SECTION 07160
REACTIVE WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Specification, preparation and installation of hydrophilic polyurethane resin chemical grout injection for waterproofing and sealing of concrete cracks and joints.
   2. Specification, preparation and installation of hydrophobic polyurethane resin chemical grout injection for waterproofing and sealing of concrete cracks and joints.
   3. Specification, preparation and installation of hydrophobic polyurethane resin chemical grout injection for soil stabilization.

1.2 RELATED SECTIONS

A. The following are related to Work in this Section, but are specified in other Sections:
   1. Section 07900 – Joint Sealant and Expansion Joint Systems

1.3 DEFINITIONS

A. Catalyst – A substance that increases the rate of a chemical reaction.

B. Elongation – The degree to which a material may be bent, stretched or compressed before it ruptures.

C. Hydrophilic – Having a tendency to react with, mix with, dissolve in or be wetted by water.

D. Hydrophobic – Having a tendency to repel or fail to mix with water.

E. Viscosity – A measure of a fluid's resistance to flow.

1.4 REFERENCE STANDARDS

A. Reference Standards (Refer to the latest edition):
   1. American Society for Testing and Materials (ASTM):
      a. ASTM C273: Standard Test Method for Shear Properties of Sandwich Core Materials
      b. ASTM D93: Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester
      c. ASTM D638 Standard Test Method for Tensile Properties of Plastics
      d. ASTM D1622: Standard Test Method for Apparent Density of Rigid Cellular Plastics
      e. ASTM D2196: Standard Test Methods for Rheological Properties of Non-Newtonian Materials by Rotational Viscometer
      f. ASTM D2369: Standard Test Methods for Volatile Content of Coatings
      g. ASTM D2842: Standard Test Method for Water Absorption of Rigid Cellular Plastics
      h. ASTM D3278: Standard Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus
      i. ASTM D3574: Standard Test Methods for Flexible Cellular Materials – Slab, Bonded, and Molded Urethane Foams
      j. ASTM D4016: Standard Method for Viscosity and Gel Time of Chemical Grouts by Rotational Viscometer
      k. ASTM D4659: Standard Test Method for Polyurethane Raw Materials: Determination of Specific Gravity of Isocyanates
      l. ASTM D5202: Standard Test Method for Determining Triaxial Compression Creep Strength of Chemically Grouted Soils
      m. ASTM D6286: Standard Guide for Selection of Drilling Methods for Environmental Site Characterization

n. ASTM D8109: Standard Test Method for Viscosity and Gel Time of Chemical Grouts by Rotational Viscometer
o. ASTM D8109: Standard Guide for Waterproofing Repair of Concrete by Chemical Grout Crack Injection
p. ASTM E2128: Standard Guide for Evaluating Water Leakage of Building Walls
q. ASTM F2304: Standard Practice for Sealing of Sewers Using Chemical Grouting
r. ASTM F2414: Standard Practice for Sealing Sewer Manholes Using Chemical Grouting
s. ASTM F2454: Standard Practice for Sealing Lateral Connections and Lines from the Mainline Sewer Systems by the Lateral Packer Method, Using Chemical Grouting

2. International Concrete Repair Institute (ICRI):
   a. Guideline No. 340.1 Guide for the Selection of Grouts to Control Leakage in Concrete Structures
3. U.S. Army Corps of Engineers:
   a. Manual No. 1110-1-3500 Chemical Grouting

