Interim Remedial Measure Work Plan

Brownfield Cleanup Program No. C360115
1-5 Holland Avenue
White Plains, NY
14206 / 47376

Prepared for:

One Holland Avenue Development, LLC

Prepared by:

O'Brien & Gere Engineers, Inc.
And
In-Situ Oxidative Technologies, Inc.

June 20, 2013

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1. INTRODUCTION

1.1 GENERAL

The Interim Remedial Measure (IRM) described in this Work Plan for the 1-5 Holland Avenue site in White Plains, New York is being conducted by One Holland Avenue Development, LLC. (OHAD) in accordance with the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program. The Brownfield Cleanup Program Site ID number is C360115. A site location map is provided as **Figure 1**.

The scope of work included herein was developed based on data presented in the draft Remedial Investigation (RI) report and discussions with the NYSDEC.

1.2 PROJECT OBJECTIVES

The objectives of the IRM are to:

- treat tetrachloroethylene (PCE)-impacted soils, bedrock, and groundwater in the area of floor drains FD-2 and FD-3 (suspected source area)
- reduce concentrations of PCE in groundwater to below the New York State Groundwater Class GA standard or to the extent practical.

1.3 PROJECT CONTACT INFORMATION

The project contact information for this IRM is as follows:

Property Owner:	One Holland Avenue Development, LLC 11280 Cornell Park Drive Cincinnati, OH 45242-1812
Environmental Consultant:	O'Brien & Gere Engineers, Inc. 333 West Washington Street Syracuse, NY 13221-4873
Key Project Personnel:	James R. Heckathorne, PE – Project Officer Guy Swenson, CPG – Senior Technical Director Mark Randazzo, CPG, CSP – Project Manager
Remediation Contractor:	In-Situ Oxidative Technologies, Inc. (ISOTEC) 11 Princess Road, Suite A Lawrenceville, NJ 08648
Key Project Personnel:	Michael Temple – Project Manager

1.4 PROFESSIONAL ENGINEER’S CERTIFICATION

I, James R. Heckathorne, certify that I am currently a New York State registered professional engineer and that this IRM Work Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10)(a).

O’BRIEN & GERE ENGINEERS, INC.

IT IS A VIOLATION OF LAW FOR ANY PERSON, UNLESS HE OR SHE IS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER, TO ALTER THIS DOCUMENT.

JAMES R. HECKATHORNE
56609

James R. Heckathorne, P.E.
Vice President

Date: June 20, 2013
Registration No.: 56609
State: New York

2. BACKGROUND

2.1 SITE LOCATION AND DESCRIPTION

The Site, zoned light industrial, comprises 0.65 acres and is located at 1-5 Holland Avenue, White Plains, New York. The surrounding buildings and properties are of mixed use, consisting of:

- White Plains rural cemetery to the south
- Harlem Line of Metro North Railroad tracks immediately to the west
- commercial buildings immediately to the east and north
- commercial and residential buildings further to the north and east.

The Bronx River is located approximately 400 feet west of the Site. A Site location map is presented as **Figure 1**.

2.2 CONCEPTUAL SITE MODEL

The draft RI Report was submitted to the NYSDEC in October 2012. As detailed in that report the conceptual site model for the Site is as follows:

The Site is underlain by 0.5 feet to 5 feet of sandy fill followed by a well sorted fine to medium grained sand to a depth between 15 and 17 feet below grade surface (fbgs). A poorly sorted sandy-gravel believed to be glacial till is present below this depth. Bedrock (Inwood Marble) is present between 20 and 24 fbgs and is characterized as a calcitic-dolomitic marble with majority of fractures occurring in the upper 10 feet that act as the principal pathway for horizontal groundwater flow through the bedrock. Bedrock becomes increasingly competent and unfractured with depth.

Groundwater is generally encountered at approximately 12-15 fbgs with primary flow from the east to the west/northwest. Approximate *in situ* hydraulic conductivity values for the overburden, shallow bedrock, and suspected source area wells were as follows:

- Overburden range – 0.29 feet/day (ft/day) to 58.39 ft/day
- Shallow bedrock range – 0.0003 ft/day to 5 ft/day
- MW-4S, Overburden – 10 ft/day
- MW-4D, Shallow bedrock – 5 ft/day

The bedrock hydraulic conductivity in the suspected source area is higher than the average (1.6 ft/day) calculated for the Site. The suspected source area hydraulic conductivities suggest that the overburden and bedrock units within the proposed treatment area will be able to accept injected reagents at a reasonable flow rate.

Soil Analytical Data

Soil analytical results from the suspected source area did not indicate the presence of PCE above NYSDEC soil cleanup objectives. However, the groundwater results from the Site, discussed below, suggest that a residual source of PCE is present.

Groundwater Analytical Data

Groundwater impacts exist within the overburden and shallow bedrock groundwater at the Site. Results of groundwater sampling indicated the presence of PCE in groundwater, on-site and along the hydraulically downgradient western edge of the property, above the NYS Class GA groundwater standard of 5 ug/l. Groundwater in the bedrock also exceeds the Class GA standard for PCE. During the most recent groundwater sampling event (May 2012), the suspected source area wells MW-4S and MW-4D exhibited the highest concentrations of PCE at 1,020 ug/l and 6,140 ug/l, respectively.

Suspected Source Area

Based on historical reports and data collected during the RI Investigation, the source of PCE is believed to be from historical degreasing operations at the Site and possible releases through cracks in floor drains, which discharged to the sanitary sewer.   Soil sampling, membrane interface probe (MIP) testing, and groundwater sampling conducted inside the building indicated elevated concentrations of PCE in groundwater in the area of floor drains FD-2 and FD-3. These data suggest that a residual source of PCE may be present in the soil and bedrock in this area. Historical figures depicting locations and concentrations of PCE in soil, as presented in the draft RI report, are presented as **Figures 2** (MIP Electron Capture Detector Readings), **3** (MIP Confirmation Sampling Results), and **4** (Historical Soil Sample Location Map).

The proposed treatment area encompasses the suspected source area in the vicinity of floor drains FD-2 and FD-3, monitoring wells MW-4S and MW-4D, and soil boring and MIP locations that suggested the presence of PCE. A site map showing the proposed treatment area is included as **Figure 5**.

3. ISCO REMEDIAL PROGRAM

3.1 DESCRIPTION OF SUSPECTED SOURCE AREA

The suspected source area proposed for treatment is approximately 1,100 square feet in the area of floor drains FD-2 and FD-3. The proposed vertical treatment interval is between approximately 10 and 20 fbgs within the overburden and between 20 and 45 fbgs within the shallow bedrock. The injections in the bedrock will be divided into two 10 foot intervals (23-33 and 35-45 fbgs). The proposed treatment area is depicted on **Figure 5**.

3.2 IN-SITU CHEMICAL OXIDATION TECHNOLOGY

In-situ chemical oxidation (ISCO) is selected as the remedial technology to treat the suspected source area. ISCO was selected as the IRM technology based on its performance at other similar sites, the Site access constraints, its ability to convert PCE to innocuous compounds, and its implementability.

The following assumptions were used to develop the ISCO IRM design:

- Overburden treatment thickness = 5-10 feet (ft) utilizing a single injection well per location screened from approximately 15-20 fbgs
- Shallow bedrock treatment thickness = 28 ft utilizing two injection depth intervals per location with the injection wells screened from approximately 24-34 and 38-48 fbgs
- Radius of influence (ROI) per injection well = approximately 6-7 ft (overlapping ROI's as part of the injection point layout)
- Number of injection well clusters = 12 (3 screened intervals per location)
- Number of injection events = Estimated at 2
- Maximum PCE concentration in overburden groundwater = 1,020 ug/l (MW-4S - Based on May 2012 sampling event.)
- Maximum PCE concentration in shallow bedrock groundwater = 6,140 ug/l (MW-4D - Based on May 2012 sampling event.)

The activated sodium persulfate process utilizes sodium persulfate ($Na_2S_2O_8$) oxidant activated using various methods to produce sulfate free radicals. The activators include ISOTEC’s^{SM} proprietary, patented chelated iron catalyst, base/alkali (*e.g.,* sodium hydroxide - NaOH), heat or hydrogen peroxide. Persulfate reagents are designed for both solo use or in combination with other ISOTEC^{SM} reagents (*e.g.* modified Fenton’s reagent, permanganate reagent). The reaction mechanism associated with the activated sodium persulfate process is shown below.

$$S_2O_8^{2-} + \text{Activator} \leftrightarrow 2SO_4^{\bullet -}$$

$S_2O_8^{2-}$ = Sodium persulfate

$SO_4^{\bullet -}$ = Sulfate free radical

Activator = NaOH, Chelated Iron Catalyst or Hydrogen Peroxide

Sodium persulfate activation via sodium hydroxide (BASP - Base activated sodium persulfate) is proposed as the ISCO treatment method. The activation is generally achieved at pH greater than 10.5-11. A review of well development logs indicate native pH to be in the range of 7-11, which will allow for an easier transition to alkali conditions following the addition of sodium hydroxide compared to other sites where native pH values are typically in the range of 5-7. Due to the anticipated low permeability within the shallow bedrock fractures, BASP is being selected over other ISCO technologies such as modified Fenton's reagent (MFR) and permanganate (all of which are capable of treating Site COCs) for the following reasons:

- MFR has the potential to produce off-gassing from associated ISCO reactions occurring in the subsurface, which may inhibit the amount of reagent volume that can safely be injected within the tight bedrock fractures that exist at the Site. If large amounts of off-gassing occur within the tight fractures, significant back-pressure will occur making injection of reagent even more difficult within the shallow bedrock, which may lead to a very limited volume of reagent being injected.
- Permanganate (either sodium or potassium) reagent has the potential to create manganese dioxide as a product of the reaction between permanganate and Site COCs. When created, manganese dioxide can deposit in the subsurface and cause problems associated with injections including clogging of well screens, available pore space, and small fractures within the bedrock.

