CITY OF HALLANDALE BEACH
STORMWATER PIPE CLEANING PROJECT

EXHIBIT A
TECHNICAL SPECIFICATIONS

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TABLE OF CONTENTS

SECTION	DESCRIPTION	NUMBER OF PAGES
0101	Mobilization	1
0102	Maintenance of Traffic	12
0430	Cleaning and Internal Inspection	4
0450	Cured-In-Place Pipe Liner	16

SECTION 101
MOBILIZATION

101-1 Description.

Perform preparatory work and operations in mobilizing for beginning work on the project, including, but not limited to, those operations necessary for the movement of personnel, equipment, supplies, and incidentals to the project site and for the establishment of temporary offices, buildings, safety equipment and first aid supplies, and sanitary and other facilities.

Include the costs of bonds and any required insurance and any other preconstruction expense necessary for the start of the work, excluding the cost of construction materials.

101-2 Basis of Payment.

101-2.1 When a Separate Item is Included in the Proposal: When the proposal includes a separate item of payment for this work, the work and incidental costs specified as being covered under this Section will be paid for at the Contract lump sum price for the item of Mobilization.

Payment will be made under:

Item No. 101- 1- Mobilization -lump sum.

101-2.2 Partial Payments: When the proposal includes a separate pay item for Mobilization and the Notice to Proceed has been issued, partial payments will be made in accordance with the following:

For contracts of 120 contract days duration or less, partial payment will be made at 50% of the bid price per month for the first two months. For contracts in excess of 120 contract days duration, partial payment will be made at 25% of the bid price per month for the first four months. In no event shall more than 50% of the bid price be paid prior to commencing construction on the project site.

Total partial payments for Mobilization on any project, including when more than one project or job is included in the Contract, will be limited to 10% of the original Contract amount for that project. Any remaining amount will be paid upon completion of all work on the Contract.

Retainage, as specified in 9-5, will be applied to all partial payments.

Partial payments made on this item will in no way act to preclude or limit any of the provisions for partial payments otherwise provided for by the Contract.

SECTION 102
MAINTENANCE OF TRAFFIC

102-1 Description.

Maintain traffic within the limits of the project for the duration of the construction period, including any temporary suspensions of the work. Construct and maintain detours. Provide facilities for access to residences, businesses, etc., along the project. Furnish, install and maintain traffic control and safety devices during construction. Furnish and install work zone pavement markings for maintenance of traffic (MOT) in construction areas. Provide any other special requirements for safe and expeditious movement of traffic specified in the Plans. MOT includes all facilities, devices and operations as required for safety and convenience of the public within the work zone.

Do not maintain traffic over those portions of the project where no work is to be accomplished or where construction operations will not affect existing roads. Do not obstruct or create a hazard to any traffic during the performance of the work, and repair any damage to existing pavement open to traffic.

Include the cost of any work that is necessary to meet the requirements of the Contract Documents under the MOT pay item, when there is not a pay item provided.

102-2 Materials.

Meet the following requirements (from the corresponding sections of the latest FDOT Specifications Documentation):

Bituminous Adhesive.....Section 970
Temporary Retroreflective Pavement Markers Section 990
Paint ..... Section 971
Removable Tape .....Section 990
Glass Spheres.....Section 971
Temporary Traffic Control Device Materials..Section 990
Retroreflective and Nonreflective Sheeting
for Temporary Traffic Control Devices.....Section 994

102-2.1 Temporary Traffic Control Devices: Use only the materials meeting the requirements of Section 990, Section 994, Design Standards and the Manual on Uniform Traffic Control Devices (MUTCD).

102-2.2 Detour: Provide all materials for the construction and maintenance of all detours.

102-2.3 Commercial Materials for Driveway Maintenance: Provide materials of the type typically used for base, including recycled asphalt pavement material, and having stability and drainage properties that will provide a firm surface under wet conditions.

102-3 Specific Requirements.

102-3.1 Beginning Date of Contractor's Responsibility: Maintain traffic starting the day work begins on the project or on the first day Contract time is charged, whichever is earlier.

102-3.2 Worksite Traffic Supervisor: Provide a worksite traffic supervisor in accordance with Section 105. Provide the worksite traffic supervisor with all equipment and

materials needed to set up, take down, maintain traffic control, and handle traffic-related situations.

Ensure that the worksite traffic supervisor performs the following duties:

1. Performs on site direction of all traffic control on the project.
2. Is on site during all set up and take down, and performs a drive through inspection immediately after set up.
3. Is on site during all nighttime operations to ensure proper MOT.
4. Immediately corrects all safety deficiencies and does not permit minor deficiencies that are not immediate safety hazards to remain uncorrected for more than 24 hours.
5. Is available on a 24 hour per day basis and present within 45 minutes after notification of an emergency situation and is prepared to positively respond to repair the work zone traffic control or to provide alternate traffic arrangements.
6. Conducts daily daytime and weekly nighttime inspections of projects with predominately daytime work activities, and daily nighttime and weekly daytime inspections of projects with predominantly nighttime work activities of all traffic control devices, traffic flow, pedestrian, bicyclist, and business accommodations.

Advise the project personnel of the schedule of these inspections and give them the opportunity to join in the inspection as is deemed necessary. Submit a comprehensive weekly report, using the Department's currently approved form, to the Engineer detailing the condition of all traffic control devices (including pavement markings) being used. Include assurances in the inspection report that pedestrians are accommodated with a safe, accessible travel path around work sites separated from mainline traffic in compliance with the Americans with Disabilities Act (ADA) Standards for Transportation Facilities, that existing or detoured bicyclist paths are being maintained satisfactorily throughout the project limits, and that existing businesses in work areas are being provided with adequate entrances for vehicular and pedestrian traffic during business hours. Have the worksite traffic supervisor sign the report and certify that all of the above issues are being handled in accordance with the Contract Documents. When deficiencies are found, the worksite traffic supervisor is to note such deficiencies and include the proposed corrective actions, including the date corrected.

The Department may disqualify and remove from the project a worksite traffic supervisor who fails to comply with the provisions of this Section. The Department may temporarily suspend all activities, except traffic, erosion control and such other activities that are necessary for project maintenance and safety, for failure to comply with these provisions.

102-4 Alternative Traffic Control Plan.

The Contractor may propose an alternative traffic control plan (TCP) to the plan presented in the Contract Documents. Have the Contractor's Engineer of Record sign and seal the alternative plan. Prepare the TCP in conformance with and in the form outlined in the current version of the Department's Plans Preparation Manual. Indicate in the plan a TCP for each phase of activities. Take responsibility for identifying and assessing any potential impacts to a utility that may be caused by the alternate TCP proposed by the Contractor, and notify the Department in writing of any such potential impacts to utilities.

Engineer's approval of the alternate TCP does not relieve the Contractor of sole responsibility for all utility impacts, costs, delays or damages, whether direct or indirect, resulting from Contractor initiated changes in the design or construction activities from those in the original Contract Specifications, Design Plans (including TCPs) or other Contract Documents and which effect a change in utility work different from that shown in the Utility Plans, joint project agreements or utility relocation schedules.

The Department reserves the right to reject any alternative TCP. Obtain the Engineer's written approval before beginning work using an alternate TCP. The Engineer's written approval is required for all modifications to the TCP. The Engineer will only allow changes to the TCP in an emergency without the proper documentation.

102-5 Traffic Control.

102-5.1 Standards: FDOT Design Standards are the minimum standards for the use in the development of all TCPs. The MUTCD, Part VI is the minimum national standard for traffic control for highway construction, maintenance, and utility operations. Follow the basic principles and minimum standards contained in these documents for the design, application, installation, maintenance, and removal of all traffic control devices, warning devices and barriers which are necessary to protect the public and workers from hazards within the project limits.

102-5.2 Maintenance of Roadway Surfaces: Maintain all lanes that are being used for the MOT, including those on detours and temporary facilities, under all weather conditions. Keep the lanes reasonably free of dust, potholes and rutting. Provide the lanes with the drainage facilities necessary to maintain a smooth riding surface under all weather conditions.

102-5.3 Number of Traffic Lanes: Maintain one lane of traffic in each direction. Maintain two lanes of traffic in each direction at existing four (or more) lane cross roads, where necessary to avoid undue traffic congestion. Construct each lane used for MOT at least as wide as the traffic lanes existing in the area before commencement of construction. Do not allow traffic control and warning devices to encroach on lanes used for MOT.

The Engineer may allow the Contractor to restrict traffic to one-way operation for short periods of time provided that the Contractor employs adequate means of traffic control and does not unreasonably delay traffic. When a construction activity requires restricting traffic to one-way operations, locate the flaggers within view of each other when possible. When visual contact between flaggers is not possible, equip them with 2-way radios, official, or pilot vehicles, or use traffic signals.

