

Addendum No. 1

Project: **Third Creek Mini-Basin 13A1 – Phase 1 CIPP Project**
Control No: **1205**
Issued: **To all listed plan holders**
Date: **April 3, 2018**

This addendum forms a part of the Agreement described above. The original Contract Documents and any prior addenda remain in full force and effect except as modified by the following, which shall take precedence over any contrary provisions in prior documents.

1. Section 00001 – Table of Contents

- DELETE Section 00001, page 2, and REPLACE with revised Section 00001, page 2, attached. In addition, the deleted page is of an obsolete version and the release date for Specs 02546, 02547, & 02548 have been updated.

2. Section 02530 – Sewer Manholes_(EpoxyLining_Xypex_DropAssembly)

- DELETE Section 02530, in its entirety, as it was inadvertently added to the original bid package.

3. Section 02546 – Cured in Place Pipe

- DELETE Section 02546 in its entirety, and REPLACE with revised Section 02546, attached. In addition, the deleted pages are of an obsolete version and the revised version has changes throughout the entire document.

4. Section 02547 – Manhole Rehabilitation

- DELETE Section 02547 in its entirety, and REPLACE with revised Section 02547, attached. In addition, the deleted pages are of an obsolete version and the revised version has changes throughout the entire document.

5. Section 02548 – Cured in Place Pipe Lateral Liner

- DELETE Section 02548 in its entirety, and REPLACE with revised Section 02548, attached. In addition, the deleted pages are of an obsolete version and the revised version has changes throughout the entire document.

END

Each Bidder/Proposer shall acknowledge receipt of this addendum by affixing his signature below, by noting this addendum on his Bid/Proposal Form, and by attaching this addendum to his Bid/Proposal. **Failure to acknowledge this addendum could be cause for bid/proposal rejection.**

ACKNOWLEDGMENT

The undersigned acknowledges receipt of this addendum and the Bid submitted is in accordance with information, instructions and stipulations set forth herein.

BIDDER / PROPOSER _____

AUTHORIZED SIGNATURE _____

DATE _____

TECHNICAL SPECIFICATIONS

DIVISION 1; GENERAL REQUIREMENTS

01110	Summary of Work	08/26/13
01120	KUB Addresses & Emergency Phone Numbers	03/30/07
01250	Change Order Procedures	12/21/07
01270	Measurement and Payment	03/26/15
01290	Applications for Payment	03/01/17
01380	Pre and Post Construction Video Photography	12/01/08
01400	Quality Control	X
01450	Testing Laboratory Services	08/30/02
01530	Site Access and Security	11/07/13
01550	Work Zone Traffic Control	05/07/01
01560	Work In Easements and Rights-of-Way	09/03/02
01570	Erosion Prevention and Sediment Control	05/10/12
01600	Material and Equipment	05/07/01
01720	Field Engineering	09/03/02
01725	Underground Utility Damage Prevention Act	06/01/17
01740	Surface Restoration Special Provisions	07/01/05
01770	Contract Closeout	03/01/17

DIVISION 2; SITE WORK

02050	Water-Wastewater General Information	07/01/06
02230	Clearing and Grubbing	07/01/06
02310	Finish Grading	07/01/06
02315	General Excavation	07/01/06
02321	Excavation, Bedding & Backfill for Utilities	01/28/15
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02372	Geotextiles	07/01/06
02530	Sewer Manholes	01/01/09
02532	Sanitary Sewers (Gravity)	01/01/09
02533	Sanitary Sewers - Air Test Guidelines	10/01/93
02540	Sewer Cleaning	01/01/09
02541	Sewer Television Inspection	01/01/09
02542	Sewer Flow Control	01/01/09
02546	Cured in Place Pipe (Liner Process)	03/12/18
02547	Manhole Rehabilitation	03/12/18
02548	Cured In Place Pipe Lateral Liner	03/12/18
02740	Pavement Repair	08/10/10
02770	Concrete Pavement Construction	07/01/06
02920	Seeding	07/01/06
02925	Sodding	02/01/05
02930	Replacement of Trees, Plants and Ground Cover	07/01/06

**SECTION 02546
CURED-IN-PLACE PIPE****PART 1. GENERAL****1.01 SCOPE**

Rehabilitation of existing gravity sanitary sewer lines by the Cured-in-Place Pipe (CIPP) process.

1.02 DESIGN CRITERIA

- A. Design liner thickness in accordance with ASTM F1216, F1743, or F2019 (as appropriate for the proposed liner product) using the following criteria:
1. Pipe Diameters: Per Project Drawings
 2. Ovality: 3 percent, or as shown on plans
 3. Pipe Condition: Fully deteriorated
 4. External Water: Ground Surface
 5. Short-Term Tensile Strength (ASTM D638):
 - a. Unreinforced: 3,000 psi
 - b. Reinforced: 9,000 psi
 6. Tensile Strength Reduction Factor: 50 percent
 7. Long-Term Tensile Strength:
 - a. Unreinforced: 1,500 psi
 - b. Reinforced: 4,500 psi
 8. Flexural Strength (ASTM D790):
 - a. Unreinforced: 4,500 psi
 - b. Reinforced: 6,500 psi
 9. Short-Term Flexural Modulus (ASTM D790):
 - a. Unreinforced: 250,000 psi, or as shown on plans
 - b. Reinforced: 700,000 psi, or as shown on plans
 10. Flexural Modulus and Flexural Strength Reduction Factor:
 - a. Unreinforced: 50 percent
 - b. Reinforced: 35 percent, contingent upon approval of Owner and Engineer after review of submittal with long-term test data, otherwise 50 percent shall be used.
 11. Long Term Flexural Strength:
 - a. Unreinforced: 2,250 psi
 - b. Reinforced: 3,250 psi
 12. Long-Term Flexural Modulus:
 - a. Unreinforced: 125,000 psi, or as shown on plans
 - b. Reinforced: 455,000 psi, or as shown on plans
 13. Enhancement Factor: 7
 14. Soil Modulus: 1,000 psi, or as shown on plans
 15. Soil Density: 120 pcf, or as shown on plans

16. Highway Live Load: AASHTO HS20-44
17. Safety Factor: 2 minimum
18. Minimum Thickness: 6 millimeters for steam and water cured liners
19. Poisson's Ratio: 0.3
20. Liner shall be watertight

1.03 SUBMITTALS

- A. Action Submittals:
 1. Manufacturer's technical literature on proposed lining system.
 2. Resin:
 - a. Specifications.
 - b. Characteristics.
 - c. Properties.
 - d. Itemize exceptions and deviations to Specification.
 3. Annular space sealant
 4. Service connection fittings
 5. In-Line Curing Temperature Monitoring System
- B. Informational Submittals:
 1. Design calculations:
 - a. Liner thickness design calculations signed and sealed by Professional Engineer in the State of TN.
 - b. Manufacture certification of material to values utilized in calculations.
 - c. If reinforced liners are proposed, submit long-term ASTM D790 and ASTM D2990 test data supporting reduction factor used in design.
 2. Manufacturer's installation instructions and procedures. Furnish information, essentially in the same format as below, or give details of the procedure and the steps to be followed for the installation of the CIPP, even if the process is named in the Specification.
 - a. Wet Out.
 - b. Insertion.
 - c. Curing.
 - d. Cool Down.
 - e. Finished Pipe.
 3. "Wet out" and curing schedule.
 4. Process control sheets for temperature/time during curing, including outputs from in-line curing temperature monitoring system.
 5. Installer's and accredited testing laboratory statement of qualifications.
 6. Manufacturer's Certificate of Compliance certifying compliance with the applicable specifications and standards.
 7. Warranty and/or Special Guarantee.
 8. Manufacturer's instructions for material shipping, storage, and handling requirements.
 9. Certified copies of test reports of factory tests required by the applicable standards and this Section.
 10. Dye testing results

11. DVD or external hard drive of both pre- and post CCTV inspections.

1.04 QUALITY ASSURANCE

- A. Installer shall have a minimum of 5 years' experience and have installed a minimum of 500,000 linear feet with the selected liner product and method of curing.
- B. Superintendent shall have minimum of 3 years of onsite experience with the selected liner product and method of curing.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products as recommended by the manufacture to prevent damages. Materials shall be made safe from theft, vandalism, and damage.
- B. All products and materials specified herein shall be inspected at the request of OWNER or RESIDENT PROJECT REPRESENTATIVE. All materials that fail to conform to these Specifications shall be rejected. After delivery to the Site, any materials that have been damaged in transit or are otherwise unsuitable for use in the Work shall be rejected and removed from the Site by the CONTRACTOR at no cost to the OWNER
- C. Ship resin directly to wet-out facility from manufacturer.
- D. Maintain resin-impregnated tubes in refrigerated truck trailers at a temperature below 45 degrees F to prevent premature curing. Prior to beginning inversion, no portion of the resin-impregnated liner shall be subjected to sunlight or ultraviolet radiation. Resin-impregnated tubes with signs of premature curing shall not be installed and shall be removed from the Project Site.

