# In-situ Solidification (ISS) Mix Design/Construction Work Plan

Soil & Ground Water Remediation Project
The Polychrome East & West Sites
Yonkers, NY
April 30, 2018

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## 1. INTRODUCTION

This document provides the general details and procedures that Geo-Solutions, Inc. (GSI) will implement during the In-Situ Stabilization (ISS) and ground improvement work as part of the Soil & Ground Water Remediation Project at the Polychrome East & West Sites in Yonkers, NY. The ISS work will be performed in accordance to the project specifications, drawings, addenda, relative correspondences, and this work plan. GSI intends to perform the ISS work in four phases: West Slurry Wall installation via bucket mixing, West Plug/Pile Modifications via auger mixing, West ISS via bucket mixing, and East ISS via bucket mixing. In general, GSI's portion of the project consists of the following:

- ISS Mix Design to determine reagent addition rates;
- Submittals including the mix design, work plan, and QC plan;
- Mobilization to the West Site of equipment and manpower including the batch plant, pumps, excavators, drill rig, and other miscellaneous support equipment necessary for the ISS work;
- Temporary Facilities and Controls specific to the ISS work;
- ISS Slurry Wall installation via bucket mixing;
- ISS Plug/Pile modifications via auger mixing within the Special DNAPL Areas;
- ISS bucket mixing within Units B, D, and G;
- Mobilization to the East Site;
- ISS bucket mixing within Units #1 and #2;
- Quality Control (QC) testing of all materials related to the ISS work; and
- General site clean-up of our work areas and final demobilization of material, equipment and crew directly related to the ISS work.

The means and methods described herein are subject to change in response to changes in field conditions. Changes will only be initiated to the extent that they remain in compliance with the specifications and intent of this plan. GSI's project team representatives will maintain communication with Posillico, AKRF, and Avalon Bay onsite personnel to assure their awareness of any deviations in construction methods.

A preliminary planning schedule was included in GSI's proposal to Posillico. GSI's schedule is based off working 5 days per week, 10 hours per day, Monday through Friday. GSI will work extended hours as necessary to complete the work in a timely fashion.

## 2. KEY PERSONNEL

GSI's key personnel consists of the following individuals:

Project Manager – Josh Bonetto will serve as the Project Manager. The Project Manager has overall responsibility for the project including client interface, signature authority, quality control, safety and production. It is the Project Manager's responsibility to assure that the field staff has the necessary corporate support to perform the project with the highest level of safety, quality, and production.

Site Superintendent – Sam Kellar will be serving as GSI's Site Superintendent (SS) for the installation of the Soil Mixed elements. The SS has overall responsibility for the day-to-day work on the project site. He will be responsible for the overall safety of his crew, the quality of product installed, and adherence to the project schedule.

Project Engineer/QC Technician – Alex Campbell will be serving as GSI's on site Project Engineer/QC Technician. The Project Engineer/QC Technician will assist the Site Superintendent and the Project Manager in the implementation of Quality Control measures and ensuring compliance with the project specifications.

Field Crew – GSI will provide union operators from Local 137 and laborers from Local 60 necessary to complete the ISS work.

Key personnel resumes can be submitted upon request. If there are changes to the above personnel, GSI will submit to Posillico in advance.

## 3. PRE-CONSTRUCTION ACTIVITIES

### *3.1. SUBMITTALS*

Preconstruction activities will include, but are not limited to, preparation and submission of required submittals, procurement of materials and equipment, and coordination with Posillico and other contractors involved in the site work. GSI will prepare and submit the required preconstruction submittals prior to field personnel mobilizing to the project.

### *3.2. MIX DESIGN*

GSI is currently performing an ISS Mix Design to determine an adequate reagent blend that will meet the strength and permeability requirements of the ISS work. During the mix design work, site soils are mixed with varying reagent blends consisting of Portland Cement, Blast Furnace Slag, and/or Bentonite at a total cement addition rate of 20% by weight of soil. The full report and results will be

submitted under separate cover once completed. The following mixtures have been made and are awaiting lab results:

| Mix | Slag/Portland Ratio | % Total Cement | % Bentonite |
|---|---|---|---|
| 1 | 50/50 | 20% | 0% |
| 2 | 50/50 | 20% | 1% |
| 3 | 70/30 | 20% | 0% |

### *3.3. MOBILIZATION*

The ISS activities will begin with the mobilization of personnel, material, and equipment to the West project site. Heavy equipment and materials will be delivered using the designated site access points. GSI's batch plant setup and staging area shall be located in the West project site in a location established by Posillico.

