days. Approved manufacturers are:

“Crystex” - by L & M Construction Chemicals

“588 Non-Metallic, Non Shrink Grout” - by W.R. Meadows

“Master Flow 713” – by Master Builders

“SonogROUT 10K” – by Sonneborn

“Five Star Grout” – by US Grout Corp.

Or approved equal.

- 11. Manhole Inverts:** Shall be Class M-6 concrete per Section 56.

- 12. Pipe Connections to New Manholes:** Shall be constructed with a compression-type flexible connector cast into the manhole wall, as manufactured by A-Lok Products, Inc., or approved equal.

Alternatively, shall be constructed with a boot-type flexible connector consisting of a rubber gasket or boot, metal expansion ring, and double metal take-up clamps, as manufactured by Press Seal Gasket Corporation, or approved equal. A stainless steel “power sleeve” shall be supplied for connecting the boot to the manhole. The boots shall be type PSX as manufactured by Press Seal Gasket Corporation or approved equal. Rubber boots and gasket material shall meet or exceed ASTM C-923.

- 13. Pipe Connections to Existing Manholes:** Are not allowed unless prior approval of the Engineer has been obtained. If approved the connection shall be made by coring the existing manhole and installing a boot-type flexible connector consisting of a rubber gasket or boot, metal expansion ring and double metal take-up clamps, as manufactured by Press Seal Gasket Corporation, or approved equal. A stainless steel “power sleeve” shall be supplied for connecting the boot to the manhole. The boots shall be type PSX as manufactured by Press Seal Gasket Corporation or approved equal. Rubber boots and gasket material shall meet or exceed ASTM C-923. The existing manhole inverts shall be reconstructed to meet specifications. Refer to Section 9.3 regarding Construction Requirements and the Standard Detail for further guidance with this installation.

- 14. Coating for Concrete Manholes and Lift Station Wet Wells:** When indicated on the plans or specified in the detailed specifications a corrosion resistant interior grout liner shall be provided on manholes or lift station wet wells. This includes coating of the manhole walls and bench, unless noted on the plans otherwise. The

liner shall be Sauereisen Sewergard™ No. 210, Induron Ceramasafe 90 Ceramic Epoxy, or approved equal. These products are specifically formulated for coating the interior of concrete manholes or wet wells for corrosion protection.

Coating color shall be the Earthcoat gray for manholes and Earthcoat white for wet wells unless otherwise indicated on the plans or specified in the detailed specifications.

#### **D. Manhole Frames and Covers:**

1. **All Frame and Covers:** Shall be constructed with gray iron having a tensile strength of not less than 35,000 pounds per square inch. The frame and covers shall conform to ASTM A48, Class 35B. The castings shall be heavy-duty type, designed for H2O loading conditions. The castings shall be free from cracks, blowholes, porosity, shrinkage distortion or other imperfections. They shall be true to pattern and free from warpage. The frame and covers shall fit together in a satisfactory manner. Machined bearing surfaces shall be provided to prevent rocking and rattling. Manhole frames and covers shall be as follows:
  - a) Standard frames and covers shall have a minimum casting height of 7 inches.
  - b) Standard frames and covers shall be Neenah 1733, Deeter 1260, Municipal Castings (MC) 301, or approved equal unless otherwise indicated on the plans or specified in the detailed specifications.
  - c) Extra deep frames and covers shall be installed where manholes are located in pavements thicker than 7 inches. A casting height corresponding to or exceeding the pavement thickness (up to 10 inches) shall be selected. Extra deep frames and covers shall be Neenah 1733-A; 1733-B; or 1733-C, Deeter 1261, or approved equal.
  - d) Bolt down frames and covers shall be installed as specified but will mainly be used in areas, which are without hard surfacing and are subject to flooding. Bolt down frames and covers shall be Neenah R1916-F, Deeter 1247-B, or approved equal.
2. **All Covers:** Shall be supplied with concealed pick holes as specified in the standard plates. All covers shall be marked with the letter "S" or word "Sewer" formed in the center of the cover. The cover style shall be a Neenah Type "B" Lid, indented top design, or approved equal. All covers shall be supplied with self-sealing type "T" or O-Ring gaskets as manufactured by Neenah Foundry Company, machined groove continuous O-Ring gasket as manufactured by Deeter Foundry Inc., or approved equal. The covers shall be delivered from the manufacturer with pre-installed glued-in gaskets. The gasket shall be installed in a machined groove and be continuous around the perimeter. The gasket material shall be oil resistant Nitrile (60 DURO) glued in the groove, and have a maximum swell of 90 percent when tested in accordance with ASTM D471 using ASTM No.

3 oil. The glue shall be Lock-rite Black Max as manufactured by 3M Products or approved equal.

## E. Manhole Adjusting Rings:

### 1. Concrete Adjusting Ring Materials:

- a) **Masonry Bricks, Masonry Blocks, or Masonry Shimming Devices:** will be allowed for use in adjusting manhole castings. Wood blocking or wood shimming devices greater than one inch in thickness will not be allowed. Any blocking or shimming device, when used, will not extend to the interior of the manhole.
- b) **Adjusting Rings:** Concrete adjusting rings shall be in accordance with ASTM C478. The adjusting rings shall be sized to conform to the standard manhole 27-inch cone opening, frame, and cover.
- c) **Mortar:** Shall be "Non-Shrink Grout" as previously specified in this section.

### 2. Plastic Adjusting Ring Materials:

- a) **Sealant:** Butyl Rubber Sealant in trowelable form shall be used. EZ-STIK #3 as manufactured by Pre-seal Gasket Corporation or approved equal. The material must meet or exceed the requirements of Federal Specification TT-S-001657, ASTM C-990 and AASHTO M-198.
- b) **Plastic Adjusting Rings:** The adjusting rings shall be injection molded HDPE as manufactured by Ladtech, Inc. or approved equal. The adjusting rings shall be manufactured from polyethylene plastic as identified in ASTM D-1248 (Standard Specification for Polyethylene Plastic Molding and Extrusion Materials). Material properties shall be tested and qualified for usage in accordance with the ASTM Test Methods referenced in ASTM D-1248. The plastic adjusting rings shall be manufactured utilizing the injection molding process as defined by SPE (Society of Plastic Engineers).

The adjusting rings shall be tested to assure compliance with impact and loading requirements in accordance with the AASHTO Standard Specification for Highway Bridges. The adjusting rings shall meet and exceed the static load requirements of AASHTO Highway Bridge Specification HS-25 (21,280 lbs). The rings must withstand 1,000,000 plus full load cycles of 10 seconds or less duration. The rings must perform without failure to a minimum of 150 percent of these load values. The adjusting rings shall be sized to conform to the standard manhole 27-inch cone opening, frame, and cover.

### 3. Rubber Adjusting Ring Material:

- a) **Sealant:** Sealant shall be polyurethane, formulated specifically for use with rubber adjusting rings and shall be manufactured by GNR Technologies, or approved equal.
  - b) **Rubber Adjusting Rings:** Rubber adjusting rings shall be Infra-Riser multi-purpose rubber adjustment riser as manufactured by GNR Technologies, or approved equal.
- F. Manhole Internal Frame Seal:** Manhole internal frame seals shall be installed with all manholes, unless pre-approved by the Engineer to be installed without a chimney seal. Manhole internal frame seals shall be CRETEX Internal Manhole Chimney Seals as manufactured by CRETEX Specialty Products, NPC Flexrib Seal, or approved equal. Internal frame seals shall consist of a flexible internal rubber sleeve and extension that completely covers all rings from cone to casting and stainless-steel compression bands.
- G. Tracer Wire System:** Tracer Wire shall be a direct bury wire per Section 8B except shall be modified as having the insulation color be green.

### 9.3 CONSTRUCTION REQUIREMENTS

#### A. Wastewater Flow Modifications:

1. **Interruption of Service:** The Contractor shall provide continuous, uninterrupted sanitary sewer service to all users in and upstream of the project area.
2. **Flow Handling Plan:** Prior to beginning work on any manhole or sewer main requiring flow modifications the Contractor shall present a plan for handling wastewater flows to the Engineer for approval. The plan shall describe the methods to be used and shall identify all materials and equipment that will be required for flow handling. The Contractor's plan shall also identify a contingency plan and procedures to be implemented in the event of an equipment failure or other emergency.
3. **Methods:** Bypass pumping is required during construction hours and temporary connections between existing and new sewer mains are required during non-working hours. Wastewater flows shall not be conveyed in open ditches nor in the trench excavation, and at no time shall wastewater be allowed on the ground surface, trench, streets, gutters, storm sewers, or other places, which may constitute a health hazard. Whenever, in the opinion of the Engineer, a health hazard exists because of actions or inactions of the Contractor, the Contractor shall immediately correct the situation to the satisfaction of the Engineer. If not corrected in a timely manner, the City may cause to take any actions necessary to remove the health hazard and charge the Contractor one and a half (1 ½) times the cost incurred.