1.06 SPECIAL GUARANTEE

- A. Provide manufacturer's extended guarantee or warranty, with OWNER named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at the option of the OWNER, removal and replacement of Work specified in this Specification section found defective, due to material or workmanship failure, during a period of 5 years after the date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in the General Conditions. A warranty inspection can be completed by the OWNER up to 5 years after final acceptance.

PART 2. PRODUCTS

2.01 MATERIALS

A. Resin:

1. Unless otherwise specified, CONTRACTOR shall furnish a general purpose, unsaturated, polyester, epoxy, isophthalic neopentyl glycol, or thermosetting vinyl ester resin, catalyst system, initiators, or hardeners that provide specified cured physical strengths and properties, and compatible with reconstruction inversion process.
2. Resistant to municipal wastewater environment; immersion in septic sewage at temperatures up to 75 degrees F.
3. Curing:
 - a. Designed to cure properly within selected curing method.
 - b. Initiation Temperature: 180 degrees F, maximum for water cure.
4. Resins shall be chemical resistant and tested and manufactured in accordance with ASTM F1216 and ASTM D543.
5. For lines smaller than 24 inches PET resins, resin fillers, resin additives, and resin enhancement agents are prohibited. Only neat resins are acceptable.
6. For lines 24 inches and larger, any resin additives are contingent upon OWNER and ENGINEER approval. All enhanced resins shall be submitted as a part of the action submittal process.
7. For reinforced liners, only neat resins are acceptable.
8. Old resins and reworked resins are prohibited, regardless of whether or not they are mixed with new resin.
9. Produce a cured tube resistant to shrinkage that will not corrode or oxidize and is resistant to abrasion from solids, grit, and sand in wastewater.
10. Bond between tube layers shall be strong and uniform. Layers, after cure, shall be saturated with resin.
11. Styrenated resins are prohibited for pipes that will discharge directly to the environment (e.g. storm drains).
12. Manufacturers and Products:
 - a. Reichhold
 - b. Interplastic Corporation
 - c. Ashland Specialty Chemical Company
 - d. AOC

B. Catalysts:

1. Primary catalyst shall not exceed 1 percent of the resin by volume.
2. Secondary catalyst shall not exceed 1/2 percent of the resin by volume.
3. Catalysts shall be:
 - a. Primary Catalyst: Akzo Products, or as required to meet the performance requirements of the liner.
 - b. Secondary Catalyst: Akzo Products or Puritan Products; or as required to meet the performance requirements of the liner.

- C. Tube:
1. Consist of layers of flexible nonwoven and absorbent polyester felt manufactured under quality controlled conditions set by manufacturer and applicable requirements set forth in ASTM F1216 and ASTM F1743 that, when cured, will be chemically resistant to reagents as defined in ASTM D543.
 2. Lining shall be correct diameter; after installation, there shall be no wrinkles or form permanent fins. Tube shall be capable of stretching to fit irregular pipe sections and fabricated and sized for each section to ensure snug and firm fit inside existing sewer; produce required thickness after resin is cured.
 3. Wastewater-contact inside layer of tube shall be coated with an impermeable material compatible with resin and felt and shall not be a dark or non-reflective nature that inhibits proper closed circuit television inspection.
 4. For lines 24 inches and larger if reinforcement is utilized it shall consist of Impregnated flexible fiberglass. Each lot of fiberglass liner shall be inspected for defects and tested in accordance with applicable ASTM F2019.
 5. Manufacturers:
 - a. Applied Felt
 - b. Insituform Technologies
 - c. Liner Products
 - d. National Liner
 - e. Layne Inliner
 - f. Mississippi Textile

2.02 ACCESSORIES

- A. Hydrophilic Rubber Joint Seal:
1. Greenstreak, Inc
 2. Hydrotite, LMK, Insignia
 3. Adeka, KM-String
- B. PVC Saddle Tees: Solvent welded type for 8-inch CIPP sewer main connection. Tee shall fit the existing pipe and have an integral 6-inch branch connection with gasket. The saddle shall include two stainless steel straps. Saddle tees shall meet the requirements of ASTM D3034 and ASTM F477.
- C. Connections to CIPP mains greater than 8-inches in diameter shall be with a minimum 6-inch "Inserta-Tee" manufactured by Inserta Fittings Company and specifically designed for the thickness of the installed CIPP liner.
- D. Couplings shall be installed in accordance with Specification 02532, Sanitary Sewers (Gravity).

- E. Curing Temperature Monitoring System:
 - 1. ZIA Systems
 - 2. Pipeline Renewal Technologies, VeriCure.

PART 3. EXECUTION

3.01 WORKER SAFETY

- A. Contractor shall implement all current recommendations, guidelines, and regulations of the National Institute for Occupational Safety and Health (NIOSH), and the Occupational Health and Safety Administration (OSHA) for the safety of workers and the public affected by the CIPP installation.
- B. Records of any complaints or incidents shall be provided to the OWNER.

3.02 PRE-INSTALLATION PREPARATIONS

- A. Complete the following activities, unless approved otherwise by OWNER:
 - 1. Pre-Insertion Cleaning: Rewash, re-clean and ready existing sewer pipe immediately before the pre-insertion television inspection.
 - 2. Pre-Insertion CCTV Inspection: Inspect sewer pipe before insertion of resin impregnated tube to ensure pipe is clean and existing pipe conditions are acceptable for lining. Provide a DVD of the CCTV inspection.
 - 3. Dye Testing: Where sewer line segments may contain abandoned services, CONTRACTOR shall be responsible for performing dye testing to determine if the services are live and require re-instatement.
 - 4. Bypassing Wastewater: Reference Section 02542, Sewer Flow Control.
 - 5. Line Obstructions: If pre-insertion video CCTV inspection reveals an obstruction in the existing pipe (such as heavy solids, dropped joints, protruding service taps or collapsed pipe which may prevent completion of the inversion process), that is not identified on the Project Drawings and cannot be removed by sewer cleaning equipment, then a point repair using a shielded coupling may be made with the approval of OWNER. Shielded couplings shall be used in accordance with Specification 02532, Sanitary Sewers (Gravity).
 - 6. Remove active infiltration prior to installation of the liner.

3.03 INSTALLATION PROCEDURES

- A. Wet Out:
 - 1. Verify lengths in field before cutting liner to length
 - 2. Wet out shall be vacuum impregnated with resin under controlled conditions.
 - 3. Use roller system to uniformly distribute resin throughout tube.
 - 4. Resin shall fill all voids in tube material with no air spaces or pockets.

5. Handle resin impregnated tube to retard or prevent settling until it is read for insertion.
 6. Use of alternative methods of resin impregnation shall be approved by the OWNER prior to implementation.
- B. Insertion:
1. Install CIPP in accordance with ASTM F1216 (direct inversion) or ASTM F1743 (pull installations) or F2019 (reinforced liners) as appropriate for the liner product used.
 2. Dewater existing host pipe prior to installation
 3. Insert wet-out tube through an existing manhole or approved access point by means of an inversion method and application of sufficient hydrostatic head to extend tube to next designated termination point.
 4. A pull in method using a bladder to expand the tube may be employed if approved by OWNER.
 5. After insertion, maintain sufficient pressure to hold tube tight against the host pipe.
- C. Curing:
1. Complete a curing process control sheet for every lining completed.
 2. Control sheets shall provide required temperatures and time for the different steps of curing process; initial cure, post cure, and cooling as outlined in ASTM F1216.
 - a. Initial cure may be considered completed when exposed portions of flexible tube pipe take a hard set and temperature is adequate, as recommended by manufacturer.
 3. After installation, apply steam, hot water, or ultraviolet (UV) light as recommended by liner manufacturer.
 - a. Steam:
 - 1) Provide safety system specifically structured for use of steam.
 - 2) Thermoset Resin: Designed to cure properly when using steam.
 - 3) CIPP Tube Thermoplastic Coating:
 - a) Formulated from material designed specifically to withstand high temperature curing process utilizing steam.
 - b) Polypropylene/polyethylene blend or equal.
 - 4) Equipment:
 - a) Heat source shall be capable of delivering steam throughout section and uniformly raising steam temperature above temperature required to affect cure of resin.
 - b) Install temperature gauges in the following areas:
 - (1) Incoming steam supply.
 - (2) Outgoing steam supply.
 - (3) Between impregnated tube and pipe invert at lining termination point (lowest elevation point).