3.3 IMPLEMENTATION OF ISCO TREATMENT PROGRAM

3.3.1 Injection Well Installations

Twelve injection well clusters will be installed as depicted on **Figure 5** (actual locations may vary slightly based on overhead/subsurface obstructions and nearby walls). For installation of the injection wells, a 4-inch diameter steel casing will be driven to the top of bedrock and then evacuated of earthen material by an air hammer. The air hammer will then be used to create a rock hole approximately 28 feet into the bedrock. Soil sampling from grade to top of bedrock is expected to be limited based on low ceilings heights. A sample of soil will be collected near the bedrock interface at the well cluster boring closest to MW-4S and -4D. This sample will be provided to ISOTEC to perform a buffering capacity (oxidant demand) test, which will provide data on the quantity of sodium hydroxide needed to achieve the proper pH to activate the sodium persulfate. A sample of the bedrock will also be collected during injection well installation for oxidant demand testing. Each well cluster will consist of three ¾-inch diameter Schedule 40 PVC wells in a single borehole with either 5 or 10 feet of 0.010-inch slot screen. Well screen positions will be adjusted to screen water bearing fractures, if noted during drilling activities. Each borehole will have wells screened approximately at the following intervals:

- Overburden well: 15 – 20 fbgs
- Shallow bedrock well: 24 – 34 fbgs
- Deep bedrock well: 38 – 48 fbgs

The annular space around the well screens will be backfilled with #00 sand and a cement grout seal capped with bentonite chips will be installed between well screens. Well construction and boring depths may vary based on field conditions. Each well cluster will be finished at grade with a flush-mounted protective well housing. A typical well construction schematic and a cross-section detailing the relationship between injection well and nearby monitoring well screens are presented as **Figures 6 and 7**, respectively.

Soil and groundwater generated during injection well installation activities will be drummed for off-site disposal at a USEPA permitted treatment, storage and disposal facility.

3.3.2 Mobilization/Demobilization of ISCO Equipment

ISCO mobilization activities include transportation and staging of equipment, materials, instruments, personnel, and services required for implementing the treatment program at the Site. Equipment that will be transported to the Site will include a treatment trailer/box truck housing hoses, tanks, drums, gas powered air compressor and generator, electric mixers and pumps, pneumatic pumps and secondary containment pads. Equipment and chemicals will be stored inside of the building during each treatment event. The materials that will be transported to the Site will include 6,380 pounds (lbs) of sodium persulfate in 55 lb bags and 1,012 gallons of 25% sodium hydroxide (10,800 lbs) in 55-gallon drums. ISOTEC will procure sodium persulfate from the FMC Plant in Tonawanda, New York via truck delivery. Liquid sodium hydroxide drums will be staged on collapsible secondary containment pads in an area separate from sodium persulfate.

Demobilization activities will include removal of all staged equipment, materials, instruments, personnel, and services from the project area. Demobilization activities will take place at the conclusion of each treatment event. All non-regulated waste and debris generated during the injections will be removed. Any unused chemicals will be transported from the Site during demobilization activities.

3.3.3 Material Handling and Storage

The remedial contractor will handle and store concentrated oxidants (*i.e.*, sodium persulfate), and sodium hydroxide (25% NaOH) to complete this project. Members of the injection crew have received training in the proper handling and storage of these chemicals and have also received specific training in the PPE required to handle and inject these chemicals safely into the subsurface.

Liquid reagents will be stored within secondary containment pads. For sodium persulfate solution, mixing motors will be utilized to prepare a 10% persulfate solution from dry powder and potable water in 50 to 300-gallon high density polyethylene (HDPE) tanks. A pre-determined volume of 25% sodium hydroxide will be added to each batch of prepared sodium persulfate just prior to injection. The injection specialist handling the oxidants will wear proper PPE, which can include splash shields, safety glasses, hardhats with face shields, dust masks, and nitrile gloves while completing the transfer.

Flammable materials (*i.e.,* gasoline), will not be stored near the oxidants or in locations where a spill of oxidant could occur. If concentrated oxidant does come in contact with organic materials (*i.e.,* wood, asphalt or clothing), the areas should be rinsed with water, contained, and cleaned up following the procedures in the Health and Safety Plan (HASP). Sodium persulfate at a concentration of 10% is insufficient to cause instantaneous combustion of non-flammable organic materials.

3.3.4 Reagent Preparation

Sodium persulfate will be mixed next to the injection area in Building No. 1 on-site in small bulk tanks at a concentration of approximately 10%. Concentrated reagents will be stored within collapsible secondary containment pads within designated chemical storage areas. Chemical application equipment consists of varying size storage containers, pumps, reinforced tubing, valves, and cam-lock connectors. Reagents are conveyed through reinforced tubing and connected to the injection point with an injection head containing ball valves, fittings, and a pressure gauge. Injection pressures typically range from 0 to 40 psi measured at the well head. Material Safety Data Sheets for the reagents to be utilized are presented within the site-specific HASP, which will be available at all times while working at the Site.

3.3.5 Injection Method

An injection process flow diagram is shown in **Figure 8**. The oxidants will be delivered into the subsurface under constant gravity feed as much as possible. If needed, low to moderate pressure (0 to 40 psi) will be used in an effort to distribute materials in a homogeneous fashion throughout the injection screen intervals and to minimize the potential for reagent channeling along utility corridors and other preferential pathways. The proposed approach consists of injection at multiple locations within the suspected source area simultaneously to try and mitigate short-circuiting/saturation issues. Higher injection pressures and concentrations may be required and will be evaluated during the treatment program. The ISCO injection rates and volume of discharge are interrelated to the reaction rates with the contaminants, the contaminant distribution coefficients in the subsurface systems, and the rate of oxidant decomposition within the subsurface. The rate at which the oxidant flow can be injected into the subsurface is initially determined by the overburden/bedrock porosity characteristics, or possible premature stoppage due to oxidant material seeping up from monitoring well seals or injection points. Field decisions regarding injection volumes will be based on the subsurface intake, radial effects noted during injection, and the distance of the injection point from the nearest monitoring point. If it becomes impossible to inject the proposed volume, reagent concentrations may be increased with volumes decreasing to meet treatment goals.

3.3.6 ISCO Treatment

The remedial treatment program will be implemented at the Site using the BASP ISCO process. The proposed treatment area (suspected source area) is estimated to be approximately 1,100 ft^2. The vertical treatment interval is from approximately 15-48 fbgs inclusive of both the overburden and shallow bedrock zones. BASP will be introduced into the subsurface within the suspected source zone area through the 12 nested injection well clusters (36 injection wells) as shown on **Figure 5**.

It is estimated that 7,200 gallons of sodium persulfate and 6,380 lbs of FMC Klozur® Persulfate will be needed per treatment event. This volume is to be equally distributed over the 12 injection well clusters with each receiving approximately 600 gallons of sodium persulfate solution (300 gallons into the overburden well and 150 gallons into each of the bedrock pair of wells) per event. This equates to a sodium persulfate solution concentration of approximately 10%. Sodium persulfate solution would be activated by the sodium hydroxide (25%). Oxidizer and activator will be combined together in mixing tanks and injected as a single solution just prior to injection into the subsurface. The estimated molar ratio of oxidant to activator will be approximately 3:1 (19.05 gallons of 25% NaOH for every 100 lbs of sodium persulfate) within the overburden groundwater zone, and approximately 2:1 (12.70 gallons of 25% NaOH for every 100 lbs of sodium persulfate) within the bedrock groundwater zone. The 25% sodium hydroxide will be applied at a maximum ratio of 0.5 gallon for each 1 gallon of 10% sodium persulfate (per FMC recommendation).

Data obtained from the oxidant demand test may alter the amount of 25% sodium hydroxide required for proper pH activation of the sodium persulfate. It is assumed that a slightly higher molar ratio will be required for the overburden activation to occur compared to the bedrock activation based on expected higher pH values within the Inwood Marble. Additional 25% sodium hydroxide may be required to optimally activate the sodium persulfate.

Table 1: Treatment Program Design Summary

Treatment Area	Number of Injection Wells (IW)	Proposed Vertical Interval (fbgs)	Reagent Volume/ IW/ Event (gal)	Reagent Volume/ Event (gal)	Klozur/ IW/ Event (lbs)	Klozur/ Event (lbs)	Estimated No. Days/ Event	Estimated No. Events
Overburden	12	~15-20	~300	~3,600	~266	~3,190	5	2
Bedrock (upper zone)	12	~24-34	~150	~1,800	~133	~1,595		
Bedrock (lower zone)	12	~38-48	~150	~1,800	~133	~1,595		
Totals	12		~600	~7,200	~532	~6,380		

Notes:

1. The above treatment duration assumes injection at ~10% concentration. Alternate concentrations will alter the treatment duration.
2. Reagent to consist of approximately 10% sodium persulfate ($Na_2S_2O_8$) activated by 25% sodium hydroxide (NaOH) to be injected as a single solution.

Injection procedures are summarized below.