If bypass pumping is required by site conditions or as per plan note, the following shall apply.



- a) The Contractor shall furnish all labor, supervision, tools, equipment, appliances, and materials to perform all operations in connection with bypass pumping of sewage flow for the purpose of preventing interference with the televising of the sanitary sewer manholes and mainlines as well as providing reliable sewer service to the occupants of the buildings being served.
- b) The Contractor will be required to provide adequate pumping equipment and force mains in order to maintain reliable sanitary sewer service in all mains involved in the scope of the work.
- c) Under no circumstances shall the flow be interrupted or stopped, such that damage is done to either private or public property, or sewage flows/overflows into a storm sewer or natural waterway.
- d) The Contractor shall provide bypass pumping of sewage around each segment(s) of main that is to be televised and shall be responsible for all required bulkheads, pumps, equipment, piping, and other related appurtenances to accomplish the sequence of pumping. Also refer to Section 205 for bypass pumping requirements when televising.
- e) The Contractor shall be required to have all materials, equipment, and labor necessary to complete the repair or replacement on the jobsite prior to isolating the sewer manhole or line segment and beginning bypass pumping operations.
- f) The Contractor shall locate bypass pumping suction and discharge lines so as to not cause undue interference with the use of streets, private driveways, and alleys to include the possible temporary trenching of force mains at critical intersections.
- g) The Contractor shall not initiate any effort to accommodate bypass pumping piping operations until specific written approval is given by the Engineer.
- h) The Contractor shall coordinate with all property owners to ensure that no damage will be caused to their property during any and all sewer rehabilitation work.
- i) The Contractor shall complete the televising as quickly as possible and shall satisfactorily meet all requirements prior to discontinuing bypass pumping operations and returning flow to the sewer manhole or main segment.
- j) The Contractor shall ensure that no damage will be caused to private property as a result of bypass pumping operations. Ingress and egress to adjacent properties shall be maintained at all times.
- k) Ramps, steel plates, or other methods shall be employed by the Contractor to facilitate traffic over surface piping.

- 4. Damages to Property:** Any damages to private or public property due to backups, overflows, or surcharging resulting from work under this section shall be the responsibility of the Contractor and shall be corrected as soon as practical and at no cost to the City. If not corrected in a timely manner, the City will take the necessary action and charge the Contractor one and a half (1½) times the cost incurred.

**B. Materials Handling and Storage:**

The Contractor shall be responsible for the safe handling and storage of all materials furnished, and shall replace, at their expense, all such materials found defective in manufacture or damaged in transportation, handling, or storage.

Pipe, manholes, castings, and accessories shall be loaded and unloaded by lifting with hoists or skidding to avoid shock or damage. Under no circumstances shall such materials be dropped. All material shall be stored in a neat and orderly manner. Pipe shall be stored, to the greatest extent possible, in unit packages or bundles and shall be handled to prevent stress to bell joints and prevent damage to bevel ends. In addition, materials shall be handled and stored in accordance with manufactures' recommendations.

The Contractor shall cover all PVC pipe and fittings in accordance with manufacturer recommendations. In the absence of manufacturer recommendations, PVC pipe and fittings shall be stored to minimize direct rays of sun and UV exposure. This may be accomplished with a minimum of a light opaque material covering the pipe. The covering shall be positioned to allow adequate ventilation to prevent heat buildup. The submittal for this material shall identify the proposed method of storage. Pipe material that shows signs of UV impact including impacts such as chalking, faded colors will be removed from use on the project.

- C. Underground Obstructions:** The Contractor shall expose existing underground obstructions shown on the plans or located in the field and shall determine their elevations far enough in advance of pipe laying that the proposed sewer main can be adjusted. Wherever obstructions not shown on the plans are encountered during the progress of the work and interfere with the proposed horizontal or vertical alignment of the sewer, the Contractor shall notify the Engineer so that the Engineer may modify the plans and order a deviation in the line and/or grade, or may arrange for the removal or relocation of the obstruction(s). The Contractor shall not deviate from plan line or grade without the Engineer's approval.
- D. Sewer Main and Water Main Crossings:** Refer to Section 11 Utility Excavation and Backfill.
- E. Protection of Existing Sewers:** The Contractor shall take necessary precautions to ensure that dirt, debris, and foreign materials do not enter existing sewers. Where new sewer mains are to be extended from and connected to existing sewers, the Contractor shall give, the City Utility Maintenance Division 24-hour notice in order that City personnel may install a temporary plug at the terminal manhole on the existing sewer.

Contractor is responsible to ensure that the plug remains functional. Said plug shall remain in place and functional until all work on the new sewer has been completed and the Engineer is satisfied that the new sewer is free of dirt, debris, and foreign materials. Plugs shall be salvaged to City Utility Maintenance upon removal. Any costs incurred by the City due to the Contractor allowing dirt, debris, foreign materials, trench water, or storm water to enter an existing sewer shall be charged to the Contractor at one and a half (1 ½) times the cost incurred.

#### F. Installation of Pipe:

1. **Trenching, Bedding, and Backfill:** Shall comply with the requirements of Section 11 Utility Excavation and Backfill. Trench dewatering discharges shall not be allowed to enter the sanitary sewer collection system at any time.
2. **Alignment and Grade:** Pipe shall be laid true to the line and grade established on the plans. Pipe shall be installed within 1/2 inch (0.04 feet) of the specified alignment and within 1/4 inch (0.02 feet) of the specified grade. These tolerances apply to any point along the entire pipe length.

The Contractor shall carry line and grade into the trench by means of an approved laser beam system and by surveying level instrument. At no time shall the Contractor change the grade without approval from the Engineer. If an underground obstruction is encountered at the assigned grade, the Contractor shall notify the Engineer and wait until the revised grade for the sewer has been determined, if necessary.

As a secondary check to the laser beam device, the Contractor shall check the grade from a surveyed grade stake to the pipe invert a minimum of every 100 feet using a surveying level instrument. The Contractor shall record all grade checks and produce the grade stake record if requested by the Engineer.

3. **Cleaning:** Shall be done as necessary so that the interior of all sewer pipe is free from all dirt, cement, or other foreign material before installation. Contact surfaces shall be wire brushed immediately prior to jointing.
4. **Pipe Cutting:** Shall be done without damage to the pipe with saw or abrasive wheel and shall be smooth, straight, and at right angles to the pipe axis. Ends of pipe shall be dressed and beveled to remove roughness and sharp corners.
5. **Laying and Joining of Pipes:** Shall be in accordance with the pipe manufacturer's instructions, unless specifically required otherwise by these specifications.
  - a) Each pipe length shall be inspected for defects prior to being lowered into the trench. All pipes shall be carefully lowered into the trench to prevent damage to the pipe and/or coating.
  - b) Sewer pipe shall not be installed in frozen ground or in water, and no water will be allowed to run into or through the pipe.

- c) Pipe shall be carefully installed to line and grade in accordance with line and grade stakes so that the finished sewer will present a uniform grade. Any noticeable variations from true alignment or grade will be cause for rejection of the work.
- d) All pipe shall be installed upgrade with spigot ends pointing in the direction of flow. The bottom of the trench shall be free of all rocks and stones and shall be hand shaped and bedded and the pipe shall be in firm contact with the bedding material for its entire length.
- e) At every bell and spigot pipe joint, a hole shall be dug of sufficient size so that the weight of the pipe will rest on the barrel of the pipe and not on the bells, and the bell hole shall not be compacted. All pipe must be properly fitted together.
- f) During the course of construction, a suitable stopper shall be kept in the end of the pipe to prevent any dirt and or water from entering during the progress of the work at all times. Any dirt, loose material or cement mortar, which may accumulate in the pipe, shall be removed as the work progresses.
- g) Standard length pipe shall be utilized for all installations. Shorter lengths will only be allowed for use at manhole terminations, except as noted in the plans and as needed for the installation of service inline tees or wyes. A full standard length pipe shall be used upstream of all manholes.
- h) Joint surfaces shall be cleaned and lubricated immediately before completing the joint. Lubricant other than that furnished with the pipe shall not be acceptable. Pipe jointing shall be accomplished in a relatively dry trench condition.
- i) At manhole connections the Contractor shall take extra care to ensure the pipe is properly bedded to prevent shifting, settlement, deflection, or other failures.
- j) Joints in PVC Sanitary Sewer Pipe:
  - 1) All PVC Sanitary Sewer Pipe shall be jointed utilizing elastomeric gaskets as specified. All pipe, fittings and joints shall be installed in full compliance with the recommended practices of the pipe manufacturer and as specified in the latest revision of ASTM D2321.
  - 2) The joint surfaces (external and internal) shall be wiped free of all foreign materials, and the spigot end shall be centered on grade into the bell end and the joint shall be properly seated in accordance with the manufacturer's recommendations.