1.5 SUBMITTALS

A. CONTRACTOR shall provide the following submittals, specific to this Section, to OWNER for review and/or approval:
   1. Pre-Award Submittals: Submitted as part of the Bid Process.
      a. CONTRACTOR and Subcontractor qualifications:
         1) Include CONTRACTOR and individual certifications, licenses, work experience and related documentation.
         2) Include evidence that company has a minimum of 3-years experience in application of specified materials. Submit list of at least three completed Projects of similar scope and size, including:
            a) Project Name.
            b) Owner's Name.
            c) Owner's Representative's Name, Address and Contact Information.
            d) Description of Work.
            e) Product(s) / Material(s) Used.
            f) Project Manager / Supervisor.
            g) Total cost of Work.
            h) Start and Completion Date.
      b. Intent to Warrant and Sample Warranty:
         1) Copy of warranty, stating obligations, remedies, limitations, and exclusions.
   2. Pre-Construction Submittals: Submitted prior to Work.
      a. Product Data / Safety Data: Material manufacturer's literature including written instructions for evaluating, preparing and treating substrate, technical data including tested physical and performance properties, installation instructions and safety data.
      b. Letter from Manufacturer indicating that specific products and auxiliary products are recommended for the intended application and exposures on Project. Based on mockups, include specific recommendations for surface preparation and installation for Project.
      c. Quality Control Forms:
         1) To be submitted as part of Quality Control System.
      d. Product Samples.
      e. Proposed layout of drilled holes for injection, estimated volume of material based on known conditions, etc.
   3. During Construction: Submitted at specified intervals during construction.
      a. Quality Control Documentation (weekly or as requested).
      b. Quality Assurance Documentation.
   4. Closeout Documents: Submitted upon Project completion and prior to final payment.
      a. Final Warranty.

b. Submit a letter from the material manufacturer indicating that a representative portion of all major steps in the Work were inspected by the manufacturer and that all that work was performed in accordance with the manufacturer's recommendations and instructions.
c. Record Documentation.
    1) Includes as-built documentation and records of work completed such as red-lines drawings, specifications, etc.
d. Construction Photos.
e. Quality Control Documentation.

1.6 QUALITY CONTROL AND ASSURANCE REQUIREMENTS

A. Installer Qualifications:
1. Approved, authorized, or licensed by the material manufacturer to install specified product and/or system, and eligible to receive material manufacturer's warranty.
2. Must have documented installations of specified materials in local area in use for minimum of 3 years.
    a. Employ foreman with minimum 3-years of experience as foremen on similar projects to be on-site at all times.
    b. Employ only personnel who have been trained, or approved, by the material manufacturer in writing as being qualified to perform the Work covered herein.

B. Quality Control:
1. General:
    a. Verify existing conditions and details prior to installation of materials. Notify OWNER of conditions found to be different than those indicated in Contract Documents. OWNER will review situation and inform CONTRACTOR and Applicator of changes.
    b. Inspect all materials upon receipt to verify product and condition.
    c. Inspect to verify that specified storage conditions for materials are provided
    d. Do not use or retain contaminated, outdated, or improperly stored materials. Do not use materials from previously opened containers.
    e. Make available all locations and phases of the work for periodic and/or required observation and/or inspection by OWNER, OWNER's designated representative and/or Quality Assurance Inspector.
        1) The CONTRACTOR shall provide necessary access, support, ventilation, egress, safety and other means required.
    f. Provide daily quality control reports to OWNER on a weekly basis, or as requested. Submit reports in a Portable Document Format (PDF). At a minimum, Quality Control Report's shall include:
        1) Project Identification.
        2) Date and Time(s).
        3) Atmospheric and Ambient Conditions.
        4) Inspector and Foreman Identification.
        5) Number of Workers On-Site.
        6) Work Area(s).
        7) Work Scope Performed.
        8) Work Progress.
        9) Product Data (Name, Lot, Exp.).
        10) Substrate and Application Conditions.
        11) Quality Control Inspections.
        12) Quality Assurance Inspections (Internal and By Others).
        13) Other Pertinent Information.
    g. The methods of construction shall be in accordance with requirements of the Contract Documents and best trade practices unless otherwise permitted by OWNER.

C. Inspection by OWNER, OWNER's designated representative or Quality Assurance Inspector does not limit the CONTRACTOR's responsibilities for inspection, quality workmanship or quality control as specified herein or as required by the Manufacturer's instructions.

