HIGHFILL

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To:	ALL PLANHOLDERS	**Copies:**	Darren Redfield, City Purchasing Jordan Toney, WSFC Utilities
Date:	May 25, 2023	**Proj. No.:**	WIN2001
Subject:	Addendum No. 1 Peters Creek Outfall – Phase 2 Bid No.: FB#23283 Owner: Winston-Salem/Forsyth County Utilities		

ADDENDUM NO. 1

BID DATE: JUNE 7, 2023 @ 2:00 PM
BID OPENING LOCATION: CITY HALL, FRONT STEPS

Please be advised of the following changes in the plans and specifications for this project:

Item 1.01: Add the following attached specification sections to the Project Manual:

1. Section 33 01 30.23 – Pipe Bursting
2. Section 33 01 30.72 – Cured-in-Place Piping

Item 1.02: Refer to the "University Parkway Crossing Notes (MH21 to MH22)" on plan sheet SS-1.3:

There is a typo in manhole numbers. Revise "University Parkway Crossing Notes (MH21 to MH22)" to "University Parkway Crossing Notes (MH19 to MH20)"

No further changes at this time.

A list of all bid set holders is available through a link on our website (www.hiepc.com) under the Project Links/Bid Documentation section.

Please acknowledge receipt of this Addendum in the space provided in the Itemized Proposal Form for each bid submitted. Failure to do so may constitute grounds for the rejection of your Bid.

HIGHFILL INFRASTRUCTURE ENGINEERING, P.C.

Eddie Sasser

Eddie Sasser, PE
Project Manager

SECTION 33 01 30.23
PIPE BURSTING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe bursting and pipe splitting force mains, waterlines, sanitary sewers, and sanitary sewer laterals.

B. Related Requirements:

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. See Construction Specification Section 01 40 00, Quality Requirements for abbreviations and acronyms used throughout the Contract Documents.

B. Definitions:

1. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action.

2. Informational Submittals: Written and graphic information and physical samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements.

3. Host Pipe: The existing pipeline that will be replaced via pipe bursting.

4. Replacement Pipe or Pipe String: The pipe inserted into the host pipe by the pipe bursting system.

5. Continuous Pipe: Pipe with welded joints assembled and inserted so as to form a continuous section between manholes or access pits, such as High Density Polyethylene (HDPE) or Fusible Polyvinyl Chloride (FPVC) pipe.

6. Sectional Pipe: Pipe assembled using leak proof joints and inserted into the host pipe in sections, such as vitrified clay pipe (VCP), polymer pipe, ductile iron (DI) pipe, PVC pipe, or HDPE pipe.

7. Pipe Bursting (Process): A trenchless method of pipe replacement, in which a bursting head is pulled or pneumatically driven through an existing (host) pipe, fragmenting or splitting the host pipe, displacing the broken pipe and soil, and replacing it with a new pipe pulled behind the bursting head and expander (or pushed in the case of segmental pipe).

8. Pipe Bursting System: The complete combination of equipment and tools necessary for the trenchless replacement of pipe via the pipe bursting process including, but not limited to, hydraulic power systems, bursting machines, bursting rods, cutters, expanders, pneumatic bursting tools, winches, air compressors, cables, and related mechanisms, components, and appurtenances.

9. Pipe Bursting Contractor: A prime contractor or subcontractor that is certified by the Pipe Bursting System manufacturer as a fully trained user of the Pipe Bursting System.

C. Reference Standards: See Construction Specification Section 01 40 00, Quality Requirements, for a list of reference standards used throughout the Contract Documents.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate pipe bursting with pipe installed by direct bury.

2. Coordinate interruption of service and pipeline shutdowns in accordance with Construction Specification Section 01 14 00, Work Restrictions.

3. The Engineer and Owner must be notified at least 72 hours in advance of testing. Testing and inspections for final approval must be performed in the presence of the Engineer or the Owner's representative.

4. Contact North Carolina 811 by calling 811 or 1-800-632-4949 before digging for locates of existing utilities in accordance with 811 notification requirements.

B. Pre-installation Meetings:

1. Conduct a Pre-installation Meeting in accordance with Construction Specification Section 01 31 00, Project Management and Coordination, Article 1.6, Pre-installation Meetings.

2. In addition to the requirements of Construction Specification Section 01 31 00, Article 1.5, review the following:

a. Identify personnel trained in the use of the Pipe Bursting System, butt fusion equipment, and electrofusion equipment. Confirm fusion and electrofusion training certifications.

b. Detailed Pipe Bursting Plan.

c. Bypass Pumping Plan.

d. Work Schedule.

e. Field Testing and Quality Control.

1.4 ACTION SUBMITTALS

A. Provide submittals in accordance with Construction Specification Section 01 33 00, Submittal Procedures.

B. Pipe Bursting Contractor Qualification Statements: Provide in accordance with Paragraph 1.7C.2.

C. Operation and Training Certifications: Provide for all equipment.

D. Pipe Bursting Equipment Qualification Statements: Provide in accordance with Paragraph 1.7C.1.

E. Pipe Bursting Equipment Manufacturer Affidavits: Submit an affidavit from the equipment manufacturer, stating that they currently support the equipment with technical staff and resources that can evaluate acceptable condition and operability of the equipment, provide spare and repair parts, and evaluate proper operation and use of the equipment by the Contractor.

F. Manufacturer's Affidavits: Manufacturers must furnish a performance affidavit stating that material, and other products provided have been manufactured and tested in accordance with the requirements of the applicable referenced Standards.

G. Product Data/Shop Drawings: Submit product data/shop drawings for pipe, fittings, couplings, connectors, waterstops, adapter pieces, restraints, bolts, gaskets, supports, and appurtenances. Submit dimensional drawings for piping. Submit dimensional drawings and weights for fittings. Include manufacturer’s installation instructions.

H. Detailed Pipe Bursting Plan: Describe, in detail, the proposed method(s) and procedure(s) for the entire pipe bursting operation, including, but not limited to, the following:

1. Type, size, and capacity of equipment and related mechanisms, components, and appurtenances.

2. Type of bursting head and splitting/cutting tools with proposed procedure for use.

3. Material and equipment layout plan(s) including proposed location and size of bursting pits if different than shown on the Drawings.

4. Lubrication methods and materials, if any.

5. Methods for dewatering excavations.

6. Construction sequence, which includes bypass pumping and traffic control operations.

I. Fusion Submittals: Type of equipment and procedure for pipe fusion.

J. Restrained Ductile Iron Pipe Joining Procedure: Manufacturers recommendations.

K. Pipe Bursting Schedule: Submit two weeks prior to commencing work. Include each burst as a separate task and indicate the order in which the work will be performed with the beginning and ending dates for each burst.

1.5 INFORMATIONAL SUBMITTALS

A. Provide submittals in accordance with Construction Specification Section 01 33 00, Submittal Procedures.

B. Fusion Report: Fusion data must be collected during each fusion using a McElroy Data Logger or equal device. Data collected must include time, temperature, and pressure. Submit on a weekly basis in digital format. Upon completion of the pipe bursting, submit data for each joint and electrofusion fitting/coupling in a Fusion Technician’s Report.

1.6 CLOSEOUT SUBMITTALS

A. Record Documentation:

1. Pressure Test and Disinfection Reports: For pressure applications as specified in Part 3.

2. Record Drawings: Maintain a clean, undamaged set of contract drawings and shop drawings to be marked up for submittal as record drawings. The set must be marked in red to show the actual installation where the installation varies from the Work as originally shown. Mark the drawing most capable of accurately showing the constructed conditions. Provide location of couplings, fittings, and connections. Where shop drawings are used, record a cross-reference at the corresponding location on the contract record drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date. Drawings must be signed and dated by Contractor's construction project manager.

3. As-built Drawings: Provide as-built survey of manhole and structure elevations shown on the Drawings. Provide by a Professional Land Surveyor licensed to practice in the State of North Carolina.

1.7 QUALITY ASSURANCE

A. Comply with Construction Specification Section 01 40 00, Quality Requirements.

B. The difficulty or risk of pipe bursting can be roughly evaluated based on the North American Society of Trenchless Technology (NASTT) Risk Classification. The shaded areas of the table indicate the conditions for the Project. Note that the range of sizes, depths, lengths, and soil conditions provide a range of ratings. The NASTT Risk Classification generally ranks the range of risk for the project sewers from Moderately Difficult to Difficult.

NASTT Risk Classification			
Criteria	**Routine**	**Moderately Difficult to Challenging**	**Difficult to Extremely Difficult**
Existing Pipe Diameter	4 - 12 inches	12 - 20 inches	20 - 36 inches
New Pipe Upsize	Same size, one upsize in diameter	Two upsize in diameter	Three or more upsize in diameter
Burst Length	Less than 350 feet	350 to 450 feet	Greater than 450 feet
Burst Depth	Less than 12 feet	12 to 18 feet	Greater than 18 feet
Soils	Compressible (soft clay, loose sand)	Moderately Compressible (medium to stiff clay, medium dense to dense sand)	Incompressible (hard clay, very dense sand, rock)

C. Qualifications:

1. Pipe Bursting System:

a. Pipe Bursting Systems must be commercially proven. For a Pipe Bursting System to be considered commercially proven, it must demonstrate the following minimum successful system installations for the specific category of work in the United States:

i. Water Mains: 500,000 Linear Feet
ii. Sanitary Sewer Mains: 500,000 Linear Feet
iii. Wastewater Force Mains: 50,000 Linear Feet
iv. Sanitary Sewer Services: 10,000 Linear Feet

b. Pipe Bursting Systems must be manufactured by companies currently supporting the equipment with technical staff and resources that can supplement the Pipe Bursting Contractor's knowledge and experience and provide additional technical expertise. Pipe Bursting Systems no longer support by the manufacturer will not be accepted.

c. Pipe Bursting System manufacturer technical staff must be present at the project site during pipe bursting operations periodically and when requested by the Engineer to confirm proper operation of the pipe bursting equipment, evaluate and assist with resolving problems, and provide additional technical assistance to the Pipe Bursting Contractor at no additional cost to the Owner.

d. Pipe Bursting System manufacturer technical staff must demonstrate that they have continuously (projects every year) been involved with pipe bursting projects of similar size, material, and complexity during employment with the system manufacturer over the past five years. They must document this involvement and their expertise to the satisfaction of the Engineer.

e. Determine the required pulling force for the type of conditions to be encountered. Provide a Pipe Bursting System that has sufficient capacity to burst the pipe and pull in the replacement pipe without exceeding the allowable tensile stress on the pipe.

2. Pipe Bursting Contractor:

a. The Pipe Bursting Contractor must be fully trained by the Pipe Bursting System manufacturer for the Pipe Bursting System(s) accepted for use on the project. Operation of the Pipe Bursting System must be performed by trained personnel only. Training must be conducted by a qualified representative of the Pipe Bursting System manufacturer.

b. The Pipe Bursting Contractor must meet the following Work Classification Minimum Requirements specified for the appropriate risk classification and job value for each method specified.

Work Classification		Work Value	Minimum Requirements
A	Routine	$500,000 or less	A minimum of 10,000 feet of experience in Class A or more difficult jobs.
		Greater than $500,000	A minimum of 20,000 feet of experience in Class A or more difficult jobs.
B	Moderately Difficult to Challenging	$1,000,000 or less	A minimum of 10,000 feet of experience in Class A and 5,000 feet in Class B or more difficult jobs.
		Greater than $1,000,000	A minimum of 20,000 feet of experience in Class A and 10,000 feet in Class B or more difficult jobs. Cumulative Class A and B Income of $2,000,000.
C	Difficult to Extremely Difficult	$1,000,000 or less	A minimum of 10,000 feet of experience on Class B jobs and 5,000 feet in Class C, to include 2,000 feet of 20-inch diameter or larger.
		Greater than $1,000,000	A minimum of 20,000 feet of experience on Class B jobs and 10,000 feet in Class C, to include 3,000 feet of 20" or larger diameter. Cumulative Class B and C Income of $3,000,000.

c. Work Value is defined as the value of the pipe bursting pay items only, not including other pay items, such as mobilization, cleaning and CCTV, erosion control, traffic control, bypass pumping, manhole replacement or rehabilitation, restoration and other pay items not requiring use of the Pipe Bursting System for completion. Pipe bursting service laterals does not qualify as experience toward meeting minimum requirements for bursting mains.

d. For work to meet Work Classification Minimum Requirements, it must meet NASTT Risk Classification criteria for 21-inch Existing Pipe Diameter, 30-inch New Pipe Upsize, 550-foot Burst Length, 12-foot Burst Depth, and Moderately Compressible Soils.