### *3.4. PERSONNEL AND EQUIPMENT*

GSI's site personnel will be prepared to mobilize and begin work activities upon approval by Posillico. GSI will mobilize management personnel for site meetings prior to mobilization of the full site crew (as required). GSI will utilize local union labor forces, only supplying management from its various office locations and specialty operators and/or laborers. GSI will submit all training documentation for personnel assigned to this project prior to mobilization for review and approval.

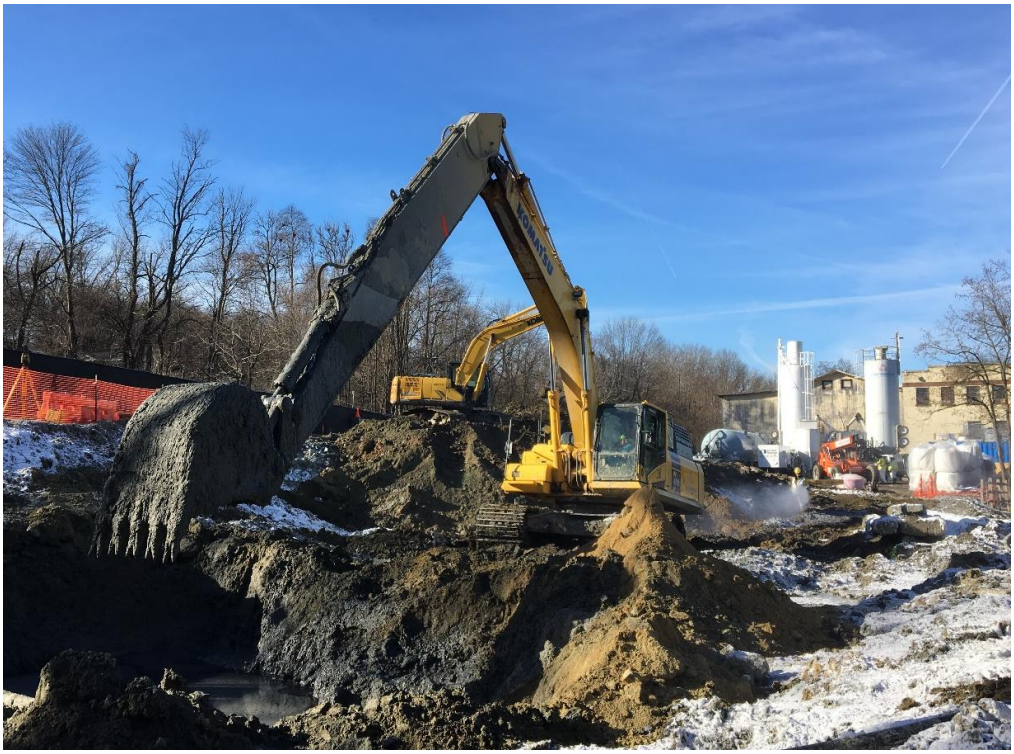
After arrival on site and review of the project scope and safety protocols for the project, GSI will begin receiving deliveries of ISS equipment and materials. All equipment and material deliveries will be coordinated with Posillico and other site personnel prior to arriving on site. Field crew shall review the JSAs for each particular piece of equipment prior to utilization on-site.

### *3.5. ISS EQUIPMENT*

The following equipment will be necessary to complete the ISS Work:

- Mix plant along with storage tank(s) and pumps as needed for the mixing and transporting of grout;
- 2 –Silos for cement and slag storage;
- 1 – Bulk Storage Container (Pig) for additional slag/Portland cement storage (as needed);
- Generator to power electric pumps, batch plant, and blowers;

- Mixing Excavator 1 – Komatsu PC490 (or similar) with long stick attachment and excavating bucket (for deep bucket mixing in West Unit G);
- Mixing Excavator 2 – Komatsu PC210 (or similar) with excavating bucket (for Slurry Wall and shallow bucket mixing);
- Drill Rig –track mounted drill rig with auger attachment for mixing Plug/Pile modifications;
- Forklift – unloading of equipment and materials;
- Manlift – installing long stick onto excavator and maintenance;
- Survey Equipment – Layout of ISS locations;
- Office trailer
- Miscellaneous support equipment (i.e. welders, tool boxes, air compressor, connex box, etc.).