D. Mockups: For each material and/or system to be installed, prepare and install to a representative location designated by OWNER to demonstrate quality of materials, execution and effectiveness.
   1. Material manufacturer's representative and Quality Assurance Inspector shall observe mockup and approve, in writing, preparation, execution and installation.
   2. If Quality Assurance Inspector determines mockup does not comply with requirements, modify mockup or construct new mockup until mockup is approved. Do not proceed with Work until mockup is approved.
   3. Approved mockup will be acceptance standard for remainder of Work.
   4. Mockup requirements will be waived by OWNER and/or ENGINEER where multiple locations and/or applications are not required and/or practicable.

E. Quality Assurance Testing and Inspection:
   1. Quality assurance observation and inspection will be performed by qualified Quality Assurance Inspector's to be provided by OWNER.
      a. Refer to Contract Documents for general quality assurance reporting requirements.
      b. Observation and/or inspection frequency may be increased or decreased at OWNER's discretion.
      c. Quality assurance observation and inspection includes, but is not limited to:
         1) Crack and/or joint preparation, routing, etc.
         2) Installation of crack and/or joint surface sealer, overlay, etc. required to retain required pressures during installation.
         3) Proposed locations and installation techniques of injection port placements.
         4) Verification of materials to be installed.
         5) Installation of injection materials.
         6) Water testing to verify functionality of installed materials.
      d. Inspection reports shall include date when material(s) was installed, name of installer, material lot/batch number, location(s)/mapping of installed material, volume of product installed and related information.
      e. Where Quality Assurance Inspector determines Work does not comply with requirements, CONTRACTOR shall remedy non-conformance by means of replacement, additional application and/or other suitable means at CONTRACTOR's expense.

F. Inspection Hold Points:
   1. The Quality Assurance Inspector shall conduct hold point inspections. The CONTRACTOR is required to coordinate such hold points in the Work with OWNER or its designated representative such that inspections can be performed on a scheduled basis. CONTRACTOR shall provide OWNER a minimum 48-hour advanced notice for required quality assurance hold point inspections.
   2. Refer to Checklist's herein for typical chemical grout Quality Control/Assurance checklist for cementitious and soil applications. OWNER and/or their designated representative may modify the contents of Quality Control/Assurance checklists as required based on Project needs, changes, constraints, etc.

G. Identification and Resolution of Conflicts
   1. It shall be the responsibility of the CONTRACTOR to notify OWNER of any conflicts, obstructions, discrepancies and similar items related to Contract Document content, specifications, instructions, field conditions, weather, etc. promptly upon discovery by means of a formally submitted Request for Information (RFI).

1.7 WARRANTY

A. CONTRACTOR & Manufacturer Joint Warranty, include:
   1. Labor and materials for remediation to address non-performing, defective and/or otherwise non-conforming materials and/or installations. Non-performance, defects and/or conformance includes, but is not limited to:
      a. Material defects of installed product identified at the time of installation and/or at a later date.
      b. Loss of moisture sealing/retaining abilities.
      c. Failure to adequately seal cracks and/or joint at area(s) of Work that were intended to be sealed.
   2. Remediation shall include, but is not limited to:
      a. Installation of additional materials to address unsealed portions of Work.
      b. Installation of alternate materials to achieve intended function of original installation material.
   3. Warranty Period: 1 year (min) from date of Project Completion.

1.8 DELIVERY, STORAGE AND HANDLING

A. Adhere to requirements herein and applicable requirements within the Contract Documents.

B. Deliver, store, and handle materials according to manufacturer's recommendations and in such manner as to prevent damage to materials and structure.

C. Deliver materials to Project site in original containers with seals unbroken, labeled with:
   1. Product name or title of material.
   2. Manufacturer’s stock/batch number
   3. Date of manufacture and shelf life, or expiration date.
   4. Application and mixing instructions.
   5. Handling instructions and precautions.
   6. Hazardous material identification label

D. Keep materials dry and do not allow materials to be exposed to moisture during transportation, storage, handling, or installation. Reject and remove from Site new materials which exhibit evidence of moisture during application or which have been exposed to moisture.