- 3) Any pipe that is field cut shall have a square end with beveled edge equal to a factory cut and all field repairs shall be performed per manufacturer's recommendations.
  - k) Joints in Pipe Material Other than Identified in the specifications: Repairs on existing pipe not otherwise specified in this Section shall be approved by the Engineer.
6. **Protection of the Work:** At the end of each day's work, or when sewer pipe is not being laid, the Contractor shall protect the end of the pipe by a close-fitting stopper to prevent soil, water, or other matter from entering the pipe, and shall take adequate precautions to overcome possible uplift. The elevation of the last pipe laid the previous workday shall be checked the next day before work resumes.
  7. **Connections:** When coupling PVC pipe to PVC pipe a PVC repair coupling shall be used. A clamp style coupling shall generally be used when coupling dissimilar pipe materials or for coupling non-PVC pipes. When using the Power seal or Fernco type installation, the Contractor shall encase the coupling in six inches of concrete for one (1) foot either side of the coupling. PVC couplings do not require concrete encasement.
  8. **Minimum Cover:** Depth from the top of pipe to finished grade shall not be less than 5.0 feet for Collector Sewers (sewer mains with service connections) or 4.0 feet for Interceptor Sewers (sewer mains with no service connections). In the event adequate cover cannot be achieved by alignment or grade adjustment then, with prior approval of the Engineer, the sewer pipe may be insulated. Refer to Section 11 Utility Excavation and Backfill and Standard Details for insulation requirements in cases where minimum cover cannot be provided. The use of insulation shall only be permitted in those rare instances where the pipe's grade cannot be adjusted, or the finished surfacing grade cannot be adjusted to maintain the minimum cover. Insulation shall be required in instances where less than 18 inches of separation between culverts or storm sewers cannot be achieved.
  9. **Dewatering:** Shall be accomplished per Section 11 Utility Excavation and Backfill.
  10. **Insulation:** Shall be accomplished per Section 11 Utility Excavation and Backfill.
  11. **Sanitary Sewer Force Main:**
    - a) Shall conform to Section 8A Water Piping Systems, subsection 8A.3 Construction Requirements.
    - b) In addition to meeting the above requirements Tracer Wire Access Boxes shall be installed at a minimum of every 500 feet along the length of the force main and at all system valves. Each Tracer Wire Access Box shall be located as identified in Section 8B Corrosion Protection – Plastic Pipe Systems.

- c) PVC force main shall utilize a green dye resin for color in order to represent wastewater or a green locator ribbon with the word “sewer” stenciled shall be used. The green locator ribbon shall be installed with ductile iron pipe. The locator ribbon shall be placed on top of the “select bedding material” approximately 12 inches above the top of pipe and centered horizontally directly over the pipe.

#### G. Installation of Manholes:

1. **All Manhole Barrel and Cone Sections:** Shall be numbered and/or measured by the Contractor prior to installation to ensure that each furnished manhole component is correct for that location and that the finished manhole will be to the grade specified. External joint seals shall be installed on all manhole joints when ground water is present.

Placement of manholes shall be on a 4-inch (minimum thickness) leveling course of Type 1 Bedding Material. Manholes shall be set level and to the grade specified.

2. **Invert Channels:**

- a) **General:** Channels shall have smooth, clean surfaces and shall be semi-circular U-shaped conforming to the adjacent pipe. Changes in size and grade of the channels shall be made gradually and evenly. In no case shall the invert width through the manhole be greater than that of the outlet pipe. Changes in direction flow and side branch connections shall be made with a full, smooth, and sweeping curve with a radius meeting the requirements per the Standard Details.

Manhole inverts shall be U-shaped with a channel depth equal to the diameter of the outlet pipe and with the channel sides, above the spring line, vertical or slightly laid back at a slope not to exceed (1/10, horz./vert.). Refer to Standard Details. Manhole inverts shall be Class M-6 concrete per Section 56, manufactured using Type II cement.

The manhole invert shall be shaped and finished with a smooth steel trowel finish.

- b) **Inverts for New Manholes:** Materials for new manhole inverts and benches shall be as specified in Section 9.2 Materials. New manhole benches and inverts shall be constructed by the same manufacturer that produces the precast monolithic base and constructed at the production facility. Field cast inverts will not be allowed for new manholes unless pre-approved by the Engineer.

The manhole invert and bench shall have a smooth steel trowel finish.

- c) **Inverts for Existing Manholes:** Materials for existing manhole inverts shall be as specified in Section 9.2 Materials and as further described.

Existing manhole benches and inverts may be reconstructed with hand formed inverts and benches provided the other components of the specification are met. The manhole invert and bench shall have a smooth steel trowel finish.

All sewer flows shall be removed by bypass pumping or other approved methods from the manhole to be reconstructed. The existing invert and bench shall be demolished to the extent necessary to maintain a minimum new concrete invert thickness of 3 inches and side thickness of 8 inches throughout the manhole.

Acceptable methods for demolishing the existing invert include the use of concrete saws, core drilling, jackhammers, chisels and other hand tools. The existing concrete shall be rough and have an approved bonding agent applied to it prior to placing the new concrete. The new invert shall be constructed using a concrete mix as specified with the exception that the concrete shall be low slump.

Sewer flows will not be permitted on the concrete until 4 hours after the initial set has occurred and the Engineer has inspected and approved the reconstructed invert.

3. **Shelves/Benches:** Shall be formed from the top of the channel to the manhole wall and shall slope up from the channel at a minimum rate of 1 inch per foot and a maximum rate of 3 inches per foot.
4. **Steps:** Anytime work is done on the inside of an existing manhole with steps, steps must be removed, and grout applied over any remaining metal or holes from the old steps filled in.
5. **Pipe Connections to New Manholes:** Manhole connections to the sewer main shall be accomplished with a rubber boot or a gasket seal that insures a watertight seal. Ends of pipes, which enter manholes, shall be cut smooth, straight, and at right angles to the pipe axis. The annular space between the boot or gasket and the pipe shall be grouted flush with the inside of the manhole such that a smooth, continuous channel is formed through the manhole. The annular space above the flow channel on top of the pipe shall not be grouted.

Drop manholes shall have the lower connection and 45-degree fitting, outside the manhole, totally encased in concrete. Refer to Standard Details. The interior pipe connections shall have the annular space grouted as described above.

When a sewer main stub is provided for future extension, the sewer main stub shall be capped with a watertight cap.

6. **Pipe Connections to Existing Manholes:** Pipe Connections to existing manholes shall not be allowed unless preapproved by the Engineer. When a connection or

extension is necessary the Engineer may require the manhole be replaced with a new manhole.

If preapproved by the Engineer the manhole connections shall be made by coring the existing manhole and installing a boot-type flexible connector consisting of a rubber gasket or boot, metal expansion ring and a metal take-up clamp, as manufactured by Press Seal Gasket Corporation, or approved equal. Rubber boots and gasket material shall meet or exceed ASTM C-923. Drop manholes shall have the lower connection and 45 degree fitting, outside the manhole, totally encased in concrete. Refer to Standard Details. The interior pipe connections shall have the annular space grouted as described for "Pipe Connections to New Manholes".

The Contractor shall test the existing manhole for water tightness prior to making any modifications as required under Section 9.3.1 - Manhole Tests. If the manhole does not pass a water tightness test prior to modifications, the Contractor will not be required to pass a test after modifications are made to the manhole. Manhole must pass a visual inspection by the Engineer. If the manhole does pass a water tightness test prior to modifications, the Contractor shall test the manhole after modifications are made and if the manhole does not pass the test it shall be the Contractor's responsibility to correct the deficiencies and demonstrate a passing test. The Contractor is responsible for correcting deficiencies in the manhole.

External joint seals shall be installed on an existing manhole for all exposed manhole joints when adding a pipe connection to an existing manhole, when ground water is present and no external joint seals exist.

