In-situ Solidification (ISS) Construction Quality Assurance Project Plan (CQAPP)

Soil & Ground Water Remediation Project
The Polychrome East & West Sites
Yonkers, NY
May 4, 2018

Prepared by:

Geo-Solutions
Soil and Groundwater Problems Solved

1250 Fifth Avenue
New Kensington, PA 15068

Prepared for:

Posillico

1750 New Highway
Farmingdale, NY 11735

Geo-Solutions
Soil and Groundwater Problems Solved

TABLE OF CONTENTS

TABLE OF CONTENTS 2
1. INTRODUCTION 3
2. ESTIMATED QUANTITIES 3
3. DAILY QUALITY CONTROL 4
4. ISS CELL/COLUMN LAYOUT 5
5. MATERIAL TESTING 5
6. CORING 6
7. DOCUMENTATION AND MONITORING 7

1. INTRODUCTION

This document provides the general Quality Control (QC) 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 quality control testing and reporting will be performed in accordance to the project specifications, drawings, addenda, relative correspondences, and this 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 QC testing and reporting during the project consists of the following:

- ISS Mix Design to determine reagent addition rates (submitted under separate cover);
- Submittals including the mix design, work plan, and QC plan;
- Testing and Reporting during the ISS Slurry Wall installation via bucket mixing;
- Testing and Reporting during ISS Plug/Pile modifications via auger mixing within the Special DNAPL Areas (18 Columns);
- Testing and Reporting during ISS bucket mixing within Units B, D, and G;
- Testing and Reporting during ISS bucket mixing within Units #1 and #2;

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.

The successful completion of the soil solidification work will involve a thorough Quality Control (QC) program. All test results, sampling procedures and any abnormalities will be documented on Daily QC Reports. A majority of the QC testing and documentation will be performed onsite by GSI's Project Engineer and/or Quality Control Technician in an effort to verify that the ISS is constructed in accordance with industry standard soil mixing procedures, project specifications and this plan. GSI is a highly qualified specialty geotechnical contractor that has extensive experience with many types of in-situ soil mixing techniques.

2. ESTIMATED QUANTITIES

The following table lists the estimated ISS quantities per area:

Location	Description of Work	Max Depth (ft)	Quantity (CY)
Polychrome West	ISS Slurry Wall	13	193
Polychrome West	ISS Plug/Pile Modifications	36	143
Polychrome West	ISS Bucket Mixing - Unit B	16	2,969
Polychrome West	ISS Bucket Mixing - Unit D	16	830
Polychrome West	ISS Bucket Mixing - Unit G	26	2,533
Polychrome East	ISS Bucket Mixing - Unit #1	13	1,358
Polychrome East	ISS Bucket Mixing - Unit #2	13	2,234

3. DAILY QUALITY CONTROL

GSI's on site Project Engineer will perform the daily quality control testing, sampling, and reporting. Mixing depth, cell/column start and stop times, and total grout volume per cell/column will be continuously monitored and recorded during ISS operations. Samples of fresh grout will be taken periodically throughout the day from the batch plant and tested for density and viscosity. 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 based on the volume of the cell. 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 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. GSI shall utilize a 20% total cement addition rate for the bucket mixing and slurry wall ISS. A 15% total cement addition rate will be used for the ISS Plug/Pile modifications.

Cell locations and column center points will be survey located using a portable GPS unit or a total station tied into a known coordinate system and marked in the field with wooden stakes or pin flags. GSI elects to use surveying equipment in order to increase accuracy, thus maintaining tight horizontal and vertical tolerance. Daily cell/column layout will be performed by GSI's Project Engineer or superintendent. Final cell depths will also be recorded by the surveying equipment. The auger mixing drill rig will be equipped with a depth sensor to monitor drill depth.

4. ISS CELL/COLUMN LAYOUT

GSI will utilize either GPS or Total Station survey equipment to accurately locate the corners of each cell and the center points of the auger mixed columns. Wooden stakes or pin flags will be used in the field to allow the operators to accurately locate and track each cell. The total station system GSI anticipates using for this project is a Topcon 3107 (or similar) capable of operating with standard survey prisms or in "reflectorless" mode; meaning it is capable of taking distance and angle readings without the use of a prism. This technology affords GSI the flexibility to locate cells accurately, quickly, and efficiently in standard prism mode while also using the same instrument to obtain depth information in reflectorless mode using a target on the excavator stick (or extension).