E. Store materials in original, undamaged containers in a clean, dry, protected location on raised platforms with weather-protective coverings, within temperature range required by manufacturer. Protect stored materials from direct sunlight. Manufacturer’s standard packaging and covering are not considered adequate weather protection.

F. Limit stored materials on structures to safe loading of structure at time materials are stored, and to avoid permanent deck deflection.

G. Handle and store materials to prevent damage.

H. Conspicuously mark damaged or opened containers, expired materials and/or diluted materials and remove from site as soon as possible.

I. Dispose materials in accordance with local, state and federal laws, rules and regulations.

1.9 CLEANING

A. At end of each workday, clean site and work areas and place rubbish, containers, rags, and other discarded materials in appropriate disposal containers.

B. Clean off excess grout and/or material as Work progresses by methods and with cleaning materials approved in writing by the manufacturer. Exercise care to avoid damage to adjacent surfaces, equipment, etc. Remedy surfaces stained, marred, or otherwise damaged during Work.

C. At conclusion of Work, clean up debris and surplus materials and remove from site.

1.10 SAFETY

A. Adhere to requirements herein and applicable requirements within the Contract Documents.

B. The CONTRACTOR is required to attend a safety briefing with OWNER prior to Work.

C. The CONTRACTOR shall ensure OWNER and CONTRACTOR personnel are aware of any hazards peculiar to the jobsite.
   1. Provide and/or identify location(s) of available first aid stations, eye wash stations and pertinent safety equipment.
   2. Provide contact information of responsible personnel and emergency phone numbers.
   3. Obtain contact information for OWNER stakeholders and pertinent OWNER site personnel.
   4. Determine and communicate evacuation routes.

D. Keep all work areas clean and safe.

E. Obey all plant rules and regulations.

F. The CONTRACTOR shall conduct all work covered by this section in accordance with all pertinent OSHA regulations.

1.11 CHANGES IN WORK

A. During Work, existing conditions may be encountered which are not known or are at variance with the Contract Documents. Such conditions may interfere with Work and may consist of damage or deterioration of substrate or installed materials that could jeopardize integrity or performance of the material(s) and/or system(s).

B. Notify OWNER of conditions that may interfere with proper execution of Work or jeopardize integrity of new material(s) and/or system(s) prior to proceeding with Work.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MATERIALS

A. General:
   1. Source Limitations: Obtain product(s) through one source from single manufacturer, or from sources approved by material manufacturer.
   2. Material Compatibility: Provide materials that are compatible with one another and with concrete substrates under conditions of service and application, as demonstrated by material manufacturer based on testing on similar projects, mockups inspection and testing for this project and field experience.

B. Hydrophilic Polyurethane Chemical Grout (For Cementitious Substrate):
   1. General
      a. Utilizes existing moisture to initiate expansive properties of material.
      b. For use as a reactive expanding sealer/filler to seal and waterproof moving and non-moving cracks, joints, voids and/or other openings in actively leaking and/or saturated cementitious substrates.
      c. For use to seal large openings, cracks and/or joints through the injection of material into saturated oakum or open-celled foam and backer rod to form an impermeable gasket.
      d. Not for use as a structural epoxy-resin sealer.
   2. HRSD System #1: Hydrophilic Polyurethane Chemical Grout; Medium Viscosity (500 – 750 cps); High Elongation (> 300%):
      a. For primary use to seal most conventional and larger crack widths where high elongation properties are desired.
      b. Not recommended for use to seal hairline cracking and/or thick cementitious substrates where hairline cracking may exist within its matrix.
         1) Products:
            a) Sikafix HH; Sika Corporation.

b) Dural Aqua-Fil; Euclid Chemical.
c) AV-330 Safeguard; Avanti
d) ST-526 Poly-Foam Ultra Injection Resin; Strata-Tech, Inc.
e) Approved Equal.