102-5.4 Crossings and Intersections: Provide and maintain adequate accommodations for intersecting and crossing traffic. Do not block or unduly restrict any road or street crossing the project unless approved by the Engineer. Before beginning any construction, provide the Engineer the names and phone numbers of persons that can be contacted when signal operation malfunctions.

102-5.5 Access for Residences and Businesses: Provide continuous access to all residences and all places of business.

102-5.6 Protection of the Work from Injury by Traffic: Where traffic would be injurious to a base, surface course, or structure constructed as a part of the work, maintain all traffic outside the limits of such areas until the potential for injury no longer exists.

102-5.7 Flagger: Provide trained flaggers in accordance with Section 105.

102-5.8 Conflicting Pavement Markings: Where the lane use or where normal vehicle or pedestrian paths are altered during construction, remove all pavement markings (paint, tape, thermoplastic, raised pavement markers, etc.) that will conflict with the adjusted vehicle or pedestrian paths. Use of paint to cover conflicting pavement markings is prohibited. Remove conflicting pavement markings using a method that will not damage the surface texture of the pavement and which will eliminate the previous marking pattern regardless of weather and light conditions.

Remove all pavement markings that will be in conflict with "next phase of operation" vehicle pedestrian paths as described above, before opening to vehicle traffic or use by pedestrians.

Cost for removing conflicting pavement markings (paint, tape, thermoplastic, raised pavement markers, etc.) to be included in Maintenance of Traffic, Lump Sum.

102-5.9 Vehicle and Equipment Visibility: Equip all pickups and automobiles used on the project with a minimum of one Class 2 amber or white warning light that meets the Society of Automotive Engineers Recommended Practice SAE J595, dated November 1, 2008, or SAE J845, dated December 1, 2007, and incorporated herein by reference. Existing lights that meet SAE J845, dated March, 1992, or SAE J1318, dated April, 1986, may be used to its end of service life. Lights should be unobstructed by ancillary vehicle equipment such as ladders, racks or booms. If the light is obstructed, additional lights will be required. The lights shall be operating when a vehicle is in a work area where a potential hazard exists, when operating the vehicle at less than the average speed for the facility while performing work activities, making frequent stops or called for in the Plans or Design Standards.

Equip all other vehicles and equipment with a minimum of 4 square feet of retroreflective sheeting or flashing lights.

To avoid distraction to motorists, do not operate the lights on the vehicles or equipment when the vehicles are outside the clear zone or behind a barrier.

102-5.10 No Waiver of Liability: Conduct operations in such a manner that no undue hazard results due to the requirements of this Article. The procedures and policies described herein in no way acts as a waiver of any terms of the liability of the Contractor or his surety.

102-6 Detours.

102-6.1 General: Construct and maintain detour facilities wherever it becomes necessary to divert traffic from any existing roadway or bridge, or wherever construction operations block the flow of traffic.

102-6.2 Construction: Plan, construct, and maintain detours for the safe passage of traffic in all conditions of weather. Provide the detour with all facilities necessary to meet this requirement. Where pedestrian facilities are detoured, blocked or closed during the work, provide safe alternate accessible routes through or around the work zone meeting the requirements of the ADA Standards for Transportation Facilities.

When the Plans call for the Department to furnish detour bridge components, construct the pile bents in accordance with the Plans, unless otherwise authorized by the Engineer.

Submit a letter with the following: company name, phone number, office address, project contact person, project number, detour bridge type, bridge length, span length, location and usage time frames, to the Engineer at least 30 calendar days before the intended

pick-up date, to obtain the storage facility location and list of components for the project. Upon receipt of letter, the Engineer will, within ten calendar days provide an approved material list to the Contractor and the appropriate Department storage yard.

Provide a letter with an original company seal, identifying the representative with authority to pick up components, to the Engineer at least 10 calendar days before the proposed pick-up date. The Department is not obligated to load the bridge components without this notice. Take responsibility and sign for each item loaded at the time of issuance.

Provide timber dunnage, and transport the bridge components from the designated storage facility to the job site. Unload, erect, and maintain the bridge, then dismantle the bridge and load and return the components to the designated storage facility.

Notify the Engineer in writing at least 10 calendar days before returning the components. Include in this notice the name of the Contractor's representative authorized to sign for return of the bridge components. The yard supervisor is not obligated to unload the bridge components without this notice.

The Department will provide equipment and an operator at the Department's storage facility to assist in loading and unloading the bridge components. Furnish all other labor and equipment required for loading and unloading the components.

The Departments representative will record all bridge components issued or returned on the Detour Bridge Issue and Credit Ticket. The tickets must be signed by a Department and a Contractor representative, after loading or unloading each truck to document the quantity and type of bridging issued or returned.

Bind together all bridge components to be returned in accordance with the instructions given by the storage facility. The yard supervisor will repack components that are not packed in compliance with these instructions. Upon request, written packing instructions will be made available to the Contractor, before dismantling of the bridge for return to the Department's storage facility.

Assume responsibility for any shortage or damage to the bridge components. Monies due the Contractor will be reduced at the rate of $35.00 per hour plus materials for repacking, repairs or replacement of bridge components.

The skid resistance of open steel grid decking on the detour bridge may decrease gradually after opening the bridge to traffic. The Department will furnish a pneumatic floor scabbler machine for roughening the roadway surface of the detour bridge decking. Provide an air compressor at the job site with 200 cubic foot per minute capacity, 90 psi air pressure for the power supply of the machine, and an operator. Transport the scabbler machine to and from the Department's structures shop. Repair any damage to the scabbler machine caused by operations at no expense to the Department. Perform scabbling when determined necessary by the Engineer. The Department will pay for the cost of scabbling as Unforeseeable Work in accordance with
4-4.

Return the bridge components to the designated storage facility beginning no later than 10 calendar days after the date the detour bridge is no longer needed, the date the new bridge is placed in service, or the date Contract Time expires, whichever is earliest. Return the

detour bridging at an average of not less than 200 feet per week. Upon failure to return the bridge components to the Department within the time specified, compensate the Department for the bridge components not returned at the rate of $5.00 per 10 feet, per day, per bridge, for single lane; and $10.00 per 10 feet, per day, per bridge, for dual lane until the bridge components are returned to the Department.

102-6.3 Construction Methods: Select and use construction methods and materials that provide a stable and safe detour facility. Construct the detour facility to have sufficient durability to remain in good condition, supplemented by maintenance, for the entire period that the detour is required.

102-6.4 Removal of Detours: Remove detours when they are no longer needed and before the Contract is completed. Take ownership of all materials from the detour and dispose of them, except for the materials on loan from the Department with the stipulation that they are returned.

102-6.5 Detours Over Existing Roads and Streets: When the Department specifies that traffic be detoured over roads or streets outside the project area, do not maintain such roads or streets. However, maintain all signs and other devices placed for the purpose of the detour.

102-6.6 Operation of Existing Movable Bridges: The Department will maintain and operate existing moveable bridges that are to be removed by the Contractor until such time as they are closed to traffic. During this period, make immediate repairs of any damage to such structures caused by use or operations related to the work at no expense to the Department, but do not provide routine repairs or maintenance. In the event that use or operations result in damage to a bridge requiring repairs, give such repairs top priority to any equipment, material, or labor available.

102-7 Traffic Control Officer.

Provide uniformed law enforcement officers, including marked law enforcement vehicles, to assist in controlling and directing traffic in the work zone when the following types of work is necessary on projects:

1. Directing traffic/overriding the signal in a signalized intersection.
2. When FDOT Design Standards, Index No. 619 is used on freeway facilities (interstates, toll roads, and expressways) at nighttime for work within the travel lane.
3. When FDOT Design Standards, Index No. 655 Traffic Pacing for overhead work is called for in the Plans or approved by the Engineer.
4. When pulling conductor/cable above an open traffic lane on limited access facilities, when called for in the Plans or approved by the Engineer.
5. When FDOT Design Standards, Index No. 625 Temporary Road Closure 5 Minutes or Less is used.

102-8 Driveway Maintenance.

102-8.1 General: Ensure that each residence and business has safe, stable, and reasonable access.

102-8.2 Construction Methods: Place, level, manipulate, compact, and maintain the material, to the extent appropriate for the intended use.

As permanent driveway construction is accomplished at a particular location, the Contractor may salvage and reuse previously placed materials that are suitable for reuse on other driveways.

102-9 Temporary Traffic Control Devices.

102-9.1 Installation and Maintenance: Install and maintain temporary traffic control devices as detailed in FDOT Index 600 of the Design Standards and when applicable, in accordance with the approved vendor drawings, as provided on the FDOT Qualified Products List (QPL) or the FDOT Approved Products List (APL). Erect the required temporary traffic control devices to prevent any hazardous conditions and in conjunction with any necessary traffic re-routing to protect the traveling public, workers, and to safeguard the work area. Use only those devices that are on the QPL or the APL. Immediately remove or cover any devices that do not apply to existing conditions.