1. A total chemical quantity of 6,380 lbs of sodium persulfate (116 bags @ 55 lbs) and 1,012 gallons of 25% sodium hydroxide (to be delivered in drums) will be procured for the Site. This equates to a total liquid volume of 7,200 gallons of approximately 10% BASP to be applied over 5 days at approximately 1-4 gallons per minute (gpm) per well (slower injection rates and smaller volumes are anticipated for injections into the two bedrock well screens). The remedial contractor will spend a reasonable time and effort to inject the reagent at the prescribed dosage of approximately 10% concentration. If difficulties are encountered injecting the proposed volumes due to tight bedrock fractures, then the total liquid volume may be reduced and percent concentration of BASP may be increased to up to 15%.
2. Each of the 12 injection well clusters will receive approximately 600 gallons of approximately 10% BASP as a single solution. The total volume will be divided as follows: 300 gallons into the overburden well screen and 150 gallons into each of the bedrock well screens (300 gallons total).
3. The remediation contractor will connect to each injection point via a dedicated injection well head, which will consist of an influent injection port, a discharge off-gas venting port, ball valves, quick disconnect cam fittings and a pressure gauge. Oxidant will be injected into multiple injection wells simultaneously within the same subsurface interval. Specifically, injections will occur in overburden wells, followed by shallow bedrock injection wells, followed by deep bedrock injection wells. This strategy is proposed to minimize the potential for seals between well screens from failing should it be

necessary to inject oxidant solutions at a higher pressure in the less permeable deep bedrock. In addition, it will be easier for technicians to maintain consistency when preparing oxidant solutions and injecting solutions of varying chemistry. Once the proposed volume is injected into a given point, the injection hoses will be disconnected from the cam-lock and moved to the next location.

4. Groundwater monitoring during the treatment program will be performed by on-site personnel to the extent feasible from the injection wells and existing monitoring wells located within the treatment area to obtain information related to the treatment process. Monitoring wells MW-4S and -4D, near active injection points, will be sampled 1 to 3 times a day for process parameters (sodium persulfate, oxidation-reduction potential, total dissolved solids, depth to water and pH). Treatment program injection activities will be reviewed daily and adjusted, if necessary, based on results of work conducted during the prior day of treatment.

3.4 POST INJECTION POINT CLOSURE

When treatment in the suspected source area has been deemed to be complete, the injection wells will be closed via pressure grouting in accordance with NYSDEC Policy, *CP-43: Groundwater Monitoring Well Decommissioning Policy, November 3, 2009.*

3.5 BASELINE AND POST INJECTION GROUNDWATER MONITORING

This work plan includes baseline and post injection performance groundwater monitoring as detailed below.

3.5.1 Baseline Groundwater Monitoring

Prior to the start of oxidant injections a full round of groundwater elevations will be collected from off-site and on-site wells (8 overburden wells and 9 bedrock wells) followed by the collection of groundwater samples. The collection of groundwater samples is needed to:

- further assess the seasonal variations of PCE concentrations
- obtain a baseline set of data prior to initiation of ISCO treatment activities in order to evaluate the success of the IRM.

Samples will be collected using passive diffusion bags (PDBs). PDBs will be positioned in each well for 14 days prior to collecting groundwater samples. A sampling protocol for PDB groundwater sampling is presented in **Appendix A**. For quality control purposes matrix spike/matrix spike duplicate and blind duplicate samples will also be collected and a trip blank will accompany each shipment of samples. Collected groundwater samples will be shipped on-ice under chain-of-custody to a New York certified laboratory and analyzed for VOCs using USEPA Test Method 8260. The laboratory will provide NYSDEC ASP Category B data deliverables and a data usability summary report (DUSR) will be developed. In addition to the PDB groundwater sampling, baseline monitoring will include field monitoring of PCE and water parameters to be collected during ISCO Performance Monitoring as discussed below.

(Baseline sampling of ISCO injection wells is not proposed based on time constraints that would not allow the IWs to equilibrate prior to starting injection activities. Therefore, sampling of these wells prior to injection activities would not be expected to provide representative VOC data.)

3.5.2 ISCO Performance Monitoring

Post injection groundwater monitoring for oxidant levels, field monitoring of PCE concentrations, and groundwater sampling for laboratory analysis will be scheduled as follows.

<u>Groundwater Monitoring – Post Treatment Event No. 1</u>

- Oxidant monitoring

  Following the first ISCO treatment event, groundwater in select injection wells (four well clusters with three wells per cluster) will be monitored weekly to assess the remaining concentration of persulfate and pH level in the suspected source area. This testing will be conducted in the field using CHEMetric field kits (http://www.chemetrics.com/Persulfate) and pH litmus paper and results will be recorded in the treatment field log. Once the persulfate has dissipated and/or pH levels have returned to normal levels field monitoring for PCE will commence as noted below.

- Field monitoring of PCE and water parameters

  Once the persulfate has dissipated, on-site monitoring wells (MW-1, -2, -2S, -2D, -4S, -4D, -5, -5S, -5D), and four injection well clusters (12 injection wells) will be monitored for field parameters (pH, sodium persulfate concentration, total dissolved solids, oxidation reduction potential, temperature, specific conductance, depth to water) and field-tested for PCE concentrations. The field parameters will be monitored using field instrumentation, and PCE concentrations will be monitored using an AQR Color-Tec® field instrumentation kit (http://www.aqrcolortec.com/). The AQR Color-Tec® field manual is presented in **Appendix B**. This post injection groundwater monitoring and sampling will initially be conducted weekly; however, the frequency will be adjusted as needed to reflect the groundwater response timeframe.

- Groundwater sampling for laboratory analysis

  Once groundwater field parameters have stabilized as assessed by field monitoring or field testing documents the rebound of VOC concentrations, groundwater samples will be collected from on-site monitoring wells (MW-1, -2, -2S, -2D, -4S, -4D, -5, -5S, -5D) for laboratory analysis. Samples will be collected using passive diffusion bags (PDBs). PDBs will be positioned in each well for 14 days prior to collecting groundwater samples. A sampling protocol for PDB groundwater sampling is presented in **Appendix A**. For quality control purposes matrix spike/matrix spike duplicate and blind duplicate samples will also be collected and a trip blank will accompany each shipment of samples. Collected groundwater samples will shipped on-ice under chain-of-custody to a New York certified laboratory and analyzed for VOCs using USEPA Test Method 8260. The laboratory will provide NYSDEC ASP Category B data deliverables and a DUSR will be developed. A full round of groundwater elevations will be collected from off-site and on-site wells during this sampling event.

  Subsequent additional groundwater sampling events or a second persulfate injection event will be based on groundwater analytical results. The decision to conduct a second round of persulfate injections or continue groundwater monitoring will be discussed with the NYSDEC case manager following the receipt laboratory analytical data. Should a second round of persulfate injections be implemented, the post treatment monitoring schedule described above will be re-initiated.

4. PROJECT COORDINATION

4.1 REGULATORY PERMITS

O'Brien & Gere researched potential required permits at the county, state, and federal level. The only regulatory permit documents required for this IRM are related to the USEPA Underground Injection Control (UIC) Program. Under the USEPA UIC program the ISCO injection wells are classified as Class V UIC wells and are subject to "Permit-by-Rule" regulations as detailed in 40 Code of Federal Regulations (CFR) Parts 144.11, 144.26, and 144.79-83.

As confirmed by Mr. Frank Brock of the USEPA UIC program, OHAD is required to submit the following information to the USEPA Region 2 office prior to initiating ISCO injection activities:

- Completed EPA Form 7520-16 – *Inventory of Injection Wells*
- Site plan detailing location of injection wells
- Summary of types and quantities and chemicals to be injected

A copy of the USEPA Form 7520-16 is presented in **Appendix C**. Required UIC documentation will be submitted to the USEPA prior to initiating ISCO injection activities.

4.2 HEALTH AND SAFETY ISSUES

The Site currently has a site-specific HASP, which was included in the RI Work Plan approved by the NYSDEC. This HASP has been amended to include activities associated with IRM activities. Daily health and safety tailgate meetings will be held prior to start of field activities. The injection team members have completed health and safety training consistent with the Occupational Safety and Health Act (Title 29 of the Code of Federal Regulations 1910.120) with current certificates. The HASP amendment is included as **Appendix D**.

4.2.1 On-site Remedial Workers

The proposed ISCO injection processes have been designed with health and safety as a prime consideration. The proposed ISCO method does not include the generation of hazardous vapors or explosive conditions. The hazard to workers is primarily associated with the management of chemicals and their potential contact with skin. Remedial contractors understand the potential dangers associated with the chemicals involved, and have completed extensive safety training.

4.2.2 Tenant

The current tenant at the Site is located in one room (Bldg No. 3), ground level at the northwest corner of the building and is not located over the treatment area. The following activities will be conducted to assess the potential for a hazardous vapor plume entering the building and nearby properties:

- O'Brien & Gere personnel will periodically monitor the air in Bldg. No. 3 for VOCs using a photo-ionization detector (PID) as a safety precaution.
- A PID in data-logging mode will be set up near the former doorway between buildings No. 1 (mixing room) and No. 3 (tenant). Sustained PID readings of total VOCs at a concentration of 5 parts per million or greater will result in cessation of injection activities.
- Based on the Site's active sub-slab depressurization system (SSDS) and the ISCO treatment method selected it is unlikely that hazardous vapors will migrate into the structure. SSDS will be inspected at approximately 2 hour intervals to assess its operational status during the injection activities.
- A water level probe with audible alarm will be placed in groundwater monitoring well MW-4 (overburden well). Should a sudden rise in water level occur in the overburden the alarm will sound notifying ISOTEC personnel of this condition and flow rates of oxidants will be reduced.

4.2.3 Neighboring Properties

Hazardous materials will be secured at all times. Impacts to neighboring properties are not anticipated based on the ISCO method proposed. To minimize potential impacts to neighboring properties the mixing of chemicals will occur inside the building and doors/windows on the first floor of the building will remain closed during the injection activities.

4.3 CITIZEN PARTICIPATION PLAN ISSUES

Prior to finalizing, this IRM Work Plan will be submitted to the repositories (*e.g.,* White Plains Public Library, NYSDEC Headquarters, and NYSDEC Region 3 office) listed in the Citizen Participation Plan. Copies of follow-up documentation, such as IRM status memorandums, will also be submitted once provided and approved by the NYSDEC Project Manager.