3. HRSD System #2: Hydrophilic Polyurethane Chemical Grout ; Low Viscosity (250 – 450 cps); Elongation (> 100%):
   a. For primary use to seal conventional and hairline crack widths.
   b. Recommended for thick cementitious substrates where hairline cracking may exist within its matrix.
      1) Products:
         a) De Neef Sealfoam PURe; GCP Applied Technologies Inc.
         b) Hydro Gel SX; Prime Resins, Inc.
         c) Prime Flex 900 XLV; Prime Resins, Inc.
         d) Approved Equal.
4. Auxiliary Materials:
   a. Oakum: Oil free conforming to Federal Specification HH-P-117.
      1) Used as a fibrous filler reinforcement material with polyurethane chemical grout to seal cracks, joints and other openings exceeding 1/4-inch (W).
      2) Use one of the following:
         a) De Neef Dry Oakum by GCP Applied Technologies Inc.
         b) Approved Equal.
   b. Open-Cell Polyethylene or Polyester Foam: Sheet, backer rod or other shapes.
      1) Used as a filler and reinforcement material with polyurethane chemical grout to seal cracks, joints and other openings exceeding 1/4-inch (W).
   c. Injection Ports: As recommended by manufacturer.
   d. Surface Sealer / Filler / Hydraulic Cement: As recommended by manufacturer.

C. Hydrophobic Polyurethane Chemical Foam Grout (For Cementitious Substrate):
1. General:
   a. Utilizes a catalyst (activator) to initiate expansive properties of material.
   b. For use as a reactive expanding sealer/filler to seal and waterproof moving and non-moving cracks, joints, voids and/or other openings in cementitious substrates that are not actively leaking during installation.
   c. For use to seal large openings, cracks and/or joints through the injection of material into saturated oakum or open-celled foam and backer rod to form an impermeable gasket.
   d. Not for use as a structural epoxy-resin sealer.
2. HRSD System #3: Hydrophobic Polyurethane Chemical Grout; Medium Viscosity (450 – 650 cps); High Elongation:
   a. For primary use to seal most conventional and larger crack widths where high elongation properties are desired.
   b. Not recommended for use to seal hairline cracking and/or thick cementitious substrates where hairline cracking may exist within its matrix.
      1) Products:
         a) De Neef Flex LV PURe; GCP Applied Technologies Inc.
         b) Sikafix HH LV; Sika Corporation.
         c) Dural Aqua-Dam; Euclid Chemical.
         d) Prime Flex 940; Prime Resins, Inc.
         e) AV-248 Flexseal; Avanti.
         f) Resfoam HB 45; MAPEI.
         g) Approved Equal.
3. HRSD System #4: Hydrophobic Polyurethane Chemical Grout; Low Viscosity (100 – 450 cps):
   a. For primary use to seal conventional and hairline crack widths.
   b. Recommended for thick cementitious substrates where hairline cracking may exist within its matrix.

1) Products:
a) De Neef Flex SLV PURe; GCP Applied Technologies Inc.
b) AV-248-LV Flexseal LV; Avanti.
c) Prime Flex 920; Prime Resins, Inc.
d) Approved Equal.

4. Auxiliary Materials:
a. Oakum: Oil free conforming to Federal Specification HH-P-117.
1) Used as a fibrous filler reinforcement material with polyurethane chemical grout to seal cracks, joints and other openings exceeding 1/4-inch (W).
2) Use one of the following:
a) De Neef Dry Oakum; GCP Applied Technologies Inc.
b) Approved Equal.
b. Open-Cell Polyethylene or Polyester Foam: Sheet, backer rod or other shapes.
1) Used as a filler and reinforcement material with polyurethane chemical grout to seal cracks, joints and other openings exceeding 1/4-inch (W).
c. Injection Ports: As recommended by manufacturer.
d. Surface Sealer / Filler: As recommended by manufacturer.