All temporary traffic control devices must meet the requirements of National Cooperative Highway Research Program Report 350 (NCHRP 350) or the Manual for Assessing Safety Hardware 2009 (MASH) and current FHWA directives. Manufacturers seeking evaluation must furnish certified test reports showing that their product meets all test requirements set forth by NCHRP 350 or the MASH. Manufacturers seeking evaluation of Category I devices for inclusion on the QPL shall include the manufacturer's self-certification letter. Manufacturer's seeking evaluation of Category II and Category III devices for inclusion on the QPL shall include the FHWA WZ numbered acceptance letter with attachments and vendor drawings of the device in sufficient detail to enable the Engineer to distinguish between this and similar devices. For devices requiring field assembly or special site preparation, vendor drawings shall include all field assembly details and technical information necessary for proper application and installation and must be signed and sealed by a Professional Engineer registered in the State of Florida. Manufacturers seeking evaluation of Category IV devices for inclusion on the QPL or APL must comply with the requirements of FDOT Specification Section 990 and include detailed vendor drawings of the device along with technical information necessary for proper application, field assembly and installation.

Ensure that the QPL or APL number is permanently marked on the device at a readily visible location. Sheeting used on devices is exempt from this marking requirement.

Notify the Engineer of any scheduled operation which will affect traffic patterns or safety sufficiently in advance of commencing such operation to permit his review of the plan for the proposed installation of temporary traffic control devices.

Ensure an employee is assigned the responsibility of maintaining the position and condition of all temporary traffic control devices throughout the duration of the Contract. Keep the Engineer advised at all times of the identification and means of contacting this employee on a 24 hour basis. Keep temporary traffic control devices in the correct position, properly directed, clearly visible and clean, at all times. Ensure that all traffic control devices meet acceptable standards as outlined in American Traffic Safety Services Association (ATSSA) "Quality Guidelines for Temporary Traffic Control Devices and Features". Immediately repair, replace or clean damaged, defaced or dirty devices.

102-9.2 Work Zone Signs: Provide signs in accordance with the Plans and Design Standards. Meet the requirements of 700-1.2.4 and 990-8. Use only approved systems, which includes sign support posts or stands and attachment hardware (nuts, bolts, clamps, brackets, braces, etc.), meeting the vendor requirements specified on the QPL drawings.

Attach the sign to the sign support using hardware meeting the manufacturer's recommendations and as specified in the Design Standards.

Provide Federal Highway Administration's (FHWA) accepted sign substrate for use with accepted sign stands on the National Highway System (NHS) under the provisions of the NCHRP Report 350 "Recommended Procedures for the Safety Performance Evaluation of Highway Features."

102-9.3 Business Signs: Provide and place signs in accordance with the FDOT Design Standards, Index No. 600 series. Furnish signs having retroreflective sheeting meeting the requirements of Section 990.

102-9.4 High Intensity Flashing Lights: Furnish Type B lights in accordance with the FDOT Design Standards.

102-9.5 Warning/Channelizing Devices: Furnish warning/channelizing devices in accordance with the FDOT Design Standards.

102-9.5.1 Retroreflective Collars for Traffic Cones: Use collars for traffic cones listed on the QPL that meet the requirements of FDOT Specification Section 990. Use cone collars at night designed to properly fit the taper of the cone when installed. Place the upper 6 inch collar a uniform 3-1/2 inches distance from the top of the cone and the lower 4 inch collar a uniform
2 inches distance below the bottom of the upper 6 inch collar. Ensure that the collars are capable of being removed for temporary use or attached permanently to the cone in accordance with the manufacturer's recommendations. Provide a white sheeting having a smooth outer surface and that has the property of a retroreflector over its entire surface.

102-9.5.2 Barrier Wall (Temporary): Furnish, install, maintain, remove and relocate a temporary barrier wall. Ensure that temporary concrete barrier wall for use on roadway sections, complies with FDOT Design Standards, Index Nos. 412, 415 or 414 as specified in the Plans. Ensure that temporary concrete barrier wall for use on bridge and wall sections, complies with FDOT Design Standards, Index No 414 as specified in the Plans. Ensure that temporary water filled barrier wall used on roadway sections meets the NCHRP Report 350 criteria or the MASH and is listed on the QPL. Barriers meeting the requirements of FDOT Design Standards, Index Nos. 412, 415 or temporary water filled barriers on the QPL will not be accepted as an alternate to barriers meeting the requirements of FDOT Design Standards, Index
No. 414.

102-9.5.3 Glare Screen (Temporary): Use temporary glare screens listed on the QPL that meet the requirements of FDOT Specification Section 990. Furnish, install, maintain, remove and relocate glare screen systems in conjunction with temporary barrier wall at locations identified in the Plans. Ensure the anchorage of the glare screen to the barrier is capable of safely resisting an equivalent tensile load of 600 pounds per foot of glare screen, with a requirement to use a minimum of three fasteners per barrier section. When glare screen is utilized on temporary barrier wall, warning lights will not be required.

102-9.6 Temporary Crash Cushion (Redirective/Gating): Furnish, install, maintain and subsequently remove temporary crash cushions in accordance with the details and notes shown in FDOT Design Standards, and requirements of the pre-approved alternatives listed on the QPL. Maintain the crash cushions until their authorized removal. Repair all attachment scars to permanent structures and pavements after crash cushion removal. Make necessary

repairs due to defective material, work, or Contractor operations at no cost to the Department. Restore crash cushions damaged by the traveling public within 24 hours after notification as authorized by the Engineer.

102-9.7 Guardrail (Temporary): Furnish guardrail (temporary) in accordance with the Plans and Design Standards. Meet the requirements of FDOT Specifications Section 536.

102-9.8 Arrow Board: Furnish arrow boards that meet the requirements of FDOT Specifications Section 990 as required by the Plans and Design Standards to advise approaching traffic of lane closures or shoulder work. Type B arrow boards may be used on low to intermediate speed (0 mph to 50 mph) facilities or for maintenance or moving operations on any speed facility. Type C arrow boards shall be used for all other operations on high-speed (50 mph and greater) facilities and may be substituted for Type B arrow boards on any speed facility.

102-9.9 Portable Changeable Message Sign (PCMS): Furnish PCMSs that meet the requirements of FDOT Specifications Section 990 as required by the FDOT Design Standards to supplement other temporary traffic control devices used in work zones. A truck mounted PCMS may be used as a stand alone MOT device only when used for accident or incident management situations as defined in the MUTCD and is listed on the APL.

102-9.10 Portable Regulatory Signs (PRS): Furnish PRSs that meet the requirements of FDOT Specifications Section 990 as required by the FDOT Design Standards. Activate portable regulatory signs only during active work activities and deactivate when no work is being performed.

102-9.11 Radar Speed Display Unit (RSDU): Furnish RSDUs that meet the requirements of FDOT Specifications Section 990 as required by the FDOT Design Standards to inform motorists of the posted speed and their actual speed.

Activate the radar speed display unit only during active work activities and deactivate when no work is being performed.

102-9.12 Temporary Signalization and Maintenance: Provide temporary signalization and maintenance at existing, temporary, and new intersections including but not limited to the following: the Plans, devices.

(1) Installation of temporary poles and span wire assemblies as shown in
(2) Temporary portable traffic signals as shown in the Plans,
(3) Adding or shifting signal heads,
(4) Trouble calls,
(5) Maintaining intersection and coordination timing and preemption

Restore any loss of operation within 12 hours after notification. Provide traffic signal equipment that meets the requirements of the FDOT Design Standards and 603-2. The Engineer may approve used signal equipment if it is in acceptable condition. Replacement components for traffic signal cabinet assemblies will be provided by the maintaining agency.

102-9.13 Temporary Traffic Detection and Maintenance: Provide temporary traffic detection and maintenance at existing, temporary, and new signalized intersections. Provide temporary traffic detection equipment listed on the APL. Restore any loss of detection within 12 hours. Ensure 90% accuracy per signal phase, measured at the initial installation and after any lane shifts, by comparing sample data collected from the detection system with ground truth data collected by human observation. Collect the sample and ground truth data for a minimum of five

minutes during a peak and five minutes during an off-peak period with a minimum three detections for each signal phase. Perform the test in the presence of the Engineer.

102-9.14 Truck Mounted Attenuators and Trailer Mounted Attenuators: Furnish, install and maintain only those attenuators that meet the requirements of NCHRP 350 or the MASH.

Use truck mounted attenuators or trailer mounted attenuators, when called for in the FDOT Design Standards. Use attenuators listed on the QPL.