3. Butt Fusion Technicians:

a. HDPE or fusible PVC pipe fusion must be performed by personnel trained in the use of butt fusion equipment by a qualified representative of the fusion equipment manufacturer or the pipe manufacturer.

4. Electrofusion Technicians:

a. Installation of HDPE electrofusion couplings and fittings must be performed by personnel trained in the use of the electrofusion equipment by a qualified representative of the equipment manufacturer.

D. Certifications:

1. Certificates of training from the Pipe Bursting System manufacturer stating that the Pipe Bursting Contractor's employees that are directly involved in the

supervision or operation of the Pipe Bursting System have been fully trained in the use of the Pipe Bursting System accepted for use on the project.

2. Certifications of training by the pipe fusion equipment manufacturer or the pipe manufacturer that the butt fusion technicians have been fully trained in the use of the fusion equipment by an authorized representative within the previous 12 months.

3. Certifications of training by the electrofusion equipment manufacturer that the electrofusion technicians have been fully trained in the use of the electrofusion equipment by an authorized representative within the previous 12 months.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with Construction Specification Section 01 60 00, Product Requirements, for transporting, handling, storing, and protecting products.

B. Transport, receive, store, and handle pipe, fittings, and appurtenances in accordance with manufacturer recommendations and the following:

1. HDPE Pipe:

a. AWWA M55 PE Pipe – Design and Installation

b. Handbook of PE Pipe by the PPI

c. Material Handling Guide by the PPI

C. Special care must be exercised in handling pipe during transportation, delivery, storage, and distribution to avoid damage and unnecessary stress. Pipe must be adequately supported to prevent sagging or bending. Damaged pipe will be rejected and must be immediately removed from the jobsite and replaced at the Contractor's expense.

D. Do not drop or roll pipe off trucks. Do not otherwise drop, roll, or skid pipe. Materials cracked, gouged, chipped, dented, or otherwise damaged will not be approved.

E. Pipe and appurtenances must be unloaded as close to the place where they are to be laid as is practical to avoid unnecessary handling.

F. Block individual and stockpiled pipe to prevent unintentional movement.

G. Store HDPE materials out of sunlight.

H. Pipe, fittings, and appurtenances must be kept clean. Pipe and fittings must be stored to prevent entry of water, dirt, and foreign matter into pipe, bells, and fitting flanges. If pipe is provided with end protectors, do not remove protectors until ready for inspection or installation. Replace protectors after inspection.

I. String pipe along the road shoulder and not in ditches.

J. Pipe Condition/Examination:

1. Inspect each truckload of materials thoroughly upon arrival at the site. Examine materials for damage and verify conformance with approved submittals. Pipe must be protected during handling against impact shocks and free fall. Care must be taken when unloading pipe to avoid damaging the pipe lining. Pipe that has been damaged either in transit or during unloading must be plainly marked and immediately removed from the project site.

2. Prior to fusing, each section of the pipe must be carefully examined for damage and conformity with approved submittals and these specifications. Pipes damaged or deemed not to conform to these specifications, must be plainly marked and immediately removed from the project site.

1.9 SITE CONDITIONS

A. See Construction Specification Section 02 32 00, Geotechnical Investigations, for subsurface data available through Owner.

PART 2– PRODUCTS

2.1 PIPE

A. General:

1. The pipe DR or thickness is specified to meet the operational requirements of the pipeline and is considered a minimum. The DR or thickness is not based on the projected installation loading, which is related to the Contractor's means and methods. Contractor must calculate the projected installation loads based on his means and methods and increase the DR or thickness of the pipe as necessary to withstand those loads without exceeding the allowable material stress as recommended by the pipe supplier. If the pipe DR or thickness is increased and the resulting inside diameter is decreased below what is acceptable to the Owner, increase the pipe diameter as necessary to provide the same inside diameter as the specified pipe. No additional payment will be made for cost increases related to an increase in DR, thickness, and diameter due to installation loads. Use equipment and methods such as lubrication as necessary so that the allowable material stress is not exceeded during installation.

B. High Density Polyethylene Pipe:

1. Designed in accordance with AWWA M55 PE Pipe – Design and Installation and the Handbook of PE Pipe by the Plastics Pipe Institute.

2. Manufactured from a PE 4710 resin which meets ASTM D 3350 with a minimum cell classification of 445574C to the dimensions of ASTM F 714. HDPE pipe for water supply systems must be certified to NSF International Standard No. 61.

3. Contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. The pipe must be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.

4. Meet the requirements of ANSI/AWWA C901 (3/4-inch to 3-inch) or ANSI/AWWA C906 (4-inch to 65-inch).

5. Provide a minimum classification of DR 17 with a pressure rating of 250 psi. For pressure pipelines, provide an allowable total pressure during recurring surge conditions equal to 1.5 times the pipe pressure class and an allowable total pressure during occasional surge conditions equal to 2.0 times the pipe pressure class. The outside diameter of the pipe must be based upon the IPS or DIPS sizing system as indicated on the drawings.

6. Provide identification markings that will remain legible during normal handling, storage, and installation. Markings must include nominal size and outside diameter basis, dimension ratio, AWWA pressure class, AWWA designation for

standard AWWA C901 (3/4-inch to 3-inch) or AWWA C906 (4-inch to 65-inch), manufacturer's name or trademark and production-record code, and NSF Seal of Approval for potable water service according to NSF 14.

2.2 COMPONENTS FOR HDPE PIPE

A. General:

1. HDPE components must be made from material meeting the same requirements as the pipe and must have a pressure rating at least equal to that of the pipe.

B. Fittings:

1. Meet the requirements of AWWA C901 (3/4-inch to 3-inch) or AWWA C906 (4-inch to 65-inch).

2. Butt fusion fittings must meet the requirements of ASTM D3261.

3. Fabricated fittings are to be manufactured with a data logger recording the temperature and fusion pressure. Graphic representations of the fusion cycles must be provided with the pipe submittals.

4. Markings for molded fittings must comply with the requirements of ASTM D 3261. Fabricated fittings must be marked in accordance with ASTM F 2206. Socket fittings must meet ASTM D 2683.

5. Mechanical fittings used with HDPE pipe must be specifically designed for use with polyethylene pipe. Mechanical fittings designed for other materials must not be used unless authorized by the mechanical fitting manufacturer.

C. Electrofusion Couplings:

1. Manufactured and marked in accordance with ASTM F1055.

2. Manufactured from a PE 4710 resin which meets ASTM D 3350 with a minimum cell classification of 445574C.

3. Suitable for use as pressure conduits and have nominal burst values of four times the Working Pressure Rating (WPR) of the fitting.

4. Water supply systems must be certified to NSF International Standard No. 61.

D. Gasketed Electrofusion Sewer Saddles:

1. Produced from a pre-blended virgin resin which complies with ASTM D3350 and manufactured and marked in accordance with ASTM F1055.

2. Incorporate a gasket to seal sewer service connection, eliminate infiltration and inflow, and restrain pipe movement.

3. Manufactured by George Fischer Piping Systems or equal.

E. Mechanical Joint (MJ) Adapters:

1. Provide in accordance with ASTM D 3261 or ASTM F 2206 if machined. Markings for molded or machined MJ adapters must be per ASTM D 3261.

2. MJ adapters must consist of a high-density polyethylene adapter for butt fusion onto the end of high density polyethylene pipe and a gasket, bolts, nuts, and gland for completing a fully self-restrained connection to pipe and fittings having mechanical joint bells in accordance with AWWA C111.

3. MJ adapters must have a molded collar flange around the perimeter to properly compress the mechanical joint gasket and provide joint restraint in the assembled joint. Gaskets, bolts, nuts, and glands must conform to the requirements of AWWA C111.

F. Flange Adapters:

1. Provide in accordance with ASTM D 3261 or ASTM F 2206 if machined. Markings for molded or machined flange adapters must be per ASTM D 3261. Fabricated (including machined) flange adapters must be per ASTM F 2206.

2. Van-Stone style, metallic (including stainless steel), convoluted or flat-plate, back-up rings and bolt materials must follow the guidelines of PPI Technical Note # 38, and must have the bolt-holes and bolt-circles conforming to one of these standards:

a. ASME B-16.5 Class 150

b. ASME B-16.47 Series A Class 150

c. ASME B-16.1 Class 125

d. AWWA C207 Class 150 Series B, D, or E.

3. The back-up ring must provide a long-term pressure rating equal to or greater than the pressure-class of the pipe with which the flange adapter assembly will be used. The pressure rating must be marked on the back-up ring. The back-up ring, bolts, and nuts must be protected from corrosion by a system such as paint, coal-tar epoxy, or polyether or polyester fusion bonded epoxy coatings.

4. Flange adapters must have sufficient through-bore length to be clamped in a butt fusion joining machine without the use of a stub end holder.

5. Flange bolts and nuts must be Type 304 SS as a minimum.

G. Stiffening Inserts:

1. Install in the end of the HDPE pipe when plain end HDPE pipe is inserted into the bell end of a non-HDPE pipe, valve, or fitting or into the hub of a bolted coupling.

2. Provide specially designed inserts for use on the inside of HDPE pipe in conjunction with AWWA C111 mechanical joints. Stiffening inserts must provide circumferential inside support of the pipe end and be made of Type 304 stainless steel.

2.3 PRECAST CONCRETE MANHOLE CONNECTOR

A. Connector must be the sole element relied on to assure a flexible watertight seal of the pipe to the manhole. No adhesives or lubricants must be employed in the installation of the connector into the manhole. The rubber for the connector must comply with ASTM C923, “Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes and Laterals,” and consist of EPDM and elastomers designed

to be resistant to ozone, weather elements, chemicals including acids and alkalis, animal and vegetable fats, oils, and petroleum products from spills.

B. The connector must be specifically designed for the pipe material and size and must be installed properly to provide a watertight joint.

C. All stainless steel elements of the connector must be completely non-magnetic series 304 stainless, excluding the worm screw for tightening the steel band around the pipe, which must be series 304 stainless. The worm screw for tightening the steel band must be torqued by a breakaway torque wrench available from the precast manhole supplier. Torque must be per manufacturer requirements.

D. Boots must have a serrated flange of the boot cast into the manhole wall, or an expanding stainless steel interlocking sleeve may be used to compress the boot against a cast or core hole. Mechanical expansion of the interlocking ring must be accomplished in accordance with the manufacturer's recommendations. Flexible sleeve boots must not be used with concrete pipe or on pipe larger than 18 inches in diameter.

E. The connector must be KOR-N-SEAL, as manufactured by NPC, Inc., Milford, New Hampshire, PSX as manufactured by Press-Seal Gasket Corporation, Fort Wayne, Indiana, or equal.

2.4 ACCESSORIES

PART 3– EXECUTION

3.1 EXAMINATION

A. Conduct CCTV inspection of segments to be burst in accordance with Construction Specification Section 33 01 30.11, CCTV Inspection of Sewers. Locate active service laterals and identify obstructions, deficiencies, or materials that prevent the pipe from being burst in accordance with these specifications. Notify Engineer immediately of problematic or changed conditions.