- 5) Steam Temperature: 230 degrees F, minimum.
 - 6) Minimum Interface Temperature between Liner and Tube: 120 degrees F.
 - 7) Pressure Required to Keep Tube Inflated: Per manufacturer's instructions.
 - 8) Time: Per manufacturer's instructions.
 - 9) Cool Down:
 - a) Send air through steam cured CIPP liner until liner cools down to 120 degrees F interface temperature.
 - b) Once 120 degrees F has been reached, water may be introduced to finish cooling line down to 90 degrees F.
 - c) During release of water, prevent vacuum that could damage newly installed CIPP.
- b. Hot Water:
- 1) Equipment:
 - a) Heat source shall be capable of delivering hot water throughout section and uniformly raising water temperature above temperature required to affect cure of resin.
 - b) For diameters, smaller than 24 inches in diameter Install temperature gauges in the following areas:
 - (1) Incoming water supply.
 - (2) Outgoing water supply.
 - (3) Between impregnated tube and pipe invert at lining termination point.
 - c) For diameters 24 inches and larger utilize a curing temperature monitoring system.
 - (1) To monitor the temperature inside the tube wall and to verify proper curing temperature sensors shall be placed between the host pipe and the liner and in the bottom of the host pipe (invert) throughout the reach to record the heating and cooling that takes place on the outside of the liner during processing.
 - (2) The sensors shall be spaced apart at intervals no greater than 10 feet.
 - (3) Additionally, sensors shall be strategically placed at points where a significant heat sink is likely to be anticipated (such as areas where the host pip is exposed, made of differing materials, or submerged such as under a river crossing.
 - (4) Prior to installing the liner in the host pipe, the temperature monitoring system's functionality shall be confirmed by measuring the ambient temperature with the temperature sensors.
 - (5) No more than two sensors per manhole-to-manhole

- segment can be found faulty during this test. If three or more sensors are discovered faulty, a new sensor array shall be pulled into the host pipe replacing the previously installed array; and the new array shall be again tested for its proper functioning at the CONTRACTOR's expense.
- (6) Curing of the resin system shall be as per the directions of the CIPP manufacturer. The temperatures achieved and the duration of holding of the liner at those temperatures shall be per the CIPP manufacturer's established procedures.
 - (7) If any sensors or sensors along the reach indicates that there is a localized issue with respect to achieving proper curing per the written installation procedure, the CONTRACTOR shall address the issue immediately using previously established protocols for such an event.
 - (8) The sensor array's database required in the above paragraph shall have an output report that identifies each sensor by its station in the reach and shows the maximum temperature achieved during the processing of the CIPP and the time sustained at or above the manufacturer's required curing temperature at each sensor.
- 2) Minimum Interface Temperature between Liner and Tube: 120 degrees F.
 - 3) Time: 3 hours, minimum unless manufacturer recommends otherwise and approved by the OWNER.
 - 4) Cool Down:
 - a) Introduce cool water into CIPP to replace water being drained from small hole made in downstream end.
 - b) Cool liner to temperature below 90 degrees F before relieving hydrostatic head.
 - c) During release of water, prevent vacuum that could damage newly installed CIPP.
- c. UV: If this method of curing is selected, material shall be a polyester needle felt or fiberglass based CIPP liner impregnated with an isophthalic neopentyl glycol resin.
- 1) Curing parameters, such as curing speed, inner air pressure, and wattage, per the manufacturer.
 - 2) Optimal curing speed or travel speed of energized UV light sources is determined for each length of liner based on liner diameter, liner thickness, and exothermic reaction temperature.
 - 3) Invert liner into pipe with standard pressure drum or pull into pipe

- using a slip sheet.
- 4) After completion of inversion process introduce light chain in liner and close ends with couplings.
 - 5) Remove and discard inner film material after curing to provide optimal quality of final product.
 - 6) Control panel operating UV curing unit light chain may be pulled on a trailer attached to UV unit.
 - 7) Flushing of UV cured CIPP liner to reduce styrene residual is not required.
- D. The finished CIPP shall:
1. Be continuous over entire length from manhole to manhole and be free from visual defects such as foreign inclusions, dry spots, keel, boat hull, pinholes, wrinkles, and other deformities.
 2. For lines 24 inches or larger the CIPP shall have no radially positioned (perpendicular to flow) wrinkles, fins or other discontinuities in the lower third of the pipe which exceed more than 3% of the host pipe inside diameter. Have no radial wrinkles, fins or other discontinuities in the upper 2/3rds of the pipe having a height of 5% or more of the host pipe inside diameter, unless approved.
 3. When passing through or terminating in a manhole shall be carefully cut out in a shape and manner approved by OWNER.
 4. Annular space between existing pipe and the CIPP shall be sealed with a hydrophilic rubber joint seal per manufacturer's instructions.
 5. Meet leakage requirements of pressure test as specified in Section 02532, Sanitary Sewers.

3.03 SEALING AND BENCHES IN MANHOLE

- A. CIPP shall make a tight-fitting seal with existing pipe(s) in manhole. For CIPP that is installed continuous through manhole, the top half of the pipe shall be neatly cut off and not broken or sheared off at least 2 inches away from wall. The channel in the manhole shall be a smooth continuation of the pipe(s) and shall be merged with other pipes or channels, if any.
- B. At each pipe opening into manhole, hydrophilic rubber joint seal shall be bonded with adhesive to the host sewer pipe or to the opening in the manhole barrel to hold it in place during inversion and creating a water-tight seal after curing.
- C. Seal CIPP and existing pipe in manhole as stated above before proceeding on to next manhole section. Manholes shall be individually inspected for liner cut-offs, benches, and sealing of liner annular space.

3.04 MANHOLE DROP CONNECTIONS

- A. Drop connections on existing sewer mains shall be abandoned prior to the installation of CIPP by plugging the manhole to pipe connection with a bulkhead and filling the drop assembly with flowable fill.
- B. Use of internal manhole drop connections shall be indicated on the Project Drawings or directed and approved by the OWNER.

3.05 SERVICE LATERALS

- A. Shutdown
 - 1. Notify OWNER at least 1 week prior to the shutdown when it is necessary to shutdown a private service line while Work is in progress and before the service lines are reconnected. Notify building occupants with a KUB approved door hanger not less than 36 hours prior to shutdown.
 - 2. When a service lateral will be disconnected the flow shall be controlled in accordance with Specification 02542, Sewer Flow Control.
 - 3. No service is to remain shut down without sewer flow control or a leak free temporary connection. Otherwise, CONTRACTOR shall then provide temporary living quarters (i.e., hotel) for the resident at no additional cost to OWNER or the resident. Temporary living quarters shall be approved by OWNER and coordinated through OWNER's Customer Support Representative. Commercial sewer services shall be maintained when businesses are open.
- B. Temporary Service Reinstatements
 - 1. The exact location and number of service connections shall be determined from a pre-CCTV inspection and field located by marking existing service connections. CONTRACTOR shall determine and identify all active services. CONTRACTOR shall perform temporary service cut outs at active service connections immediately after liner has cured. Initial internal service cut outs shall be made to the lesser of a 6-inch diameter opening or 90 percent of the original diameter of the connection. Do not damage liner pipe and allow to normalize to ambient temperature before 6-inch diameter hole is drilled out.
 - 2. If the service cannot be replaced through excavation then internally reinstate the service to 100 percent of original opening, and provide a smooth opening with no ragged edges. The OWNER must approve all permanent lateral cut outs.
 - 3. Services shall not be reconnected from abandoned or vacant lots, unless directed otherwise by OWNER. Restore and correct missed or faulty reconnections as well as damage caused to property OWNERS for not reconnecting the services soon enough or for not giving notice to the OWNERS.

C. PERMANENT SERVICE CONNECTION BY EXCAVATION

1. Excavate existing active service connections. Disconnect at joints and existing sewer (now the carrier pipe for the liner) and remove to expose the liner to the extent necessary. Coat cut out hole in liner with approved resin/epoxy that will cure at the ambient temperature.
2. Install PVC saddle tee for the new sewer service lateral over the cut out. Saddle shall be a one-piece saddle attached to the liner with epoxy so that a complete seal is accomplished when the strap-on saddle is tightened with two stainless steel bands; one on each side. The stub-out attached to the saddle shall protrude into liner a distance equal to the wall thickness of liner.
3. All permanent lateral re-instatements shall be completed within 30 days of the initial temporary cut out.
4. Services which are reconnected to rehabilitated liner shall be shown on “as-built drawings” with the distance from the nearest downstream manhole, depth at clean out, and the cleanout distant from mainline.
5. Replace sewer service laterals per Section 02532, Sanitary Sewers (Gravity).

