### SP-XX, INJECTION GROUTING OF PIPES AND STRUCTURES

Version Date: 1/18/2024 Revision Date: XX/XX/XXXX by XXX

**1.0 DESCRIPTION**

This work shall consist of injection of polyurethane grout (PU) at locations identified on the contract documents and as directed by the Engineer. Injection grouting may be used to address infiltration of soil and or water through pipe joints and drainage structures, curtain/permeation grouting and subgrade stabilization.

**2.0 MATERIALS**

**POLYURETHANE GROUT REQUIREMENTS:**

Provide PU material that is supplied by manufactures on the NCDOT Approved Products List. Contractor is responsible for verifying that the appropriate PU is selected for each specific application and is applied per manufactures specifications. Provide Type 3 material certifications in accordance with Article 106-3 of the *Standard Specifications* for polyurethanes. Do not use expired or improperly stored PU components or materials. If an expiration date is not provided by the PU Manufacturer, assume an expiration date 6 months after production. The Engineer may perform independent verification testing, if necessary. The material certifications shall not be interpreted as a basis for payment.

1. **Type 1 Polyurethane**

Type 1 polyurethane is a two component, high density, hydrophobic and hydro-insensitive resin mixed with a ratio of 1:1 by volume. This material is generally used for significant void filling and high strength soil stabilization. When injected, the two components react to expand and harden forming a rigid closed cell foam. URETEK 486 STAR Polymer or equivalent is an acceptable product. Provide PU resins that meet the following:

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| TYPE 1 POLYURETHANE MINIMUM REQUIREMENTS |
| Property | **Requirement** | Test Method |
| Apparent Density(Free Rise) | 3 lb/cf | ASTM D1622 |
| Compressive Strength1(Free Rise) | 30 psi | ASTM D1622 |

1. Compressive strength of at least 90% of maximum strength within 30 minutes of injection.
2. **Type 2 Polyurethane**

Type 2 polyurethane is a single component, low or medium viscosity, hydrophobic PU resin that is typically used to address gushing leaks in below grade pipes and structures, curtain grouting of manholes, pipe joints, and stabilization of loose soils. Type 2 PU may be mixed with an optional or required catalyst/accelerator per the PU Manufacturer’s instructions to initiate or speed up reactions. When injected, the PU resin reacts with moisture in the soil to expand and form a rigid watertight closed cell foam within voids. Prime Flex 920 or equivalent is an acceptable product. Provide PU resins that meet the following:

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| TYPE 2 POLYURETHANE MINIMUM REQUIREMENTS |
| Property | **Requirement** | Test Method |
| Viscosity1 | 50 centipoise | ASTM D4016 or D4878 |
| Compressive Strength2(With Sand) | 1135 psi | ASTM D695  |
| Tensile Strength3 | 150 psi | ASTM D638 |

1. Maximum viscosity of uncured resin.
2. Compressive strength of cured rigid foam; does not apply to flexible foam.
3. Tensile strength is based on the resin being confined.
4. **Type 3 Polyurethane**

Type 3 polyurethane is a single component, low viscosity, hydrophilic PU resin that is typically used to stop active leaks within drainage pipes and structures. When injected, the PU resin reacts with water to expand and produce a watertight closed cell foam/impermeable gel. Provide PU resins similar or equivalent to Prime Flex Hydro Gel SX and/or Prime Flex 900 XLV that meet the following:

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| TYPE 3 POLYURETHANE MINIMUM REQUIREMENTS |
| Property | **Requirement** | Test Method |
| Viscosity1 | 150 centipoise | ASTM D4016 or D4878 |
| Tensile Strength2 | 250 psi | ASTM D3574 |

1. Maximum viscosity of uncured resin.
2. Tensile strength of cured foam; does not apply to gel.

**Handling and Storing**

The Contractor shall notify the Engineer upon arrival of a shipment of materials to the site. All material shall arrive in sealed containers for inspection by the Engineer. Material shall not be loaded into the equipment until inspected by the Engineer. Handle, store and dispose of polyurethanes per the manufacturer’s instructions.

Sufficient material to perform the operation shall be in proper storage at the site prior to any field preparation, so that there shall be no delay in procuring the material for each day’s application.

**3.0 Submittals**

The Contractor is required to provide the following items 2 weeks prior to work commencing:

* Provide Contractor’s qualifications.
	+ Contractor and supervisor should have a minimum of 5 years’ experience including but not limited to injection grouting of pipes and structures described herein.
	+ A list of 5 projects, including references and contact information with similar pipe culvert or drainage structure rehabilitation.
	+ The onsite supervisor’s NCDOT Level I or II certified for Erosion and Sedimentation Control.
* Provide material technical data sheets that document the polyurethanes to be used meet or exceed all material property requirements listed in Section 2.0 above.
* Where injection grouting for soil stabilization is specified, provide a site-specific construction plan with manufactures product recommendations for filling known subsurface voids. Plan to be prepared and sealed by a licensed North Carolina Professional Engineer.
* Manufacturers installation instructions to include required equipment.