When attenuators are called for, use either a truck mounted attenuator or a trailer mounted attenuator system designed and installed in accordance with the manufacturers recommendations.

Equip the attenuator cartridge with lights and reflectors in compliance with applicable Florida motor vehicle laws, including turn signals, dual tail lights, and brake lights.

Ensure that lights are visible in both the raised and lowered positions if the unit is capable of being raised.

Ensure that the complete unit is painted DOT yellow (Fed. Std. 595 b, No. 13538). Stripe the rear facing of the cartridge in the operating position with the alternating
6 inch white and 6 inch safety orange 45 degree striping to form an inverted "V" at the center of the unit and slope down and toward the outside of the unit, in both directions from the center. In the raised position, place at least the same square footage of striping on the bottom of the cartridge as placed on the rear facing cartridge in the open position. Use Type III retroreflectorized sheeting for striping.

Attenuators will not be paid for separately. Include the cost of the truck with either a truck mounted attenuator or a trailer mounted attenuator in MOT Lump Sum. Payment includes all costs, including furnishing, maintaining and removal when no longer required, and all materials, labor, tools, equipment and incidentals required for attenuator maintenance.

102-9.15 Temporary Raised Rumble Strip Sets: When called for in the Plans, furnish, install, maintain, remove, and reinstall temporary raised rumble strip sets.

Install the temporary raised rumble strip sets per the manufacturer's recommendations and in accordance with FDOT Design Standards, Index No. 600.

The temporary raised rumble strip may be either a removable polymer striping tape or a molded engineered polymer material.

102-9.16 Automated Flagger Assistance Devices (AFAD): Furnish, install, maintain, remove and relocate AFADs in accordance with the FDOT Design Standards. Position AFADs where they are clearly visible to oncoming traffic and out of the lane of traffic. The devices may be operated either by a single flagger at one end of the traffic control zone, from a central location, or by a separate flagger near each device's location.

AFADs may be either a remotely controlled Stop/Slow AFAD mounted on either a trailer or a movable cart system, or a remotely controlled Red/Yellow Lens AFAD.

AFADs will not be paid for separately. AFADs may be used as a supplement or an alternate to flaggers in accordance with FDOT Standard Index 603. Include the cost for AFADs in Maintenance of Traffic Lump Sum.

102-9.17 Temporary Lane Separator: Furnish, install, maintain, remove and relocate temporary lane separator in accordance with FDOT Design Standards, Index No 600.

Anchor the portable temporary lane separator with a removable anchor bolt. Use epoxy on bridge decks where anchoring is not allowed. Remove the epoxy from the bridge deck by hydroblasting or other method approved by the Engineer.

102-10 Work Zone Pavement Marking.

102-10.1 Description: Furnish and install work zone pavement markings for MOT in construction areas and in close conformity with the lines and details shown in the Plans and Design Standards.

Centerlines, lane lines, edge lines, stop bars and turn arrows will be required in work zones prior to opening the road to traffic.

The most common types of work zone pavement markings are painted pavement markings and removable tape. Other types of work zone pavement markings may be identified in the Plans.

102.10.2 Painted Pavement Markings:

102-10.2.1 General: Use painted pavement markings meeting the requirements of Section 710. Use standard waterborne paint unless otherwise identified in the Plans or approved by the Engineer.

102-10.3 Removable Tape:

102-10.3.1 General: Use removable tape listed on the QPL and meeting the requirements of 990-4.

102-10.3.2 Application: Apply removable tape with a mechanical applicator to provide pavement lines that are neat, accurate and uniform. Equip the mechanical applicator with a film cut-off device and with measuring devices that automatically and accumulatively measure the length of each line placed within an accuracy tolerance of plus or minus 2%. Ensure removable tape adheres to the road surface. Removable tape may be placed by hand on short sections, 500 feet or less, if it is done in a neat accurate manner.

102-10.3.3 Retroreflectivity: Apply white and yellow traffic stripes and markings that will attain an initial retroreflectivity of not less than 300 mcd/lx·m^2 for white and contrast markings and not less than 250 mcd/lx·m^2 for yellow markings. Black portions of contrast tapes and black masking tapes must be non-reflective and have a reflectance of less than 5 mcd/lx m^2. At the end of the six month service life, the retroreflectance of white and yellow removable tape shall not be less than 150 mcd/lx·m^2.

102-10.3.4 Removability: Provide removable tape capable of being removed from bituminous concrete and portland cement concrete pavement intact or in substantially large
strips, either manually or by a mechanical roll-up device, at temperatures above 40ºF, without the use of heat, solvents, grinding or blasting.

102-10.4 Temporary Retroreflective Pavement Markers (RPM's): Use markers listed on the QPL and meeting the requirements of 990-5. Apply all markers in accordance

with the Design Standards, Index No. 600, prior to opening the road to traffic. Replace markers any time after installation when more than three consecutive markers fail or are missing, at no expense to the Department, in a timely manner, as directed by the Engineer.

102-11 Method of Measurement.

102-11.1 General: Devices installed/used on the project on any calendar day or portion thereof, within the allowable Contract Time, including time extensions which may be granted, will be paid for at the Contract unit price for the applicable pay item, except those paid for as Lump Sum.

102-12 Basis of Payment.

102-13.1 Maintenance of Traffic (General Work): When an item of work is included in the proposal, price and payment will be full compensation for all work and costs specified under this Section except as may be specifically covered for payment under other items.

102-13.23 Payment Items: Payment will be made under:

Item No. 102- 1- Maintenance of Traffic – lump sum.

SECTION 430
CLEANING AND INTERNAL INSPECTION

430-10 Desilting Pipe or Concrete Box Culvert.

430-10-1 Description.

Remove and dispose of silt, debris, vegetation, soil, rock, or any type of blockage inside a pipe or box culvert to provide maximum drainage capacity.

430-10-2 General Requirements.

Clean the pipe or box culvert by removing all of the silt and debris so that the drainage capacity is close to one-hundred percent of the original design capacity of the pipe or box culvert.

Perform desilting operations in a manner not to damage the pipe, box culvert or surrounding area.

Meet the requirements of Federal, State and local environmental standards and laws when performing all activities.

Meet the requirements of Section 104 Prevention, Control and Abatement of Erosion and Water Pollution of the Florida Department of Transportation Standard Specifications for Road and Bridge Construction and revisions thereto (current at the time of request for bid advertisement).

Grade and sod any disturbed areas caused by the desilting operation.

Repair or replace damage to turf, pavement, signs or structures, etc. due to negligence to the satisfaction of the City at no additional cost. Complete repairs prior to submission of the invoice for work accomplished.

430-10-3 Cleaning Equipment.

Cleaning equipment shall be either high-velocity hydrocleaning equipment, or mechanical cleaning equipment. Where solids accumulations are such that mechanical cleaning equipment must be used first to remove the major portion of the material within the culverts, high-velocity hydrocleaning equipment shall be brought in for finish cleaning at no additional cost to the City. Selection of the equipment used shall be based on the conditions of the lines at the time of work commences. The equipment and methods selected shall be satisfactory to the City.

High-velocity Jet (Hydrocleaning) Equipment: All high-velocity culvert cleaning equipment shall be constructed for ease and safety of operation. The equipment shall have a minimum of 600 feet of high-pressure hose with a selection of two or more high-velocity nozzles. The nozzles shall have a minimum capacity of 60 gallons per minute (gpm) at a minimum working pressure of 1,200 pounds per square inch (measured at the pump), and shall be capable of producing a scouring action from 15 to 45 degrees in all size lines designated to be cleaned. Equipment shall also include a high-velocity gun for washing and scouring manhole walls and floor. The gun shall be capable of producing flows from a fine spray to a solid stream. The gun capacity shall be at least 10 gpm

at 200 pounds per square inch (psi). The equipment shall carry its own water tank, auxiliary engines, pumps, and hydraulically driven hose reel.

Mechanically powered equipment: Bucket machines shall be in pairs with sufficient power to perform the work in an efficient manner. Machines shall be belt operated or have an overload device. Machines with direct drive that could cause damage to the pipe will not be allowed. A power rodding machine shall be either a sectional or continuous rod type capable of holding a minimum of 750 feet of rod. The rod shall be specifically heat-treated steel. To ensure safe operation, the machine shall be fully enclosed and have automatic safety clutch or relief valve.

Water source will be City fire hydrants which will require a water meter for construction water use. Contractor to pay for the water and include in the desilting unit pricing.

430-10-4 Root Removal.

Should roots be encountered during the cleaning or inspection phases of the project, they are to be removed. Special attention should be used during the cleaning operation to ensure complete removal of the roots from the joints. Procedures may include the use of mechanical equipment such as rodding machines, bucket machines, and winches using root cutters and porcupines, and equipment such as high-velocity jet cleaners. Chemical root removers will not be allowed. Cost to remove roots should be included in the cost of culvert cleaning.