3.06 TESTING FOR ACCEPTANCE

- A. Sampling and Measuring: Two minimum 12-inch long samples shall be cut from the cured liner installation; sample shall be collected and prepared in accordance with restrained sample method described in ASTM F1216 or ASTM F2019. Samples removed for testing shall be individually labeled and logged to record the following:
 1. OWNER’s project number and title.
 2. Sample number.
 3. Segment number of line as noted on supplements.
 4. Date and time of sample.
 5. Name of CONTRACTOR.
 6. Location and by whom tested.
 7. Street name and address.
 8. Test results.
- B. Field Thickness testing shall be in accordance with ASTM D2122. The average thickness, calculated from four measurements on each specimen, shall be equal to or greater than the required design thickness. Plate samples may be used in lieu of restrained samples for pipes greater than 18 inches in diameter and in accordance with ASTM F1216.
- C. Send samples to an independent accredited laboratory and test for modulus of elasticity and flexural strength in accordance with ASTM D790, as directed by OWNER. Failure of any test can be grounds for rejection of the CIPP liner. At the direction of OWNER, the second sample shall be tested. Testing results shall be provided to the OWNER within 7 days of receipt.
- D. Destructive Testing: In cases where test results of samples from the 12-inch long

pipe section are lower than required values, at the direction of OWNER, CONTRACTOR shall cut samples from liner along length of pipe. The size and shape of the samples shall be determined by OWNER. The CONTRACTOR shall repair the CIPP liner and host pipe at no additional cost to OWNER. Failure of the thickness test shall be grounds for rejection for the CIPP liner.

- E. Resin Sampling: “Wet-out” facility resin mixing equipment shall have a valve downstream of the mixing functions and immediately upstream of the application of the mixed resin to the tube where OWNER can draw resin samples. CONTRACTOR’s batch mix facilities, if any, shall provide for sampling of the mixed batch. Submitted “wet-out” schedule cannot be modified without 24-hour notice to OWNER. Resin samples shall be drawn at times determined by OWNER. The OWNER drawing the samples will arrive unannounced and shall be afforded immediate access to the equipment.
- F. CCTV shall be as specified in Section 02541, Sewer Television Inspection. Televising shall be done after service connections have been made, unless required earlier by OWNER. Provide CCTV DVD’s or external hard drive within two weeks after permanent lateral reinstatements have been completed.
- G. For lines 24-inches and less in diameter shall be air tested as specified in Section 02532, Sanitary Sewers after liner has been installed and service lateral connections have been completed.
- H. For lines greater than 24-inches shall be tested as specified in Sections 02532, Sanitary Sewers.
- I. No visible leak around liner at manhole connections will be allowed.
- J. Correct failed liner or liner deemed unacceptable by OWNER as a result of the post-video inspection or test reports for structural values and thickness.
 - 1. Remedy shall be defined as shown in the following table and shall be based upon lowest test in each test category. Where pipe replacement is required, payment shall be made in full for the cured-in-place pipe. No payment will be made to construct a new sewer segment.

PIPE CORRECTION			
TEST	REQ'D VALUE	TEST RESULT	REMEDY
Flexural Strength	Design value per approved submittal	95 to 99% of Req'd value	10% Unit Price Reduction
	Design value per approved submittal	90 to 94% of Req'd value	30% Unit Price Reduction
	Design value per approved submittal	Less than 90% of Req'd value	Pipe Replacement
Flexural Modulus	Design value per approved submittal	95 to 99% of Req'd value	10% Unit Price Reduction
	Design value per approved submittal	90 to 94% of Req'd value	30% Unit Price Reduction
	Design value per approved submittal	Less than 90% of Req'd value	Pipe Replacement
Thickness	Design Value per approved submittal	95 to 99% of Req'd value	10% Unit Price Reduction
	Design Value per approved submittal	90 to 94% of Req'd value	30% Unit Price Reduction
	Design Value per approved submittal	Less than 90% of Req'd value	Pipe Replacement

END OF SECTION

SECTION 02547
MANHOLE REHABILITATION

PART 1. GENERAL

1.01 SCOPE

- A. This specification details the materials, products, and performance requirements for the rehabilitation of sanitary sewer manholes. This specification includes lining manhole interiors, chimney liner seals, and reconstruction of manhole benches and channels.
- B. Refer to Specification 02547, Manholes, for frame and cover replacement, re-installations, and adjustments.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Manufacturer's literature & product data describing the following:
 - a. Rehabilitation System
 - b. Equipment Components
 - c. Material/chemical properties
 - d. Mixing and proportioning requirements
 - e. Maximum pot life
 - f. Coating thickness
 - g. Curing
 - h. Environmental requirements for application
 - i. Epoxy Resins: Specifications, Characteristics, and Properties
 - j. Hydraulic cement
- B. Informational Submittals:
 - 1. Manufacturer's certificate of compliance
 - 2. Safety Data Sheets (SDS)
 - 3. Manufacturer's instructions on shipping, storage, and handling requirements
Manufacturer's application and repair instructions
 - 4. Testing, certification, and warranty sample statements
 - 5. Confined space entry plan
 - 6. Qualifications and experience history of installers

1.03 QUALITY PERFORMANCE

- A. Mortar mix for cementitious lining shall have at least 5 years of successful performance in similar applications, and shall be supplied by an ISO 9002 certified manufacturer. Manufacturer's ISO 9002 certificate shall be submitted to the OWNER.
- B. Installers shall have a minimum of 5 years of experience installing the product provided, and shall be certified by the manufacturer. Installers of liners, coatings, and wall repair systems shall submit qualifications and include:
 - 1. Manufacturer's approved equipment list, by name and model number for application of product and CONTRACTOR's equipment list showing approved equipment available for use in product application.
 - 2. List of CONTRACTOR's personnel who have satisfactorily completed manufacturer's training in product application within previous two years. Include date of certification for each person.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products as recommended by the manufacture to prevent damages. Deliver lining products to site in unopened containers that clearly show, at time of use, product name, date of manufacture, batch number, and name manufacturer. Materials shall be made safe from theft, vandalism, and damage.
- B. Store lining products in protected area with heating or cooling to maintain temperatures within range recommended by lining manufacturer.
- C. All products and materials specified herein shall be inspected at the request of OWNER or RESIDENT PROJECT REPRESENTATIVE. All materials that fail to conform to these Specifications shall be rejected. After delivery to the Site, any materials that have been damaged in transit or are otherwise unsuitable for use in the Work shall be rejected and removed from the Site by the CONTRACTOR at no cost to the OWNER.
- D. The CONTRACTOR shall dispose of all wastes in accordance with all applicable laws, codes, and regulations.

1.05 PERFORMANCE REQUIREMENTS

- A. Perform work needed to make manholes structurally sound, improve flow, prevent entrance of inflow or groundwater, prevent entrance of soil or debris, and provide protection against corrosion.

B. Manufacturer's Product Support:

1. Through the CONTRACTOR, manufacturers of wall sealing, coating or lining systems shall submit to the Engineer for review and approval a detailed description of the proposed rehabilitation process. Describe surface preparation, independent laboratory test results, mix design procedures and methods of controlling uniform thickness.
2. A representative employed by the manufacturer and having technical training in admixture and concrete mix design shall be named and available for consultation by telephone during business hours and on site upon 48 hours notice.
3. Manufacturer's representative on concrete lining systems shall provide technical assistance to concrete batch plant operators to ensure proper usage of dispensing equipment and accurate proportions of admixtures.

1.06 PROJECT CONDITIONS

A. Manholes Containing Mechanical or Electrical Equipment:

1. Contract Drawings may not show locations of flow monitoring equipment. If a manhole contains any mechanical hardware or electrical flow monitoring equipment, do not remove or disturb and immediately notify the OWNER or RESIDENT PROJECT REPRESENTATIVE.
2. Reschedule work in such manholes until equipment has been removed by OWNER and further instructions are given.
3. Do not subject manholes with mechanical hardware or electrical equipment to diversion/bypass pumping.
4. Damage to installed equipment, due to negligence of CONTRACTOR, will be repaired by OWNER and cost of repairs charged to CONTRACTOR.

B. Field Location of Manholes, Cleanouts and Inlets:

1. CONTRACTOR is responsible for locating and uncovering all manholes and cleanouts in lines being rehabilitated. If difficulty is encountered in locating a manhole or clean-out covered by ground or pavement, notify the OWNER or RESIDENT PROJECT REPRESENTATIVE and await instructions.
2. Manholes may be located within project limits which are not part of the system being rehabilitated. Properly identify manholes before starting cleaning and sealing operations.

PART 2. PRODUCTS

2.01 MATERIALS

A. General:

1. The materials used shall be designed, manufactured and intended for sewer manhole rehabilitation and the specific application in which they are used. The materials shall have a proven history of performance in sewer manhole rehabilitation. The materials shall be delivered to the job site in original unopened packages and clearly labeled with the manufacturer's identification and printed instructions. All materials shall be mixed and applied in accordance with the manufacturer's written instructions.
2. Each lining system shall be designed for application over wet (but not active running water) surfaces without degradation of the final product and the bond between the product and the manhole surfaces.