GSI PC490 EXCAVATOR

### *3.6. ISS MATERIALS & MATERIAL HANDLING*

Portland cement (PC) and Slag Cement will be delivered to the site via bulk pneumatic transport vehicles and stored in silos and/or a bulk storage container (Pig). GSI's grout mixing plant will be setup in the West project site at a location that is accessible for daily cement deliveries. The plant will consist of a mixing tank, holding tank, pumps, scales and valves used to mix and transfer the cement grout. Water will be provided to GSI directly from the site source (frac tanks).

## 4. ISS MEANS AND METHODS

The ISS work will be completed by mixing the site soils with a cement/slag grout through the use of the excavator bucket mixing and auger mixing techniques. The site soils will be thoroughly mixed and blended with the cement grout until a homogenous mixture has been created. The bucket mixing treatment areas, Units B, D, and G and the Slurry Wall in the West and Units #1 and #2 in the East, will be divided into cells of predetermined volume allowing for increased Quality Control and workflow. Auger mixed columns will be a minimum of 3' in diameter and mixed to the termination depths required by the project documents. The volume of the auger mixed cell will be calculated prior to mixing to ensure the proper cement dosage is used.

### *4.1. GROUT PREPARATION*

Initially, GSI's batch plant will be located within the West project site as close as practical to the ISS Areas and in a location accessible to cement truck deliveries. Grout will be prepared on a batch basis in GSI's high-shear mixer. The appropriate weights of reagents will be added to the water that has been metered or weighed into the plant. A predetermined amount of grout will be weighted/metered and pumped from the mix plant for each cell/column based on the volume of the cell/column. Parameters for each batch mix will be recorded and can be related to the particular cell/column in which it is to be injected.

The effective area of each cell/column will be calculated individually prior to mixing. The quantity of reagents added will be calculated based on the effective untreated volume of soil in the given cell/column at pre-determined in-place density. Reagent grout will be metered via magnetic mag-flow meters and/or weighed to ensure the prescribed quantities of reagents are added and mixed into the ISS cell/column.


TYPICAL GSI BATCH PLANT

## *4.2. GENERAL BUCKET MIXING PROCEDURES*

In general, the following procedures will be utilized throughout during the ISS bucket mixing. The bucket mixing will be completed with a hydraulic excavator equipped with an excavator bucket. For the deeper mixing areas (Unit G), GSI will utilize a custom long reach attachment.

The proposed treatment areas will be divided into discrete cells for ISS bucket mixing. Generally, mixing cells will have dimensions of 15 ft. x 10 ft. (length x width) and will be identified with a unique alphanumeric designation (cells for the Slurry wall will be roughly 2'-3' x 15'). Prior to mixing, the cells will be located and staked by GSI's Project Engineer in the field using total station or GPS surveying equipment. Treatment depths are predetermined from the project documents for each individual ISS area.

Once each corner of the cell is located and staked, the soil mixing will commence through the use of one of the hydraulic mixing excavators.

Step 1: Temporary containment berms will be created surrounding the cell in order to contain the ISS swell (spoils). This berm will be made of either virgin

material or ISS spoils borrowed from a nearby completed cell. Should excess spoils not be readily available, unmixed soil will be used and will be incorporated into the subsequent soil mixed cell.

Step 2: Utilizing the hydraulic excavator and excavating bucket, remove the top portion (~4 ft.) of soil from within the extents of the cell. Cast soil off to the side or use to increase height of berm. Establish radio communication with the batch plant operator requesting grout to be pumped to the open excavation.

Step 3: Excavate the center of the cell to full depth while maintaining grout addition. Stockpile soil adjacent to the cell. Grout introduced to act as temporary hydraulic shoring in an effort to maintain sidewall stability. Once full depth is reached and verified, begin mixing and incorporating stockpiled soils.