430-10-5 Dewatering.

When water is present, contractor shall de-water the pipe to facilitate cleaning and inspection. This could be accomplished using air bag plugs and by-pass pumping downstream. Access to the pipe may require temporary removal of fence, signs, guardrail, grates or manhole covers. Replace according to City standards at the completion of the desilting operation or each day, as appropriate for safety. It is assumed most of the pipes will be submerged for this project. Television inspection to be performed in dry pipes with minimal to no water in the flowline.

430-10-6 Television Inspection.

After cleaning, every pipe shall be inspected using a television-inspection.

The television camera used for the inspection shall be one specifically designed and constructed for such inspection. The camera shall be operative in 100% humidity conditions. Lighting for the camera shall be suitable to allow a clear picture of a minimum of 6 linear feet of the entire periphery of the pipe. The camera shall produce a full color picture with a minimum resolution capability of 750 lines, and be capable of 180° pan and tilt. To ensure peak picture quality throughout all conditions encountered during the survey, variable intensity control of the camera lights and remote control adjustments for focus and iris shall be located at the monitoring station. Focal distance shall be adjustable through a range of 6-inches to infinity. The camera, television monitor, and other components of the video system shall be capable of producing bright, sharp, clear pictures with accurate colors and shall be free from distortion, tearing, rolls or any other form of imperfection. The audio portion of the recording shall reproduce the commentary of the camera operator with proper volume, clarity, and be free from distortion and interruptions. The picture

quality shall be to the satisfaction of the City's Representative; and if unsatisfactory, equipment shall be removed and no payment will be made for an unsatisfactory inspection.

Television monitor shall be located within a temperature-controlled studio which will allow seating for authorized viewing personnel in addition to the operating technician. The studio shall be of proper size to allow all persons in the studio to have a satisfactory and comfortable view of the video presentation. Cable, chains, and other devices used with the camera shall be secured so as not to obstruct the camera view of interfere with the proper documentation of the culvert conditions. Picture quality and definition shall be to the satisfaction of the City's Representative and if unsatisfactory, equipment shall be removed and no payment made for unsatisfactory inspection.

Re-clean structures determined to be unacceptable by the City within the time specified at no additional cost.

Contractor shall submit DVD's of all inspection footage clearly labeled as to which runs of pipe are being viewed to the City once a month (on the 1st if possible) throughout the duration of the project.

430-10-7 Disposal

Material removed from the drainage pipes will be collected in adjacent drainage inlets or manholes. The inlets and manholes shall then be cleaned via vacuum truck with material dumped at the Broward County Septage Receiving Facility, located at: 3100 North Powerline Road in Pompano Beach, FL. The hauling mileage, tipping fees, and any other costs associated with disposal are incidental to the desilting pay item, as well as video inspection.

430-10-8 Degree of Blockage

The pipe cleaning will be divided into three categories: light cleaning, medium cleaning, and heavy cleaning. It was assumed that 1/3 of the total pipe length is light cleaning, 1/3 of total pipe length is medium cleaning, and 1/3 of the total pipe length is heavy cleaning. The City's representative and the Contractor would come to a consensus as to what degree of blockage the pipe run qualifies for based on the following:

Light Cleaning: Pipe is 5-25% full of silt / debris for the entirety of the run

Medium Cleaning: Pipe is 26-50% full of silt / debris for the entirety of the run

Heavy Cleaning: Pipe is 51-100% full of silt / debris for the entirety of the run

430-10-9 Measurement and Payment.

Measurement will be per linear foot of pipe cleaned, tv-inspected, and disposal of silt & debris.

Payment will be made under:

Item No. 0430-94-6: Grade and Re-Sod – per Square Yard (SY)

Item No. 0430-94-7: Disposal of Large Items (i.e. shopping cart, items over 20 pounds) – per each (EA)

Item No. 0430-94-8: Plug Installation & Removal, 18 – 24” – per weekly rental (Week)

Item No. 0430-94-9: Plug Installation & Removal, 25 – 36” – per weekly rental (Week)

Item No. 0430-94-10: Plug Installation & Removal, 37 – 48” – per weekly rental (Week)

Item No. 0430-94-11: Plug Installation & Removal, 49 – 60” – per weekly rental (Week)

Item No. 0430-94-12: Plug Installation & Removal, 61 – 72” – per weekly rental (Week)

Item No. 0430-94-13: 4” Hydraulic Pump (with up to 1000’ of discharge hose) – per hourly rental (Hour)

Item No. 0430-94-14: 6” Hydraulic Pump (with up to 1000’ of discharge hose) – per hourly rental (Hour)

Item No. 0430-94-15: 8” Hydraulic Pump (with up to 1000’ of discharge hose) – per hourly rental (Hour)

Item No. 0430-94-16: Light Cleaning, 18 – 24” – per linear foot (LF)

Item No. 0430-94-17: Medium Cleaning, 18 – 24” – per linear foot (LF)

Item No. 0430-94-18: Heavy Cleaning, 18 – 24” – per linear foot (LF)

Item No. 0430-94-19: Light Cleaning, 25 – 36” – per linear foot (LF)

Item No. 0430-94-20: Medium Cleaning, 25 – 36” – per linear foot (LF)

Item No. 0430-94-21: Heavy Cleaning, 25 – 36” – per linear foot (LF)

Item No. 0430-94-22: Light Cleaning, 37 – 48” – per linear foot (LF)

Item No. 0430-94-23: Medium Cleaning, 37 – 48” – per linear foot (LF)

Item No. 0430-94-24: Heavy Cleaning, 37 – 48” – per linear foot (LF)

Item No. 0430-94-25: Light Cleaning, 49 – 60” – per linear foot (LF)

Item No. 0430-94-26: Medium Cleaning, 49 –60” – per linear foot (LF)

Item No. 0430-94-27: Heavy Cleaning, 49 – 60” – per linear foot (LF)

Item No. 0430-94-28: Light Cleaning, 61 – 72” – per linear foot (LF)

Item No. 0430-94-29: Medium Cleaning, 61 – 72” – per linear foot (LF)

Item No. 0430-94-30: Heavy Cleaning, 61” – 72” – per linear foot (LF)

SECTION 450
CURED-IN-PLACE PIPE LINER

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards that may be referenced in this section:
   1. American Association of State Highway and Transportation Officials (AASHTO).
   2. ASTM International (ASTM):
      a. D543, Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents.
      b. D2122, Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.
      c. F1216, Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube.
      d. F1743, Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resins Pipe (CIPP).
      e. 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).
      f. F2599, Standard Practice for the Sectional Repair of Damaged Pipe by Means of an Inverted Cured-In-Place Liner.
   3. Occupational Safety and Health Administration (OSHA).

1.2 DESIGN CRITERIA

A. Design liner thickness using the following criteria:
   1. Design Life: 50 years.
   2. Pipe Diameters: Per Contract Drawings.
   3. Ovality: 3 percent.
   4. Pipe Condition: Fully deteriorated.
   5. External Water: Ground.
   6. Flexural Strength: 4,500 psi.
   7. Short-Term Flexural Modules: 250,000 psi.
   8. Reduction Factor: 50 percent.
   9. Long-Term Flexural Modules: 125,000 psi.
   10. k Enhancement Factor: 7.
   11. Soil Modules: 1,000 psi.
   12. Soil Density: 120 pcf.
   13. Highway Live Load: AASHTO HS20-44.
   14. Safety Factor: 2 minimum.
   15. Minimum Thickness:
      a. Pipe Larger than 10 Inches: 7.5 millimeters.
      b. If calculations require thicker wall, round to next higher multiple of 0.5 millimeter.

16. Poisson's Ratio: 0.3.
17. Liner shall be watertight.

1.3 SUBMITTALS

A. Action Submittals:
   1. Manufacturer's technical literature on proposed lining system.
   2. Resin:
      a. Specifications.
      b. Characteristics.
      c. Properties.
      d. Itemize exceptions and deviations to Specification.
   3. Annular space sealant.
   4. Service connection fittings.

B. Informational Submittals:
   1. Liner Thickness Design Calculations:
      a. Signed and sealed by Professional Engineer in the State of Florida.
      b. Manufacturer certification of material to values used in calculations.
   2. Qualifications:
      a. Installer:
         1) List of past projects, including references for selected curing method.
         2) Manufacturer's written certification of approval.
      b. Superintendent:
         1) List of past projects, including references.
         2) Manufacturer's written certification of approval.
      c. Testing Laboratory: Qualifications, experience history, and references.
   3. Manufacturer's Certificate of Compliance that resin material is appropriate for intended application and in conformance with specification.
   4. Certified test reports on physical properties and chemical resistance of proposed resin.
   5. Manufacturer's instructions for materials requiring special shipping, storage, or handling requirements.
   6. For CIPP 36 inches in diameter or greater, submit still pictures or videos of examples of installed CIPP showing what is acceptable as a final product. Images will be used to help determine acceptance of final product per this specification.
   7. Manufacturer's printed installation instructions. Installation method statement shall include but not be limited to the following:
      a. Details concerning curing methods.
      b. Inversion pressures necessary for proper installation.
      c. Minimum pressure required to hold tube tight against existing host pipe, and maximum allowable pressure that will not damage tube.
      d. Type of insertion.
      e. Defect Repair:
         1) Methods of repairing in conjunction with manholes, joints, laterals, and active infiltration.