B. Mortar

1. Standard premixed in accordance with ASTM C387/C387M, or proportion one part Portland cement to two parts clean, well-graded sand that will pass a 1/8-inch screen.

C. Hydraulic Cements:

1. Rapid-setting, high early strength, cementitious product specifically formulated for high volume leak control.
 - a. Manufacturers and Products:
 - 1) Strong Systems, Inc; Strong-Seal Plug.
 - 2) Quadex; Quad-Plug.
 - 3) Improved Construction Methods (ICM); ThoRoc Plug.
2. Rapid setting, fiber-reinforced, high-early-strength, corrosion-resistant material formulated for filling voids and repairing inverts in concrete, brick, or other masonry constructed structures
 - a. Manufacturers and Products:
 - 1) Strong Systems, Inc; Strong-Seal QSR.
 - 2) Quadex; Hyperform.
 - 3) Improved Construction Methods (ICM); ThoRoc Patch.
 - 4) IPA; Octocrete.

D. Chemical Pressure Grouting System:

1. General: Where pressurized injection of chemical grout behind manhole chimney and joints is required, material supplied shall be urethane gel or polyurethane resin with following properties:
 - a. During injection, chemical sealant shall be able to react/perform in presence of infiltration water.

- b. Cured sealant capable of withstanding submerged conditions, freeze/thaw, and wet/dry cycles without degradation. Must prevent passage of water and must be flexible, chemically stable, and resistant to sewer environments.
- 2. Urethane Gel Products and Materials:
 - a. Avanti International; AV-350 multi-grout or AV-254 urethane gel.
- 3. Polyurethane Resin Grout:
 - a. Viscosity: 120 to 350 centipoise.
 - b. Weight Per Gallon: 8.65 pounds to 9.48 pounds per gallon.
 - c. Solids Content, ASTM D2834: 88 percent to 100 percent.
 - d. Induction Time: 3 minutes to 4 minutes.
 - e. Cure Time: 5 minutes to 6 minutes.
 - f. Tensile Strength, ASTM D3574: 40 psi to 450 psi.
 - g. Elongation, ASTM D3574: 3 percent to 350 percent. Shrinkage, ASTM D1042: Less than 2 percent. Initial Linear Shrinkage: 9 percent.
 - h. Tear Resistance, ASTM D3574: 21 pounds per inch.
 - i. Density, ASTM D3574: 38 pounds to 119 pounds per cubic foot.
 - j. No catalyst required; single component product.
- E. Spray applied Cementitious manhole coating:
 - 1. Design Mix:
 - a. Preblended mixture of cements, chemically active aggregates, glass fibers, and other additives. No material, other than potable water, shall be used with or added to design mix without prior approval or recommendation from the OWNER.
 - b. One-component, rheoplastic, fiber or polypropylene-reinforced, shrinkage compensated mortar lining system with the following minimum requirements at 28 days:
 - 1) Compressive Strength (ASTM C109/C109M): 8000 psi
 - 2) Tensile Strength (ASTM C-496/C496M): 800 psi
 - 3) Flexural Strength (ASTM C-293/C-293M): 1200 psi
 - 4) Shrinkage (ASTM C-596): 0% at 90% R.H.
 - 5) Minimum Bond (ASTM C-952): 200 psi
 - 6) Slant Shear Bond Strength (ASTM D882): 2400 psi
 - 7) Freeze/Thaw – 100 cycles, ASTM C666/C666M No Visible Damage
 - 8) Density, when applied 105" pcf
 - c. Product shall be made with calcium aluminate cement except in cases when cementitious lining is used as underlayment for epoxy lining.

F. Spray applied Epoxy Coating for manholes:

1. Products shall meet federal, state, and local requirements limiting emissions of volatile organic compounds. Materials, including underlayment and monolithic lining shall be produced by same manufacturer.
2. Characteristics:
 - a. Materials: 100 percent solids, plural component epoxy, capable of spray or roller application.
 - b. Moisture Tolerant: System capable of application to damp concrete surfaces in high relative humidity environment.
 - c. Chemical Resistance: Resistant to attack from hydrogen sulfide and sulfuric acids generated from microbiological sources.
3. Properties:
 - a. Bond Strength, ASTM C478: Concrete failure
 - b. Tensile Strength, ASTM C307: 2,500 psi, minimum
 - c. Flexural Strength, ASTM C580: 4,800 psi
 - d. Moisture Absorption, ASTM C413: 0.1 percent
 - e. Shrinkage, ASTM C631: 0.11 percent, maximum

G. Forming and placing a concrete lining between the forms and existing manhole wall.

1. The concrete shall be Type I portland cement concrete with 3/4 inch minus coarse aggregate with fiber reinforcement and plasticizer producing a compressive strength of 4,000 psi at full cure. (Other formulations and filler materials may be selected to meet specific problems.) When corrosive elements are present, a white ribbed plastic liner shall be anchored into the new interior wall during the procedure to create an impermeable barrier.
2. Cast-in-Place, seamless concrete wall lining within the existing manhole from the pipe invert to the bottom of the frame shall be by the Permaform process or approved equal.

H. Chimney Liner Seals:

1. Manufacturers and Products:
 - a. Cretex Specialty Products; Internal Manhole Chimney Seal.
 - b. NPC, Inc.; FlexRib Chimney Seal.
 - c. Sealing Systems, Inc.; Flex-Seal.

PART 3. EXECUTION

3.01 REHABILITATION OF MANHOLE STRUCTURES

A. General Procedures:

1. **Safety:** The CONTRACTOR shall perform all work in strict accordance with all applicable OSHA standards. Particular attention is drawn to those safety requirements regarding confined space entry. Provide barricades, warning lights and signs for excavations.
2. **Maintaining waste water flows:** By-pass pumping shall be conducted in accordance with Section 02540, Sewer Flow Control.
3. **Cleaning:** All concrete and masonry surfaces to be rehabilitated shall be clean. All grease, oil, laitance, coating, loose bricks, mortar, unsound concrete and other foreign materials shall be completely removed. Water blasting with proper nozzles shall be the primary method of cleaning; however, other methods such as wet or dry sandblasting, acid wash, concrete cleaners, degreasers or mechanical means may be required to properly clean the surface to meet the manufacturer's requirements. All surfaces on which these methods are used shall be thoroughly rinsed, scrubbed, and neutralized to remove cleaning agents and their reactant products. Debris resulting from cleaning shall be removed from the manhole and not allowed to be carried downstream.
4. **Stopping Infiltration:** After surface preparation and prior to the application of linings and coatings, infiltration shall be eliminated with the materials specified herein and in accordance with the manufacturer's recommendation. Remove existing roots prior to application by cutting them flush with the manhole wall.
5. **Patching:** Prepare surfaces with any necessary patching in accordance with manufacturer's instructions. All holes, voids, cracks, and disintegrated material shall be patched or repointed, providing a subbase that meets the manufacturer's recommendations.
6. **Invert & channel repairs:** Remove all loose grout and rubble from existing channel. Rebuild channel if required by reshaping, repairing slope of shelves or benches. Work shall include aligning inflow and outflow ports in such a manner as to prevent the deposition of solids at the transition point. All inverts shall follow the grades of the pipe entering the manhole. Changes in direction of the sewer and entering branch or branches shall have a true curve as large a radius as the size of the manhole will permit, but will be shaped to allow easy entrance of maintenance equipment including buckets, T.V. camera, etc.

7. Manhole steps: Existing manhole steps shall be cut and removed and not replaced after rehabilitation.
8. All abandoned pipe and associated connections to the manhole shall be properly sealed with a bulkhead and filled with grout prior to manhole rehabilitation.

3.02 APPLICATION OF CEMENTITIOUS COATING

- A. Clean and prepare substrate surfaces in accordance with these specifications, and recommendations of manufacturer. Materials shall be spray applied to a minimum uniform thickness to insure that all cracks, crevices, and voids are filled and to a somewhat smooth surface.
- B. Bonding agent: Apply to existing surface per the manufactures recommendations to provide firm adhesion between original and new material.
- C. Apply cementitious lining material per manufactures recommendations to a minimum thickness of 1-inch for depth. For manhole depths greater than 12 feet increase the minimum thickness to 1 ½ inches below the 12 foot depth. Cementitious lining shall be applied to fresh mortar before new bacterial growth or debris can contaminate underlying mortar.
- D. The bench and invert shall be sprayed such that a gradual slope is produced from the walls to the invert with the thickness at the edge of the invert being no less than 1/8 inch. The wall-bench intersection shall be rounded to a uniform radius the full circumference of the intersection.
- E. No application shall be made to frozen surfaces or if freezing is expected to occur within the manhole for 24 hours after application. Do not apply materials if ambient temperature is below 40 degrees F. If ambient temperatures are in excess of 90 degrees F, precautions shall be taken to keep the mix temperature at time of application below 90 degrees F, using ice if necessary. Do not exceed a mix water temperature of 80 degrees F.
- F. The final application shall be allowed to cure for a minimum of four (4) hours before being subjected to active flow. If the manufacture recommends a longer cure time the CONTRACTOR shall follow the manufactures recommendation.