## 7. Frames and Covers:

- a) **Grade and Slope:** Manhole frames and covers shall be placed at finished grade. When placed in asphalt, concrete, or gravel surfaces, frames and covers shall match both the crown slope and profile slope of the street. The cover shall be set at an elevation and slope that it is not above the surface and no more than 1/2 inch below the surface at all points around the circumference of the cover. Decreasing the surfacing thickness around the manhole frame and cover, as a method of achieving the above tolerances, is not permitted.

Finished grade for frames and covers located outside of paved areas shall be graded such that positive drainage will be maintained away from the manhole.

Frames shall be blocked and shimmed to correct elevations and slopes prior to placing pavement. The lid shall be adjusted to match both the cross slope of the street and the profile of the street. Following paving, the frame shall be checked for correct placement and adjusted as necessary. The joint between frame and adjusting ring shall then be grouted watertight with non-shrink grout. Blocks and shims shall be placed no closer than 2 inches from the inside edge of the adjusting ring. The internal frame seal shall be installed after the manhole frame and cover has been installed in its final position and is complete.



Vertical Adjustment of manhole frames and covers:

Adjusting rings shall be installed per the Standard Details and as specified herein. Adjustments greater than those shown on the details shall be accomplished by replacing or adding additional barrel sections rather than adjusting rings.

Plastic, rubber or concrete adjusting rings may be used. The plastic or rubber adjusting rings shall be installed as recommended by the manufacturer. No shims or other leveling devices, other than leveling rings provided by the manufacturer, will be permitted with use of the plastic or rubber adjusting rings. The annular space between the adjusting rings shall be sealed using an approved sealant. The first plastic adjusting ring on existing manholes may require leveling with concrete mortar and therefore the first plastic ring may be set in mortar.

The manhole frame and adjusting rings where concrete adjusting rings are used shall be set in a full bed of mortar to the grade and slope as specified. The mortar shall be tuck pointed between rings and shall not be applied to the inside diameter surface of the adjusting rings. Smearing of mortar on the inside of the adjusting rings will be cause for rejection of the work.

- 1) **New Manholes:** New Manhole barrels and cone sections shall be manufactured to a tolerance that provides from 2 inches to 8 inches of vertical adjustment between the top of the cone and the bottom of the frame. Vertical adjustments, between the top of the cone and the bottom of the frame, greater than 8 inches shall be accomplished by installing a new appropriately sized manhole barrel section. Rings shall be vertically aligned to be straight with the top of the cone section without any offset.
- 2) **Existing Manholes:** Existing manhole frames and lids may be adjusted to grade by adding additional adjusting rings. The vertical adjustment between the top of the cone and the bottom of the frame however shall not exceed 18 inches. Vertical adjustments greater than 18 inches shall be accomplished by installing a new appropriately sized manhole barrel section or manhole cone section. Rings shall be vertically aligned to be straight with the top of the cone section without any offset.

Steel adjusting rings that are inserted into the existing frame and allow the cover to be raised are not permitted. All manhole adjustments shall be done as specified above.

External joint seals shall be installed when a vertical adjustment of a manhole occurs on an existing manhole for all exposed manhole joints, when ground water is present and no external joint seals exist.

- b) **Chimney Seal:** Unless pre-approved by the Engineer, manhole chimney seals shall be installed in all cases. Whether an existing manhole is adjusted or a new manhole is installed, the manhole chimney shall be sealed. All manhole chimneys shall be sealed using a manhole internal frame seal. The seal shall be installed according to the manufacturers recommendations and when properly installed will prevent the inflow of water between the manhole cone and the frame and cover.
8. **Coating for Concrete Manholes and Lift Stations Wet Wells:** When indicated on the plans or specified in the detailed specifications a corrosion resistant interior coating shall be provided on manholes or lift station wet wells. The coating may be field applied or applied at the manufacture's site. New manholes shall be coated prior to installation. This includes coating of the manhole walls and bench, unless noted on the plans otherwise. The material shall be applied as per manufacturer's recommendations. Manhole coating color shall be as specified in Section 9.2 Materials.
9. **Manhole Depth:** Manholes 5.5 feet and greater in depth, measured from invert to rim, shall have eccentric cone top section per Standard Manhole Detail. Manholes less than 5.5 feet in depth shall have flat concrete covers designed for AASHTO H-20 wheel loading as per Standard Shallow Manhole Detail.

#### H. Sewer Main Tests:

1. **General:** A visual inspection, a television inspection, a leakage test, and a pipe deflection test shall be performed as specified herein for all sewer mains and manholes as a condition of acceptance by the City. All tests shall be performed after backfill is complete but prior to any surface restoration.
2. **Pre-Cleaning:** Prior to testing newly installed sewer pipe, the Contractor shall remove all accumulated construction debris, rock, gravel, sand, silt, and other foreign matter from the sewer with an appropriately sized cleaning ball.

The Contractor shall be responsible for all work necessary to make the sewer acceptable for usage including removal of all mud, silt, rocks, or blockages that make said sewer unacceptable for final acceptance and usage. Also included is all work necessary in the manholes and all cleanup work required prior to final acceptance.

The City will not be responsible for cleaning lines prior to televising the sewer. In the event that the line is not acceptable for televising, due to the Contractor's operations, the Contractor will be notified. It will be the Contractor's responsibility to arrange to clean the sewer and make it acceptable for the television inspection work. If not cleaned in a timely manner, the City may cause to take any actions necessary and charge the Contractor one and a half (1½) times the cost incurred.

3. **Visual Tests:** All newly installed sewer main pipe shall pass a visual, or "lamping", inspection by the Engineer, and a television inspection performed by the

Contractor. Refer to Section 205 – Televising for requirements. Straight alignment shall be checked either with lamping or with the laser beam. Lamping shall be conducted by viewing the pipe from inside a manhole to determine proper alignment. The television inspection shall consist of viewing the inside of all sewer main pipe installed to determine proper alignment, joining, properly installed service connections, infiltration, etc. The Contractor shall correct, at their own expense, any defects discovered because of lamping and/or televising the pipe.

Both a visual and television inspection shall be completed unless specified otherwise on the plans or specified in the detailed specifications.

If defective workmanship of material or construction is noted, the Contractor at no expense to the City, shall correct the deficiency. Additional television inspections to review if the repairs were made properly and in accordance with the specifications shall be provided by the Contractor per Section 205. The Contractor shall be responsible for all related costs, including concrete or asphalt resurfacing if the street has been surfaced. The Contractor shall be required to repair all areas of infiltration and other deficiencies. The City may cause to take any actions necessary for any items not completed or repaired in a timely manner and may charge the Contractor one and a half (1½) times the costs incurred.

It is the Contractors responsibility to notify the Engineer/City Inspector that the sewer is ready for inspection and when television inspection will occur. Any surfacing started prior to the television inspection is at the Contractors own risk.

- 4. Leakage Tests:** The Contractor shall conduct leakage testing of all newly constructed or reconstructed sewer mains. The Contractor shall furnish all necessary equipment and be responsible for conducting the leakage test in the presence of the Engineer and/or City Inspector.

The preferred Leakage Test method is the “Low Pressure Air Test”, provided groundwater conditions allow it. Alternative leakage tests may be the “Ex-Filtration Test” if groundwater is less than 4 feet above the top of pipe, or the “Infiltration Test” if groundwater is 4 feet or more above the top of pipe.

Leakage tests for sewer mains shall include testing of the mains and service pipe connections including inline sewer service wyes/tees.

When existing sanitary sewers which have service connections are being reconstructed or replaced (example: street reconstruction projects), the leakage test requirements may be waived or other testing methods substituted, subject to the approval of the Engineer.

- a) Low Pressure Air Test:** This is the preferred testing method. The Contractor may conduct low-pressure air testing of newly installed sewer mains in lieu of ex-filtration testing if the ground water is less than 1 foot above the top of the finished sewer main at the lowest point of the test section as determined by construction records and/or test borings. The test shall conform to the

procedures outlined in Uni-Bell Specification Uni-B-6-98 or latest, Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe.

The pressurizing equipment shall include a regulator or relief valve set no higher than nine (9) psig to avoid over-pressurization.

Pipeline segments between manholes shall be tested separately. Mechanical or pneumatic plugs shall be placed in the line at opposing manholes and each plug braced as a safety precaution. An aboveground air pressurizing device including shut-off valve, pressure-regulating valve, pressure relief valve, input pressure gage and a continuous monitoring pressure gage shall be provided and connected to the test plug at one end.