B. Confirm services are active, or that the Owner desires to replace the inactive service, prior to excavating at the connection of the service lateral to the main. Contractor will not be paid excavation and restoration costs for excavating service connections that are inactive and will not be replaced.

C. Examine the conditions under which pipe bursting is to be performed and notify the Engineer, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work where unsatisfactory conditions have been identified until a plan has been developed to resolve the unsatisfactory conditions.

D. Verify that existing utility main size, location, and invert are as indicated on Drawings. Field verify the size, type material, etc. of the existing and proposed pipes to be connected prior to ordering materials.

E. Confirm utilities have been located prior to excavating.

3.2 PREPARATION

A. Contractor must familiarize itself with conditions, limitations, and requirements of permits, encroachment agreements, easements, and occupancy permits. Comply with requirements throughout the pipe burst installation. Work must be confined to the rights-of-way, easement, and permit limits.

B. Establish traffic control in accordance with the Traffic Management Plan.

C. Flow Bypassing:

1. See Construction Specification 01 14 00, Work Restrictions, for requirements for facility outages, pipeline shutdowns, and interruption of service.

2. Provide continuity of sanitary sewer service to each facility connected to the sewer mains during execution of the Work. Bypass sewer flow around the pipe to be replaced, or into adjacent sanitary sewers, if available and approved by the Owner. The bypass pumping system must be of sufficient capacity to convey flows without sewage backup to private property or discharge.

3. Establish bypass of flows in accordance with the Bypass Pumping Plan (BPP). See Construction Specification Section 01 51 39.10, Temporary Bypass Pumping of Wastewater Pipelines, for further requirements.

4. Sanitary Sewer Service Laterals:

a. Locate, expose, and disconnect active sewer service laterals, and inactive service laterals identified for replacement by the Owner, from the main prior to pipe bursting to prevent damage to the service during bursting and to expedite reconnection.

b. Temporary connections must be provided so there is no interruption of service to existing users except as permitted in the BPP.

c. Temporary connections must be provided at disconnected services to ensure no discharge of wastewater. Contractor will be responsible for damages to the Owner resulting from lack of conformance with this requirement.

d. Provide temporary service to sewer service laterals in one of the following manners:

i. Excavate the service lateral at the main or at the right-of-way line and collect waste in a 55-gallon barrel. Maintain a sewer vacuum truck on site to pump down the barrels as necessary to prevent discharge.
ii. In accordance with a plan submitted by the Contractor and approved by the Engineer.

e. The Contractor is solely responsible for method of wastewater collection and any discharges that occur. Clean-up, repair, and pay property damage costs and claims resulting from failure of the bypass system.

f. Excavate the existing pipe sufficiently on both sides to allow for uniform circumferential expansion of the existing pipe through the service connection pit.

g. Upon completion of insertion of the new pipe, expedite the reconnection of services to minimize any inconvenience to the customers.

D. String pipe sections along the sewer route in a manner that protects the pipe and interferes the least with pedestrian and vehicular traffic. Pipe must be set on high ground, positioned to prevent silt deposits, storm water, or other matter from entering the pipe prior to its installation.

E. Protection of Existing Sewers:

1. Plug existing sanitary sewer downstream of new sewer with a mechanical plug (wing nut, rim bolted type, or equal). The plug must be placed in the manhole outlet connection and secured with a steel cable. The plug must remain in place until acceptance of sanitary sewers by the Owner.

2. Sediment laden water must not be allowed to enter the sanitary sewer system or storm drainage system. Surface water and debris must not be allowed to enter the existing or new sanitary sewer. Existing Owner manholes located within the construction area must remain accessible at all times. Contractor is responsible for any damage to the Owner's wastewater collection system and must immediately rectify any violation of this specification and repair any impact or damage to the Owner's satisfaction.

F. Protection of Fused Pipe:

1. Install pulleys, rollers, bumpers, alignment control devices, and other equipment required to protect the pipe from damage during fusion and installation.

2. Pipe must not be dragged across pavement or any other surface or obstacle that can gouge, scrape, dent, bend, or otherwise damage the pipe.

3. Place on rollers during fusion and move on rollers once the pipe string has been fused. Place on rollers during installation. Rollers must be spaced to adequately support the pipe and prevent sagging or bending that exceeds the allowed bending radius of the pipe.

G. HDPE Joining:

1. Butt Fusion: The pipe must be joined by the butt fusion procedure outlined in ASTM F 2620 or PPI TR-33. Fusion joints must be made in compliance with the pipe or fitting manufacturer's recommendations. Only appropriately sized and outfitted fusion machines that have been approved by the pipe supplier must be used for the fusion process. Upon request, the manufacturer must provide assistance in the manufacturer's recommended butt fusion and saddle fusion procedures to the Contractor's installation personnel and to the inspectors representing the Owner.

2. Electrofusion: Electrofusion joining must be done in accordance with the manufacturers recommended procedure, ASTM F 1290, and PPI TN 34. Electrofusion equipment must include an electric source, a transformer, (commonly called an electrofusion box that has wire leads), a method to read electronically (by laser) or otherwise input the barcode of the fitting, and a fitting that is compatible with the type of electrofusion box used. The electrofusion box must be capable of reading and storing the input parameters and the fusion results for download to a record file later.

3. Mechanical: Mechanical connection of HDPE to auxiliary equipment, such as valves, pumps, and fittings, must use MJ adapters and other devices in conformance with the PPI Handbook of Polyethylene Pipe and AWWA Manual of Practice M55. Assemble and install mechanical joints in accordance with AWWA C111 and AWWA C600. A restraint harness or concrete anchor must be provided with mechanical couplings to prevent pullout.

4. Flange Adapters: Flange connections must be installed in accordance with the manufacturer's recommended procedure. Flange faces must be centered and

aligned to each other before assembling and tightening bolts. In no case will the flange bolts be used to draw the flanges into alignment. Bolt threads must be lubricated, and flat washers must be fitted under the flange nuts. Bolts must be evenly tightened according to the tightening pattern and torque step recommendations of the manufacturer. At least one hour after initial assembly, flange connections must be retightened following the tightening pattern and torque step recommendations of the manufacturer. The final tightening torque must be as recommended by the manufacturer.

H. Fusible Polyvinyl Chloride (FPVC) Pipe Joining:

1. Joining by Butt Fusion: Joints between plain end pipes must be made by butt fusion. FPVC pipe will be handled in a safe and non-destructive manner before, during, and after the fusion process and in accordance with this specification and pipe supplier's guidelines. Pipe supplier's procedures must be followed during fusion operations. Only appropriately sized and outfitted fusion machines that have been approved by the pipe supplier will be used for the fusion process.

2. Mechanical: Mechanical connection of FPVC to auxiliary equipment such as valves, pumps, and fittings must use restrained MJ fittings. Assemble and install mechanical joints in accordance with AWWA C111. A restraint harness or concrete anchor must be provided with mechanical couplings to prevent pullout.

I. Restrained Ductile Iron Pipe Joining:

1. Join restrained joint ductile iron pipe in strict accordance with manufacturer recommendations.

J. Pre-installation Pressure Test (Pressure Mains Only):

1. Prior to installation, the Contractor may elect to hydrostatically test the pipe at his expense to determine the integrity of the butt fusion joints. This will not be considered an alternative to the testing to be done after installation.

K. Subsurface Data:

1. All additional subsurface investigations deemed necessary by the Contractor to complete the work must be included in the prices bid for pipe bursting at no additional cost to the Owner. Copies of geotechnical reports and information obtained by Contractor must be provided to the Owner.

L. Excavation of Pipe Insertion and Receiving Pits:

1. Excavate, shore, brace, dewater, protect, and maintain bursting pits in accordance with the requirements of Construction Specification Section 31 23 33, Trenching and Backfilling.

2. The location and number of insertion and receiving pits must be as indicated on the plans if shown. Where different locations are proposed, submit a marked-up plan sheet indicating the proposed locations for review and consideration by the Engineer. Submit with the Pipe Bursting Plan.

3. The number of insertion and receiving pits must be the minimum necessary to most efficiently accomplish the work. Consider the use of excavation required for other purposes, such as for sanitary sewer service reconnections and manhole replacement, for use as bursting and receiving pits. Where manholes are not planned for replacement and are damaged, replace them at no additional cost to

the Owner. Any manhole modification required will be considered incidental to the pipe bursting installation.

4. All construction must be kept within the rights-of-way and easement limits. Should additional work area be necessary, obtain temporary construction easements and rights-of-way at no cost to the Owner. Agreements must be in writing and a copy must be provided to the Owner and Engineer.

5. Pipe insertion pits must be long enough to properly align the bursting tool with the existing pipe and to allow continuous pipe enough space to begin a graceful "S" bend out of the pit without exceeding the bend radius of the pipe and then transition to a “tail ditch” at grade.

6. Center pits over the existing pipe. The side of the pit must be braced and rendered secure with either open or closed sheeting. Sheeting, bracing, trench boxes, and pit construction methods must conform to the latest Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act (OSHA) of 1970. Safety and OSHA compliance is the sole responsibility of the contractor. No extra payment will be made for sheeting and bracing. Such cost will be included in the cost of installing the pipe.

7. Open excavations must be kept secure using barricades with appropriate lights and signs, covering with steel plates, etc., or as directed by the Engineer. Open excavations must be covered with steel plates overnight.

8. Furnish machinery for pumping, bailing, and well pointing and pump, bail, or otherwise remove water that accumulates in the pits. Keep pits dry. Dispose of water in accordance with sedimentation and erosion control law requirements and the Contract Documents, to the satisfaction of the Engineer.

M. Replacement Pipe Inspection Prior to Burst:

1. Pipe must be inspected by the Owner and RPR immediately prior to installation. Where gouges, scrapes, or other damage result in the loss of 10% of the pipe wall thickness, that section must be cut out and removed from the project.

2. Pipe having other defects, such as concentrated ridges, discoloration, excessive spot roughness, pitting, variable wall thickness or any other defect of manufacturing or handling, as determined by the Engineer, must be discarded and not used. Butt fusion misalignment must not exceed 10% of the minimum wall thickness required for the pipeline's operating pressure.

3.3 PIPE BURSTING – GENERAL REQUIREMENTS

A. Install pipe bursts in accordance with the pipe and equipment manufacturer's instructions, these specifications, the Contract Documents, and as directed by the Owner. Install pipe to line and grade shown unless otherwise approved by the Owner.

B. Pipe and appurtenances must be kept clean and open ends securely plugged when construction is not in progress.

C. Field cutting of pipe, where required, must be made with a machine specifically designed for cutting pipe. Cuts must be carefully executed, without damage to the pipe, to leave a smooth end at right angles to the axis of the pipe. Cut ends must be tapered and sharp edges filed off smooth.

D. Pipe bursting operations must not interfere with, interrupt, or endanger the ground surface or activity above grade. Continually maintain close observation of the ground surface and adjacent facilities to detect settlement or displacement and immediately notify the RPR and Owner if settlement or displacement is detected. Take appropriate actions as necessary to prevent damage and maintain safe conditions.

E. The pipe string must be pulled so that it moves freely and is not damaged during pulling. Pulling operations must not exceed the tensile strength of the pipe.

F. Use lubrication where necessary to ensure the successful completion of the burst.

G. Upon commencement of the bursting process, pipe insertion must be continuous and without interruption from one entry point to another, except as approved by the Engineer.

H. Notify the RPR and Owner immediately if forward motion of the burst is stopped to allow for review of the situation by both the Contractor, Owner, and Engineer. Proceed as directed by the Engineer.

I. Provide access fittings to permit testing, air release, and disinfection where required.

J. Install pipe identification in accordance with Construction Specification Section 33 05 97, Identification and Signage for Utilities.