2) Quality control/quality assurance plan.
3) Repair material test results.

8. "Wet-out" Plan: For each proposed lining section, method for "wet-out" of flexible tube together with specific insertion and curing schedule.
9. Field Report, After Completion of Each Section:
   a. Process control sheet; include temperature/time log information, tap cut information, and curing cycle.
   b. Pre-CCTV and post-CCTV inspection DVD's
   c. CIPP manufacturer's Certificate of Proper Installation, Manufacturers' Field Services.
   d. Certified test reports of CIPP samples obtained during installation.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. Installer:
      a. Employees of CIPP manufacturer, or installers trained and approved by manufacturer for installation of liner.
      b. Projects completed within past 5 years that total each of the following criteria.

Diameter Range (inches)	Total Installed Footage	Contractor's Onsite Construction Manager
Up to 15	500,000	5 years
15 - 21	100,000	5 years
24 - 36	75,000	4 years
Greater than 36	50,000	3 years

   2. Superintendent shall have minimum experience as shown above.
   3. If required, Contractor shall demonstrate experience for selected method of curing in a mockup before actual lining of pipe.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Resin: Shipped directly to wet-out facility from resin manufacturer.

B. Store water cured or steam cured resin-impregnated tubes in refrigerated truck trailers at a temperature below 45 degrees F to prevent premature curing.

C. If liner tube is impregnated with resin at factory, transport, install, and cure before expiration of shelf life.

D. No cuts, tears, or abrasions shall occur to liner tube during handling.

E. Prior to beginning installation, do not subject resin-impregnated liner to sunlight or ultraviolet radiation.
   1. UV liner may be stored for 3 months maximum before installation.

2. Remove resin-impregnated tubes with signs of premature curing from Site.

1.6 SPECIAL GUARANTEE

A. Material Warranty: A written guarantee of 1 year shall be provided by manufacturer against breakdown of material effectiveness of structural repair elements.

B. Workmanship Warranty: A written guarantee of 1 year minimum shall be provided by Contractor against defects of workmanship.

C. Warrantee Inspection: A warranty inspection shall be conducted in the 11th month following final acceptance of the Work. Contractor and liner manufacturer representative shall participate in inspection. Deficiencies related to material and workmanship shall be repaired by Contractor to satisfaction of City at no cost to the City. Inspection shall be conducted by City or designated representative of City.

PART 2 PRODUCTS

2.1 MATERIALS

A. Resin:
1. General purpose, unsaturated, polyester, epoxy, isophtalic neopentyl glycol, or thermosetting vinyl ester resin, catalyst system, initiators, or hardeners that provide specified cured physical strengths and properties, and compatible with reconstruction inversion process.
2. Resistant to municipal wastewater environment; immersion in septic sewage at temperatures up to 75 degrees F.
3. Curing:
   a. Designed to cure properly within selected curing method.
   b. Initiation Temperature: 180 degrees F, maximum.
4. Resistant to ultra-violet light (sunlight) prior to installation.
5. PET resins, resin filters, resin additives, and resin enhancement agents are prohibited. Only neat resins are acceptable. Old resins and reworked resins are prohibited, regardless of whether or not they are mixed with new resin.
6. Chemical resistance of resin system shall have been tested by resin manufacturer in accordance with ASTM D543. Exposure to chemical solutions listed below at temperatures of up to 75 degrees F shall be conducted for a minimum period of 1 month and shall result in a loss of not more than 20 percent of initial structural properties.
   a. Minimum Chemical Solution Concentration, ASTM F1216:
      1) Tap Water, pH 6 to 9: 100 percent.
      2) Nitric Acid: 5 percent.
      3) Phosphoric Acid: 10 percent.
      4) Sulfuric Acid: 10 percent.
      5) Gasoline: 100 percent.
      6) Vegetable Oil: 100 percent.
      7) Detergent or Soap: 0.1 percent.

7. Produce cured tube resistant to shrinkage, not corrode or oxidize, and resistant to abrasion from solids, grit, and sand in wastewater.
8. Bond between tube layers shall be strong and uniform.
9. Layers, after cure, shall be saturated with resin.
10. Manufacturers and Products:
    a. Reichhold; Polylite #33420 or DION 9800-20.
    b. Interplastic Corporation; #COR72-AA-455HV, #COR72-AA-656, or #CORVE8190.
    c. Ashland Specialty Chemical Company; #AROPOL MR12018 or HETRON Q6405.
    d. AOC; 701 or 102NA.
    e. Vipel; L704NET-11 or L704AAP-12.

B. Catalyst:
1. Primary: 1 percent maximum of resin by volume.
2. Secondary: 1/2 percent of resin by volume.
3. Manufacturers and Products:
    a. Primary Catalyst:
        1) Akzo; Perkadox 16, Perkadox BTW-50, or Norox 600.
    b. Secondary Catalyst:
        1) Akzo; Trigonox C or Norox TBPB.
        2) Puritan Products; N, N-dimethyl aniline (DMA).

C. Flexible Liner Tube:
1. Consist of layers of flexible nonwoven and absorbent polyester felt manufactured under quality controlled conditions set by manufacturer and applicable requirements set forth in ASTM F1216 and ASTM F1743.
2. Capable of stretching to fit irregular pipe sections.
3. Fabricated and sized for each section to ensure snug and firm fit inside existing stormpipe; produce required thickness after resin is cured.
4. Inside layer of tube shall be coated with an impermeable material compatible with resin and felt.
5. Fit length and diameter of manhole with allowance for longitudinal and circumferential stretching or shrinkage.
6. Maximum Stretching Allowance: In accordance with ASTM F1216.
7. Fabricate in lengths, that when installed, liner occupies length of pipeline between launch and reception manholes.
8. Lining shall be correct diameter; after installation there shall be no wrinkles or form permanent fins.
9. Contain no intermediate layers that may delaminate after resin curing. Not capable of separating layers with a probe or knife blade such that layers separate cleanly or probe or knife blade moves freely between layers.
10. Where several layers of felt are required, inner layer shall be stitched to form a tube.
    a. Each successive layer shall be individually wrapped around previous one and stitched together.

b. Outer layer of felt shall have an installation tube prebonded to it, or a sheet of this material shall be wrapped around completed felt tube.
c. Where a prebonded material is used, bond a covering strip over seam to form airtight joint.

11. Fabricated from materials which when cured will be chemically resistant to reagents as defined in ASTM D543.
12. Preliner:
    a. If required by Engineer, apply to tube on what will become interior wall of finished CIPP.
    b. Polypropylene compatible with resin system and shall not adversely affect adhesive properties of resin used in mainline or lateral liners.
13. Interior Pipe Wall Color: Shall not be a dark or nonreflective nature that could inhibit proper closed circuit television (CCTV) inspection.
14. Manufacturers:
    a. Applied Felts.
    b. Insituform Technologies.
    c. Liner Products.
    d. National Liner.

D. Annular Space Sealant, Hydrophilic Rubber Joint Seal:
1. Greenstreak, Inc.; Hydrotite.

2.2 SOURCE QUALITY CONTROL

A. At time of manufacture, each lot of liner shall be inspected and certified to be free of defects.

B. Mark inside of tube in at least one location per setup. Mark shall include manufacturer of liner at regular intervals, not to exceed 10 feet, along full length.

PART 3 EXECUTION

3.1 TEMPORARY FLOW BYPASS AND DIVERSION PUMPING

A. No bypass pumping will be allowed.

3.2 OVERFLOWS OR SPILLS

A. Schedule and perform the Work in a manner that does not cause or contribute to incidence of overflows or spills of sewage from storm system.

B. In the event Contractor’s work activities contribute to overflows or spills, take appropriate action to contain and stop overflow, clean up spillage, disinfect area affected by spill and notify City in a timely manner.

3.3 PRIVATE SERVICE LATERAL SHUTDOWN

A. Notify Engineer at least 1 week prior to shutdown.

B. Notify building occupants regarding service lateral disconnection by placing a door hanger approved by City and Engineer. Place door hangers between 1 day and 3 days prior to disconnection.