D. Hydrophobic Polyurethane Chemical Foam Grout (For Soils):
1. General:
a. For use as a reactive expanding sealer/filler to stabilize loose sand or soils.
2. HRSD System #5: Hydrophobic Polyurethane Chemical Grout; Ultra-Low Viscosity (≤ 50 cps):
a. Products:
1) De Neef Soil PURe; GCP Applied Technologies Inc.
2) Prime Flex 910; Prime Resins, Inc.
3) AV-550 Soil Strengthener; Avanti.
4) Approved Equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Coordinate Work with applicable stakeholders to ensure that continuous installation is achieved. Coordinate with:
1. OWNER or OWNER's designated representative.
2. ENGINEER.
3. Quality Assurance Inspector.
4. Other trades to avoid or minimize Work in immediate vicinity of Work in progress or completed Work.

3.2 EXAMINATION

A. CONTRACTOR shall examine and verify existing dimensions, conditions and details prior to installation of materials. CONTRACTOR shall report to OWNER, in writing, any conditions that would adversely affect the performance of the material and/or system to be installed and which cannot be put into an acceptable condition by the preparatory work specified herein.

B. Do not proceed with affected Work until concerns have been dispositioned and clear direction is provided.

C. Installation of material and/or system indicates acceptance of conditions.

3.3 WORK CONDITIONS

A. Environmental Limitations: Install materials when existing and forecast weather conditions and substrate conditions permit materials to be installed according to manufacturer's written instructions and warranty requirements.

B. Maintain adequate ventilation during preparation and placement.

3.4 PROTECTION

A. General:
   1. Protect adjacent surfaces and surrounding site.
   2. Protect prepared substrates, cracks and joints from windborne and local debris and/or contaminants.
   3. Protect finished Work from damage.
   4. Remove protective measures upon completion of Work.
   5. Restore surfaces and site to condition prior to Work, to satisfaction of OWNER and at no additional cost to OWNER.

3.5 EQUIPMENT

A. Provide equipment that is capable of injecting materials at the minimum pressures recommended by the material manufacturer.

B. Pumps used for pressure injection shall be capable of providing pressures at the injection gun or nozzle as recommended by the material manufacturer.
   1. The gun shall be fitted with a liquid filled gauge for measuring the injection pressure.
   2. Check valves shall be placed in the hoses at the proper locations to prevent backflow.

3.6 SURFACE & SITE PREPARATION

A. Cementitious:
   1. Prepare surfaces in general accordance with the manufacturer's specifications and requirements.
   2. Locate cracks and/or similar openings to be sealed.
   3. For cracks with active moisture as evident by dampness, weeping or flowing), plug, fill and/or seal to reduce and/or eliminate active moisture prior to installation of injection material. Methods include, but are not limited to:
      a. Application of hydraulic cement.
      b. Installation oakum (dry or saturated with chemical grout) or appropriate filler.
      c. Other methods as recommended by OWNER and/or ENGINEER.
   4. For cracks and joints greater than 1/4-inch (W):
      a. Install oakum, open cell foam or equivalent material to reinforce large openings during application of injection material.
   5. Mark proposed locations of injection points for review by OWNER and/or ENGINEER.
   6. Clean out cracks and openings to be sealed with compressed air to remove dust, debris, contamination, etc.
   7. Drill holes along the side of the crack and/or opening to be sealed in accordance with manufacturer requirements.
      a. Size holes to be 5/8-inch diameter unless otherwise specified by manufacturer.
      b. Drill holes at a 45-degree angle to intersect cracks midway through the substrate.
      c. Clean dust and debris from drilled holes and adjacent surfaces.
   8. Clean surfaces of substrates at material injection port and sealing locations to remove dust and debris.
   9. Install injection ports and/or packers as appropriately spaced intervals along the crack to permit adequate material coverage and verify coverage during injection.
   10. (As Required) Seal substrate surfaces to be injected to prevent release of injection material and ensure adequate pressure retention.
   11. Pump water through injection ports to verify appropriate pathway(s) have been achieved between cracks, joints and/or ports.
   12. Verify substrate moisture content meets manufacturer requirements to ensure activation of materials.