5. CONSTRUCTION COMPLETION AND PROJECT STATUS REPORTS

5.1 PROJECT STATUS MEMORANDUMS

During the ISCO program O'Brien & Gere will provide the NYSDEC project status memorandums detailing newly acquired information approximately every two weeks. These memorandums will summarize field activities conducted, field data, laboratory data, and schedule of future activities to be conducted to complete the IRM.

5.2 DESCRIPTION OF CONSTRUCTION COMPLETION AND ENGINEERING REPORT

A description of the ISCO treatment program will be presented in a Construction Completion and Engineering Report (CCR) to be prepared in accordance with DER-10 upon completion of Site remedial activities. The CCR will include the following:

- NYS PE certification statement
- A description of the remedy
- A summary of remedial actions completed
    - Data pertaining to oxidant injection volumes and flow rates
    - Summary of field procedures and data along with confirmatory groundwater sampling and laboratory analysis
    - a listing of the waste streams, quantity of materials disposed and facility where such materials were disposed
    - quantities and concentrations of contaminants removed or treated
    - restoration actions
- Tables and figures containing pre- and post-remedial data
- Laboratory reports.

6. PROJECT SCHEDULE

The proposed project schedule is as follows.

Task/Event Description	Sub-Task Description	Start Date	End Date
Draft IRM Work Plan Submitted to NYSDEC (CPP Submittal)		April 22	April 28
CPP Comment Period		May 1	June 1
Baseline Groundwater Monitoring		May 6	June 10
Injection Well Installation Activities	Oxidant demand test	May 20	May 25
	Well installations	May 20	June 7
NYSDEC Provides Comments on Draft IRM Work Plan		June 6	June 6
OBG Submits E-mail to NYSDEC Detailing Proposed Changes to Draft IRM Work Plan to Address NYSDEC Comments		June 10	June 10
NYSDEC Provides Letter Accepting Proposed Changes		June 11	June 11
ISCO Injection Event I		June 10	June 14
Revised Final IRM Work Plan Submittal to NYSDEC for Approval		June 20	June 20
Final IRM Work Plan NYSDEC approval		June 28	June 28
Post Injection Event I Sampling	Oxidant monitoring	June 21	July 5*
	Field monitoring of PCE and water parameters	July 5	July 17*
	Groundwater sampling for laboratory analysis	July 17*	August 23
ISCO Injection Event II	Second injection event to be determined based on groundwater data		

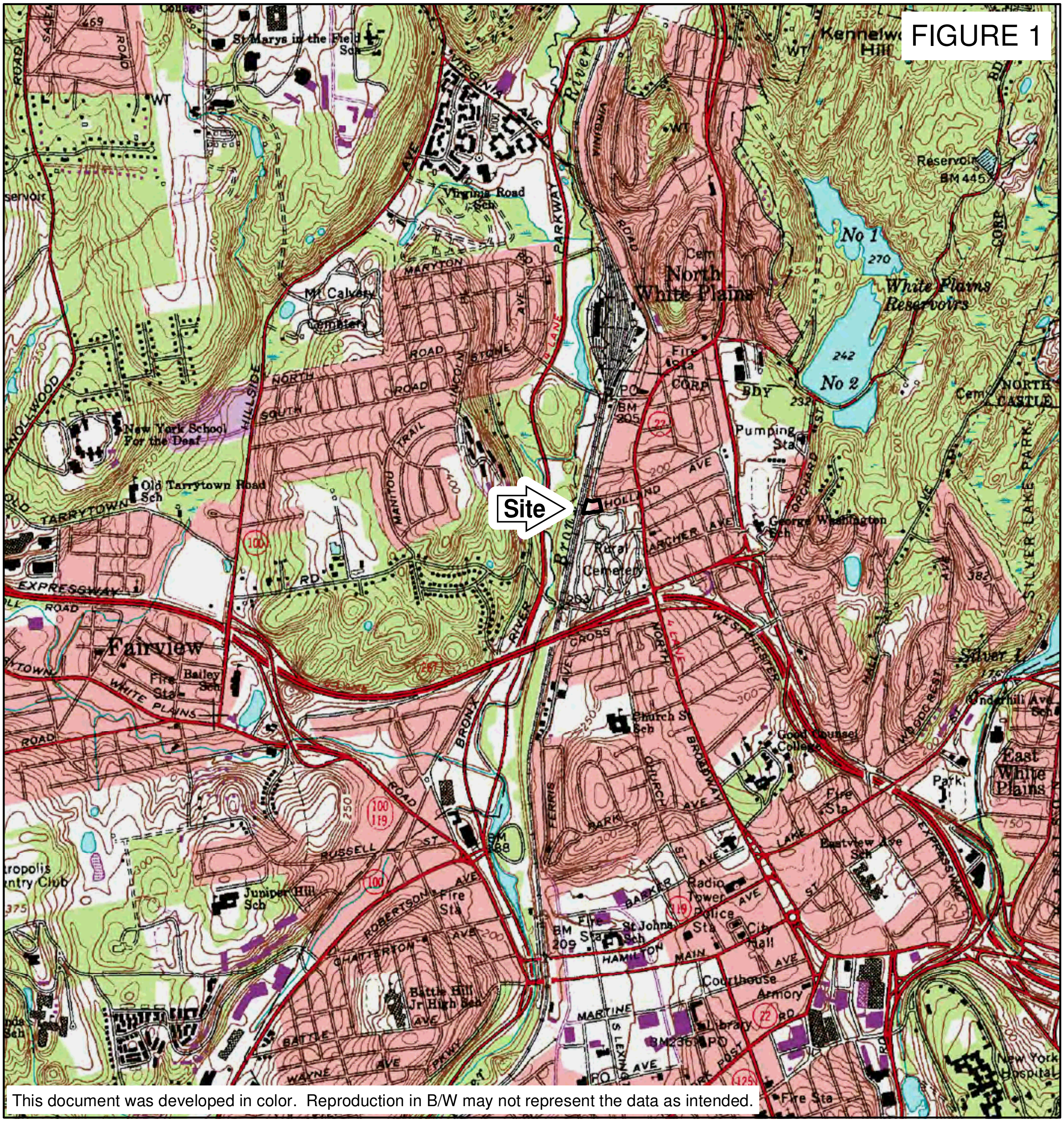
Notes: * Date to be based on groundwater analytical results.

Site Location Map

PATH: I:\Feintool-Ny.14206\47376.Ri-Implementati\Docs\DWG\MXD\FWIA\SITE_LOC.mxd

PLOT DATE: 8/13/2012 9:47:05 AM MortonAK

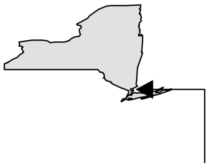
FIGURE 1



This document was developed in color. Reproduction in B/W may not represent the data as intended.

ADAPTED FROM: (WHITE PLAINS) USGS QUADRANGLE

ONE HOLLAND AVENUE DEVELOPMENT
FISH AND WILDLIFE IMPACT ANALYSIS
1-5 HOLLAND AVENUE SITE
WHITE PLAINS, NEW YORK


MAP LOCATION

N

SITE LOCATION

0 1,000 2,000 4,000 6,000 8,000

Feet

1:24,000

SEPTEMBER 2012
14206.47376.001.902

O'BRIEN & GERE

MIP Electron Capture Detector Readings

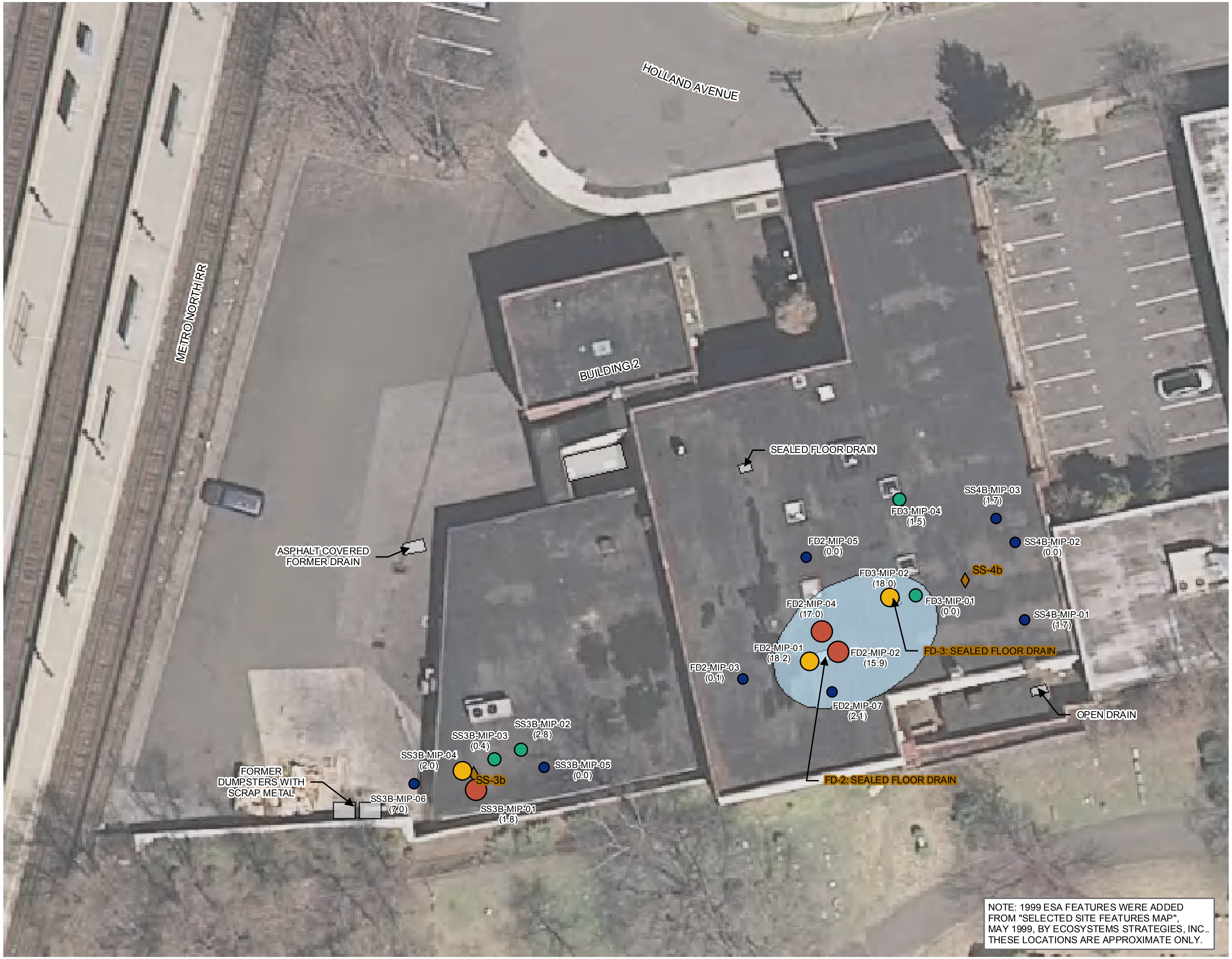
PATH: I:\Feintool-Ny.14206\STDS\GIS\White-Plains\MXD\GIS10\MIP_ECD_Mags.mxd