3.4 PNEUMATIC PIPE BURSTING – NOT USED

3.5 STATIC PIPE BURSTING

A. The pipe bursting tool must be static and hydraulically operated. The bursting head or rolling blade cutters must be pulled through the host pipe, fragmenting or splitting the host pipe, and then displacing the broken pipe and soil with an expender to increase the external dimensions sufficiently to allow insertion of the new pipe string pulled behind the bursting head or expander (or pushed in the case of segmental pipe).

B. The static pulling frame must be telescopic in design to allow the cutting head to release at the termination of the pull and minimize trench length.

C. The unit must maintain automatic thrust and pull back and be capable of pipe bursting in two directions from the same excavation.

3.6 PIPE BURSTING SANITARY SEWER

A. Pipe Installation:

1. Install pulleys, rollers, bumpers, alignment control devices, and other equipment required to protect existing manholes and to protect the pipe from damage during installation. Center the winch line in the host pipe with an adjustable boom.

2. Under no circumstances must the pipe be stressed beyond its elastic limit. Maintain logs documenting the pulling force.

3. Use lubrication as recommended by the manufacturer. Match lubricants to soil and insertion conditions.

B. HDPE Pipe Requirements:

1. Cooling and Relaxation: The installed pipe must be allowed the manufacturer's recommended amount of time, but not less than 4 hours, for cooling and relaxation due to tensile stressing prior to any reconnection of service laterals,

sealing of the annulus or backfilling of the insertion pit. Sufficient excess length of new pipe, no less 4 inches, must be allowed to protrude into the manhole to provide for relaxation. After the relaxation period, cut and trim the replacement pipe 3 inches inside the manholes.

2. Terminal sections of pipe that are joined within the bursting pits, and connections of pipe burst installations to direct-bury pipe, must be made with electrofusion couplings.

C. Manhole Reconnection:

1. Install replacement pipe with a tight-fitting seal with the existing or new manhole.

2. Reconnect to precast concrete manholes with a flexible pipe-to-manhole connector.

3. Reconnect to brick and block manholes with a fused-on waterstop embedded in cementitious non-shrink grout to prevent infiltration into the manhole.

3.7 PIPE BURSTING SANITARY SEWER SERVICE LATERALS

A. Furnish and install sewer service laterals in accordance with this construction specification section, Construction Specification Section 33 31 11, Sanitary Sewerage Gravity Piping, and as shown on the Drawings.

B. Install sanitary sewer service laterals via pipe bursting where indicated on the Drawings.

C. The face of the burst pit excavations must be a minimum of five feet beyond the edge of pavement unless directed to do otherwise by the Engineer.

D. The pipe must be joined by the butt fusion procedure outlined in ASTM F 2620 or PPI TR-33. Fusion joints must be made in compliance with the pipe or fitting manufacturer's recommendations.

E. Mechanical connection of HDPE to other pipe materials and fittings must use devices in conformance with the PPI Handbook of Polyethylene Pipe and AWWA Manual of Practice M55.

3.8 RESTORATION

A. Backfilling Pipe Insertion and Receiving Pits:

1. Backfill, compact, and restore bursting pits in accordance with the requirements of Construction Specification Section 31 23 33, Trenching and Backfilling. Where pits are in roadways, backfill, compact, and restore pits in accordance with roadway owner's requirements.

3.9 FIELD QUALITY CONTROL

A. Sanitary Sewer:

1. General:

a. Provide equipment (pumps, gauges, instruments, etc.), materials, water, labor, and anything additional that is necessary to perform field quality control testing. Equipment and materials used for testing must be checked and approved by the Engineer prior to their use.

b. Repair leakage, infiltration, damage, defects, deformities, improper alignment and grade, and excessive deflection (above the allowable limit) identified during installation and testing. Work necessary to bring sewers into conformance with the Contract Documents must be performed by the Contractor at no extra cost to the Owner.

2. Pipe Grade Survey at Bursting Pits as the Work Progresses:

a. After setting each manhole, and prior to backfilling bursting pits, provide manhole inverts and elevations of the replacement sewer from one end of the pit to the other at a maximum spacing of five feet to confirm consistent grade across the excavation. Where the grade of the pipe is not consistent, raise or lower pipe and manhole by increasing or removing bedding until the grade is consistent.

b. Elevations must be provided in legible writing to the RPR for review prior to backfilling each bursting pit. Information provided to the RPR must identify the location (street and sewer run), the manhole, the elevations of the sewer, the location of elevations in relation to the manhole, the location of couplings, and the face of the excavation in relation to the manhole. Adjustments must be made to the manhole elevation as directed by the Engineer. Where installation has increased the elevation of the replacement pipe at the wall of the excavation, the excavation must be extended until the replacement sewer is at the correct grade at no cost to the Owner.

3. Preparation:

a. After backfilling, sewers must be thoroughly cleaned with appropriate tools by flushing or jetting, in accordance with Construction Specification 33 01 30.41, Cleaning of Sewers. Cleaning must be performed in a manner acceptable to the Owner and must remove dirt, stones, and debris that accumulated in the sewer during construction. Sediment laden water must not be allowed to enter the sanitary sewer system or storm drainage system.

b. Sewers must be cleaned and pretested prior to notifying the Engineer and Owner and arranging for inspections and tests.

4. Visual Inspection:

a. Perform a CCTV inspection of sewers in accordance with Construction Specification Section 33 01 30.11, CCTV Inspection of Sewers, after installation of all service connections, completion of all manhole rehabilitation, installation of all air release assembly tees (pressure mains), and completion of the cleaning. Provide the Engineer two copies of video for each sewer segment on hard drives or flash drives. The video must clearly identify the sewer being inspected. Files must be labeled using the manhole numbers on each end of the sewer segment.

b. Water must be introduced into the segment of the sewer to be televised to aid in the detection of sags and defects. Water must be continuously introduced to provide a width of flow of 1-2 inches. CCTV of dry sewers will not be accepted.

c. Defects in the sewers and appurtenances must be remedied by the Contractor at no additional cost to the Owner and must be re-tested and

re-inspected after corrections have been made. Sewers that do not exhibit a true line and grade or that have structural defects must be corrected to meet these specifications.

d. No infiltration is allowed.

5. Deflection (Mandrel) Testing:

a. If visual inspection indicates potential deflection in excess of allowable limits, perform deflection testing in accordance with Construction Specification Section 33 31 11, Sanitary Sewerage Gravity Piping.

6. Low-Pressure Air Testing:

a. If visual inspection indicates potential leakage, perform low pressure air testing in accordance with Construction Specification Section 33 31 11, Sanitary Sewerage Gravity Piping.

7. Provide as-built survey in accordance with Part 1 of this Specification.

B. Sanitary Sewer Service Laterals:

1. Low-Pressure Air Testing:

a. Testing must be accomplished by plugging the line at each end with pneumatic plugs. Low-pressure air must be introduced to the sealed lateral until the internal pressure reaches 4.0 psig greater than the average back pressure (the design groundwater pressure) on the pipe. The time required for internal pressure to decrease from 3.5 to 2.5 psig greater than the average back pressure on the pipe must not be less than 1 minute for 4-inch pipe and 2 minutes for 6-inch pipe.

b. Low-pressure air test 20% of the new service laterals. Owner or Engineer will designate which services to inspect. Laterals that fail the low-pressure air test must be removed and replaced or repaired at the Contractor’s expense by a method approved by the Engineer. If more than 10% of the laterals tested fail, test 100% of the new service laterals.

2. Service Lateral Rehabilitation Report:

a. Submit a report of service laterals rehabilitated, which includes service address, rehabilitation or replacement method, service connection product used, and color photographs showing post-installation service prior to backfill.

b. Photographs must be labeled to correspond with report address and must be submitted on CD. Each photograph must contain the service address, and any other pertinent information, written (on a whiteboard or notebook) in a manner that is neat and large enough to be legible. The written address and the service connection must be visible in the same photograph.

3. Visual Inspection:

a. Perform a CCTV inspection of 20% of the new sewer service laterals according Paragraph A.4 in this section above. Owner or Engineer will designate which services to inspect. Laterals that are determined

unacceptable by the Engineer must be removed and replaced or repaired at the Contractor's expense by a method approved by the Engineer. If more than 10% of the laterals inspected fail, perform a CCTV inspection of 100% of the new service laterals.

3.10 PROTECTION

A. Protect pipe bursts and appurtenances from damage until accepted into service by the Owner.

3.11 ACTIVATION OF SANITARY SEWERS

A. Sanitary sewers must be returned to service as soon as possible after pipe grade survey confirms proper installation. Receipt of NCDEQ approval is not required.

3.12 ACTIVATION OF WATER MAINS

A. Upon receipt of State Final Approval, the main valve serving the new section of main(s) must be opened and placed into service by the Owner.

B. No further Work on the water main and appurtenances will be permitted without full knowledge of the Owner.

3.13 ACTIVATION OF FORCE MAINS

A. Upon receipt of NCDEQ acknowledgement of the Engineer's certification, the force main can be placed into service by the Owner.

B. No further Work on the force main, valves, and appurtenances will be permitted without full knowledge of the Owner.

END OF SECTION

SECTION 33 01 30.72
CURED-IN-PLACE PIPE LINING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes

1. Reconstruction of 2- to 108-inch pipelines and conduits by the installation of a resin-impregnated, flexible tube which is inverted into the existing conduit by use of a hydrostatic head or air pressure. The resin is cured by circulating hot water or introducing controlled steam within the tube.

2. Reconstruction of 4- to 60-inch pipelines and conduits by the pulled-in place installation of a glass reinforced plastic (GRP) cured-in-place thermosetting resin-impregnated pipe into an existing conduit followed by inflation with compressed air. The resin/GRP tube is cured with ultraviolet light.

B. Related Requirements

1.2 REFERENCES

A. Abbreviations and Acronyms

1. The following is a partial list of typical abbreviations and acronyms used in this section. See Construction Specification Section 01 40 00, Quality Requirements for additional abbreviations and acronyms used throughout the Contract Documents.

CCTV	Closed-Circuit Television
CIPP	Cured-in-Place Pipe
GRP	Glass Reinforced Plastic
NASSCO	National Association of Sewer Service Companies
PACP©	Pipeline Assessment and Certification Program (NASSCO)
SLSS	Service Lateral Sealing System
UV	Ultraviolet

B. Definitions

1. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action.

2. Informational Submittals: Written and graphic information and physical Samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements.

3. Cured-in-Place Pipe: A flexible tube consisting of felt, fiberglass, or carbon fiber, impregnated with a polyester, vinyl ester, or epoxy thermosetting resin, and cured to form a hollow cylinder that is continuous throughout the pipe, tight-fitting, water-tight, and impermeable.

4. Host Pipe: The existing pipeline that will be lined.

C. Reference Standards:

1. The following is a partial list of typical referenced Standards. See Construction Specification Section 01 40 00, Quality Requirements, for a list of reference standards used throughout the Contract Documents.

ASTM - D543 Standard and Practice for Evaluating the Resistance of Plastics to Chemical Reagents

ASTM - D578 Specification for Glass Fiber Strands

ASTM - D638 Standard Test Method for Tensile Properties of Plastics

ASTM - D790 Standard Test Methods for Flexural Properties of Un-reinforced and Reinforced Plastics and Electrical Insulating Materials

ASTM - D792 Standard Test Methods for Density and Specific Gravity of Plastics by displacementASTM - D1600 Terminology for Abbreviated Terms Relating to Plastics

ASTM - D2122 Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings

ASTM - D2412 Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading

ASTM - D2990 Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics

ASTM - D3039 Test Method for Tensile Properties of Polymer Matrix Composite Materials

ASTM - D3517 Standard Specification for Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe

ASTM - D3567 Standard Practice for Determining Dimensions of Fiberglass (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fittings

ASTM - D3681 Standard Test Method for Chemical Resistance of “Fiberglass (Glass Fiber Reinforced Thermosetting Resin) Pipe in a Deflected Condition

ASTM - D3839 Standard Guide for Underground Installation of Fiberglass (Glass-Fiber Reinforced Thermosetting-Resin) Pipe

ASTM - D5813 Standard Specification for Cured-in Place Thermosetting Resin Sewer Pipe

ASTM - F412 Terminology Relating to Plastic Piping Systems

ASTM - F1216 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube

ASTM - F1417 Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air

ASTM - F1743 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)

ASTM - F2019 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe (CIPP)

ASTM - F2561 Standard Practice for Rehabilitation of a Sewer Service Lateral and Its Connection to the Main Using a One Piece Main and Lateral Cured-in-Place Liner

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Coordinate CIPP lining with manhole rehabilitation and replacement and service lateral replacement.