C. When service lateral will be disconnected from main for more than 8 hours, lateral shall be positively drained or pumped down.
   1. Monitor status of flow and storage.
   2. Pump lateral more frequently where flows exceed storage capacity of lateral or Contractor-provided temporary storage.

D. If service lateral cannot be positively drained or pumped down or disconnection of service lateral is anticipated to be 48 hours or longer, Contractor shall provide temporary living accommodations for resident at no additional cost to City or the resident. Temporary living quarters accommodations shall be approved by Engineer and coordinated through resident and City's Customer Support Representative.

E. Temporarily restore services in uncompleted sections during nonwork hours.

F. Notify building occupants when Work is complete and uninterrupted service restored.

G. Maintain uninterrupted commercial storm services while businesses are open. No sewage from the services or main line shall be allowed to be discharged on the ground or in waterways. Holding pits or tanks are not allowed unless permitted by governing agency.

3.4 PREINSTALLATION PROCEDURES

A. Complete the following activities, unless approved otherwise by Engineer:
   1. Perform operations in accordance with OSHA Standards.
   2. Before Work commences, required preinstallation submittals shall be approved by Engineer, including traffic management measures, safe pedestrian passage, provision of vehicular access to property, bypass/diversion pumping, and emergency measures.
   3. Notify Engineer prior to beginning preinstallation activities.
   4. Preinsertion Cleaning:
      a. Clean storm pipe before preinsertion television inspection.
      b. Debris removed from storm during cleaning shall be transported in watertight containers and disposed of in accordance with local, State, and Federal Regulations.
   5. Preinsertion CCTV Inspection:
      a. Television Inspection of Storm Pipelines.
      b. Inspect storm pipe before insertion of resin impregnated tube to ensure pipe is clean and existing pipe conditions are acceptable for lining.

6. Dye Testing: Where storm line segments may contain abandoned services, Contractor may be directed by Engineer to perform dye testing to determine if services are live and require reinstatement.
7. Line Obstructions: If preinsertion video CCTV inspection reveals obstruction in existing pipe that cannot be removed by storm cleaning equipment, with approval of Engineer, perform point repair using flexible coupling.
8. Ensure proper sequence of work occurs between mainline and lateral lining activities.
9. Confirm accurate location and serviceability of existing lateral or service connection (tap). Serviceability shall be confirmed by flowing water, dye testing, or visually with CCTV inspection.
10. When service connections protrude into existing pipe more than 1/2 inch, as measured from inside pipe wall, remove protruding portion of service connection to within 1/2 inch of inside pipe wall.

3.5 INSTALLATION

A. Verify lengths in field before cutting liner to length.

B. Wet-Out:
1. Tube shall be vacuum impregnated with resin (wet-out) under controlled conditions.
   a. Designate vacuum-impregnated location prior to CIPP installation.
   b. If requested, allow Engineer to inspect materials and procedures used to vacuum impregnate tube.
   c. If Contactor uses an alternative method of resin impregnation, method shall produce the equivalent results of a roller system. An alternative resin impregnation method shall be documented to Engineer and City's satisfaction that saturation of CIPP is sufficient.
   d. Handle resin impregnated tube to retard or prevent settling until it is ready for insertion.
2. Use roller system to uniformly distribute resin throughout tube.
3. Volume:
   a. Resin shall fill voids in tube material at nominal thickness and diameter; no air spaces or pockets allowed.
   b. Adjust by adding excess resin to change resin volume because of polymerization and to allow for migration of resin into cracks and joints in original pipe.
4. Complete wet-out process control sheet for every lining completed. Control sheet shall provide the following information:
   a. Liner manufacturer.
   b. Liner diameter.
   c. Number of layers.
   d. Resin manufacturer.
   e. Resin amount.
   f. Resin type.
   g. Batch number.

h. Catalyst and accelerator name/type.
i. Hardener name/type.
j. Filler name/type, if any.
k. Percent of filler, if any.
l. Mixing ratios.
m. Vacuum pressure of impregnation process.
n. Wet-out start time and date.

C. Insertion:
1. Install CIPP in accordance with practices outlined in ASTM F1216 for direct inversion installations and ASTM F1743 for pull in installations.
2. Dewater existing host pipe for CIPP installation that does not use an inversion method to expand tube against pipe wall.
3. If vacuum impregnation process is used, point of vacuum shall be no further than 25 feet from point of initial resin introduction. After vacuum in tube is established, vacuum point shall be no further than 75 feet from leading edge of resin. Leading edge of resin slug shall be as near to perpendicular to longitudinal axis of tube as possible.
4. Insert wet-out tube through existing manhole or approved access point by means of an inversion process or pulled in method and application of hydrostatic head sufficient to extend tube to next designated manhole or termination point.
5. Alternately, tube may be pulled into place and expanded with inflation bladder. Insertion method shall not result in abrasion or scuffing of the tube.
6. Once installation has begun, maintain pressure between minimum and maximum pressures until installation has been completed. Pressure shall be sufficient to hold tube tight against host storm pipe.
7. Place temperature gauges between tube and host pipe's invert position to monitor temperature during cure cycle.
8. CIPP shall be continuous over entire length from manhole to manhole.
9. Complete installation process control sheet for every lining completed. Control sheet shall provide the following information:
   a. Liner length.
   b. Hydrostatic head at point of inversion.
   c. Hydrostatic head at termination point.
   d. Time inversion process started.
   e. Time cutting ends started.
   f. Time cutting laterals started.
   g. Number of laterals cut.

D. Inflation Bladder Removal: For pulled-in-place installation techniques where inflation bladder is designed not to bond to CIPP, remove bladder material from CIPP.

E. Curing:
1. Complete curing process control sheet for every lining completed.
2. Control sheets shall provide required temperatures and time for the different steps of curing process; initial cure, post cure, and cooling as outlined in ASTM F1216.

a. Initial cure may be considered completed when exposed portions of flexible tube pipe take a hard set and temperature is adequate, as recommended by manufacturer.

3. After installation, apply steam, hot water, or ultraviolet (UV) light as recommended by liner manufacturer.
   a. Steam:
      1) Provide safety system specifically structured for use of steam.
      2) Thermoset Resin: Designed to cure properly when using steam.
      3) CIPP Tube Thermoplastic Coating:
         a) Formulated from material designed specifically to withstand high temperature curing process utilizing steam.
         b) Polypropylene/polyethylene blend or equal.
      4) Equipment:
         a) Heat source shall be capable of delivering steam throughout section and uniformly raising steam temperature above temperature required to affect cure of resin.
         b) Install temperature gauges in the following areas:
            (1) Incoming steam supply.
            (2) Outgoing steam supply.
            (3) Between impregnated tube and pipe invert at lining termination point.
      5) Steam Temperature: 230 degrees F, minimum.
      6) Minimum Interface Temperature between Liner and Tube: 120 degrees F.
      7) Pressure Required to Keep Tube Inflated: Per manufacturer's instructions.
      8) Time: Per manufacturer's instructions.
      9) Cool Down:
         a) Send air through steam cured CIPP liner until liner cools down to 120 degrees F interface temperature.
         b) Once 120 degrees F has been reached, water may be introduced to finish cooling line down to 90 degrees F.
         c) During release of water, prevent vacuum that could damage newly installed CIPP.
   b. Hot Water:
      1) Equipment:
         a) Heat source shall be capable of delivering hot water throughout section and uniformly raising water temperature above temperature required to affect cure of resin.
         b) Install temperature gauges in the following areas:
            (1) Incoming water supply.
            (2) Outgoing water supply.
            (3) Between impregnated tube and pipe invert at lining termination point.
      2) Minimum Interface Temperature between Liner and Tube: 120 degrees F.

3) Time: 3 hours, minimum.
4) Cool Down:
   a) Introduce cool water into CIPP to replace water being drained from small hole made in downstream end.
   b) Cool liner to temperature below 90 degrees F before relieving hydrostatic head.
   c) During release of water, prevent vacuum that could damage newly installed CIPP.

c. UV: If this method of curing is selected, material shall be a polyester needle felt or fiberglass based CIPP liner impregnated with an isophthalic neopentyl glycol resin.
   1) Curing parameters, such as curing speed, inner air pressure, and wattage, per the manufacturer.
   2) Optimal curing speed or travel speed of energized UV light sources is determined for each length of liner based on liner diameter, liner thickness, and exothermic reaction temperature.
   3) Invert liner into pipe with standard pressure drum.
   4) After completion of inversion process introduce light chain in liner and close ends with couplings.
   5) Remove and discard inner film material after curing to provide optimal quality of final product.
   6) Control panel operating UV curing unit light chain may be pulled on a trailer attached to UV unit.
   7) Flushing of UV cured CIPP liner to reduce styrene residual is not required.