Separate hoses for introducing air and for monitoring air pressure shall be provided. The monitoring hose shall be equipped with two (2) accurate pressure gauges. The monitoring gauges shall read in divisions of 0.1 psi with an accuracy of plus or minus 0.04 psi.

Procedure:

- 1) Clean the section of sewer line to be tested by flushing or other means prior to conducting the low-pressure air test. This cleaning serves to eliminate debris and produce the most consistent results.
- 2) Isolate the section of sewer line to be tested by inflatable stoppers or other suitable test plugs.
- 3) Plug or cap the ends of all branches, laterals, tees, wyes, and stubs to be included in the test to prevent air leakage. All plugs and caps shall be securely braced to prevent blow-out. One of the plugs or caps should have an inlet tap, or other provision for connecting a hose to a portable air control source.
- 4) Connect the air hose to the inlet tap and portable air control source. The air equipment shall consist of necessary valves and pressure gauges to control an oil-free air source and the rate at which air flows into the test section to enable monitoring of the air pressure within the test section.
- 5) Low pressure air shall be introduced into the line until the internal pressure reaches four (4) psig, and the supply throttled to maintain four (4) psig for at least two (2) minutes. The supply shall then be shut off or disconnected. The pressure shall be allowed to drop to about three and one-half (3 ½) psig at which time the timing shall commence and the time accurately measured for a one (1) psig pressure drop per Table 9-1.
- 6) If the test section fails to meet these requirements, the Contractor shall, at their own expense, determine the source of leakage, repair or replace all deficiencies, and retest the installation until passing, all in a manner

approved by the Engineer. This does not mean that the Low Pressure Air Test has to be repeated but rather a passing test has to be achieved by either the Low Pressure Air Test or the Ex-filtration Test.

- 7) The Engineer may reduce the testing time to one-half the testing time if the pressure drop is less than 0.5 psi for the first one-half the test period listed in Table 9-1.
- 8) Upon completion of the test, open the bleeder valve and allow all air to escape. Plugs should not be removed until all air pressure in the test section has been reduced to atmospheric pressure.

**TABLE 9-1  
LOW PRESSURE AIR TEST  
ALLOWABLE LEAKAGE FOR A 1 PSIG PRESSURE DROP \***

Pipe Diameter	Time of Test (sec.'s)	Minimum Time of Test (sec.'s)
4	0.380 x L	226
6	0.854 x L	340
8	1.520 x L	454
10	2.374 x L	566
12	3.418 x L	680
15	5.342 x L	850
18	7.692 x L	1020
21	10.470 x L	1190
>21	as per plans	

\* Use of Table 9-1:

The time of test shall be calculated using the formula presented in Table 9-1. Time is in seconds and L is in feet of pipe being tested. If the calculated time is less than the minimum time of test then the minimum test time shall govern. For example: 200 feet - 10 inch sewer would have a calculated time of  $2.374 \times 200 = 475$  seconds. The minimum test time however is 566 seconds. Thus the minimum length of time for a 1 psig pressure drop would be 566 seconds not the calculated 475 seconds.

If there has been no leakage (zero psig drop) after one hour of testing, the test section shall be accepted and the test considered.

L is the length of the sewer main. If sewer services are included in the air test, no additional time for the test is necessary beyond that needed for the sewer main.

- b) **Ex-Filtration Test:** Shall be used if groundwater is less than 4 feet above the top of pipe as determined by construction records and/or test borings. The test shall be conducted in a manner approved by the Engineer and shall provide a minimum head of 2 feet at the highest point in the test section, but no more than 10 feet of head at the lowest point, with head measured from top of pipe, except when the groundwater surface is above the pipe, in which case head shall be measured from the groundwater surface.

Unless otherwise specified, the pipe shall not allow ex-filtration of water of more than 50 gallons per inch diameter per mile of pipe (50 gallons/inch/mile) in any 24-hour period as per Table 9-2.

The minimum test period shall be for two (2) hours and the values derived from Table 9–2 will need to be adjusted for the actual test time. If the test section fails to meet these requirements the Contractor shall, at their own expense, determine the source of leakage, repair or replace all deficiencies, and retest the installation until passing, all in a manner approved by the Engineer. This does not mean that the Ex-filtration test has to be repeated but rather a passing test has to be achieved by either the Ex-filtration Test or the Low Pressure Air Test.

It is not recommended to conduct the pipe leakage test concurrently with the manhole ex-filtration test, as the allowable parameters for head (H) in the two tests differ. However, a separate manhole ex-filtration test will not be required when manholes are tested simultaneously with the sewer pipe ex-filtration test.

The Contractor shall anticipate the need to conduct multiple tests in order to meet the above requirements and shall conduct testing in such a manner and sequence that the requirements indicated above are achieved.

Water used to test ex-filtration shall be clean potable water and will not be allowed to discharge to the sewer system. The Contractor shall be responsible for removing the water by pumping it from the system and discharging it at an approved location.

**TABLE 9-2  
ALLOWABLE LEAKAGE \***

PIPE SIZE (Inches)	LEAKAGE RATE (Gallons/Feet/24 Hours.)
8	0.08 x L
10	0.09 x L
12	0.11 x L
15	0.14 x L
18	0.17 x L
21	0.20 x L
24	0.23 x L
27	0.26 x L
>27	as per plans

\* Use of Table 9-2:  
The length of time for the test in the table is given as a 24-hour period and will need to be adjusted for the actual test time. The allowable leakage shall be calculated using the formula presented in Table 9-2 and L is in feet of pipe being tested.

It is not recommended to conduct the pipe leakage test concurrently with the manhole ex-filtration test, as the allowable parameters for head (H) in the two tests differ.

If the Contractor wishes to concurrently test the pipe and manhole then Table 9–4 may be used to assist in measuring the pipe loss for a concurrent test.

For example the calculated loss for 350 feet - 12 inch sewer would be  $0.11 \times 350 = 38.5$  gallons in a 24-hour period. To adjust this loss to the actual test time or if a manhole test is being conducted concurrently the 38.5 gallons would need to be converted, to say, two (2) hours; then  $(38.5 / 24 \text{ hrs}) \times 2 \text{ hrs} = 3.2$  gallons. The 3.2 gallons would be the permitted loss or if testing concurrently would have to be added to the loss calculated for the manhole.

- c) Infiltration Test:** Shall be used if ground water is 4 feet or more above the top of the finished sewer main at the highest point of the test section as determined by construction records and/or test borings. Test methods and infiltration measurements shall be conducted in a manner approved by the Engineer.

The allowable leakage into the pipe shall not exceed that set for Ex-Filtration in Table 9-2. The minimum test period shall be for two (2) hours and the table values will need to be adjusted to accommodate for the actual test time. If the test section fails to meet these requirements, the Contractor shall, at their own expense, determine the source of leakage, repair or replace all deficiencies, and retest the installation until passing, all in a manner approved by the Engineer. This does mean that the Infiltration Test has to be repeated as the other test methods would not be permitted because of the groundwater conditions.

- 5. Pipe Deflection Test:** Deflection tests shall be performed by the Contractor on all PVC sewers. Deflection tests will not be required for reinforced concrete pipe sanitary sewers. Deflection tests for other sanitary sewer pipe materials will be handled on a case-by-case basis by the Engineer. Deflection tests shall be conducted after the final backfill has been in place at least 30 days. Deflection tests shall be made using a deflection gauge (mandrel) device or other approved method. The diameter of the deflection gauge device shall be 95% of the undeflected inside diameter of the flexible pipe. The deflection test shall be performed without mechanical pulling devices. The Contractor shall be required to install the pipe in such a manner so that the diametric deflection of the pipe shall not exceed five (5) percent. All pipes exceeding the five (5) percent deflection within the two-year warranty period shall be re-laid or replaced by the Contractor at no additional cost to the City.

#### **I. Manhole Tests:**

- 1. General:** Manhole tests shall be performed on all newly installed manholes and on existing manholes where new sewer main connections have been made. The preferred Manhole Leakage Test method is the “Manhole Vacuum Test” rather than the “Ex-Filtration Test”.
- 2. Existing Manhole Modifications:** For existing manholes where new sewer main connections are to be made or any modifications, the Contractor shall test the manhole prior to any modifications to confirm manhole will pass test. Testing is not required when modifications are the addition of chimney seals or manhole

adjustment by use of adjusting rings. If the existing manhole passes the test, Contractor is required to pass the test after modifications are made to manhole. If the existing manhole does not pass the test, Contractor is not required to pass the test after modifications are made to manhole.