2. Coordinate interruption of service and pipeline shutdowns in accordance with Construction Specification Section 01 14 00, Work Restrictions.

3. Conduct installation operations and schedule work and cleanup in a manner that causes the least possible obstruction and inconvenience to traffic, pedestrians, businesses, and property owners and tenants.

B. Pre-installation Meetings

1. Conduct a Pre-installation Meeting in accordance with Construction Specification Section 01 31 00, Project Management and Coordination. Article 1.6 Pre-installation Meetings.

2. In addition to the requirements of Construction Specification Section 01 31 00, Article1.6, review the following:

a. Identify personnel trained in the installation and testing of CIPP lining and reinstatement of service laterals.

b. Detailed CIPP Installation Plan

c. Bypass Pumping Plan

d. Traffic Control Plan

e. Work Schedule

f. Field Testing and Quality Control

1.4 ACTION SUBMITTALS

A. Provide submittals in accordance with Construction Specification Section 01 33 00, Submittal Procedures.

B. CIPP Lining Contractor Qualification Statement:

1. Supportive data to demonstrate compliance with Article 1.7 Quality Assurance.

2. Installation references from at least the last five projects performed by the Contractor that were similar in size and scope to this project for different owners over the last five years. As a minimum, provide the name, address, contact person, telephone number, and email address of the client/owner, engineer, and prime contractor. Indicate the diameter and footage of pipe lining with CIPP and contents conveyed by the pipe. Provide project and design submittal requirements and testing results confirming those requirements were met for thickness and minimum initial structural properties. Projects must meet or exceed the total length of lined pipe, the pipe diameter, the thickness required, and the initial structural properties to be considered similar in scope.

3. CIPP training certificates for the full-time superintendent and lead personnel installing and curing the liner, reinstating the service laterals, taking test samples, and performing post-installation CCTV inspection.

C. CIPP Product Submittals

1. Manufacturer's Affidavits: Manufacturers must furnish performance affidavits stating that the material or product provided has been manufactured and tested in accordance with the requirements of the applicable referenced Standards. Submit performance affidavits with each shipment of materials.

2. Product Data/Shop Drawings: Submit product data/shop drawings for fabric tube, flexible membrane (coating), raw resin data, waterstops, fittings, and appurtenances. Submit dimensional drawings and weights for fittings. Include manufacturer’s installation instructions and MSDS sheets

3. Certificate of Authenticity: Submit from resin manufacturer for each shipment to the wet-out facility prior to wet-out of the liner that includes the date of manufacture and Heat Distortion Temperature.

4. A complete description of the CIPP materials indicating how the finished product will meet the requirements of the specifications.

5. A complete description of the proposed wet-out procedure. Submit certified information from the felt manufacturer on the nominal void volume in the felt fabric that will be filled with resin. Provide the wet-out report for each liner when it is delivered.

6. Manufacturers' instructions for shipping, delivery, handling, and storage.

7. Where initial structural properties are proposed that exceed those provided in Part 2, provide structural property test results from the previous five installations of the product proposed for this project. Test results must indicate that the proposed structural properties have been achieved in previous applications. Provide contact references as indicated in the previous paragraph.

8. When requested by the Engineer:

   a. Test results indicating compliance with chemical resistance requirements.

   b. Samples

9. For pressure pipelines: Submit details of end seals and for reinstatement of connections to tees, air release valves, blow-off valves, threaded taps, and other

fittings or taps. Reinstatements must provide a sufficient seal to prevent water movement between the liner and the host pipe.

D. Delegated Design Submittals

1. Engineering Design Calculations:

a. Meet the requirements of this Specification.

b. Provide for each length of CIPP liner to be installed, indicating the thickness of each proposed liner. Contractor may submit a single design for the most severe line condition for each diameter and apply that design to other line segments of the same diameter.

c. Performed, signed and sealed by a Professional Engineer licensed in the State of North Carolina.

E. Public Notification Plan:

1. Provide a detailed public notification plan including detailed staged notification to residences affected by the CIPP installation.

2. Notify property owners that will be affected by the Work seven days in advance and then again 24 hours in advance.

3. Identify and describe the work to impacted property owners including cleaning, CCTV, dye testing, lining, and service reinstatement.

4. Provide a schedule indicating dates, work times (start time and estimated completion time), expected property access and service impacts, and anticipated odors and noise. Include on project schedule.

5. Provide contacts for 24-hour complaint rectification.

F. Bypass Pumping Plan:

1. In accordance with WSFC Utilities bypass pumping requirements.. Address flow bypassing and plugging during the phases of the work.

2. Bypass pump sewage flow around the sewer segment that is being lined.

3. Small diameter sewers with minimal flow may be plugged at the Contractor’s risk but must be monitored by the Contractor on a regular basis to prevent backup of sewage into adjacent facilities. Contractor bears responsibility and costs of damages and fines related to or resulting from backup of sewage into facilities or sanitary sewer overflows.

4. Service connections may be plugged after proper notification of property owners but must not remain plugged overnight.

G. Traffic Control Plan:

1. In accordance with Construction Specification Section 01 55 26, Temporary Traffic Control, Transportation Management Plans, and NCDOT or Municipal Owner requirements.

H. Installation Plan:

1. Describe preparation work including, but not limited to, cleaning operations, pre-CCTV inspection, and method for identifying active service laterals.

2. Describe the installation procedure including, but not limited to, type and location of equipment and method and procedure for curing. Provide acceptable inversion heads and pressures, heating and cool-down procedures and temperatures, and times for each stage of the process. Identify tools and equipment. Identify redundant equipment to be kept on site so that work can continue in the event of equipment failure.

3. For pulled in place installations, provide maximum pulling forces from the tube manufacturer.

4. Address installation and reconnection of services including timing.

5. Describe other necessary work required for a complete CIPP liner installation.

6. Provide a detailed installation schedule showing the order and timing for lining of each pipe segment. Provide a typical schedule for the installation process.

I. Field Quality Control Plan:

1. Describe the field quality control plan. Provide the quality control procedures to be performed by the Contractor. Incorporate the requirements in this specification.

2. Identify personnel responsible for each component of the plan and define the responsibilities for each person. Identify a single person who will be responsible and accountable for oversight and performance of quality control procedures.

3. Provide a sample installation report and curing log. Revise and resubmit as directed by the Engineer.

4. Submittals during construction: As required in Part 3.

J. Odor Control Plan: Identify how project specific odors will be minimized and dissipated at the project site and adjacent areas.

1.5 INFORMATIONAL SUBMITTALS

A. Provide submittals in accordance with Construction Specification Section 01 33 00, Submittal Procedures.

B. Records of field measurements obtained prior to lining.

C. CIPP Lining Contractor Safety Plan:

1. Submit prior to beginning Work to Engineer who will forward to Owner without review.

2. As a minimum, identify competent persons, equipment, operating procedures, and emergency procedures to be implemented in the event of a safety incident. Conform to work safety requirements of pertinent regulatory agencies. Provide a description of a daily safety program and regular periodic safety meeting for the project.

D. Special Procedure Submittals.

1.6 CLOSEOUT SUBMITTALS

A. Provide submittals in accordance with Construction Specification Section 01 33 00, Submittal Procedures.

B. Warranty Documentation

C. Record Documentation

1. Record Drawings: Maintain a clean, undamaged set of contract drawings to be marked up for submittal as record drawings on site at times. The set must be marked in red to show the actual installation where the installation varies from the Work as originally shown. Mark the drawing most capable of accurately showing the constructed conditions. Provide location of reinstated services. Drawings must be signed and dated by Contractor's construction project manager.

1.7 QUALITY ASSURANCE

A. Comply with Construction Specification Section 01 40 00, Quality Requirements.

B. Qualifications: CIPP Cured by Water or Steam

1. Manufacturers/Suppliers

a. CIPP lining products must be commercially proven. For a water or steam cured CIPP product to be considered commercially proven, it must demonstrate the following minimum successful installations in the United States without failure or defect for the specific category of work:

Product	Minimum Linear Footage	Minimum Time in Service
Gravity pipe liner, 12-inch & less	2,000,000	10 years
Gravity pipe liner, > 12-inch	1,000,000	10 years
*Pressure pipe liner, 12-inch & less	200,000	5 years
*Pressure pipe liner, > 12-inch	10,000	3 years

*For pressure applications only.

b. Gravity pipe liner manufacturers:

i. Inliner Technologies, LLC.
ii. Insituform Technologies, Inc.
iii. National Liner
iv. Premier-Pipe USA
v. Or equal

c. Pressure pipe manufacturers: n/a

2. Contractors/Installers:

a. Fully trained, qualified, experienced, and equipped to complete the Work expeditiously in accordance with the Contract Documents. CIPP liner installation must be performed by trained personnel only. Training must

be conducted by a qualified representative of the CIPP liner system manufacturer.

Demonstrate the following minimum successful installations in the United States without failure or defect for the specific category of work:

Product	Minimum Linear Footage	Minimum Continuous Experience
Gravity pipe liner, 12-inch & less	500,000	5 years
Gravity pipe liner, > 12-inch	100,000	5 years

b. Full-time superintendent that will be on-site to supervise lining Work must have supervised the installation of at least 500,000 linear feet of shop wet-out CIPP gravity liner of similar size and length.

c. Lead personnel installing and curing the liner, reinstating the service laterals, taking test samples, and performing post-installation CCTV inspection must have a minimum of three continuous years of experience with the product or equipment used for this contract. Experience must be demonstrated to the Engineer.

d. Personnel not performing the Work in accordance with manufacturer recommendations, approved submittals, and the contract documents must be promptly removed from the project and not return.

3. Quality Management System

a. The manufacturing process must operate under a Quality Management System (QMS) that is third-party certified to ISO 9000 standards or to another internationally or nationally recognized standard subject to the approval of the Engineer.

4. Testing Agencies:

a. Approved by Engineer prior to mobilization of materials and equipment.

C. Qualifications: GRP CIPP Cured by UV Light

1. Manufacturers/Suppliers

a. GRP CIPP lining products must be commercially proven. For a GRP UV light cured CIPP product to be considered commercially proven, it must demonstrate the following minimum successful installations in the United States without failure or defect for the specific category of work:

Product	Minimum Linear Footage	Minimum Time in Service
Gravity pipe liner, 12-inch & less	500,000	5 years
Gravity pipe liner, > 12-inch	250,000	5 years

b. Gravity pipe liner manufacturers:

i. SAERTEX-LINER
ii. Premier-Pipe USA
iii. Or equal

2. Contractors/Installers:

a. Fully trained, qualified, experienced, and equipped to complete the Work expeditiously in accordance with the Contract Documents. CIPP liner installation must be performed by trained personnel only. Training must be conducted by a qualified representative of the CIPP liner system manufacturer.

b. Demonstrate the following minimum successful installations in the United States without failure or defect for the specific category of work:

Product	Minimum Linear Footage	Minimum Continuous Experience
Gravity pipe liner, 12-inch & less	30,000	3 years
Gravity pipe liner, > 12-inch	5,000	3 years

*

c. Full-time superintendent that will be on-site to supervise lining Work must have supervised the installation of at least 15,000 linear feet of shop wet-out CIPP gravity liner of similar size and length.

d. Lead personnel installing and curing the liner, reinstating the service laterals, taking test samples, and performing post-installation CCTV inspection must have a minimum of three continuous years of experience with the product or equipment used for this contract. Experience must be demonstrated to the Engineer.

e. Personnel not performing the Work in accordance with manufacturer recommendations, approved submittals, and the contract documents must be promptly removed from the project and not return.