3.6 MANHOLES

A. CIPP terminating in manhole shall be cut in shape and manner approved by Engineer.

B. Seal pipe openings and fill in annular space using products specified in Part 2 Products.
   1. CIPP connections at manhole opening shall be watertight seal.
   2. Install seal per manufacturer’s instructions.
   3. Recheck seal repair after 48 hours. If seal does not hold, continue to repair until there are no leaks.

C. Channels: When CIPP is installed continuous through manhole, create per Engineer’s instructions. Do not break or shear pipe.

D. Inverts:
   1. Finish manhole inverts to provide smooth transition between connections.
   2. Use CIPP liner material, an approved epoxy, or similar material to form smooth transition to eliminate sharp edges of CIPP, within host pipe, and in manholes at concrete bench and channel invert.
   3. Invert rehabilitation shall be compatible with manhole rehabilitation activities.

3.7 SERVICE REINSTATEMENTS

A. General:
   1. After liner has been cured in placed, reconnect service connections.
   2. Using CCTV, field locate existing and determine number of service connections.
   3. Service interruptions shall not exceed 24 hours.
   4. Do not reconnect services from abandoned or vacant lots, unless directed otherwise by City.
   5. Do not reactivate reconnected services until accepted by Engineer. This process shall be completed prior to the work described in Paragraph, Liner Cutting, below and before installation of lateral liner.
   6. Show distance from nearest downstream manhole to reconnected service on record drawings.

B. Liner Cutting:
   1. Cut liner pipe from interior of pipeline using a robotic cutter.
   2. Holes cut through liner shall be neat and smooth in order to prevent blockage at service connections.
   3. Cut-in service connections shall be opened to a minimum of 90 percent of building's storm flow capacity.
   4. Recover coupons at downstream manhole and remove.

C. Make connections to existing lateral using elastomeric boots, full-encirclement clamps, or by other method approved by Engineer.

D. External Reconnection:
   1. Service connections to new 8-inch CIPP shall be reinstated by excavation and reconnecting service with a PVC full saddle tee.
      a. Remove appropriate amount of carrier pipe to allow saddle to be directly connected to outside wall of CIPP.
      b. Apply epoxy, meeting manufacturer's recommendations, to saddle to ensure watertight seal between saddle and CIPP.
      c. Secure saddle with stainless steel bands.
      d. After epoxy has set and prior to backfilling, seal open annular space between existing storm and new liner pipe with nonshrink grout.
   2. Service lateral connections to new 10-inch CIPP and larger to be made with an Inserta-Tee" (Inserta Fittings Company).
      a. Remove appropriate amount of carrier pipe to allow Inserta-Tee to be installed.

3.8 PARTIAL (SPOT REPAIR) CIPP LINERS

A. Install partial CIPP liner in accordance with ASTM F2599 and same requirements as for full liner.

B. Dimensions of liner shall be fabricated to size, that when installed, will neatly fit circumference of existing pipe.

C. Tube shall be vacuum impregnated with thermo-set resin. Remove air in tube by vacuum allowing resin to thoroughly impregnate tube. Retain a resin-impregnated sample for each installation to provide verification of curing process taking place in host pipe. Hang sample in entry manhole to simulate ambient conditions of host pipe.

D. Insert saturated tube and inversion bladder into carrying device and pull into host pipe. Pull shall be complete when end of launching device is aligned with beginning of section to be repaired. Protect resin and tube during pull to ensure no resin is lost by contact with manhole walls or pipe. Resin that provides structural seal shall not contact pipe until positioned at point of repair.

E. Installer shall be capable of viewing the beginning of liner contacting host pipe; verifying exact placement of liner. No measuring from a CCTV counter or estimating will be allowed.

F. Extract tube from carrying device by controlled air or water pressure. Hold tube in place against wall of host pipe by pressure until cure is complete.

G. Once sample piece in manhole has cured and inflation bladder is deflated, remove bladder and launching device from host pipe. Remove materials used in installation other than CIPP liner from host pipe. Recover sample piece and label with upstream and downstream manhole numbers and footage from downstream manhole to service connection. Test sample in accordance with Specification.

H. Restore service reinstatements covered by sectional repair in accordance with Specification.

3.9 FIELD QUALITY CONTROL

A. General:
   1. CIPP installation shall be free from visual defects such as foreign inclusions, dry spots, keel, boat hull, pinholes, wrinkles, and other deformities.
      a. Defects and deformities may, at discretion of City, be cause for rejection of entire liner.
      b. Correct failed CIPP and defective CIPP from post-installation television inspection or test reports for structural values or thickness as determined by Engineer.
      c. Method of repair, which may require field or workshop demonstration, shall be approved by Engineer prior to commencement of the Work.
      d. Remove and replace pipe identified with defects or deformities.

B. CCTV Visual Inspection:
   1. Perform television survey, Television Inspection of Storm Pipelines.
   2. Conduct finished inspections continuous over entire length of stormpipe between manholes.

C. Properties Testing:
   1. Sampling and Measuring:

a. Cut one minimum 12-inch long restrained pipe section from cured liner. Samples will be used to satisfy material testing requirements.
b. Prepare samples in accordance with restrained sample method referenced in ASTM F1216 or ASTM F2019.
c. Take restrained samples from excess cured CIPP at manhole connection where installation was started or terminated.
d. Each sample shall be large enough to provide three specimens for tensile testing and five specimens for flexural properties testing.

2. Field Thickness Testing:
   a. Perform prior to conducting laboratory tests.
   b. Take wall thickness measurements in accordance with ASTM D2122.
   c. Make a minimum of four measurements, evenly spaced, on each test specimen.
   d. Calculate average thickness using measured values.
   e. Average thickness shall be equal or greater than required design thickness.
   f. Failure of thickness test shall be grounds for rejection for CIPP liner.
3. Laboratory Testing:
   a. Send one sample to independent laboratory and test for modulus of elasticity and flexural strength.
   b. Preparation and testing standards shall be performed in accordance with approved submittals.
   c. Failure of a test may be grounds for rejection of CIPP liner. Test second sample at direction of City.
4. Resin Sampling:
   a. Wet-out facility resin mixing equipment shall have a valve downstream of the mixing function and immediately upstream of application of mixed resin to tube where resin samples may be drawn.
   b. Batch mix facilities, if any, shall provide for sampling of mixed batch.
   c. Submitted “wet-out” schedule cannot be modified without 24-hour notice to Engineer.
   d. Resin samples shall be drawn at times determined by Engineer.
5. Physical samples removed for testing as requested by Engineer shall be individually labeled and logged to record the following:
   a. City’s Project number and title.
   b. Sample number.
   c. Segment number of line as noted on plans.
   d. Date and time of sample.
   e. Name of Contractor.
   f. Location and by whom tested.
   g. Results of test.
   h. Street name and address.
   i. Starting and ending manhole identification number for each length of pipe lined.
   j. Label as follows:
      1) Sample A: Restrain Sample.
      2) Sample B: Restrain Sample.

D. CIPP Correction:
   1. Correct failed liner or liner deemed unacceptable by City as a result of CCTV inspection, laboratory testing, or thickness test.
   2. Remedy for failed laboratory and thickness test shall be as shown in the following table:

Pipe Correction			
Test	Required Value	Test Result	Remedy
Flexural Strength	4,500 psi	4,300 to 4,490 psi	10% unit price reduction
	4,500 psi	4,100 to 4,290 psi	30% unit price reduction
	4,500 psi	Less than 4,100 psi	Pipe replacement
Flexural Modulus	250,000 psi	238,000 to 249,000 psi	10% unit price reduction
	250,000 psi	225,000 to 237,900 psi	30% unit price reduction
	250,000 psi	Less than 225,000 psi	Pipe replacement
Thickness	Minimum or design, whichever is greater	≥90% to 100%	No unit price reduction
	Minimum or design, whichever is greater	≥80%, but less than 90%	15% unit price reduction
	Minimum or design, whichever is greater	<80%	Pipe replacement

   3. Where pipe removal and replacement is required, remove and replace entire segment length from manhole to manhole and payment shall be made in full for CIPP.

3.10 CLEANING

A. After liner installation has been completed and accepted by City, clean entire Project area and restore Site to original condition.

3.11 MEASUREMENT AND PAYMENT

Measurement will be per linear foot of pipe.

Payment will be made under:

Item No. 0450-1: Repair Damaged Storm Pipe, 0 – 24” – per linear foot (LF)

Item No. 0450-2: Repair Damaged Storm Pipe, 25 – 36” – per linear foot (LF)

Item No. 0450-3: Repair Damaged Storm Pipe, 37 – 48” – per linear foot (LF)

Item No. 0450-4: Repair Damaged Storm Pipe 49 – 60” – per linear foot (LF)

Item No. 0450-5: Repair Damaged Storm Pipe, 61 – 72” – per linear foot (LF)