3. **Visual Test:** The Engineer/Inspector will visually inspect each manhole exterior and interior for flaws, cracks, holes, or other deficiencies, which may affect the operation or watertight integrity of the manhole. Should any deficiencies be discovered, the Contractor shall correct them to the satisfaction of the Engineer and at no cost to the City. Manhole barrels and cones that have cracks or holes that extend from the interior of the barrel or cone to the exterior shall be replaced. Manhole barrels or cones that have spalls or cracks that extend to or through the O-ring gasketed joint shall be replaced. For other deficiencies or flaws the Contractor may submit to the Engineer a written repair procedure for consideration. The Engineer may or may not permit the proposed repair method and by allowing a repair method does not, in anyway, remove or alleviate any testing requirements.
4. **Manhole Vacuum Test:** Shall be performed in accordance with ASTM C1244. The following procedure is summarized from ASTM C1244 and shall be followed in conjunction with ASTM C1244 unless modified by the Engineer. The vacuum test shall include testing the top of the manhole, excluding the adjusting rings and manhole frame and cover. Testing will be allowed after backfilling has occurred, manhole vacuum tester assembly and vacuum pumps shall be as manufactured by Cherne Industries, Inc. or approved equal. Repair of leaks may require the removal and replacement of manhole sections. Repair of leaks shall be approved by the Engineer.

Procedure:

- a) All lift holes shall be plugged.
- b) All pipes entering the manhole shall be temporarily plugged, taking care to securely brace the pipes and plugs to prevent them from being drawn into the manhole.
- c) The test head shall be placed at the top of the manhole in accordance with the manufacturer's recommendations.
- d) A vacuum of 10 inches of mercury shall be drawn on the manhole and then the vacuum line shall be throttled to maintain the 10 in vacuum for at least two (2) minutes. After the two minutes the valve on the vacuum line of the test head shall be closed, and the vacuum pump shut off. The time shall then be measured for the vacuum to drop to 9 inches of mercury.
- e) The manhole shall pass if the time for the vacuum reading to drop from 10 inches of mercury to 9 inches of mercury meets or exceeds the values indicated in Table 9-3.



- f) Two (2) accurate vacuum pressure test gauges shall be installed to monitor the test. Vacuum pressure gauges shall have graduation marks, at minimum, for every 0.2 inches of mercury and be capable of interpreting pressure readings within 0.1 inches of mercury. The pressure reading deviation between the two pressure gauges shall not be greater than 0.1 inches of mercury. During the vacuum pressure test the pressure loss indicated between the two gauges shall not deviate by more than 0.05 inches of mercury between the two gauges.
- g) If the manhole fails the initial test, necessary repairs shall be made by an approved method. The manhole shall then be retested until a satisfactory test is obtained. This does not mean that the Manhole Vacuum Test has to be repeated but rather a passing test has to be achieved by either the Manhole Vacuum Test or the Ex-filtration Test.

**TABLE 9-3  
MINIMUM MANHOLE VACUUM TEST TIMES FOR  
VARIOUS MANHOLE DIAMETERS PER DEPTH OF MANHOLE**

<b>Manhole Depth (Feet)</b>	<b>48 inch Diam. MH (Seconds)</b>	<b>60 inch Diam. MH (Seconds)</b>	<b>72 inch Diam. MH (Seconds)</b>
8	20	26	33
10	25	33	41
12	30	39	49
14	35	46	57
16	40	52	67
18	45	59	73
20	50	65	81
22	55	72	89
24	59	78	97
26	64	85	105
28	69	91	113
30	74	98	121
>30	as per plans		

5. **Ex-filtration Test:** The Contractor shall furnish all necessary equipment and materials and shall be responsible for conducting, in the presence of the Engineer/Inspector, an ex-filtration test on each manhole. A separate manhole ex-filtration test will not be required when the manhole is tested simultaneously with the sewer pipe during an ex-filtration test.

It is not recommended to conduct the pipe leakage test concurrently with the manhole ex-filtration test, as the allowable parameters for head (H) in the two tests differ. However, a separate manhole ex-filtration test will not be required when manholes are tested simultaneously with the sewer pipe ex-filtration test. If the Contractor wishes to concurrently test the pipe and manhole then Table 9–2 may be used to assist in measuring the pipe loss for a concurrent test.

The manhole shall not allow ex-filtration of water of more than 0.10 gallons per hour per foot diameter per foot head (0.10 gallons/hour/foot diameter/feet head) with head being measured from the top of the water surface in the test manhole to groundwater level outside the manhole or to the bottom of the manhole, whichever is less.

All pipes leading into or out of the manhole shall be plugged to provide a watertight seal and the manhole filled with water to a level 3 inches to 4 inches below the casting rim or lid. The water shall be allowed to stand for 2 hours prior to beginning the test to allow for absorption into the manhole. If the water has dropped at the end of the 2 hour stabilization period, additional water shall be added to bring the water level to at least 3 inches to 4 inches below the casting rim or lid, as initially was done. If the head is greater than 30 feet refer to the plans for ex-filtration testing requirements.

The minimum test period shall be for 2 hours and the values derived from Table 9-4 will need to be adjusted for the actual test time. If the test fails to meet these requirements, the Contractor shall, at their own expense, determine the source of leakage, repair or replace all deficiencies, and retest the installation until passing, all in a manner approved by the Engineer. This does not mean that the Ex-filtration test has to be repeated but rather a passing test has to be achieved by either the Ex-filtration Test or the Manhole Vacuum Test.

The Contractor shall anticipate the need to conduct multiple tests in order to meet the above requirements and shall conduct testing in such a manner and sequence that the requirements indicated above are achieved.

Water used for ex-filtration testing shall be clean, potable water and will not be allowed to discharge into the sewer system. The Contractor shall be responsible for removing the water by pumping it from the manhole being tested and discharge it at an approved location.

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**TABLE 9-4  
MANHOLE EX-FILTRATION TEST - ALLOWABLE LEAKAGE \***

Head (Feet)	Allowable water drop in casting and cone per hour					
	4 Foot Diam.		5 Foot Diam.		6 Foot Diam.	
	(gallons)	(Inches)	(gallons)	(Inches)	(gallons)	(Inches)
2	0.8	0.32	1.0	0.40	1.2	0.48
4	1.6	0.64	2.0	0.80	2.4	0.96
6	2.4	0.96	3.0	1.21	3.6	1.45
8	3.2	1.29	4.0	1.61	4.8	1.93
10	4.0	1.61	5.0	2.01	6.0	2.42
12	4.8	1.93	6.0	2.42	7.2	2.90
14	5.6	2.25	7.0	2.82	8.4	3.38
16	6.4	2.58	8.0	3.22	9.6	3.87
18	7.2	2.90	9.0	3.63	10.8	4.35
20	8.0	3.22	10.0	4.03	12.0	4.84
22	8.8	3.55	11.0	4.43	13.2	5.32
24	9.6	3.87	12.0	4.84	14.4	5.81
26	10.4	4.19	13.0	5.24	15.6	6.29
28	11.2	4.51	14.0	5.64	16.8	6.77
30	12.0	4.84	15.0	6.05	18.0	7.26
>30	as per plans					

\* Use of Table 9-4:

Example of a concurrent manhole and pipe ex-filtration test:

Given: 370 feet of 10 inch sewer, groundwater approximately 2 feet above the pipe invert at the manhole being tested, the manhole is 5 foot in diameter and the manhole is 17 feet deep from rim to invert.

The calculated pipe loss for 370 feet – 10 inch sewer would be (from Table 9-2)  $0.09 \times 370 = 33.3$  gallons in a 24-hour period. To adjust this loss to coincide with the manhole test the 33.3 gallons would need to be converted, to two (2) hours; so  $(33.3 / 24 \text{ hrs}) \times 2 \text{ hrs} = 2.78$  gallons. The 2.78 gallons is the permitted loss for the pipe in 2 hours.

The calculated manhole loss for a 5 foot diameter manhole 17 feet deep with groundwater 2 feet above the invert would be (from Table 9-4) 17 feet – 2 feet = 15 feet H, round H down to 14 feet, the corresponding value from the 5 foot Diam. Column results in a manhole loss of 7.0 gallons per hour. This value then needs to be converted to a two hour test. So  $7.0 \text{ gallons} \times 2 = 14$  gallons for two hours.