3. Quality Management System

a. The manufacturing process must operate under a Quality Management System (QMS) that is third-party certified to ISO 9000 standards or to another internationally or nationally recognized standard subject to the approval of the Engineer.

4. Testing Agencies:

a. Approved by Engineer prior to mobilization of materials and equipment.

D. Certifications

1. Chemical resistance requirements

2. QMS certification to ISO 9000 standards

3. Licensed installer by product manufacturer

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with Construction Specification Section 01 60 00, Product Requirements for transporting, handling, storing, and protecting products.

B. Materials must be shipped and delivered to the project site with manufacturer's performance affidavits.

C. Transport, receive, store, and handle materials in accordance with manufacturer recommendations.

D. On-site storage locations must be approved by Engineer and Owner.

E. Liner must be stored and maintained at the proper temperature in refrigerated facilities to prevent premature curing. Liner showing evidence of premature curing will be rejected for use and must be promptly removed from the project site.

F. Damaged materials must be promptly removed from the site and disposed of in accordance with current regulatory requirements at the Contractor's expense. Damage includes, but is not limited to, gouging, abrasion, flattening, cutting, puncturing, or ultra-violet (UV) degradation.

1.9 FIELD CONDITIONS

A. Existing Conditions: Sewers to be rehabilitated under this Contract are old VCP. Use caution during lining operations.

1.10 WARRANTY

A. Manufacturer must warrant the liner to be free from defects in materials for a period of one year from the date of substantial completion and acceptance by the Owner.

B. Contractor must warrant the liner material and installation for a period of one (1) year. During the Contractor warranty period, defects which may materially affect the integrity, strength, function, water-tightness, and/or operation of the pipe as determined by the Engineer, must be repaired at Contractor's expense in accordance with the procedures as recommended by the manufacturer and accepted by the Engineer.

C. Warranty work completed by the Contractor must be warranted for an additional year in addition to the warrantee required by the contract.

D. Within one year of substantial completion of the project and acceptance of the lined pipelines, the Owner will CCTV and inspect between twenty-five and one hundred percent of the lined sewers. If abnormalities or defects are identified in the sewers, Contractor must return and repair the abnormalities or defects or replace the liner in accordance with Part 3 of this specification. If greater than 20 percent of the sewers have defects, Contractor must clean, CCTV, and document abnormalities and defects in the remaining sewers that were lined (when less than 100% were inspected by the owner) in accordance with Construction Specifications 33 01 30.41, Cleaning of Sewers and 33 01 30.11, CCTV Inspection of Sewers. Abnormalities and defects identified must be repaired or replaced by the Contractor in accordance with Part 3 of this specification, at no cost to the Owner.

PART 2– PRODUCTS

2.1 GENERAL

A. Mark products and materials with detailed product information so that field personnel can easily identify and confirm concurrence with project submittals.

2.2 CURED-IN-PLACE PIPE:

A. Description

1. The lining of pipelines by the installation of a thermosetting resin-impregnated flexible tube which, when cured, provides a tight-fitting, joint-less, water-tight new pipe within a pipe, that is continuous along the length of the host pipe and designed to carry the structural loadings specified below.

2. This Specification provides the minimum requirements for the rehabilitation of deteriorated pipelines by the installation of CIPP as indicated in the Contract Documents.

B. Design Criteria

1. CIPP must be designed for the “Fully Deteriorated Gravity Pipe Condition” per the “Design Considerations” in Appendix X1 of ASTM F1216. The CIPP must be designed to support hydraulic, soil, and live loads without relying on remaining host pipe strength or bonding to the original pipe wall. The minimum liner thickness must be 6.0 mm for water or steam cured or 3.0 mm for UV light cured. Liners that have a thickness lower than the required thickness as measured in accordance with ASTM D5813 must be repaired or corrected by the Contractor in a manner determined by the Engineer at no additional cost to the Owner.

2. GRP CIPP must also be designed in accordance with ASTM F2019.

3. Design Parameters:

Parameter	Requirement
Soil Depth (above the crown)	As indicated on the plans
Soil Density	120 pcf
Constrained Soil Modulus	Per AASHTO LRFD Section 12 and AWWA M45
Soil Coefficient of Friction, Ku’	0.130r
Groundwater Depth	At ground surface
Live Load	AASHTO H-20 Live Load with two trucks passing for CIPP in streets
Enhancement Factor, K	7
Poisson’s Ratio	0.3
Ovality	As measured in the field, minimum 5%
Creep Retention Factor	50%
Factor of Safety	Diameter < 36” :2.0, Diameter = 36” and larger:1.5
Minimum Service Life	50 years

C. Minimum Initial Structural Properties: Felt CIPP

Property	Test Method	Cured Composite Per ASTM F1216
Flexural Modulus of Elasticity (Short Term)	ASTM D790	250,000 psi
Flexural Strength (Short Term)	ASTM D790	4,500 psi
Tensile Strength (Short Term) (for pressure applications only)	ASTM D638	3,000 psi

D. Minimum Initial Structural Properties: GRP CIPP

Property	Test Method	Cured Composite Per ASTM F1216
Flexural Modulus of Elasticity (Short Term)	ASTM D790	725,000 psi
Flexural Strength (Short Term)	ASTM D790	6,500 psi
Tensile Strength (Short Term) (for pressure applications only)	ASTM D3039 & ASTM D638	9,000 psi

E. Chemical Resistance:

1. Provide a 50-year corrosion resistance to chemicals found in domestic sewage.

2. Comply with ASTM D5813 and F1216 without plastic coating.

3. Test samples must be of fabric tube and the specific resin proposed for project.

F. Materials and installation must not produce detrimental compounds or by-products at downstream wastewater collection or treatment facilities. Notify Owner immediately of compounds or by-products produced and test and monitor the levels to the satisfaction of the Owner. Comply with local waste discharge requirements. Neither the CIPP system, nor its installation, must cause adverse effects to the Owner's facilities or processes.

2.3 FABRIC TUBE:

A. Consist of one or more layers of absorbent non-woven felt fabric, felt/fiberglass or fiberglass meeting the requirements of ASTM F 1216, ASTM F 1743, ASTM D 5813 & ASTM F2019.

B. GRP glass fiber material must be chemically resistant EC-R Glass.

C. Capable of absorbing and carrying resins, constructed to withstand installation pressures and curing temperatures and have sufficient strength to bridge missing pipe segments, and stretch to fit irregular pipe sections.

D. The wet-out fabric tube must have a uniform thickness and excess resin distribution that when compressed at installation pressures will meet or exceed the design thickness after cure.

E. Manufactured to a size and length that when installed, will tightly fit the internal circumference of the host pipe. Allow for circumferential stretching during installation. Properly size to the diameter and length of the host pipe to be lined. Tube must be able to stretch to fit irregular pipe sections and negotiate bends. Determine the minimum tube length necessary to effectively span the designated sewer between manholes. Verify the

lengths in the field prior to ordering materials and prior to impregnation of the tube with resin, to ensure that the tube will have sufficient length to extend the entire length of the run. Measure the inside diameter of the existing pipelines in the field prior to ordering liner so that the liner can be installed to provide a tight-fitted condition.

F. The minimum length of the fabric tube must be that deemed necessary by the installer to effectively span the distance from the starting manhole or access point to the terminating manhole or access point, plus that amount required to run-in and run-out for the installation process. **There must be no splices in the fabric tube.**

G. Water and steam cured liners must have an outside or inside layer of the fabric tube (before inversion/pull-in, as applicable) that must be coated with an impermeable, flexible membrane that will contain the resin and facilitate vacuum impregnation and monitoring of the resin saturation during the resin impregnation (wet-out) procedure.

H. GRP UV light cured liners must have an outer and inner film to ensure that the liner remains intact during the insertion process and to protect the resin during the installation and curing process from water and debris contamination, and resin migration. The exterior film must be provided with a UV light blocker foil.

I. No material can be included in the fabric tube that may cause de-lamination in the cured CIPP. Dry or unsaturated layers must not be acceptable upon visual inspection as evident by color contrast between the tube fabric and the activated resin containing a colorant.

J. The wall color of the interior pipe surface of CIPP after installation must be a light reflective color so that a clear detailed examination with closed circuit television inspection equipment can be performed.

K. Seams in the fabric tube must meet the requirements of ASTM D5813.

L. The outside of the fabric tube must be marked every 5 feet with the name of the manufacturer or CIPP system, manufacturing lot, and production footage.

M. The nominal fabric tube wall thickness must be constructed, as a minimum, to the nearest 0.5 mm increment, rounded up from the design thickness for that section of installed CIPP. The thickness must not change along the length of the liner unless approved by the Engineer. The quantity of resin used in the impregnation must be sufficient to fill the felt voids for the nominal felt thickness.

2.4 RESIN:

A. Consists of a corrosion resistant polyester or vinyl ester resin and catalyst system or epoxy and hardener system.

B. Produce CIPP that:

1. Meets the requirements of ASTM F1216, ASTM F1743, or ASTM F2019 and the minimum initial physical properties stated above, based on the project design parameters.

2. Meets the chemical resistance requirements.

C. Resin to tube ratio by volume, must be as recommended by the manufacturer.

D. The hue of the color must be dark enough to distinguish a contrast between the fully resin saturated felt fabric and dry or resin lean areas.

E. Resin must be used as shipped and recommended by the resin manufacturer. The resin must not be modified at the wet-out facility including the addition of fillers or additives except for the catalyst as recommended by the resin manufacturer. The application of the resin to the felt tubing (wet-out) must be conducted under factory conditions and the materials must be fully protected against UV light, excessive heat, and contamination.

2.5 ACCESSORIES:

A. Waterstop:

1. Hydrophilic comprised of non-bentonite, modified chloroprene rubber.

2. Expandable up to 200% of its original volume when exposed to water.

3. Expands and conforms to gap variations to create a compression seal.

4. Sika Hydrotite DSS, Insignia™ End Seal Sleeve, or equal.

B. Sewer Saddles:

1. Body: cast from ductile iron in accordance with ASTM A 536, Grade 65-45-12.

2. Gasket: Made from virgin Styrene Butadiene Rubber (SBR) compounded for water and sewer service in accordance with ASTM D 2000 MBA 710.

3. Pipe stop: Molded into the inside wall of the gasket capable of holding up to 1,000 pounds of force along the branch.

4. Strap: Constructed of Type 304 Stainless Steel, 3.5 inches wide to spread out clamping forces on the pipe. M.I.G. and T.I.G welds. Passivated for corrosion resistance.

5. Bolts and Nuts: Type 304 Stainless Steel, passivated for resistance to corrosion. 0.5" National Coarse roll thread. Nuts coated to prevent galling.

6. Washers: Acetyl and Type 304 stainless steel.

7. Coating: Shop coat applied to cast parts for corrosion protection.

8. Pressure rating: Will hold a 7 psi air test.

9. Style CB by Romac Industries, Inc. or equal.

2.6 SERVICE LATERAL SEALING SYSTEM

A. Where directed by the Engineer, the Contractor must reconnect service laterals to rehabilitated sewer lines, without excavation, by means of a service lateral sealing system (SLSS) product. The SLSS must reconnect laterals by installation and UV light curing of a resin-impregnated, flexible fiberglass insert with sealing epoxy element in the form of a tube or top hat that will be installed into the existing service lateral utilizing a pressure apparatus and ultraviolet light curing device positioned in the mainline pipe.