3.03 SPRAY APPLIED EPOXY COATING

- A. The material shall be spray applied to a minimum uniform dry film thickness of 50 mils to insure all cracks, crevices, and voids are filled and a somewhat smooth surface remains. Apply material per the manufactures recommendation to prevent material run or sag. After the epoxy liner has set, repair any visible pinholes or defects per the manufactures recommendations.

3.04 CHIMNEY LINER SEALS

- A. Chimney liner & seals shall be installed as specified in the Project Drawings and Bid Form.
- B. Internal double pleated elastomeric sleeve shall be mechanically attached to and sealed against the manhole frame and chimney with internal expanding bands.
- C. The inside diameter of both the base of the manhole frame and the chimney or cone/corbel section shall be accurately measured as recommended by the manufacturer to obtain the proper size and shape of the seal.
- D. The contact surfaces for the sleeve shall be circular, clean, reasonably smooth, and free of loose material and excessive voids. If the masonry surface is rough or irregular and will not provide an effective seal, it shall be smoothed with mortar. A bed of butyl rubber caulk shall be applied to the sealing surface of the sleeve to fill minor irregularities in the masonry surface. After the sleeve has been placed in proper position, the bands are positioned and individually tightened or expanded as required to provide a watertight seal. Detailed installation instructions shall be in accordance with the manufacturer's instructions.

3.05 MANHOLE REHABILITATION ACCEPTANCE

- A. After the manhole rehabilitation work has been completed, the manhole shall be visually inspected during high groundwater by the CONTRACTOR in the presence of the Engineer and the work shall be accepted if found satisfactory to the Engineer. No evidence of visible leaks shall be allowed. In addition, at the OWNER's request, the CONTRACTOR may be required within one year to visually inspect the manholes that were rehabilitated. Any work that has become defective within the one year period shall be redone by the CONTRACTOR at no additional expense to the OWNER.

3.06 MANHOLE VACUUM TESTING

- A. All manholes shall be negative air pressure (vacuum) tested in accordance with ASTM C1244.
- B. All manholes are to be vacuum tested following rehabilitation. The ring and lid casting assembly shall be installed prior to testing. The testing system shall be equipped with an inflatable bladder to effect the seal to the manhole, an air pressure gauge, a safety valve for filling the bladder, a 30-inch Hg liquid-filled vacuum gauge, a double air exhaust manifold with quarter turn ball valves, three bolt-on feet, and a bridge assembly with height adjustment rod.
- C. The CONTRACTOR shall plug all pipe openings, taking care to securely brace the plugs and the pipe. The plugs shall be placed a minimum of 6" beyond the manhole wall.
- D. The vacuum tester shall be placed on the manhole casting and operated in accordance with the manufacture's recommendation to evacuate the manhole to 10" Hg and monitor the vacuum for the specified time period. If the vacuum does not drop in excess of 1" Hg over the specified time period, the manhole is considered acceptable and passes the test. If the manhole fails the test, identify the leaking areas by removing the head assembly, coating the interior surfaces of the manhole with a soap and water solution, and repeating the vacuum test for approximately thirty seconds. Once the leaks have been identified, complete all necessary repairs with an OWNER approved method, and repeat test procedures until satisfactory results are obtained.
- E. Upon the approval of the OWNER, the CONTRACTOR may test manholes greater than 72-inches in diameter at a reduced negative pressure.

VACUUM TEST TIMETABLE			
Manhole Diameter - Inches			
Depth - Feet	48"	60"	72"
4'	10 sec.	13 sec.	16 sec.
6'	15 sec.	20 sec	25 sec.
8'	20 sec.	26 sec.	32 sec.
10'	25 sec	33 sec.	41 sec.
12'	30 sec.	39 sec.	48 sec.
14'	35 sec.	46 sec.	57 sec.
16'	40 sec.	52 sec.	64 sec.
18'	45 sec.	59 sec.	73 sec.
20'	50 sec.	65 sec.	80 sec.
22'	55 sec.	72 sec.	89 sec.
24'	60 sec.	78 sec.	97 sec.
26'	64 sec.	85 sec.	105 sec.
28'	69 sec.	91 sec.	113 sec.
30'	74 sec.	98 sec.	121 sec.

- A. Epoxy Lined Manhole Testing:
 - 1. Wet Film Thickness Gauge: During application, use wet film thickness gauge; meet ASTM D4414 to ensure monolithic coating and uniform thickness.

- B. Holiday Detection:
 - 1. In accordance with NACE SPO 188.
 - 2. After 24 hours minimum, spark test lining system to ensure pinhole-free lining.
 - 3. Mark defects and repaired per manufacturer's instructions.

END OF SECTION

SECTION 02548
CURED-IN-PLACE PIPE LATERAL LINER

PART 1. GENERAL

1.01 SCOPE

- A. Rehabilitation of existing gravity sewer laterals by the Cured-in-Place-Pipe (CIPP) process.

1.02 DESIGN CRITERIA

- A. Design liner thickness in accordance with ASTM F1216, F1743, or F2019 (as appropriate for the proposed liner product) using the following criteria:
 - 1. Pipe Diameters: Per Project Drawings
 - 2. Ovality: 3 percent, or as shown on plans
 - 3. Pipe Condition: Fully deteriorated
 - 4. External Water: Ground Surface
 - 5. Short-Term Tensile Strength (ASTM D638): 3,000 psi
 - 6. Tensile Strength Reduction Factor: 50 percent
 - 7. Long-Term Tensile Strength: 1,500 psi
 - 8. Flexural Strength (ASTM D790): Unreinforced: 4,500 psi.
 - 9. Short-Term Flexural Modulus (ASTM D790): 250,000 psi, or as shown on plans
 - 10. Flexural Modulus and Flexural Strength Reduction Factor: 50 percent
 - 11. Long Term Flexural Strength: Unreinforced: 2,250 psi
 - 12. Long-Term Flexural Modulus: 125,000 psi, or as shown on plans
 - 13. k Enhancement Factor: 7
 - 14. Soil Modulus: 1,000 psi, or as shown on plans
 - 15. Soil Density: 120 pcf, or as shown on plans
 - 16. Highway Live Load: AASHTO HS20-44
 - 17. Safety Factor: 2 minimum
 - 18. Minimum Thickness: 3 millimeters
 - 19. Poisson's Ratio: 0.3
 - 20. Liner shall be watertight

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Manufacturer's technical literature on proposed lining system.
 - 2. Resin:
 - a. Specifications
 - b. Characteristics
 - c. Properties

- d. Itemize exceptions and deviations to Specification
 3. Annular space sealant
 4. Service connection seals
- B. Informational Submittals:
1. Design calculations:
 - a. Liner thickness design calculations signed and sealed by Professional Engineer in the State of TN.
 - b. Manufacture certification of material to values utilized in calculations.
 - c. If reinforced liners are proposed, submit long-term ASTM D790 and ASTM D2990 test data supporting reduction factor used in design.
 2. Manufacturer's installation instructions and procedures. Furnish information, essentially in the same format as below, or give details of the procedure and the steps to be followed for the installation of the CIPP, even if the process is named in the Specification.
 - a. Wet Out
 - b. Insertion
 - c. Curing
 - d. Cool Down
 - e. Finished Pipe
 3. "Wet out" and curing schedule.
 4. Installer's and accredited testing laboratory statement of qualifications.
 5. Manufacturer's Certificate of Compliance certifying compliance with the applicable specifications and standards.
 6. Warranty and/or Special Guarantee.
 7. Manufacturer's instructions for material shipping, storage, and handling requirements.
 8. Certified copies of test reports of factory tests required by the applicable standards and this Section.
 9. Dye testing results
 10. DVD or external hard drive of both pre- and post CCTV inspections.

1.04 QUALITY ASSURANCE

- A. Installer shall be trained and approved by manufacturer of lateral liner system and method of curing. Installer shall provide documentation, including references, of projects completed within the past 3 years and having a minimum of 1,000 lateral installations with the selected lateral lining system.
- B. Superintendent shall have minimum of 3 years of onsite experience with the selected lateral lining system.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products as recommended by the manufacture to prevent damages. Materials shall be made safe from theft, vandalism, and damage.
- B. All products and materials specified herein shall be inspected at the request of OWNER or RESIDENT PROJECT REPRESENTATIVE. All materials that fail to conform to these Specifications shall be rejected. After delivery to the Site, any materials that have been damaged in transit or are otherwise unsuitable for use in the Work shall be rejected and removed from the Site by the CONTRACTOR at no cost to the OWNER
- C. Ship resin directly to wet-out facility from manufacturer.
- D. Maintain resin-impregnated tubes in refrigerated truck trailers at a temperature below 45 degrees F to prevent premature curing. Prior to beginning inversion, no portion of the resin-impregnated liner shall be subjected to sunlight or ultraviolet radiation. Resin-impregnated tubes with signs of premature curing shall not be installed and shall be removed from the Project Site.