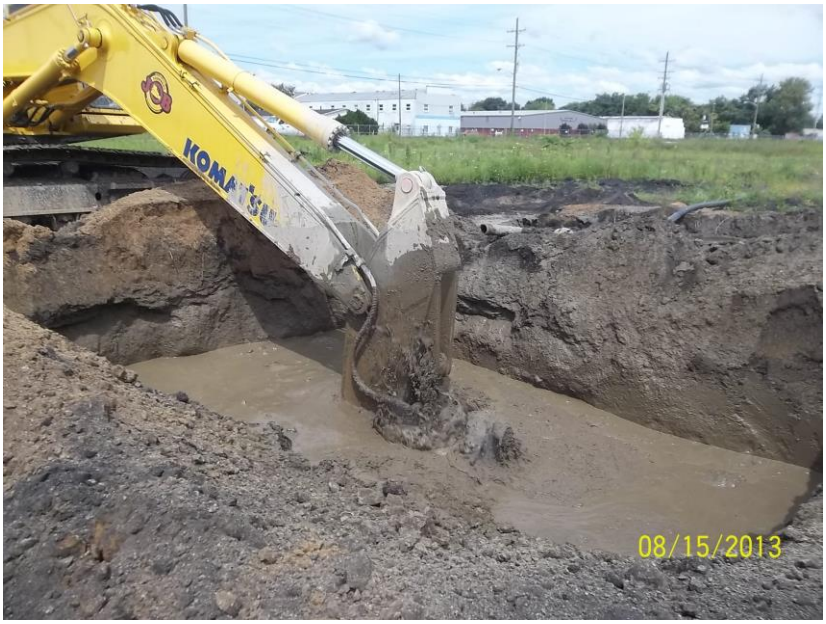
Step 4: Excavate the sidewalls to the cell limits while continuing to introduce the cement grout. Excavated soil will be stockpiled adjacent to the cell. Once full depth is reached and verified, begin mixing and incorporating stockpiled soils.

Step 5: Incorporate berm material into mixing pit.

Step 6: Introduce remaining volume of grout and blend until soil-cement mixture becomes homogeneous. Verify mixture based on visual observation. Bucket mixing excavator shall break up clods to 6” or less prior to moving to the next cell.

Step 7: Stop mixing and move it to the next proposed mixing cell. Perform Quality Control testing/sampling as required.

Each cell will be assigned an alphanumeric identifier used to distinguish between treated and untreated ISS Cells. As part of the Daily Quality Control reporting, GSI will provide a map of the treatment area(s) showing cells that have been completed during that day’s shift. This map will be updated on a daily basis.




EXCAVATOR BUCKET MIXING

### *4.3. GENERAL AUGER MIXING PROCEDURES*

The soil mixing drill rig will be a track mounted rotary drilling rig that has been modified to accept large diameter mixing tools with the capability to pump fluid through the Kelly bar and mixing tool. The ISS rig has the capability to handle up to an 8-foot diameter mixing tool. For this application GSI shall utilize a minimum of a 3' diameter auger. These types of auger and rig combinations have demonstrated the capability to produce a well-mixed soil mix material in various field conditions. The ISS rig is equipped with a mast inclination system with automatic mast adjustment to maintain verticality alignment. This ensures that the soil mixed columns are installed within strict verticality tolerances. The rig is fitted with a computerized readout in the cab of the machine to inform the operator of the drilling depth, auger rotation speed, and crowd pressure.

The following general procedures will be used during auger mixing:

Step 1: Position soil mixing rig such that the auger and Kelly bar are centered over the predetermined center point location of a column. Ensure that the rig is reasonably level and stable. Plumb the mast and Kelly bar.

Step 2: Initiate rotation of the auger and begin pumping water/grout. Lower auger to begin penetration into the soil. Proceed downward with the auger at a consistent rate, maintaining auger rotation speed and grout flow.

Step 3: Continue auger penetration to the column bottom elevation. Mix to the bottom elevation and then begin auger withdrawal.

Step 4: Withdraw auger at a relatively consistent rate, maintaining auger rotation and grout flow, until the auger is at the working pad surface.

Step 5: Repeat the column mixing until the soils appear to be homogeneous and all of the grout has been pumped into the column.

Step 6: Manage excess spoils with an assist excavator.

Step 7: Upon column completion, raise auger above work pad surface and relocate to the next column location. If necessary, spray the auger with odor suppressing foam to alleviate odor issues.