B. Service lateral connections may be a combination of tee's, wye's or break-in taps of varying sizes and angles from 30 to 90 degrees. The resin must be rapidly cured to transform the flexible insert into a hard, impermeable top hat seal around and in the lateral connection. The SLSS product must extend from the mainline into the lateral connection in a continuous tight fitting, watertight pipe-within-a-pipe to eliminate visible

ground water leakage and future root growth at the lateral to mainline connection. The SLSS must be compatible with the mainline and lateral pipe or liner.

C. The finished SLSS product must be an ECR (E-glass corrosion resistant) fiberglass laminate impregnated with an UV-light reactive polyester resin which when cured is chemically resistant to domestic sewage over the expected lifetime of the rehabilitated pipe. The SLSS product must be compatible with the lining system utilized for the main and lateral sewer lines. Comply with ASTM D543, ASTM D578, D1600, and D790.

D. The flexible fiberglass top hat tube insert must be fabricated to a size that when installed will key into the internal surface irregularities of the lateral joint and neatly fit tight to the internal circumference of the lateral. The top hat tube must be a laminate made of non-woven fiberglass materials that allow for circumferential stretching and angular alignment with the lateral pipe connection geometry during insertion. The insert laminate must seal to the inside wall of the sewer main 3 inches around the lateral opening and to the lateral wall 6 inches up into the lateral pipe from the main. Unless otherwise specified, the installer must furnish a specially formulated polyester resin and catalyst system compatible with the SLSS process that provides cured physical strength at least to the same level as required for the lateral liner if specified. A secondary epoxy-sealing component must be used to form a sealing bond between the SLSS product and the host lateral and main pipe walls.

E. The cured SLSS must have a minimum Flexural Modulus of Elasticity of 800,000 psi per ASTM D790.

2.7 ONE-PIECE MAIN AND LATERAL CURED-IN-PLACE LINER

A. Where directed by the Engineer, the Contractor must reconnect service laterals to rehabilitated sewer lines, without excavation, by means of a One-Piece Main and Lateral Cured-in-Place Liner. The lateral pipe must be remotely accessed from the main pipe and from a cleanout. This must be accomplished by the installation of a resin impregnated one-piece main and lateral lining by means of air inflation and inversion. The liner is pressed against the host pipe by pressurizing a bladder that is held in place until the thermo-set resins have cured.

B. Service lateral connections may be a combination of tees, wyes or break-in taps of varying sized and angle from 30 to 90 degrees. When cured, the liner must extend over a predetermined length of the service lateral (from main to clean out as determined in field) and a particular section of the main pipe as a continuous, one piece, tight fitting, corrosion resistant and verifiable non-leaking cured in-place pipe.

C. The liner assembly must be continuous in length and consist of one or more layers of absorbent textile material i.e. needle punched felt, circular knit, or circular braid that meet the requirements of ASTM F1216 and ASTM D5813 Sections 6 and 8 respectively. The textile tube and sheet must be constructed to withstand installation pressures, have sufficient strength to bridge missing pipe segments, and flexibility to fit irregular pipe sections. The wet-out textile tube and sheet must meet ASTM F 1216 7.2 as applicable. It must have a uniform thickness and 5% to 10% excess resin distribution that when compressed at installation pressures will meet or exceed the design thickness after cure.

D. The outside layer of the textile tube (before inversion) and the interior of the textile sheet must be coated with an impermeable, translucent flexible membrane. The textile sheet before insertions must be permanently marked as a “Lateral Identification” correlating to the address of the building and the lateral pipe services. The sheet and tube must be surrounded by a second impermeable, flexible translucent membrane (translucent

bladder) that will contain the resin and facilitate vacuum impregnation while monitoring of the resin saturation during the resin impregnation (wet-out) procedure.

E. The cured One-Piece Main and Lateral Cured-in-Place Liner must have a minimum Flexural Modulus of Elasticity of 250,000 psi per ASTM D790.

F. One-Piece Main and Lateral Cured-in-Place Liner must be T-Liner by LMK Technologies, or equal.

PART 3– EXECUTION

3.1 EXAMINATION

A. Verification of Conditions

1. Verify dimensions in the field prior to fabrication of liner. Verify that existing pipe size, material, location, and invert are as indicated on the Drawings.

2. Clean Sewers in accordance with Construction Specification Section 33 01 30.41.

3. Conduct CCTV inspection of segments to be lined in accordance with Construction Specification Section 33 01 30.11, CCTV Inspection of Sewers. Identify defects, obstructions, or deficiencies that prevent the pipe from being lined in accordance with these specifications. Notify Engineer immediately of problematic or changed conditions.

4. If point repairs or connections are made after cleaning and CCTV, confirm work was performed in accordance with the Contract Documents including but not limited to proper alignment, grade, and connection to the existing sewer. Problems must be corrected prior to installation of the liner or the area must be reinstalled or repaired as directed by the Engineer.

B. Evaluation and Assessment

1. Examine the conditions under which pipe lining is to be performed and notify the Engineer, in writing, of conditions detrimental to the proper and timely completion of the Work in accordance with the Contract Documents. Do not proceed with the Work where unsatisfactory conditions have been identified until a plan has been developed to resolve the unsatisfactory conditions.

2. Confirm the location of active service laterals by dye testing or other manner approved by the Engineer. Confirm the location of inactive services that the Owner desires to replace prior to excavating at the connection of the service lateral to the main. Contractor will not be paid excavation and restoration costs for excavating service connections that are inactive and will not be replaced.

3. Confirm the location of new service laterals that the Owner plans to install.

3.2 PREPARATION

A. Work must not begin and equipment and materials must not be delivered to the project site until submittals have been received and approved by the Engineer and property owners have been notified in accordance with the Public Notification Plan.

B. Perform Work in accordance with applicable OSHA safety standards and the Contractor’s submitted Safety Plan.

1. Entry into or work within confined spaces must be conducted in accordance with the U.S. Department of Health and Human Services/National Institute for Occupational Safety and Health [DHHS (NIOSH)] Publication No. 87-113, A Guide to Safety in Confined Spaces.

2. Erect signs and other devices as are necessary for the safety of the work site.

3. Maintain on the project site the following minimum safety equipment:

    a. Gas monitor capable of testing and detecting for combustible gas, oxygen deficiency, and hydrogen sulfide.

    b. Confined space access and retrieval winch system.

    c. Ventilating fans with large diameter ventilating hose.

    d. Supplied air respirator, MSHA/NIOSH approved type.

    e. Safety harness and lifelines.

    f. Other equipment as may be required for the project.

4. All equipment must be available for use in sufficient quantity by Contractor, Engineer, and Owner for the duration of the project.

C. Establish traffic control in accordance with the Traffic Management Plan Construction Specification 01 55 26, Temporary Traffic Control, and the NCDOT Encroachment Agreement.

D. Flow Bypassing:

1. See Construction Specification 01 14 00, Work Restrictions for requirements for facility outages, pipeline shutdowns, and interruption of service.

2. Establish bypass of flows in accordance with the Bypass Pumping Plan (BPP). See Construction Specification Section 01 51 39.10, Temporary Bypass Pumping of Wastewater Pipelines for further requirements.

3. The bypass pumping system must be of sufficient capacity to convey flows without sewage backup to private property or discharge.

4. Liner installation must not begin until plugs have been installed or a bypass system has been installed and tested under full operating conditions for mainlines and side sewer flows. Once the lining process has begun, maintain flows in accordance with the Bypass Pumping Plan until the liner has fully cured, cooled down, and been televised.

E. Cut intruding taps back to within the 1/2 inch of the pipe.

F. Contractor will be allowed to obtain water from an owner-approved fire hydrant. Obtain water only through a double check backflow assembly provided by the Contractor and approved by the Owner. Contractor must pay Owner’s standard unit price for excessive water usage.

3.3 INSTALLATION OF LINER

A. General

1. CIPP must be continuous and joint-less from manhole to manhole or access point to access point and must be free of defects that will affect the long term operation and service life.

2. Where directed or approved by the Engineer, line multiple sewer segments at one time. Neatly remove the top half of the liner in the intermediate manhole(s). Fill the void between the liner and the trough with non-shrink grout. Reconstruct manhole benches to make a smooth transition from bench to trough.

3. CIPP must fit sufficiently tight within the host pipe to provide a mechanical bond.

4. There must be no seepage or leakage at the connections to manholes or through the wall of the CIPP.

5. CIPP must be installed in accordance with ASTM F1216, ASTM F1743, or ASTM F2019.

B. Preparation

1. Prior to insertion of the liner, temperature sensors must be placed in the invert of the host pipe so they will be positioned between the liner and the host pipe to monitor the temperature of the liner wall and verify proper curing. Place temperature sensors along the host pipe at the interval recommended by the sensor manufacturer. Additional sensors must be placed where significant heat sinks are possible as directed by the Engineer.

2. Monitor sensors with computer software with a tamper-proof database and record temperatures at the sensors throughout the curing period. The software must provide real-time data to provide control of the cure for maximum quality and efficiency. In each measurement zone, the software must indicate the cure temperatures and the length of time each temperature was maintained. It must also indicate the cool down rate. Temperature readings must be continuous from the first application of heat to the final cool down temperature. A report must be provided that provides the continuous data and summarizes the cure process. The final data must be summarized in a gradient chart with axes that represent time and distance, and color that represents temperature.

C. Insertion of liner

1. The tube must be inverted or pulled-in through an existing manhole or approved access point and fully extend to the next designated manhole or termination point.

2. Comply with submitted inversion heads and pressures.

3. The tube must not be damaged during installation. Damage includes, but is not limited to, gouging, puncturing, abrasion, cutting, or any type of degradation. Damaged liners must be promptly removed from the pipe and the site and disposed of in accordance with current regulatory requirements at the Contractor’s expense.

D. Curing and Cool-Down

1. Cure and cool-down liner in accordance with ASTM standards and the submitted procedures. Comply with heating and cool-down schedules and procedures including temperatures and times for each stage of the process. Adjust as necessary to account for existing ground conditions including temperature, moisture level, and thermal conductivity of soil in accordance with ASTM standards.

2. Generate installation reports for each segment of liner installed. The reports must document installation, including manhole numbers, street names/sewer location, project number, date, time, temperature, curing temperature, curing time, liner thickness, location of each service reconnected with street address, etc. A sample report must be submitted to the Engineer for approval prior to installing lining. Submit installation reports and curing logs daily.

3. Curing and cool-down must be monitored and recorded throughout the installation process to ensure that each phase of the process is achieved in accordance with ASTM standards and the submitted procedures.

4. If a temperature sensor indicates that the liner did not cure in accordance with requirements, repair or replace the liner as recommended by the manufacturer in a manner approved by the Engineer.

E. Additional requirements for installation of UV cured GRP tubing

1. Liner insertion preparation: A continuous 10 mm plastic sheet (slip sheet) must be installed on the bottom one third to one half of the host pipe to protect the liner during insertion and reduce the drag. Provide and install as recommend by the liner manufacturer.

2. Liner insertion: Pull the glass fiber liner into position in the host pipe with a constant tension winch. The liner must have a lateral fiberglass reinforcement band which runs the entire length of the liner ensuring that the pulling force is transferred to the band and not the fiberglass liner. Do not exceed pulling forces provided by the pipe manufacturer. Once inserted, end plugs must be used to cap each end of the glass fiber liner to prepare for pressurizing the liner. Secure end plugs with straps to prevent them from being expelled due to pressure. Use liner restraints in manholes.

3. Liner inflation: Inflate liner as recommended by liner manufacture. Once inflated to working pressures the liner must fit tightly against the host pipe.

4. Equipment setup: Assemble UV light sources in accordance with manufacturer’s specifications for the liner diameter. When inserting the curing equipment in the liner, do not damage the inner film material.