1.06 SPECIAL GUARANTEE

- A. Provide manufacturer's extended guarantee or warranty, with OWNER named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at the option of the OWNER, removal and replacement of Work specified in this Specification section found defective, due to material or workmanship failure, during a period of 5 years after the date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in the General Conditions. A warranty inspection can be completed by the OWNER up to 5 years after final acceptance.

PART 2. PRODUCTS

2.01 MATERIALS

- A. Resin:
 - 1. Unless otherwise specified, CONTRACTOR shall furnish a general purpose, unsaturated, polyester, epoxy, isophthalic neopentyl glycol, or thermosetting vinyl ester resin, catalyst system, initiators, or hardeners that provide specified cured physical strengths and properties, and compatible with reconstruction inversion process.
 - 2. Resistant to municipal wastewater environment; immersion in septic sewage at temperatures up to 75 degrees F.

3. Curing:
 - a. Designed to cure properly within selected curing method.
 - b. Initiation Temperature: 180 degrees F, maximum for water cure.
 4. Resins shall be chemical resistant and tested and manufactured in accordance with ASTM F1216 and ASTM D543.
 5. PET fibers, resins, resin fillers, resin additives, and resin enhancement agents are prohibited. Only neat resins are acceptable.
 6. Old resins and reworked resins are prohibited, regardless of whether or not they are mixed with new resin.
 7. Produce a cured tube resistant to shrinkage that will not corrode or oxidize and is resistant to abrasion from solids, grit, and sand in wastewater.
 8. Bond between tube layers shall be strong and uniform. Layers, after cure, shall be saturated with resin.
 9. Resin system shall be manufactured by a company selected by CIPP lateral liner supplier.
 10. Manufacturers and Products:
 - a. Reichhold
 - b. Interplastic Corporation
 - c. Ashland Specialty Chemical Company
 - d. AOC
- B. Catalysts:
1. Primary catalyst shall not exceed 1 percent of the resin by volume.
 2. Secondary catalyst shall not exceed 1/2 percent of the resin by volume.
 3. Catalysts shall be:
 - a. Primary Catalyst: Akzo Products, or as required to meet the performance requirements of the liner.
 - b. Secondary Catalyst: Akzo Products or Puritan Products, or as required to meet the performance requirements of the liner.
- C. Lateral Lining Tube:
1. Consist of layers of flexible nonwoven and absorbent polyester felt manufactured under quality controlled conditions set by manufacturer and applicable requirements set forth in ASTM F1216 and ASTM F1743 that, when cured, will be chemically resistant to reagents as defined in ASTM D543.
 2. Lining shall be correct diameter; after installation there shall be no wrinkles or form permanent fins. Tube shall be capable of stretching to fit irregular pipe sections and fabricated and sized for each section to ensure snug and firm fit inside existing sewer; produce required thickness after resin is cured.
 3. Wastewater-contact inside layer of tube shall be coated with an impermeable material compatible with resin and felt and shall not be a dark or non-reflective nature that inhibits proper closed circuit television inspection.

4. Capable of conforming to offset joints, bells, 45-degree bends, 90-degree bends, and disfigured pipe sections.
 5. Manufacturers and Products:
 - a. Performance Liner and T-Liner, LMK Technologies
 - b. Top Seal, Amerik Supplies, Inc.
 - c. Service Connection Seal + Lateral, BLD Services, LLC
- D. Interface Seal:
1. Structural properties in accordance with ASTM F1216 and as referenced in the design criteria and compatible with the main line liner and proposed lateral liner.
 2. Meet the 50-year design life of the CIPP lateral liner.
 3. Designed to be installed via remote device without excavation or installation of cleanout.
 4. One piece construction and designed such that when expanded shall tightly fit both T and Y connections at interface between mainline and lateral pipe.
 5. Provide a watertight connection between service connection and mainline.
 6. Conform to one of the following two methods:
 - a. Method A Sectional Type Seals: A full-circle 16-inch long CIPP mainline liner integrally manufactured to lateral liner providing a seamless connection between mainline liner and lateral liner. Required if mainline does not have a CIPP lining.
 - b. Method B Brim Type Seals: Provide 3-inch minimum overlap inside of mainline. One-piece construction designed such that when expanded shall tightly fit both "T" and "Y" connections at interface between mainline and lateral pipe. Permissible only if mainline has a CIPP lining.
 7. Shall extend inside the lateral pipe past the first lateral joint up to 3 feet.
- E. Cleanouts and Boxes: As specified in Section 02532, Sanitary Sewers (Gravity).

PART 3. EXECUTION

3.01 WORKER SAFETY

- A. Contractor shall implement all current recommendations, guidelines, and regulations of the National Institute for Occupational Safety and Health (NIOSH), and the Occupational Health and Safety Administration (OSHA) for the safety of workers and the public affected by the CIPP installation.
- B. Records of any complaints or incidents shall be provided to the OWNER.

3.02 PRE-INSTALLATION PREPARATIONS

- A. Complete the following activities, unless approved otherwise by OWNER:
1. Confirm mainline CIPP liner has been installed and approved by OWNER, if applicable. Lateral liner shall not be installed prior to acceptance of mainline CIPP liner by OWNER.
 2. Pre-Insertion Cleaning: Rewash, re-clean and ready existing sewer pipe immediately before the pre-insertion television inspection.
 3. Pre-Insertion CCTV Inspection: Inspect sewer pipe before insertion of resin impregnated tube to ensure pipe is clean and existing pipe conditions are acceptable for lining. Provide a DVD of the CCTV inspection.
 4. Dye Testing: Where sewer line segments may contain abandoned services, CONTRACTOR shall be responsible for performing dye testing to determine if the services are live and require re-instatement.
 5. Bypassing Wastewater: Reference Section 02542, Sewer Flow Control.
 6. Establish appropriate Traffic Control in accordance with 01550, Work Zone Traffic Control.
 7. Line Obstructions: If pre-insertion video CCTV inspection reveals an obstruction in the existing pipe (such as heavy solids, dropped joints, protruding service taps or collapsed pipe which may prevent completion of the inversion process), that is not identified on the Project Drawings and cannot be removed by sewer cleaning equipment, then CONTRACTOR notify the OWNER.

3.03 INSTALLATION

- A. Wet Out
1. Verify lateral diameter and length in field before fabricating lateral liner system.
 2. Wet out shall be vacuum impregnated with resin under controlled conditions.
 3. Use roller system to uniformly distribute resin throughout tube.
 4. Resin shall fill all voids in tube material with no air spaces or pockets.
 5. Handle resin impregnated tube to retard or prevent settling until it is read for insertion.
 6. Use of alternative methods of resin impregnation shall be approved by the OWNER prior to implementation.
- B. Insertion:
1. Install CIPP in accordance with practices outlined in ASTM F1216 for direct inversion installations and ASTM F1743 for pull in installations.
 2. Dewater existing host pipe for CIPP installation that does not use inversion method to expand tube against pipe wall.
 3. Use lubricant as recommended by manufacturer; no resin shall be lost by contact with pipe during pull-in process.

4. Insert wet-out lining system remotely from main by means of inversion process or pulled-in method, and application of hydrostatic head sufficient to extend tube fully to lateral termination point.
 5. Utilize a hydrophilic sealant (or equivalent) to enhance a watertight seal.
 6. Once installation has begun, maintain pressure sufficient to hold tube tight against host lateral pipe.
 7. Complete installation process control sheet for every lateral lining completed. Control sheet shall provide the following information:
 - a. Type of connection seal
 - b. Lateral liner length
 - c. Hydrostatic head at point of inversion
 - d. Hydrostatic head at termination point
 - e. Time inversion process started
 8. Trim back cured liner/resin composite pipe left protruding from main line or service connection using hydraulic-powered robotic cutting device specifically designed for cutting cured-in-place pipe.
 9. Remove materials from sewer system and prevent from floating downstream. CONTRACTOR will be held responsible for cost of repairs or maintenance resulting from materials accumulating in downstream pump stations.
- C. Interface Seal:
1. Install from mainline sewer and extend inside lateral for a distance specified on the project drawings; or a minimum of 3 feet.
 2. No clean out is required for installation of connection seal to lateral liner system.
 3. Do not install in presence of active infiltration. To control infiltration at lateral interface seal use materials compatible with both mainline liner and lateral line.
- D. Curing: After installation ambient cure or, apply steam, hot water, or ultraviolet (UV) light as recommended by liner manufacturer.
1. General:
 - a. Complete curing process control sheet for every lateral liner completed.
 - b. Control sheets shall provide required temperatures and time for the different steps of curing process; initial cure, post cure, and cooling as outlined in ASTM F1216.
 - c. Initial cure may be considered complete when exposed portions of flexible tube pipe take a hard set and temperature is adequate, as recommended by manufacturer.
 2. Ambient Cure:
 - a. The wet-out liner shall be loaded inside a pressure apparatus above ground and winched into place using a robot and camera system.
 - b. Pressure Required to Keep Tube Inflated: Per manufacturer's instructions.