NAME: VoganNW

DATE: 8/24/2012 6:37:07 AM

DRAFT - FOR DISCUSSION PURPOSES

FIGURE 2



NOTE: 1999 ESA FEATURES WERE ADDED FROM "SELECTED SITE FEATURES MAP", MAY 1999, BY ECOSYSTEMS STRATEGIES, INC.. THESE LOCATIONS ARE APPROXIMATE ONLY.

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LEGEND

MIP ECD READINGS (µV)

●	<300000
●	300001 - 400000
●	400001 - 500000
●	500001 - 600000
●	600001 - 1700000
▭	ESA FEATURES
SS-4b	MIP INVESTIGATION AREA (VOC's)
(2.1)	DEPTH OF MAXIMUM ECD READING (FT BGS)

0 12.5 25 50
Feet

REMEDIAL INVESTIGATION
BROWNFIELD CLEANUP
PROGRAM NO. C360115
1-5 HOLLAND AVE
WHITE PLAINS, NY

MIP MAXIMUM ELECTRON CAPTURE DETECTOR (ECD) READINGS

APRIL 2013
14206.47376

O'BRIEN & GERE

MIP Confirmation Sampling Results

PATH: I:\Feintool-Ny.14206\STDS\GIS\White-Plains\MXD\GIS10\MIP_Results.mxd

NAME: VoganNW

DATE: 8/24/2012 6:45:30 AM

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FIGURE 3

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N

LEGEND

- ● MIP CONFIRMATION SAMPLE LOCATION
- ▲ ROTOSONIC LOCATIONS
- ▭ ESA FEATURES
- (0.022) PCE CONCENTRATION (mg/kg)

REMEDIAL INVESTIGATION
BROWNFIELD CLEANUP
PROGRAM NO. C360115
1-5 HOLLAND AVE
WHITE PLAINS, NY

MIP CONFIRMATION SAMPLING PCE RESULTS

0 12.5 25 50
Feet

APRIL 2013
14206.47376

O'BRIEN & GERE

Historical Soil Sample Location Map

I:\Feintool-Ny.14206\STDS\GIS\White-Plains\MXD\Hist_Soil_Samp_Rev.mxd

DRAFT PRIVILEGED AND CONFIDENTIAL

NOTE: 1999 SOIL SAMPLE LOCATIONS AND ESA FEATURES WERE ADDED FROM "SELECTED SITE FEATURES MAP", MAY 1999, BY ECOSYSTEMS STRATEGIES, INC.. THESE LOCATIONS ARE APPROXIMATE ONLY.

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PLOTDATE: never never StantoSA

FIGURE 4

N

LEGEND

PHASE II SAMPLE LOCATIONS

- ✦ 2001 SOIL SAMPLE LOCATION
- ✦ 1999 SOIL SAMPLE LOCATION
- ▲ GEOPROBE
- ◆ MONITORING WELL

ANALYZED CONSTITUENTS

- ⬡ VOC
- ▭ ESA FEATURES

1-5 HOLLAND AVENUE
WHITE PLAINS, NEW YORK

HISTORICAL SOIL SAMPLE LOCATIONS

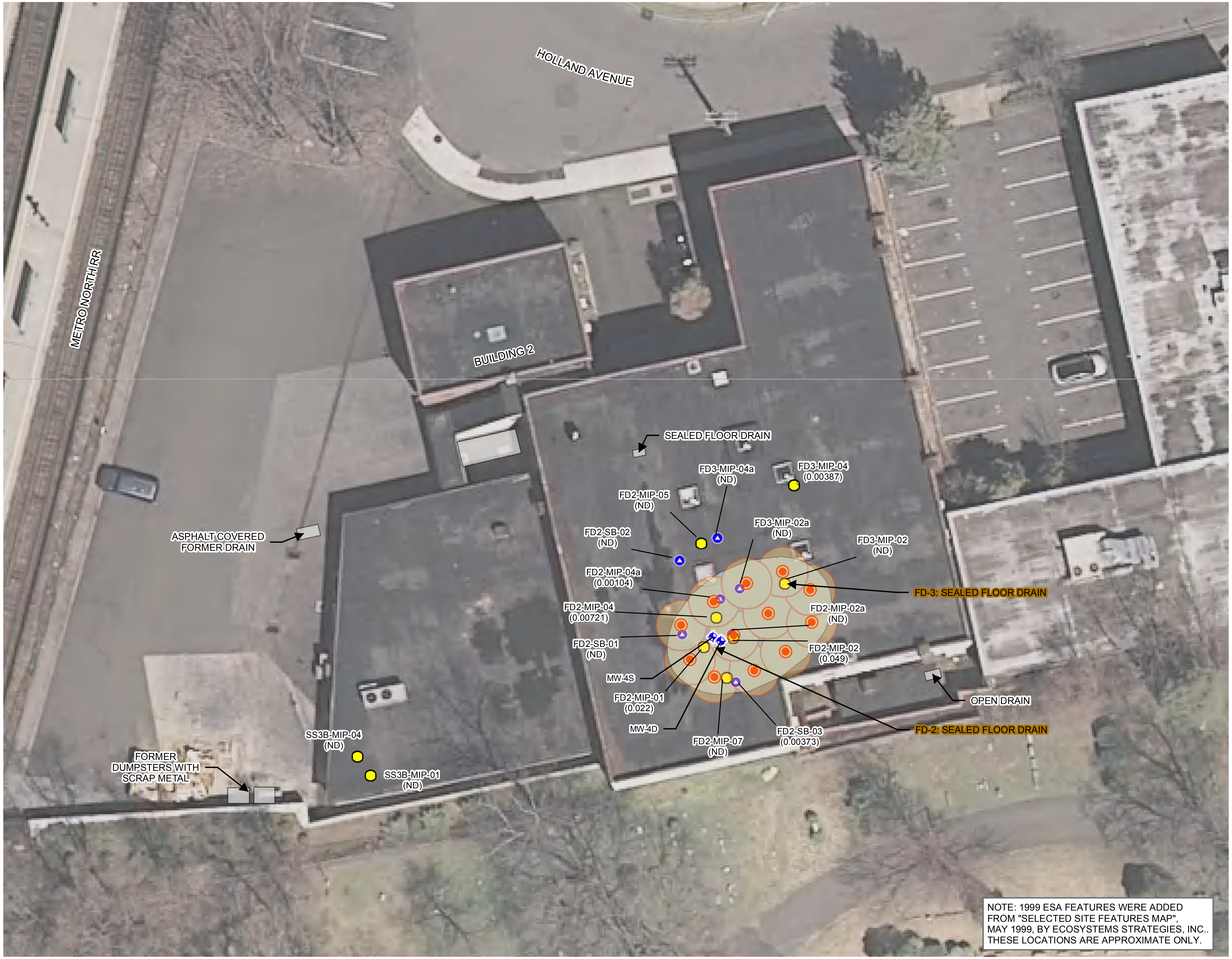
0 12.5 25 50
Feet

APRIL 2013
14206.45114

O'BRIEN & GERE

Site Plan Detailing ISCO Injection Point Configuration

FIGURE 5



NOTE: 1999 ESA FEATURES WERE ADDED FROM "SELECTED SITE FEATURES MAP", MAY 1999, BY ECOSYSTEMS STRATEGIES, INC.. THESE LOCATIONS ARE APPROXIMATE ONLY.