B. Soils:
   1. Prepare site in general accordance with the manufacturer's specifications and requirements.
   2. Identify and clearly mark perimeter of soils to be stabilized.
   3. Mark proposed locations of injection points with proposed depth of injection for review by OWNER and/or ENGINEER. Layout of injection points should consider:
      a. Underground utilities.
      b. Soil type, porosity and related existing conditions.
      c. Depth of soils to be stabilized.
      d. Targeted voids, depressions, etc.
      e. Intervals and procedures of installation.
      f. Application methods and equipment.
      g. Adjacent structures, equipment and related items.
   4. Drill holes for injection points:
      a. Size holes in accordance with manufacturer recommendations.

3.7 MIXING AND INSTALLATION

A. General
   1. Mixing:
      a. Refer to Manufacturer's written instructions for mixing requirements specific to each material and/or application. Unless otherwise specified, the following minimum requirements shall apply:
         1) Verify environment and substrate is suitable for mixing operations and installation. Unless otherwise specified by manufacturer:
            a) Do not allow materials to unintentionally come into direct contact with moisture.
            b) Do not install materials when temperatures are above 90-degrees (and rising).
            c) Do not install materials if substrates conditions are not favorable and/or appropriate preparation requirements have not been achieved.
         2) Verify substrates, cracks, joints, etc. have been properly moisture-conditioned.
         3) Thoroughly mix material using a low-speed drill with a mixing paddle.
            a) Introduce catalyst (if required) at manufacturer recommended consistencies.
            b) Hand mixing is not permitted.
         4) Place mixed material in appropriate device and/or storage for immediate application.
   2. Installation
      a. Cementitious:
         1) Pressure -inject materials with appropriate equipment at designated port locations
            a) Pressure of injected materials should vary based on configuration, crack/joint size, depth and other factors.
         2) Begin pressure injection at the lowest port location and continue until material is observed at an adjacent port.
            a) CONTRACTOR may continue installation from port before immediately moving to an adjacent port based on their expertise and experience.
            b) If material is not observed, drill additional holes and install additional ports.
            c) If liquid material is observed leaking from cracks or joints for more than 30 seconds, compress oakum, or another appropriate material, into the opening to aid the material's gel time as a dam.
         3) Close port and begin injection at adjacent port(s) moving upwards until all ports are filled.
         4) Following installation and material cure:
            a) Remove injection ports.
            b) Mechanically remove injection material protruding from cracks and/or joints.
            c) Ground flush any surfacers, sealers and/or other products used along the length of injection.
      b. Soils:

1) Pressure -inject materials with appropriate equipment at designated drilled (or similar) injection locations
    a) Pressure of injected materials should vary based on configuration, soil type, depth and other factors.
2) Begin pressure injection at pre-identified locations and progress in accordance with the approved installation plan and procedure.
3) Continue installation until all injection locations have been addressed.
    a) For injection requiring higher than anticipated pressure to create travel of materials, or for injection where the anticipated volume of material to be injected is lower, notify OWNER and/or ENGINEER. Identify and implement additional measures to ensure adequate stabilization of soils including, but not limited to:
        (1) Drilling of additional holes and injection of additional material at reduced spacing's.

3.8 FINAL INSPECTION

A. CONTRACTOR shall arrange for a final inspection with OWNER to determine whether Work meets the requirements of the Contract Documents. Testing includes, but is not limited to:
    1. Drilling of pilot holes to verify presence of soil stabilization material (1 per 100SF (max)).
    2. Review of material volume installed.