The combined total loss would be 2.78 gallons (pipe) + 14 gallons (manhole) = 16.78 gallons. This loss can be measured in inches of water surface drop in the cone by converting the gallons in Table 9-4 to inches. The 7.0 gals. = 2.82 inches of drop, therefore 16 gallons of loss equals  $2 \times 2.82 \text{ inches} = 5.64 \text{ inches}$ . The 2.78 gallons would be rounded down to 2.0 gallons, which is equivalent to a 0.80 inch drop. Therefore, the total water surface drop for a two hour test would be  $5.64 \text{ inches} + 0.80 \text{ inches} = 6.44 \text{ inches}$ .

Another option instead of measuring the surface water drop would be to measure the volume of water required to bring the water surface back to the original level, at the start of the test. In order to achieve a passing test the volume of water needed to fill the cone would have to be less than 16.78 gallons.

**J. Abandoning Sanitary Sewer Mains and Manholes:**

1. **Existing Sewer Mains:** To be abandoned between manholes shall be plugged at all open ends with concrete extending into the abandoned pipe one foot or one pipe diameter, whichever is greater. Existing sewers to be abandoned at a manhole shall be cut flush with the inside of the manhole and plugged as specified above. The pipe shall be grouted flush with the inside of the manhole and the manhole invert shall then be reconstructed. The reconstructed manhole inverts shall provide for the new flow scheme and comply with the standards for manhole inverts, as specified.
2. **Existing Manholes:** To be abandoned shall have all pipes plugged with concrete extending into the abandoned pipe one foot or one pipe diameter, whichever is greater. The upper 4 feet of the manhole shall be broken or removed and the manhole filled with compacted Select Granular Backfill Material. The floor of the manhole must be fractured to eliminate the manhole from holding water. The Contractor shall not backfill manholes to be abandoned until the Engineer/Inspector has inspected each plug and the fractured floor.

Unless shown otherwise on the plans or specified in the detailed specifications, the Contractor shall salvage manhole frames and covers and deliver to and unload them at the City Utility Maintenance Shop.

**K. Service Lines:**

1. **Service Line Separation:** Refer to Section 11 Utility Excavation and Backfill.
2. **Permits:** Obtainable from the City Utility Maintenance Division, are required for all connections to the City sanitary sewer system. Applicants must hold a City Sewer & Water Installer Contractor's License.
3. **Horizontal Distance:** Between a water main and a sewer service shall not be less than 5 feet, and a sewer main and a water service shall not be less than 5 feet.
4. **Service Pipe:** Shall be laid at a 2.00% slope or greater. Any service pipe less than 2.00% slope requires Engineer approval. Minimum depth of cover over service lines shall be 3-1/2 feet unless approved by the Engineer to be shallower. Shallower installations will require the use of insulation. Reconstruction of existing sewer service lines shall be laid with the greatest slope possible in order to reconnect into existing conditions.
5. **Cleanouts:** Shall be installed at all changes in horizontal alignment of greater than 45 degrees and at distances not to exceed 75 feet for 4 inch diameter pipe and 100 feet for 6 inch diameter pipe. Cleanouts shall be installed when the summation of the horizontal degree of change in a service line exceeds 135 degrees. Cleanout location and installation shall meet the more stringent of the above requirements or those of the adopted plumbing code.

- 6. Insulation:** For sewer services, when shown on the plans, shall be as specified for sewer mains. The use of insulation requires prior approval of the Engineer.
- 7. Sewer Service New Connections:** Where new service lines are to be installed for undeveloped property or future buildings, the Contractor shall furnish all materials necessary for connection of new service lines to the sewer main, and shall obtain and pay permits and tapping fees as established by Ordinance.
- a) With the construction of new mains, in-line wyes shall be used for 4 inch and 6 inch service lines when connecting to 8 inch and 10 inch sewer mains.
  - b) With the construction of new mains, in-line tees shall be used for 4 inch and 6 inch service lines when connecting to 12 inch or greater sewer mains.
  - c) In all cases when a 6 inch connection is to be made onto an existing 8 inch or 10 inch sewer main, the connection must be made with an in-line wye. If the connection is to an existing main, the in-line wye shall be cut into the existing main.
  - d) For new connections onto existing sewer mains that are not a 6 inch connection onto an 8 inch or 10 inch main, or at location determined necessary by the Engineer, the City will use tapping saddles, furnished and installed by the City.
  - e) In-line wyes, tees, and service lines bends installed at a depth of greater than 14 feet shall be SDR 26. All other in-line wyes and tees shall be SDR 35 minimum.
  - f) In-line wyes and tees shall be furnished and installed by the Contractor as the sewer main is installed.

New service connections and lines shall be, at a minimum, extended to the property line and the service line capped. If the termination point is not at a cleanout, the termination point shall be marked with a minimum 3 foot long steel fence post. The steel fence post shall be buried below the surface at least 8 inches and must be steel to facilitate location by magnetic locators.

- 8. Sewer Service Reconnections:** The Contractor shall furnish all materials necessary for reconnecting service lines existing prior to reconstruction of a sewer main.
- a) With the construction of new mains, in-line wyes shall be used for 4 inch and 6 inch service lines when reconnecting to 8 inch and 10 inch sewer mains.
  - b) With the construction of new mains, in-line tees shall be used for 4 inch and 6 inch service lines when reconnecting to 12 inch or greater sewer mains.

- c) In all cases when a 6 inch reconnection is to be made onto an 8 inch or 10 inch main, the reconnection must be made with an in-line wye. If the reconnection is to an existing main, the in-line wye shall be cut into the existing main.
- d) For reconnections onto existing sewer mains that is not a 6 inch connection onto an 8 inch or 10 inch sewer main, the City will use tapping saddles, furnished and installed by the City.
- e) In-line wyes, tees, and service lines bends installed at a depth of greater than 14 feet shall be SDR 26. All other in-line wyes and tees shall be SDR 35 minimum.
- f) In-line wyes and tees shall be furnished and installed by the Contractor as the sewer main is installed.

The Contractor shall visually inspect the inside of each existing sewer service line to be connected to the new sewer main prior to making the reconnection. When it is discovered that an existing sewer service line beyond the edge of the excavation is not in good physical condition or is plugged, full of roots, or is otherwise not operating properly, the Contractor shall notify the Engineer so they may document the condition and notify the property owner.

Connections between the new service line and existing service line shall be accomplished with a coupling. The Contractor shall encase the Fernco connection in 6 inches of concrete, 6 inches each side of the coupling.

- 9. Abandoning of Service Lines:** Shall be accomplished by cutting and plugging the line at the sewer main unless directed otherwise by the Engineer. The service line shall be plugged in the same manner as specified for plugging sewer mains.
- 10. Service Line Inspection and Taps:** City personnel shall inspect all sewer service connections to the City sewer main, service line installations, and service line abandonments, prior to backfilling. The Contractor shall notify the City Utility Maintenance Division a minimum of four (4) hours prior to the time of wanted inspection. Any trench backfilled without being inspected and approved by authorized City personnel shall be re-excavated by the Contractor to expose the work for the required inspection. Discrepancies shall be corrected by the Contractor and re-inspected by City personnel. City personnel shall tap all City sewer mains, at locations as identified in this Specification. The Contractor shall schedule all inspections and taps between 7:30 AM to 3:00 PM, Monday through Friday.
- 11. Tracer Wire:** Tracer wire shall be installed and extended along with all sewer service lines. The wire shall be installed along the top of the pipe and shall be securely anchored to the pipe every four (4) feet horizontally with an adhesive tape. The tracer wire shall be brought to the surface at each clean out and shall terminate at the service connection point on the main.

At locations where the service line is not being replaced entirely, the Contractor will splice the new tracer wire to the existing tracer wire at the point of reconnection. In instances where a service line is not being replaced entirely and the existing tracer wire is not encountered, the Contractor shall coil approximately five (5) feet of wire at the reconnection location(s) to facilitate a future splice.

All tracer wire connections shall be accomplished in accordance with Section 8B. In addition to meeting these requirements the Tracer Wire specification shall be modified so that the wire insulation is green with a print line saying "SEWER".