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N

LEGEND

- ● MIP CONFIRMATION SAMPLE LOCATION
- ⌖ MONITORING WELL
- ▲ ROTOSONIC LOCATIONS
- ▭ ESA FEATURES
- (0.022) PCE CONCENTRATION (mg/kg)
- ◉ IP CLUSTER LOCATION

REMEDIAL INVESTIGATION
BROWNFIELD CLEANUP
PROGRAM NO. C360115
1-5 HOLLAND AVE
WHITE PLAINS, NY

ISCO INJECTION WELL LOCATION MAP

0 12.5 25 50
Feet

JUNE 2013
14206.47376

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Typical IW Construction Schematic

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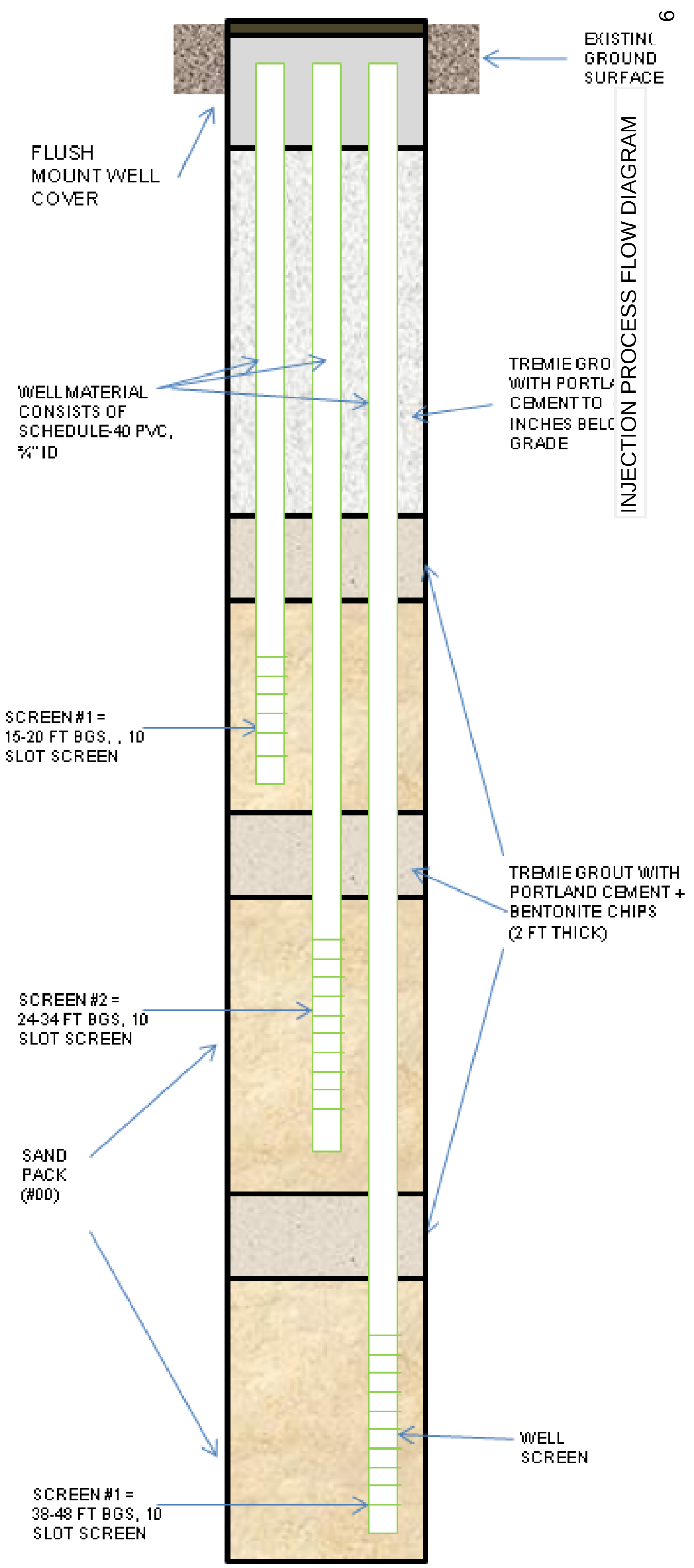

Injection Well Construction

1. Boring: 4-inch steel casing to top of bedrock followed by air hammer into bedrock.
2. Well Screen: 3 screens to target 15-20 ft bgs, 24-34 ft bgs, and 38-48 ft bgs intervals.
3. Filter Pack: Sand pack 1-foot above and 0.5-feet below the screen.
4. Tremie Grout + Bentonite Seal: Approximately 2 ft thick tremie grout with portland cement and hydrated bentonite chips will separate the screens.
5. Tremie Grout : Grout will fill from top of upper tremie grout/bentonite layer to 4 inches below grade.
6. Surface Completion: 12-inch protective well cover in concrete

FIGURE 6

INTERIM REMEDIAL
MEASURE - ISCO
1-5 HOLLAND AVENUE
WHITE PLAINS, NEW YORK

TYPICAL INJECTION WELL CONSTRUCTION

JUNE 2013
14206.47376

PLOTDATE: never never StantoSA

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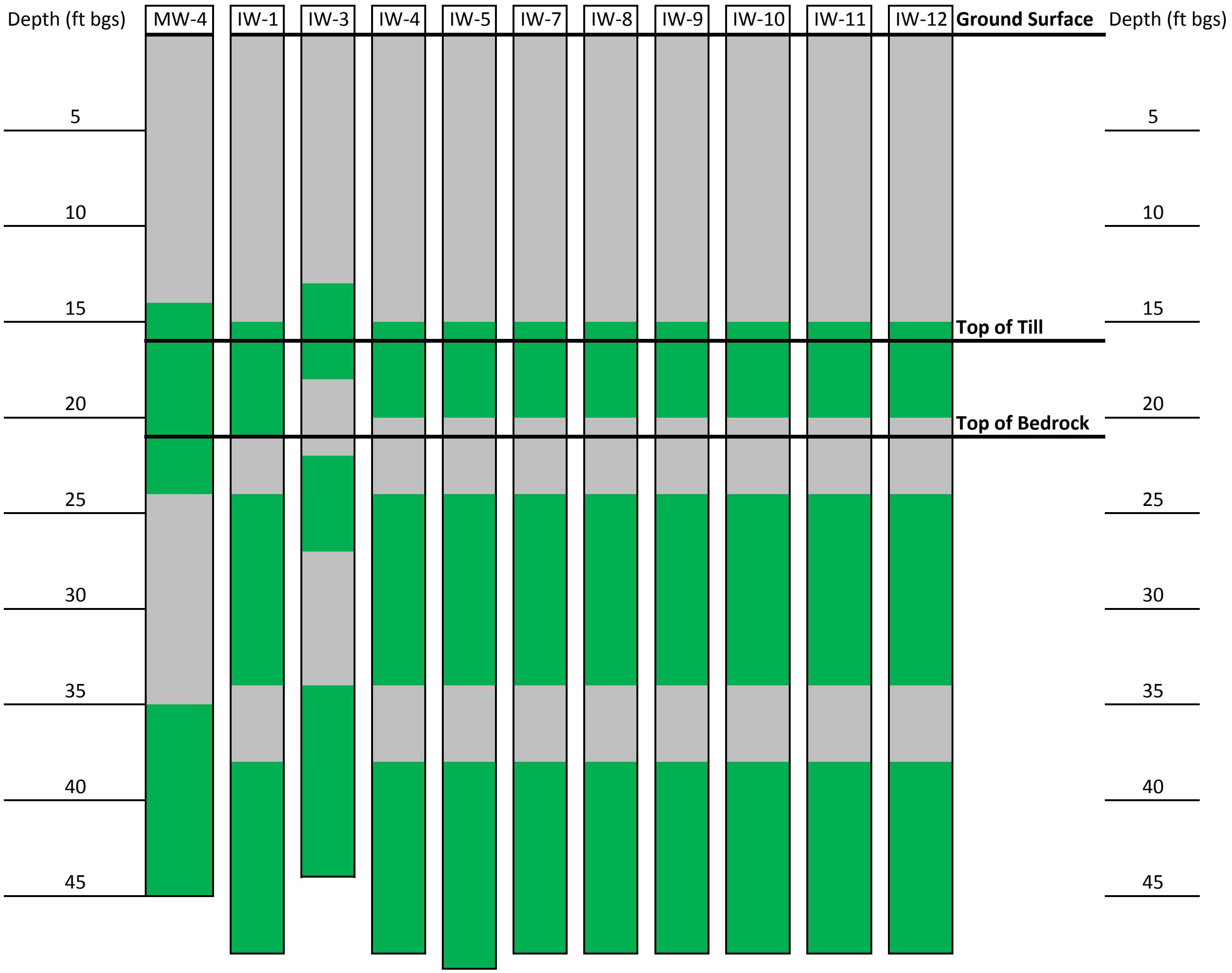
Cross-section IW and Well Screen Intervals