The 3107 will be paired with a Carlson Field PC (Windows Mobile-Based Data Collector, or similar), and Carlson SurvCE software for data import/export. The combination of these components can provide accuracy up to +/- (2mm + 2ppm x Distance in mm) when used with a prism and accuracy up to +/- (3mm + 2ppm x Distance in mm) when used in reflectorless mode. Corner coordinates for each cell will be extracted from an approved ISS Cell Layout drawing (GSI shall submit layout drawing under separate cover). The coordinates will be staked and labeled in the field by the Project Engineer to delineate the limits of each cell to be soil-mixed, cell surface elevations will be collected at this time as well. A minimum of 4 stakes (or a stake at each cell corner, depending on geometry, as required to visually demarcate the cell so that the operators can clearly distinguish the outline of the cell) will be provided for each cell. The stakes will be painted an easily distinguishable color and labeled with the Cell Name Designation. Cells will be staked out as ISS progresses. Typically, a sufficient number of cells will be laid out the day before they are scheduled to be soil-mixed. The same process will be done for the auger mixed columns only a single stake is required in the center of the column to delineate the column.

5. MATERIAL TESTING

Samples of material collected in the field will be stored on site for a brief curing period prior to transport and testing. Laboratory testing for Unconfined Compressive Strength and Permeability will be performed by Geotechnics and/or JLT Laboratories.

Samples will be collected at discrete depths within mixing cells/columns using a support excavator. Samples will be collected under the direction of GSI's Project Engineer or supervisor at a frequency of 1 sample set per every 500 cubic yards or 1 set per every 2 production days (whichever is more). The sampling will take

place immediately after mixing while the column/cell is in its most fluid condition. Sampling procedures are as follows:

1. The support excavator lowers bucket into freshly mixed cell/column to the desired approximate depth. Depth will be estimated by the stick length.
2. Once at the desired depth, bucket is closed and material is brought up to the surface.
3. GSI's Project Engineer will then transfer the material from the excavator bucket to a clean bucket (typically 5 gallon plastic).
4. The soilcrete mixture is removed from the bucket and cast into 2"x4" and 3"x 6" cylinders for laboratory testing. Sample cylinders will be allowed to cure on site for a minimum of 2 days prior to transport. Cylinders will be stored in coolers in a temperature controlled environment while on site. Final curing will be completed at the laboratory.
5. Samples will be tested for unconfined compressive strength (UCS) and Permeability by the laboratory.

Target Parameters:

Permeability – $1x10^{-6}$ cm/sec

Unconfined Compressive Strength – 50 psi

GSI shall test for UCS at 7 and 28 days. GSI shall test for permeability at 28 days (or sooner). Samples collected from the Plug/Pile modification areas will only be tested for UCS.

6. CORING

Coring of completed ISS cells will be conducted by a local drilling outfit with previous sampling experience of soft solidified material. GSI anticipates on using the wireline coring method with a triple tube core barrel (size PQ) to retrieve the samples. Coring will take place after the cells had sufficient time to cure and gain strength. Should there be any issues with retrieving samples utilizing this method, GSI will be prepared to employ other sampling techniques such as direct push method or split spoon sampling.

Core runs will be a maximum of five (5) feet. The target recovery per run is 60%. Cores shall be visually inspected for NAPL, non-mechanical induced cracking, and recovery. No laboratory testing (UCS or Permeability) will be performed on the core samples. There will be no coring performed on the Slurry Wall or auger mixed columns.

7. DOCUMENTATION AND MONITORING

Records of the following mixing parameters will be recorded and kept:

Monitored Parameter	Data Source
Cell Limits / Auger Center points	GPS/Total Station
Grout Density	Mud Balance
Grout Viscosity	Marsh Funnel
Mixing Depth – bucket mixing	GPS/Total Station
Mixing Depth – auger mixing	Readout on Drill
Start/Finish Time	Operator's Log
Gross Grout Injection and Proportioning	Batch Plant Report

An example grout proportioning calculation can be found in attachment 1.

Attachments:

1. Sample Batch Plant Calculation

ATTACHMENT 1

17-140 Yonkers, NY
Example Batch Calculation

ISS Cell ID	A1	
Length	15	ft
Width	10	ft
Depth	20	ft
Treatment Volume	3000	ft^3
Soil Density	110	pcf
Soil Weight	330000	lbs
50/50 Blend Cement	20%	by weight of soil
50/50 Blend Cement	66000	lbs
W:S Ratio	0.8 to 1	
Water Weight	52800	lbs
Water Volume	6361.4	gallons
11 Batches Total		
50/50 Blend Cement	6000	lbs
Water Weight	4800	lbs
Total Batch Weight	10800	lbs