#### 9.4 METHOD OF MEASUREMENT

- A. Sewer Main Pipe:** Installed pipe quantities shall be measured from centerline to centerline of all manholes and special items to the nearest even foot. Depth of pipe shall be determined from top of finish grade to flow line of pipe. Standard depth is 0 - 6 feet and extra depth shall be in increments of two (2) feet.
- B. Sewer Service Pipe:** Installed pipe quantities shall be measured from edge of sewer main pipe to fittings or end of pipe to the nearest even foot.
- C. Standard Manhole, Shallow Manhole, Termination Manhole, and Drop Manhole:** 0 - 6 feet, shall be measured on a per each basis for the type and diameter of the particular manhole. Measurement for ancillary items to the manhole, including but not limited to chimney seals, castings, adjusting rings and external joint seals will not be made; such work shall be incidental to the respective bid item.
- D. Extra Manhole Depth:** per diameter of manhole being installed shall be measured to the nearest one tenth (0.1) foot from the top of finish grade to the invert of the manhole minus the nominal 6 foot depth measured under Standard Manhole, Shallow Manhole, Termination Manhole, and Drop Manhole.
- E. Abandon Sewer Mains:** No separate measurement will be made for plugging abandoned sewer mains; such work shall be incidental to the project, unless otherwise specified.
- F. Abandon Manhole:** Measurement will be made on a per each basis for each manhole abandoned.
- G. Sewer Service New Connections and Reconnections with In-Line Sewer Service Wye or Tee:** Sewer service reconnections and sewer service new connections with in-line service wye or tee will be counted on a per each basis. When applicable, saddles will be furnished and installed by the City. The pipe used for connections and reconnections shall be measured and paid for under the bid item for sewer service pipe. Pipe couplings are incidental to the connection to the sewer service. All fittings and appurtenance required for change in direction of the sewer service pipe are incidental to the length of sewer service pipe.

- H. Adjust Manhole Frame and Cover:** Measurement will be made on a per each basis for each manhole frame and cover adjusted and includes adjusting rings for a complete installation. If there is an existing chimney seal the reinstallation of the chimney seal and extensions as necessary for a complete installation shall be considered as incidental to this item.
- I. Manhole Chimney Seal and Extensions:** Measurement will be made on a per each basis for each installation. The chimney seal installation includes the chimney seal and extensions, as necessary. This item is applicable for installations where an existing manhole is being retrofitted or adjusted.
- J. Reconstruct Manhole:** Measurement will be made on a per each basis for each manhole reconstructed. Reconstruct Manhole consists of the removal of or the addition of a new manhole barrel(s) or cone for vertical adjustment. Adjustments of the frame and cover associated with the addition of or removal of a barrel or cone shall be considered as incidental to this bid item.
- K. Reshape Manhole Invert:** Measurement will be made on a per each basis for each manhole that has the invert(s) reshaped and reconstructed.
- L. Sanitary Sewer Caps/Plugs:** Are incidental to the applicable bid item.
- M. Sanitary Sewer Cleanouts:** Measurement will be made on a per each basis for each type and size of cleanout installed.
- N. Sanitary Sewer Cleanout Cover Frame and Casting:** Measurement will be made on a per each basis for each type and size of cleanout cover frame and casting installed.
- O. Connection to Existing Manhole:** Measurement will be made on a per each basis for each connection to an existing manhole.
- P. Remove Manhole:** Measurement will be made on a per each basis for each manhole removed.
- Q. Remove Sewer Main:** Measurement will be made on a linear foot basis and shall be measured to the nearest foot if sewer main to be removed is located in a separate trench of any new utility being installed with the project. If the sewer main to be removed is located in the same trench of any new utility being installed with the project, removal of the sewer main shall be incidental to the installation of the new utility.
- R. Connection to Existing Sewer Main:** Measurement will be made on a per each basis for each connection to an existing sewer main. Pipe couplings are incidental to the connection to existing sewer main.
- S. Sanitary Sewer Force Main, Fittings, Valves, and Ancillary Items:** Installed quantities shall be measured conforming with the applicable provisions of Section 8A - Water Piping Systems and Section 8B - Corrosion Protection – Plastic Pipe Systems.



- T. Bypass Pumping:** Measurement will be made on a lump sum basis for bypass pumping, diversions and/or wastewater flow modifications including pumping equipment and operation of same for a complete installation for the entire project and may be multiple setups, startups, and stops. All other appurtenances to effectuate the bypass pumping are considered as incidental to this item.

## 9.5 BASIS OF PAYMENT

- A. Sewer Main Pipe:** Payment will be at the unit price bid for the appropriate size and depth of sewer pipe, furnished and installed, including , trenching, excavation, Type 1 bedding material, compacting, backfilling, dewatering, sheeting or shoring, compaction, and testing.
- B. Sewer Service Pipe:** Payment will be made at the unit price bid for the appropriately sized pipe, furnished and installed, including trenching, excavation and backfilling, bedding material, compacting, dewatering, tracing wire, and sheeting or shoring. The cost for any connections between the new service line and existing service lines shall be included in the unit price bid for the appropriate sized pipe.
- C. Standard Manhole, Standard Shallow Manhole, and Termination Manhole:** 0 - 6 feet. Payment will be made at the unit price bid for each type and diameter, furnished and installed including but not limited to the following ancillary items to the manhole: adjusting rings, frame, cover and external joint seals.
- D. Drop Manhole:** 0 - 6 feet. Payment will be made at the unit price bid for each diameter, furnished and installed, including but not limited to the following ancillary items to the manhole: adjusting rings, frame, cover and external joint seals. Price bid shall include the wye and the pipe installed from the wye to the floor of the manhole, and concrete encasement of lower connection and 45 degree fitting. No separate payment will be made for this pipe, wye, bend and concrete encasement.
- E. Extra Manhole Depth:** Payment shall be made at the unit price bid for that depth, per the appropriate manhole diameter, over and above 6 foot, which is paid for as Standard Manhole, Shallow Manhole, Termination Manhole, and Drop Manhole.
- F. Abandon Sewer Mains:** Payment for plugging abandoned sewer mains shall be incidental to the project, unless otherwise specified.
- G. Abandon Manhole:** Payment will be at the bid unit price and shall include all labor, materials, including concrete plugs, and granular backfill.
- H. Sewer Service In-Line Wye or Tee:** Payment will be made at the unit price bid for each size and type of fitting, furnished and installed.
- I. Sewer Service New Connection:** Payment will be made at the unit price bid for connecting new sewer services to the sewer main, including fittings necessary to connect the service line to sewer. When applicable, saddles will be furnished and installed by the City. Sewer service pipe will be paid for separately. Sewer service in-

line wye or tee connection to the main will be paid for separately. Payment for Sewer Service New Connection shall include Right to Work permit, New Account Setup/Inspection permit (tap permit) and tapping fees, unless otherwise specified in the detailed specifications, including all labor and material.

- J. Sewer Service Reconnection:** Payment will be made at the unit price bid for reconnecting existing sewer services to the sewer main, including fittings necessary to connect the service line to sewer. When applicable, saddles will be furnished and installed by the City. Sewer service pipe will be paid for separately. Sewer service wye or tee connection to the main will be paid for separately.
- K. Adjust Manhole Frame and Cover:** Payment will be at the unit price bid for adjusting manhole frame and cover, existing chimney seals, and includes adjusting rings.
- L. Manhole Chimney Seal and Extensions:** Payment will be made at the unit price bid for each installation.
- M. Reconstruct Manhole:** Payment will be made at the unit price bid for Reconstruct Manhole including new manhole barrel(s) and cone, or removal of manhole barrel(s) and cone.
- N. Reshape Manhole Invert:** Payment will be at the unit price bid for reshaping existing manhole inverts, including all materials, labor, equipment, wastewater flow diversions, modifications, and/or pumping.
- O. Sanitary Sewer Cleanouts:** Payment will be at the unit price bid for Sanitary Sewer Cleanout furnished and installed, including all labor and materials.
- P. Sanitary Sewer Cleanout Cover Frame and Casting:** Payment will be at the unit price bid for Sanitary Sewer Cleanout Cover Frame and Casting furnished and installed, including all labor and materials.
- Q. Connection to Existing Manhole:** Payment will be at the unit price bid and shall include all labor and materials.
- R. Remove Manhole:** Payment will be at the unit price bid and shall include all labor, materials, including concrete plugs, and backfill.
- S. Remove Sewer Main:** Payment will be at the unit price bid and shall include all labor, materials, including concrete plugs, and backfill.
- T. Connection to Existing Sewer Main:** Payment will be at the unit price bid and shall include all labor and materials.
- U. Sanitary Sewer Force Main, Fittings, Valves, and Ancillary Items:** Payment will be in conformance with the applicable provisions of Section 8A - Water and Section 8B - Corrosion Protection – Plastic Pipe Systems.

- V. Bypass Pumping:** Payment will be made on a lump sum basis for bypass pumping, diversions and/or wastewater flow modifications including pumping equipment and operation of same for a complete installation for the entire project and maybe multiple setups, startups, and stops. All other appurtenances to effectuate the bypass pumping are considered as incidental to this item.

**END OF SECTION**