FIGURE 7

SCHEMATIC CROSS-SECTION DETAILING INJECTION AND MONITORING WELL SCREEN INTERVALS

Interim Remedial Measure - ISCO
1-5 Holland Avenue
White Plains, New York

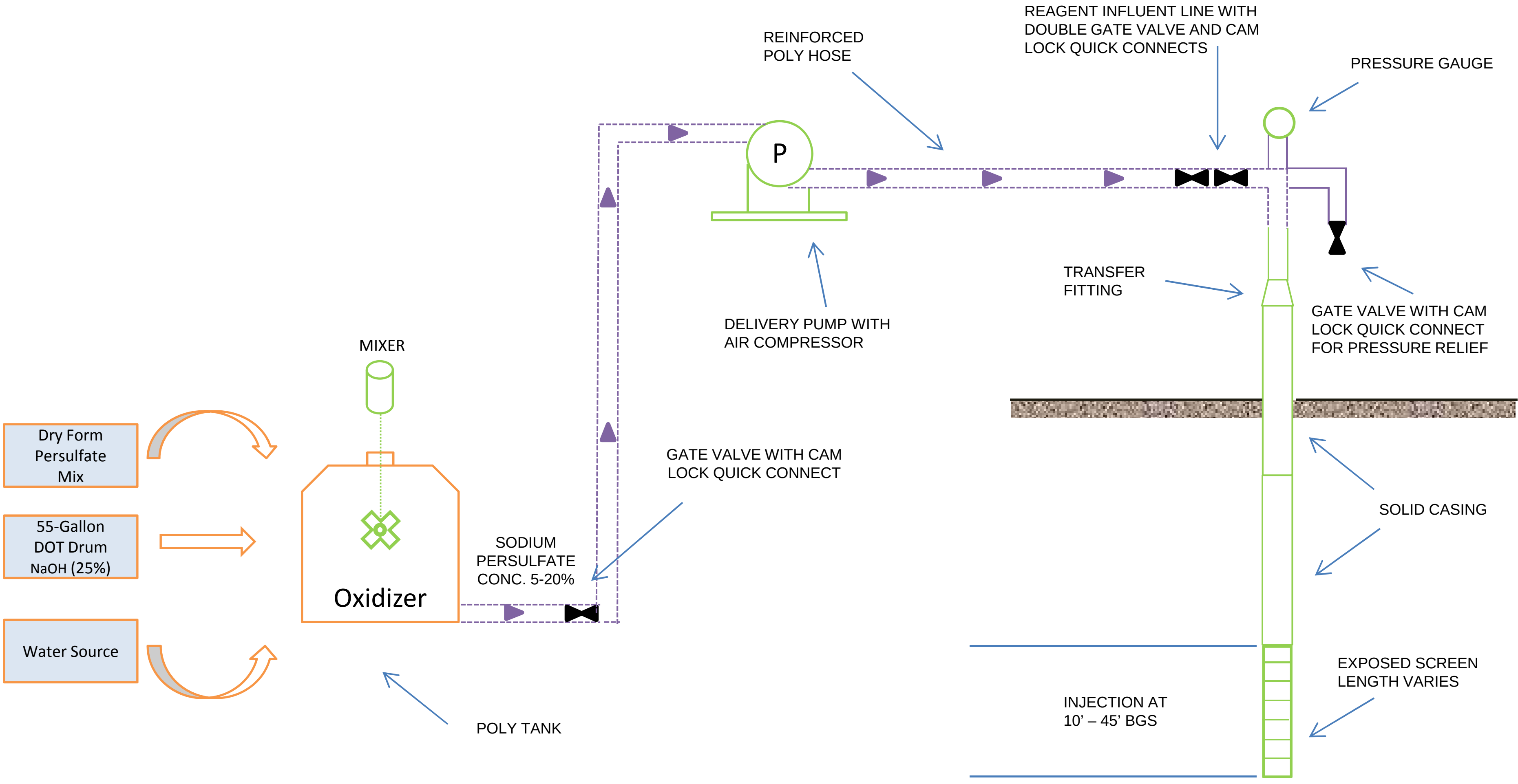


Notes:

1. Figure updated following injection well installation to reflect as-built conditions.
2. Injection well clusters IW-2 and IW-6 were not installed due to field constraints during drilling.
3. Injection well cluster IW-3 screened intervals were adjusted as a result of difficult drilling conditions.
4. ⬜ - Solid well casing
5. 🟩 - Well screen

O'BRIEN & GERE

Injection Process Flow Diagram



In- Situ Oxidative Technologies, Inc.

11 Princess Road Suite A
Lawrenceville, NJ 08648
Tel: (609) 275-8500

Scale: N.T.S

Date: 4/3/13

PROJECT #
801830

DRAWN BY: MT
CHECKED BY: PK

INJECTION PROCESS FLOW DIAGRAM

Project Name: Holland Ave. Site
City, State: White Plains, NY

FIGURE #
8

PDB Groundwater Sampling Protocol

Ground Water Sampling Protocol
Using Passive-Diffusion Bag Samplers

Pre-sampling

Prior to each sampling event, a complete round of ground water elevations will be recorded from the entire site monitoring well network. An electronic water level probe will be used to measure the depth to water in each well. The depth to water will be measured to the nearest 0.01 foot from the surveyed points on the well casings. The depth to water measurements will be recorded in the field logbook. In addition to the depth to water measurements, the condition of the wells protective casings and locks, and each well head will also be recorded in the field logbook.

Passive-Diffusion Bag Sampler Installation

Step 1 - Don appropriate personal protective equipment (as required by the Health and Safety Plan).

Step 2 - Measure the depth to water. If a complete round of water level measurements were obtained prior to conducting the ground water sampling event, redundant water-level measurements do not need to be collected at the actual time of sampling.

Step 3 - Remove the appropriate passive-diffusion bag sampler from the shipping container. Passive-diffusion bag samplers will be purchased from a licensed commercial supplier.

Step 4 - Attach the de-ionized water-filled polyethylene bag to the line of the well-specific passive bag holder or the dedicated holder using the stainless-steel snap hooks. The position of the bag(s) on the well-specific holders will be such that when installed they hang at the center of the screened interval submerged.

Step 5 - Slowly lower the passive bag sampler down the well until the stainless-steel weight reaches the bottom of the well indicating that the sampler is properly positioned in the screened interval. The passive bag sampler will be positioned adjacent to the midpoint of the well screen.

Step 6 - Secure the line extending above the top of the well riser pipe either to the steel casing or the locking cap.

Step 7 - Close and lock the well.

Step 8 - Record the date and time of placement of the passive bag sampler in the well in the field log book.

Step 9 - Allow an equilibration period of 14 days or more before retrieving the passive-diffusion bag. If necessary, the well may be accessed briefly during the equilibration period (*e.g.,* to obtain fluid water level measurements), provided that the line remains at the top of the well casing throughout the equilibration period, which should be a minimum of 14 days.

Passive-Diffusion Bag Sampler Retrieval and Sample Collection

Step 1 - Don appropriate personal protective equipment (as required by the Health and Safety Plan).

Step 2 -After the equilibration period, unlock and open the well and slowly remove the passive-diffusion bag sampler from the monitoring well.

Step 3 - Remove the sample-filled polyethylene bag from the stainless-steel snap hooks and dry with a clean paper towel. Cut a small hole in the sample-filled polyethylene bag using a decontaminated knife or decontaminated stainless-steel scissors. Pour water from the bag directly into appropriate laboratory sample containers.

Step 4 - Complete the sample label and place sample container in a cooler containing wet ice.

Quality Control Samples. Quality control samples, consisting of field (blind) duplicates and MS/MSDs, will be obtained in the same type sample containers and handled in the same manner as the field samples for contaminate determination. Triplicate volumes of sample will be collected for samples designated for MS/MSD analyses. Field (blind) duplicate samples will not be distinguishable from the field samples. The frequency and type of quality control samples will be collected at a ratio of 1:20 field samples.

Equipment blanks will not be required for the analytical program, because dedicated bag holders and disposable PDBs will be used, and there will be no cross-use of sampling equipment between wells.

Field duplicate samples will be collected at the same time from the same source, but submitted as separate samples to assess the consistency of the overall sampling and analytical system.

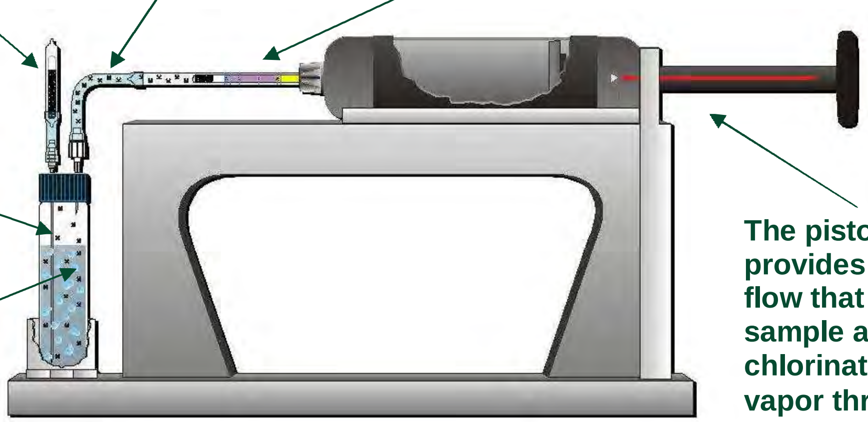
Trip blanks will be submitted to the laboratory in coolers that contain VOC samples. One trip blank will be required per cooler.

AQR Color-Tec® Field Testing Manual

Method Procedures Manual

Field-Based Analysis of Chlorinated Volatile Organic Halocarbons

- **AQR Color-Tec combines sample purging with direct-read gas detector tubes to quickly detect low-levels of chlorinated compounds in liquid and solid samples.**
- **AQR Color-Tec detects concentrations of total chlorinated volatile organic halocarbons (CVOHs) below 3 µg/L in water and 3 µg/Kg in soil samples.**
- **AQR Color-Tec provides fast, low-level, economical, decision-quality data which maximizes sampling frequency and sampling coverage to locate source areas and delineate dissolved-phase contaminant plumes.**
- **Samples are analyzed by purging the volatile compounds from either liquid or solid samples through a colorimetric detector tube, which produces a distinct color change when exposed to any chlorinated compound.**



5 The purged chlorinated volatile compounds are directed into the gas detector tube

6 A measured color change in the colorimetric tube is used to estimate the expected concentration of CVOHs in the sample

2 Ambient air enters the sample through a carbon filter

3 Filtered ambient air flows through the long purge needle to the bottom of the VOA vial

4 Ambient air purges and strips volatile compounds from the sample

1 The piston-pump provides vacuum air flow that purges the sample and pulls the chlorinated volatile vapor through the tube

---

AQR Color-Tec® Contact and Ordering Information

- For more information visit www.aqrcolor-tec.com
- For kit orders contact Phil Pecevich at 919-918-7191
- For technical support and training contact Perry Kelso at pkelso@ene.com

Table of Contents

1.0 Method History and Principles

The Color-Tec method was developed during 1997 by the environmental professionals at Ecology and Environment, Inc. while assessing/remediating the earliest sites addressed under the Florida Department of Environmental Protection’s (FDEP) Drycleaning Solvent Cleanup Program. Since its development, the method has been used extensively at EPA, DOD, and various state regulatory agency sites to provide real-time, decision quality data at thousands of chlorinated solvent sites.