Step 8: Repeat the process until all columns have been installed.

AUGER MIXING WITH TRACK MOUNTED DRILL RIG

### *4.4. SWELL MANAGEMENT AND SLOUGHING*

Based on the estimated reagent quantities, at a 1:1 water to total cement ratio (or less), GSI estimates the spoils volume to range from 40% or greater of the treated volume. During mixing, GSI will perform initialing handling of spoils generated within the ISS areas and incorporate them to the extent possible. Handling of excess spoils, final grading, and/or final disposition will be performed by Posillico.

GSI does not anticipate sloughing and/or collapsing of the cell/column to occur during the mixing operations because the ISS panel will be completely or partially filled with material at all times. GSI will only remove enough material initially to introduce grout. After that, the panel is consistently filled with material to help keep the sidewalls of the excavation open/stable.

### *4.5. OBSTRUCTIONS*

If small obstructions (boulders, concrete debris, etc.) are encountered and can be removed with the bucket mixing excavator in less than 15 minutes of effort, GSI will remove and place alongside the ISS mixing cell for final disposal by others. GSI will notify Posillico personnel immediately if an obstruction is identified as something other than a boulder or construction debris (i.e. utility, pile, etc.) or if an obstruction/oversized debris takes longer than 15 minutes to remove. GSI will document the ISS Cell number, estimated depth and approximate size/dimension of the obstruction.

### *4.6. EXTREME WEATHER*

In the event of extreme weather events such as lightning storms or heavy snow/rain, GSI shall shut down operations until it is safe to resume work. GSI is typically able to work through normal rain/snow fall conditions with minimal delays. GSI's supervisor will monitor the forecast during storm events to better prepare for extreme weather and potential shutdowns. In addition, the entire site crew will be on the lookout for lightning during storm events and mixing of grout will be handled diligently (i.e. smaller batches, etc.). Ideally, GSI will be able to identify the incoming storm and cease mixing grout and/or perform washout prior to being shut down for lightning.

EXCAVATING IN HARSH WEATHER

## *4.7. SHUTDOWN PROCEDURES*

At the end of each shift, the following procedures will be employed:

- Move the excavators and/or drill rig away from the last cell/column completed and wash out grout lines. Washout is performed by pumping the remaining grout into the last mixed cell/column. The grout is then chased with clean water from the batch plant. Clean water is pumped throughout the entire grout delivery system until all indicators of cement grout are no longer visible. Washout water will be pumped and collected in the last mixed cell/column or over multiple cells if excessive cleaning is required. Next, some fittings and connections at the plant and pumps will be disconnected. Grout lines will be blown with air and “pig” to prevent fluids from setting up and/or freezing. Collecting the washout water/grout in the last mixed cell is common practice for GSI and we do not anticipate on having any impacts to the curing/holding capacity of the cell. If excessively cleaning is required, GSI will collect the washout water/grout over multiple cells rather than just one.
- Operators and laborers will perform daily greasing, fueling, and maintenance on the excavators and mix plant, as needed.
- Prior to leaving the site, equipment keys will be removed from the equipment and the site secured.

In the case of an emergency situation in which the batch plant area must be evacuated immediately (lightning strike, etc.), GSI will implement an accelerated washout process of its batch plant. This accelerated washout will consist of the following:

- Cease mixing of fresh grout and empty mixing tanks by opening valves and allowing grout to gravity feed into an established grout waste area adjacent to the batch plant.
- Break connections on pumps and open valves.
- De-energize the batch plant.

In an effort to minimize the amount of time, GSI will only concentrate on getting grout out of the batch plant and pumps. GSI will not blow out the grout lines in an emergency situation.

### *4.8. DEMOBILIZATION*

After completion of the ISS operations within the West project site, all construction equipment, personnel, and excess material related to the soil mixing construction will be removed and the majority of it will be relocated within the East project site. GSI's office trailer and temporary facilities will remain in the West site. GSI will setup the batch plant in the East site and the same procedures listed above will be implemented during the ISS bucket mixing at this site.

Following the completion of the ISS work at the East project site, all material, personnel, and ISS equipment will be removed from the project sites. GSI shall perform general cleanup of our work areas prior to final demobilization.