5. Pre-curing Inspection: Once working inflation pressures are reached, the liner must be inspected by integrated CCTV on the light assembly to check for proper fit and expansion of the liner. If the liner does not fit tightly against the host pipe, or there are foreign inclusions, pinholes, leaks, lifts, splits, folds, wrinkles, ribs, fins greater than 1/2–inch or other defects; adjust, deflate and re-inflate, remove and reinsert, replace, or perform other measures approved by Engineer to correct or resolve the deficiency. The Resident Project Representative must witness all pre-curing inspections and relay any concerns to Engineer prior to Contractor proceeding with curing. Contractor must allow sufficient time for

Engineer to be notified, evaluate the concern, and review potential resolutions with Contractor prior to curing the liner.

6. Curing Process: Cure with UV light at a constant inner pressure and speed in accordance with equipment and liner manufacturer's requirements.

7. Provide the optimal curing speed, or travel speed of the energized UV light sources for each length of liner based on liner diameter, liner thickness, and exothermic reaction temperature.

8. UV light systems must have the ability to record specific parameters during the curing process to ensure the liner cures properly. This must be accomplished using a computer, software, and database that are tamper proof. During the curing process, infrared sensors will be used to record curing data. UV Light Systems must record as a minimum the following parameters:

    a. Project name
    b. Line section
    c. Date and time
    d. Curing speed
    e. Light source working & wattage
    f. Inner air pressure
    g. Inner temperatures
    h. Length of liner

9. Provide Engineer a record of the curing parameters for the full length of all line segment.

10. The inner film material must be removed and discarded after curing to provide optimal quality of the final product.

F. Finish

1. The installed CIPP must be continuous over the entire length of a sewer line section and be free from visual defects such as foreign inclusions, de-laminations, dry spots, pinholes, leaks, lifts, splits, cracks, folds, wrinkles, ribs, or fins greater than 1/2–inch and other defects unless predicted in writing by the Contractor prior to the installation and accepted by the Engineer. Defects must be repaired in a manner approved by the Engineer at no additional cost to the Owner.

2. There must be no leakage through the pipe wall or between the liner and host pipe. If the CIPP leaks, it must be repaired or removed and replaced with a watertight pipe as approved by the Engineer.

G. Manhole Connections

1. The liner must be neatly cut 1 inch from the manhole walls to facilitate the application of a cementitious manhole coating. The liner must be sealed at the manholes to provide a watertight liner connection at the manhole. There must be no leakage of groundwater into the manhole between the liner and existing sewer pipe.

2. A hydrophilic waterstop must be installed around the liner 6 inches from each manhole wall prior to processing the liner to provide additional waterstop protection. As the liner is expanded, the waterstop must be pressed tightly against the existing sewer to provide a leak-tight seal.

3. If leakage occurs at the manholes, seal these areas to stop leakage using a material compatible with the CIPP in a manner approved by the Engineer.

H. Reinstatement of service laterals

1. Reconnect service laterals after the CIPP has been installed, fully cured, and cooled down.

2. Contractor must identify active services laterals and reconnect those and other service laterals as directed by the Owner.

3. Internal reinstatement:

a. A CCTV camera and remote cutting tool must be used for internal reconnections. The machined opening must be at least 95 percent of the service connection opening and the bottom of both openings must match. The opening must not be more than 100 percent of the service connection opening. The edges of the opening must not have pipe fragments or liner fragments, which may obstruct flow or snag debris. The invert of the sewer connection must be cut flush with the invert entering the mainline.

b. Over-cut service connections must be repaired by installation of a service lateral sealing system at the expense of the Contractor.

4. External reinstatement:

a. External sewer saddles: In accordance with HIGHFILL Detail 33-09.

b. Remove host pipe all around the CIPP at the lateral location. Install external saddle to the CIPP.

c. If a sewer lateral cannot be reinstated via external saddle by the end of the day, reinstate the lateral internally. Do not overcut the internal opening. Over cutting may impact external saddle seal.

5. Active laterals must not be left unconnected overnight.

6. Liners damaged by removal of the cutting tool or other equipment must be repaired or replaced as directed by the Engineer.

7. Keep a redundant robotic cutter on-site so that services can be reinstated should the primary fail.

8. Coupons of pipe material resulting from service tap cutting must be collected at the next manhole downstream of the pipe rehabilitation operation prior to leaving the site. Coupons may not be allowed to pass through the system.

3.4 SERVICE LATERAL SEALING SYSTEM

A. Inspect the area around the lateral sealing surface, in both the main and lateral. Remove waste build-up, deposits, hard scale, roots, lateral cutting debris and resin slugs using high pressure water jetting, in-line cutters, or other approved methods. Removal must extend one foot beyond the SLSS product to allow the bladder to inflate tightly against the pipe walls, ensuring a smooth transition from SLSS product to the existing pipe wall.

B. Break-in connections and lateral pipes protruding into the main must be ground back to no more than a 1/8-inch. The lateral must be opened at least 95 percent with edges finished and not jagged.

C. The resin impregnated SLSS product must be loaded on the applicator apparatus, attached to a robotic manipulator devise and positioned in the mainline pipe at the service connection. The robotic devise together with a television camera will be used to align the SLSS repair product with the service connection opening. Air pressure must be used to insert the resin impregnated connection repair product into the lateral pipe. The inserted product will then be inspected using a TV camera to confirm the SLSS product is correctly positioned and centered in the lateral opening prior to curing.

D. Adjust the insertion pressure to fully deploy the SLSS product into the lateral connection and hold the SLSS product tight to the main and lateral pipe walls. The pressure apparatus must include a bladder of sufficient length in both the main and lateral lines such that the inflated bladder extends beyond the ends of both the lateral tube and main line brim segments of the SLSS product, pressing the end edges flat against the internal pipe wall thus forming a smooth transition from SLSS product to pipe wall without a step, ridge or gap between the SLSS product and the inner diameter of the lateral and mainline pipes.

E. Maintain the recommended pressure on the impregnated SLSS product for the duration of the UV light curing process and then deflate the packer and remove it from connection.

F. The finished SLSS product must be free of dry spots, lifts and delamination. Provide an electronic picture and recorded data identifying the location and showing the completed installation.

G. Repair defects with the SLSS that affect the performance or cleaning of the pipe and lateral connection in a manner acceptable to the Engineer.

3.5 FIELD QUALITY CONTROL

A. Evaluation of Initial Structural Properties

1. Verify the initial structural properties of the CIPP through field sampling and laboratory testing. Obtain samples from each CIPP at the opposite end from where hot water or steam is introduced into the liner.

2. Provide tools and materials for sampling and obtain samples in the presence of the Owner’s representative. Samples must be cut from a section of cured CIPP that has been inverted or pulled through a pipe of equal diameter which has been held in place by a suitable heat sink, such as sandbags. Samples must be at least 12 inches in length.

3. Label samples with the manhole or access pit number from which they were taken, the sewer segment they represent, the date of the installation, and the initials of the Contractor and Owner’s representative.

4. Immediately provide samples to the Owner’s representative who will store the samples until there is a sufficient number (no more than 5 for the first shipment, weekly thereafter) to ship to the testing lab. Prepare and package samples for shipment to the lab in the presence of the Owner’s representative. Contractor will deliver the samples to the shipping company and pay the shipping cost.

5. Testing must be performed by an independent third-party laboratory selected by the Owner. Tests must be performed in accordance with applicable ASTM test

methods to confirm compliance with the requirements of the Contract Documents. Liner thickness must be measured in accordance with ASTM D5813. Flexural properties must be determined per ASTM D790.Tensile properties must be tested in accordance with ASTM D3039 or ASTM D638.

6. The liner thickness must have tolerance of minus 5% or plus 10%. In man-entry size piping, the Contractor must remove a minimum of one sample for every line segment of CIPP. The samples must be taken by core drilling 2-inch diameter test plugs at random locations selected by the Owner.

7. Testing results must be forwarded directly to the Owner and copied to the Engineer who will distribute copies to the Contractor.

8. Invoices for testing must be sent directly to the Contractor who must arrange to pay for testing.

9. On pipelines greater than 18 inches in diameter, the Owner may require plate samples cured along with the CIPP or designate a location in the newly installed CIPP where the Contractor must take a sample. The Opening produced from the sample must be repaired in accordance with manufacturers recommended procedures.

10. Payment will not be made for CIPP liner until test results indicate the liner meets the requirements of this specification. If test samples do not meet the minimum physical or thickness requirements, the CIPP must be repaired or replaced by the Contractor, in a manner approved by the Engineer. If the combination of the initial structural properties and the thickness of a sample meet the specified design requirements, the liner may be accepted by the Owner at their discretion.

B. Post Rehabilitation CCTV Inspection

1. Following installation of the liner, re-opening and brushing of service connections, installation of sewer service saddles, and installation of air release assembly tees (pressure applications), perform a detailed CCTV inspection of the completed work. The inspection must be performed in accordance with ASTM standards in the presence of the Owner’s representative.

2. Perform inspections from manhole to manhole or access point to access point in a manner such that the entire sewer lining can be clearly viewed. A radial view (pan and tilt) TV camera must be used.

3. Bypass pump sewage around the sewer being inspected to prevent sewage from entering the line during the inspection.

4. Immediately prior to the CCTV inspection, thoroughly clean the liner removing sewage, debris, and other items that have accumulated.

5. Where sags are present, the pipe must be cleared of standing water so the entire liner can be clearly observed.

6. The video must note the inspection date, the location of reconnected service laterals, visual defects including but not limited to foreign inclusions, de-laminations, dry spots, lifts, bumps, bulges splits, cracks, pinholes, holes, gouges, folds, wrinkles, ribs, and fins.

7. The entire lateral opening must be clearly shown.

8. The final footage of the post-rehabilitation inspection must be within 1% of the actual sewer length as measured above ground. The camera must be panned, tilted and rotated at service lateral or force main connections and defects for complete video documentation of the conditions.

9. Submit a sample CCTV inspection immediately after the first liner is installed so the Engineer can review the performance and quality of the inspection and communicate changes required for acceptance. Sewers not inspected to the Engineer's satisfaction must be re-inspected at no additional cost to the Owner.

10. Provide unedited digital documentation of the inspections to the Engineer within ten working days of the liner installation. If post installation inspection documentation is not submitted within that timeframe, the Owner may suspend further installation of the CIPP until post-installation documentation is submitted for the completed liners. Additional contract days will not be allowed, nor will adjustments be made to the contract price as a result of the stop work order.

11. CCTV documentation must include video inspection and computer generated logs to document the inspection. Two copies of the post-rehabilitation videos and logs must be submitted to the Engineer on portable hard drives for review and approval. Payment will not be made for CIPP lining until the Engineer has reviewed and approved the videos and logs. Video must be submitted at least 10 working days in advance of payment request to provide the Engineer ample time for review.

C. Pressure Test (Pressure sewers only):

1. After installation, pressure test in accordance with testing requirements for pipelines.

2. Provide necessary test cocks and fittings at no additional cost to the Owner.

3. Prepare reports for testing activities to include time period of test, beginning and ending pressure, and personnel present. Testing must be performed in the presence of the Owner’s representative.

4. Test reports indicating compliance with this specification must be received by the Engineer prior to requesting payment for a liner.

3.6 CIPP REPAIR AND REPLACEMENT

A. Where CIPP liners are determined to be defective in accordance with this specification by the Engineer, provide a detailed step-by-step repair or replacement procedure for review by the Engineer. Repair and replacement methods and procedures must be approved by the Engineer. Repairs must result in a finished product which meets the requirements of the Contract Documents.

B. Where un-repairable defects occur, prepare a procedure for the removal and replacement of the defective CIPP.

C. Where leakage occurs through the wall of the CIPP, the liner must be repaired or removed and replaced as required by the Engineer. Final approval of the liner installation will be based on a leak-free CIPP.

3.7 FINAL ACCEPTANCE

A. Work must be subject to inspection and approval prior to final acceptance and payment. Final acceptance must be contingent upon the following:

1. Documented CIPP testing indicating compliance with the Contract Documents.

2. Repairs and replacements completed and accepted.

3. Final cleanup completed and meeting the approval of the Engineer, the Owner, and property owner where applicable.

END OF SECTION