CHECKLIST 1: CEMENTITIOUS CHEMICAL GROUT INJECTION

Project
Inspector
Task
Location

Quality Assurance Hold points are indicated in Bold Sheet 1 of 1

Date	Initials	Task
_____	_____	**1. Required submittals have been provided to OWNER for review and have been accepted.**
_____	_____	2. Existing conditions, surfaces and related items relevant to work tasks have been examined and accepted. Deficiencies, obstructions, abnormalities and/or constraints have been communicated to OWNER and/or ENGINEER and appropriately resolved.
_____	_____	**3. Cracks and/or joints to be injected and sealed have been marked and reviewed by the OWNER, ENGINEER and/or Quality Assurance Inspector.**
_____	_____	4. **Injection layout and plan have been reviewed by the OWNER, ENGINEER and/or Quality Assurance Inspector.**
_____	_____	**5.** Product/Material manufacturer has reviewed Work, substrates and conditions. Manufacturer has verified selected material(s) is suitable for application.
_____	_____	6. OWNER property including, but not limited to, equipment, components, structures, etc. have been adequately protected.
_____	_____	**7. Active water has been mitigated, reduced and/or appropriately addressed by approved means and methods.**
_____	_____	**8. Injection port holes have been drilled at specified angle and depth for application.**
_____	_____	**9.** Overlays, crack sealer and/or related items have been applied to dam materials (as required).
_____	_____	**10.** Application equipment has been inspected and is ready for use.
_____	_____	11. Material(s) are mixed in accordance with manufacturer requirements. Required catalyst(s) concentrations have been introduces (as required).
_____	_____	**12. Material(s) are injected at specified locations in accordance with the approved plans, specifications and manufacturer requirements. Application shall be observed be OWNER, ENGINEER and/or Quality Assurance Inspector.**
_____	_____	**13. Required mockups have been performed, observed, reviewed and approved (if required).**
_____	_____	**14. OWNER, ENGINEER and/or Quality Assurance Inspector has verified installation.**
_____	_____	15. Excess materials have been removed and/or cleaned from surfaces ; overlays and/or sealers have been removed.
_____	_____	**16. Final inspection (field testing, in-service testing, etc.).**

CHECKLIST 2: SOIL CHEMICAL GROUT INJECTION

Project
Inspector
Task
Location

Quality Assurance Hold points are indicated in Bold Sheet 1 of 1

Date	Initials	Task
_____	_____	**1. Required submittals have been provided to OWNER for review and have been accepted.**
_____	_____	2. Existing conditions relevant to work tasks have been examined and accepted. Deficiencies, obstructions, abnormalities and/or constraints have been communicated to OWNER and/or ENGINEER and appropriately resolved.
_____	_____	**3. Perimeter of soils to be injected and stabilized have been marked and reviewed by the OWNER, ENGINEER and/or Quality Assurance Inspector.**
_____	_____	4. **Injection layout and plan have been reviewed by the OWNER, ENGINEER and/or Quality Assurance Inspector.**
_____	_____	**5.** Product/Material manufacturer has reviewed Work, soils and conditions. Manufacturer has verified selected material(s) is suitable for application.
_____	_____	6. OWNER property including, but not limited to, equipment, components, structures, etc. have been adequately protected.
_____	_____	**7. Injection holes have been drilled at specified location(s) and depth(s) for application.**
_____	_____	**8.** Application equipment has been inspected and is ready for use.
_____	_____	9. Material(s) are mixed in accordance with manufacturer requirements. Required catalyst(s) concentrations have been introduces (as required).
_____	_____	**10. Material(s) are injected at specified locations in accordance with the approved plans, specifications and manufacturer requirements. Application shall be observed be OWNER, ENGINEER and/or Quality Assurance Inspector.**
_____	_____	**11. Required mockups have been performed, observed, reviewed and approved (if required).**
_____	_____	**12. OWNER, ENGINEER and/or Quality Assurance Inspector has verified installation.**
_____	_____	**13. Final inspection (1 per 100 SF).**

END OF SECTION