**4.0 EquIPMENT**

The Contractor shall provide all necessary equipment needed to perform the work, including but not limited to the following:

* Graco 495, Titan Impact 540 or equivalent airless pump as suggested by PU manufacturer.
	+ When using two component polyurethane grout, pump and associated equipment must be capable of mixing per manufactures specifications.
	+ When using a single component product, a dual component 1:1 ratio pump with a static mixer shall be used.
* Provide equipment with pressure and temperature control devices capable of maintaining proper temperature and proportionate mixing of the polyurethane component materials.
* Equipment shall be equipped with certified flow meters to measure the amount each component material injected so that an accurate quantity of material is recorded at each location.
	+ Calibration may be required by comparing to the capacity of the container vs. material pumped.
	+ Additional calibration documentation may be required.
* Equipment must allow operator to have full control of material application rate to precisely apply product and start/stop as needed to complete work without excess material loss.

**5.0 CONSTRUCTION METHODS**

**Weather Limitations**

Work under this contract item shall not be performed when ambient temperature is below 32°F. Contractor to verify that ambient temperatures are consistent with application guidelines provided by manufacturer.

**Preparation**

Contractor shall verify condition and locations of areas to be injection grouted as identified on construction plans, ensuring the proper material and procedures are used. If multiple grouting product types are needed to complete the site-specific repair, Contractor is expected to select and apply the products per manufactures specifications.

**Injection grouting of pipes and structures:**

1. At each location identified for injection grouting for pipes, Contractor shall drill for the installation of injection ports. Ports shall be 3/8” diameter and installed along the circumference of the pipe with spacing between 18”-24”. For injection grouting of structures, ports shall be placed every 18”-24” both vertically and horizontally along each wall of the structure.
2. After drilling is complete and prior to insertion of ports Contractor shall clean and flush injection ports with clean water.
3. Application specific material, meeting the specifications herein shall be properly mixed with water or the appropriate catalyst per manufactures specifications (if necessary) to complete the reaction.
4. Injection grouting shall be performed by starting at the lowest port, injecting the product through the ports at the manufactures recommended pressures, until material flows out of adjacent ports. Continue working from lowest to highest ports until the entire joint/structure is injected and product is visibly flowing in all ports.
	* 1. Injection pressures must be monitored to prevent damage to existing infrastructure.
		2. Contractor shall inject as much grout as is required to seal any leaks and fill voids (if present). No more than 20 gallons of grout shall be pumped into a single location.
		3. Contractor shall apply jute oakum or backer rod as needed to form a containment dam to prevent excessive grout from entering the work area.
5. After grouting of each location is completed, Contractor shall remove grout ports and plug holes with a non-shrink grout or epoxy sealer.

**Injection grouting for soil stabilization:**

Soil stabilization shall be performed by pumping the Type 1 hydrophobic polyurethane resin or approved equal into the underlying soils as directed by the construction plans, Engineer and per manufacturers recommendations.

**Protection and Cleanup**

The Contractor shall be responsible for storage, clean-up, and removal from the work area all debris, waste, residual repair materials, and by-products generated by the preparation and application operations to the satisfaction of the Engineer. The Contractor shall dispose of these wastes in strict compliance with all applicable state, local, and Federal environmental statutes and regulations.

**Warranty**

Following the date of the Engineer’s final acceptance of all work under a given project, the Contractor shall provide a **one (1) year warranty** on materials and workmanship against patent and latent defects arising from faulty materials, faulty workmanship, or Contractor negligence pertaining to this contract item. All defective material and workmanship that fails to meet the requirements of this contract item during the warranty period shall be corrected by the Contractor for contract item compliance at no additional expense to the City.

**Confined Space Entry**

The Contractor and all laborers shall be certified per OSHA regulations for Confined Space Entry. All laborers shall wear full harnesses, meeting OSHA regulations with sufficient lengths of ½ -inch nylon rope tied off at entry. An outside supervisor shall be stationed at the entry during work inside pipe. Supervisor and crew shall communicate using standard-issue 2-way communication devices. The Contractor is responsible for entry using a ladder or other acceptable means. Entry security is to be maintained by the Contractor during the project and in coordination with the contracting officer.

**Ventilation**

A ventilation fan, stationed outside the pipe manhole entry, shall be utilized to pump clean air into the work area. The fan shall employ sufficient duct to force air into the work zone. Contractor is responsible for operation of fan. Air quality detection device with alarm shall be worn to measure exhaustible and other harmful gases, such as hydrogen sulfide.

**Dewatering**

The Contractor will be responsible for all dewatering of conduit in preparation for sealing, back grouting and coating process if needed.

**5.0 MEASUREMENT AND PAYMENT**

The unit price shall include the cost of furnishing all labor, materials, and equipment to satisfactorily complete the work as specified. Injection grouting of pipes, structures and soil stabilization shall be paid for by the gallon of material needed to complete the work.

The quantity of material to be paid for shall be the actual quantity used, based on the contract unit price shown on the bid form. Contractor and the Engineer shall agree on the number of gallons injected utilizing a daily grout log. Only those items shown on the bid sheet shall be paid for directly. All other labor, tools, equipment, and incidentals including but not limited to grout ports, backer rod and jute oakum necessary for the completion of the project shall be considered incidental to the contract bid items.

Payment will be made under:

**Injection Grouting of Pipes……………………………………………………………………………………………………………………………..GN**

**Injection Grouting of Structures……………………………………………………………………………………………………………………..GN**

**Injection Grouting for Soil Stabilization…………………………………………………………………………………………………………..GN**

**6.0 FINAL ACCEPTANCE AND QUALITY CONTROL**

The City will conduct a CCTV inspection of the repairs within the 1 year warranty period. Any joints originally sealed by the Contractor that are observed to have infiltration shall be re-sealed at no cost to the City. After the Contractor has been notified of such infiltration, the Contractor shall have 60 calendar days to re-seal the joints.