- c. Time: Per manufacturer's instructions.
- d. Cool Down:
 - 1) The Installer shall cool the hardened CIPP to a temperature to approximately 90 degrees F before relieving the pressure in the pressure apparatus.
- 3. Steam:
 - a. Provide safety system specifically structured for use of steam.
 - b. Equipment:
 - 1) Heat source shall be capable of delivering steam throughout section and uniformly raising steam temperature above temperature required to affect cure of resin.
 - 2) Install temperature gauges in the following areas:
 - a) Incoming steam supply
 - b) Outgoing steam supply
 - c) Between impregnated tube and pipe invert at lining termination point
 - c. Steam Temperature: 230 degrees F, minimum.
 - d. Interface Temperature between Liner and Tube: 120 degrees F, minimum.
 - e. Pressure Required to Keep Tube Inflated: Per manufacturer's instructions.
 - f. Time: Per manufacturer's instructions.
 - g. Cool Down:
 - 1) Send air through steam cured CIPP liner until liner cools down to 120 degrees F interface temperature.
 - 2) Once 120 degrees F has been reached, water may be introduced to finish cooling line down to 90 degrees F.
 - 3) During release of water, prevent vacuum that could damage newly installed CIPP.
- 4. Hot Water:
 - a. Equipment:
 - 1) Heat source shall be capable of delivering hot water throughout section and uniformly raising water temperature above temperature required to affect cure of resin.
 - 2) Install temperature gauges in the following areas:
 - a) Incoming water supply
 - b) Outgoing water supply
 - c) Between impregnated tube and pipe invert at lining termination point
 - b. Interface Temperature between Liner and Tube: 120 degrees F, minimum.
 - c. Time: 3 hours, minimum

- d. Cool Down:
 - 1) Introduce cool water into CIPP to replace water being drained from small hole made in downstream end.
 - 2) Cool liner to temperature below 90 degrees F before relieving hydrostatic head.
 - 3) During release of water, prevent vacuum that could damage newly installed CIPP.
- 5. UV:
 - a. Curing parameters, such as curing speed, inner air pressure, and wattage, per manufacturer recommendations.
 - b. Optimal curing speed or travel speed of energized UV light sources is determined for each length of liner based on liner diameter, liner thickness, and exothermic reaction temperature.
 - c. Invert liner into pipe with standard pressure drum.
 - d. After completion of inversion process introduce light chain in liner and close ends with couplings.
 - e. Remove and discard inner film material after curing to provide optimal quality of final product.
 - f. Control panel operating UV curing unit light chain may be pulled on a trailer attached to UV unit.
 - g. Flushing of UV cured CIPP liner to reduce styrene residual is not required.

3.04 SERVICE LATERAL SHUTDOWN

- A. Notify OWNER at least 1 week prior to the shutdown when it is necessary to shutdown a private service line while Work is in progress and before the service lines are reconnected. Notify building occupants with a KUB approved door hanger not less than 36 hours prior to shutdown.
- B. When a service lateral will be disconnected the flow shall be controlled in accordance with Specification 02542, Sewer Flow Control.
- C. No service is to remain shut down without sewer flow control or a leak free temporary connection. Otherwise, CONTRACTOR shall then provide temporary living quarters (i.e., hotel) for the resident at no additional cost to OWNER or the resident. Temporary living quarters shall be approved by OWNER and coordinated through OWNER's Customer Support Representative. Commercial sewer services shall be maintained when businesses are open.

3.05 FIELD QUALITY CONTROL

- A. The finished CIPP shall be continuous over entire length and shall be free from visual defects such as foreign inclusions, dry spots, keel, boat hull, pinholes, wrinkles, and other deformities.
 - 1. Defects and deformities may, at the discretion of the OWNER, be cause for rejection of entire liner. CONTRACTOR shall correct deficiencies at not additional cost to the OWNER.
 - 2. Method of repair, which may require field or workshop demonstration, shall be approved by OWNER prior to commencement of work.
 - 3. Where repair of the liner is not achievable or acceptable to the OWNER, CONTRACTOR shall replace the service line using conventional methods.

- B. CCTV shall be as specified in Section 02541, Sewer Television Inspection. Televising shall be done after service connections have been made, unless required earlier by OWNER. Provide CCTV DVD's or external hard drive within two weeks after permanent lateral reinstatements have been completed.

- C. Low Pressure Air Test Procedure:
 - 1. Test each lateral in accordance with the procedure described herein.
 - 2. Place test balls no more than 5 inches inside CIPP lateral liner at upper point of repair.
 - 3. Place test balls in mainline a minimum of 12 inches from and centered on lateral opening.
 - 4. Introduce air into sealed line until internal pressure of 4.0 psig is achieved.
 - 5. Allow pressure to stabilize for 2 minutes, but in no case let pressure drop to less than 3.5 psig.
 - 6. Failed Test:
 - a. If pressure drops 0.5 psig in less than 4 minutes, test will be considered to have failed.
 - b. If lined lateral fails air test, locate leak and perform corrective measures including:
 - 1) Re-inspection of lateral by CCTV
 - 2) Repair using materials and methods specified
 - 3) Repeat air test

- D. Laboratory Testing:
 - 1. Samples: For every 10 laterals lined, two flat plate samples shall be processed and tested. Samples removed for testing shall be individually labeled and logged to record the following:
 - a. OWNER's project number and title
 - b. Sample number
 - c. Segment number of line as noted on supplements
 - d. Date and time of sample
 - e. Name of CONTRACTOR

- f. Location and by whom tested
 - g. Street name and address
 - h. Test results
2. CONTRACTOR shall prepare the flat plate samples onsite using the actual CIPP liner being installed. Once the liner is applied to the clamped mold, the Sample shall be placed in either the upstream or downstream manhole, to simulate the environmental conditions that the lateral liner being installed will experience during the curing process. After the curing process has being completed, the sample shall be removed, labeled, and sent to the laboratory facility for physical properties testing.
 3. Field Thickness testing shall be in accordance with ASTM D2122. The average thickness, calculated from four measurements on each specimen, shall be equal to or greater than the required design thickness. Failure of the thickness test shall be grounds for rejection of all CIPP liners installed since the last successful test.
 4. Samples shall be tested for modulus of elasticity and flexural strength in accordance with ASTM D790. Preparation and testing samples shall be performed in accordance with the approved submittals. Failure of either the modulus or flexural strength tests on either sample shall be grounds for the rejection of all CIPP liners installed since the last successful test.
 5. Testing shall be completed by an accredited laboratory at the CONTRACTOR's expense. Testing results shall be provided to the OWNER within 7 days of receipt.

E. CIPP Correction:

1. Correct failed liner or liner deemed unacceptable by Engineer as result of CCTV inspection, leakage test results, laboratory testing, or thickness test.
2. Remedy for failed laboratory and thickness test shall be as shown in the following table:

Pipe Correction			
Test	Required Value	Test Result	Remedy
Flexural Strength	4,500 psi	4,300 to 4,490 psi	10% unit price reduction
	4,500 psi	4,100 to 4,290 psi	30% unit price reduction
	4,500 psi	Less than 4,100 psi	Pipe replacement
Flexural Modulus	250,000 psi	238,000 to 249,000 psi	10% unit price reduction
	250,000 psi	225,000 to 237,900 psi	30% unit price reduction
	250,000 psi	Less than	Pipe replacement

Pipe Correction			
Test	Required Value	Test Result	Remedy
		225,000 psi	
Thickness	Minimum or design, whichever is greater	$\geq 90\%$ to 100%	No unit price reduction
	Minimum or design, whichever is greater	$\geq 80\%$, but less than 90%	15% unit price reduction
	Minimum or design, whichever is greater	$< 80\%$	Pipe replacement

3.06 CLEANING

- A. After liner installation has been completed and accepted, the CONTRACTOR shall clean up the entire project area and restore Site to its original condition prior to the commencement of work. Excess material and debris not incorporated into the permanent installation shall be disposed of by the CONTRACTOR.

END OF SECTION