Color-Tec is a field-based analytical method which combines the use of colorimetric gas detector tubes (originally designed for occupational breathing-zone monitoring) with sample purging to detect very low (<3 µg/L or µg/Kg) concentrations of total chlorinated volatile organic halocarbons (CVOHs) in liquid and solid samples. Samples are analyzed by purging the volatile compounds from a groundwater or soil sample directly through the colorimetric tube, which is designed to produce a distinct color change when exposed to chlorinated compounds. Estimated sample concentrations are obtained by comparing the tube readings to a conversion table, which was developed based on comparison of Color-Tec readings to GC/MS analysis of split samples.

Each colorimetric tube contains an oxidizer (PbO_2) and a catalyst (H_2SO_4) which decomposes and converts the chlorinated compounds to hydrogen chloride, which discolors a reagent (4-phenylazodiphenylamine) in the tube from yellow to purple. The reaction formula provided by Gastec® for the PCE tube is as follows:

$$\mathbf{Cl_2C{:}CCl_2 + PbO_2 + H_2SO_4 \rightarrow HCl}$$

$$\mathbf{HCl + (4\text{-}Phenolazo)\ Diphenylamine \rightarrow Chloride}$$

The colorimetric tubes react positively to all chlorinated volatile organic halocarbons, including saturated and unsaturated chlorinated alkenes and alkanes. The total response indicated by the detector tube (the distance that the color change travels through the tube) reflects the sum of the concentration of each individual chlorinated compound present in the sample. The method is primarily qualitative (detects the presence/absence of a compound or class of compounds).

The colorimetric gas detector tubes used in the method are designed to detect CVOHs in ambient air. **Color-Tec is an alternate use of these tubes**, which purges CVOHs from a water or soil sample and concentrates them into the colorimetric tube. When using colorimetric tubes for the Color-Tec method, the units (ppmV) printed on the tubes do not directly reflect the quantity of CVOHs present in the water or soil sample being analyzed. The Color-Tec tube reading (the distance that the color change travels through the tube) is a **relative response** to the amount of chlorinated-compound molecules that have been purged from the sample and directed into the tube. Therefore, the Color-Tec tube reading is a **unit-less** value used only to record the **relative response** for each analysis in order to facilitate comparison of that response to laboratory GC/MS analysis.

THE COLOR-TEC TUBE READING IS NOT THE SAMPLE CONCENTRATION!

The tube reading is a unit-less value which must be compared to laboratory results from split samples in order to yield an estimate of the actual concentration present in the sample.

This manual provides a conversion table, developed using comparison of Color-Tec tube responses to split-sample GC/MS analyses conducted on thousands of samples, which can be used to provide an estimate of the expected sample concentration based on the tube reading (See Table 2 on page 15).

2.0 AQR Color-Tec Test Kit Description and Set-up

The Color-Tec Chlorinated VOH Soil/Water Test Kit System consists of two primary components:

1. A hardware kit which contains all **reusable equipment** needed to conduct the method, plus a carrying case; and
2. Expendables kits containing all **disposable components** needed for analysis of 20 water or soil samples using the following ranges of Gastec® 133-series tubes:
    a. Ultra low range 133-LL tubes (expected detection range ~ 3 to 1200 µg/L or µg/Kg)
    b. Low range 133-L tubes (expected detection range ~ 75 to 25,000 µg/L or µg/Kg)
    c. Medium range 133-M tubes (expected detection range ~ 500 to 130,000 µg/L or µg/Kg)

2.1 Materials Provided

2.1.1 Color-Tec Hardware KIT (See Figure 1)

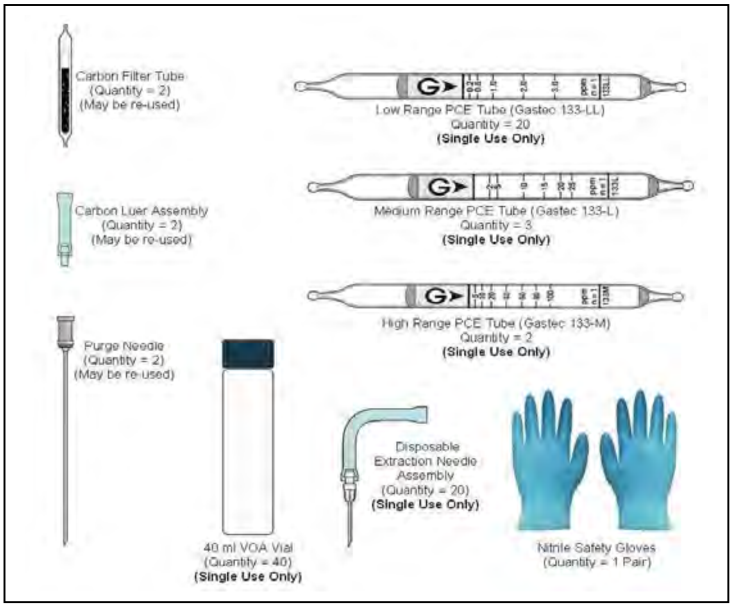
Item	**Quantity**
Gastec® Piston pump	1
Color-Tec Pump Stand	1
Corning® Hot Plate	1
Stainless Steel Heating Pan	1
Nalgene® VOA Heating Rack	1
Thermometer	1
Decontamination Syringe	1
Pelican® hard case	1

2.1.2 Color-Tec 20-Sample Expendables Pack (See Figure 2) (Analyzes 20 samples)

Item	**Quantity**
Low-Range (133LL) Colorimetric Detector Tubes	20
Medium-Range (133L) Colorimetric Detector Tubes	3
High-Range (133M) Colorimetric Detector Tubes	2
Disposable Extraction Needle Assemblies **(single use only)**	25
40 Milliliter VOA Vials – empty (for samples)	40
Carbon Filter (may be re-used)	2
Carbon Filter Luer Assembly (may be re-used)	2
Purge Needle (may be re-used)	2
Nitrile Safety Gloves (pair)	1

Figure 1
Hardware Kit

Figure 2
Expendables Kit



2.2 Accessories Supplied by User

The following items (not provided in the AQR Color-Tec kit) are suggested for use with the Color-Tec method to perform the listed functions.

Item	Purpose
Organic-free water	for soil sample extraction and equipment decontamination
Safety gloves	personal protection
Safety glasses	personal protection
120V AC power source	for hot plate
Permanent marker	labeling sample bottles

Performance of the Color-Tec method requires the use of two standard, unpreserved VOA vials per sample. These VOA vials are not included in the standard expendables kits, but may be added as an option. The user may wish to collect a quantity of split samples for laboratory analysis to provide comparison data which may be used to determine site-specific method detection limits and/or to tentatively quantify Color-Tec results. Split sampling will likely require three pre-preserved VOA vials per sample. Pre-preserved VOA vials for split samples are not available in the Color-Tec expendables kits.

2.3 Storage & Stability of Colorimetric Tubes

The Gastec® colorimetric tubes have a shelf-life of two years with refrigeration. Tubes should be stored at or below a temperature of 10°C/50°F when not in use. Colorimetric detector tubes are single-use (one tube per analysis) and should be used immediately after the tips are broken. Tube readings should be recorded immediately following analysis because the intensity of the color-change fades over time. Each box of tubes has an expiration date printed in red ink on the top of each box. When heating the tubes for use with the Color-Tec method, it is recommended that the tube temperature does not exceed 40°C/104° F.

Other procedures and guidelines associated with the use of the tubes for their designed purpose (gas detection in ambient air) are included in the tube manufactures data sheets and tube instructions included in the tube packaging.

2.4 Heating Colorimetric Tubes and Samples

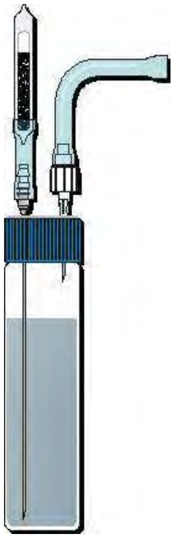
The colorimetric gas detector tubes used in the Color-Tec method were designed for the purpose of detecting volatile organic compounds (CVOHs) in ambient air. When using the tubes for analysis of ambient air, the calibrated operating temperature is 20°C/68°F. Using the tubes at temperatures above or below 20°C/68°F, for the purpose of testing ambient air, introduces error into the measurements requiring application of correction factors to correct that error. Because Color-Tec is an alternate use of the colorimetric tubes which concentrates CVOHs from water or soil samples into the tubes, the units (ppmV) printed on the tubes have no direct relationship to the quantity of CVOHs dissolved in the water/soil sample being analyzed and the temperature correction factors used for analysis of ambient air are not required when using the colorimetric tubes as part of the Color-Tec method. However, since the colorimetric tubes are more sensitive to the presence of chlorinated compounds at 40°C/104°F, and the purpose of the Color-Tec method is to detect the presence/absence of CVOHs in water at concentrations at the lowest concentrations possible, the tubes are heated to their optimum sensitivity (40°C/104°F) to maximize their detection capability.

The samples are also heated (in the VOA vials) to maximize contaminant volatilization and transfer of CVOHs from the water sample to the colorimetric tube. To heat the samples and colorimetric tubes, a hot plate is used to heat a water bath containing a test tube rack to hold the sample-filled VOA vials and unbroken colorimetric tubes. Special attention must be paid to the temperature of the water to avoid prolonged overheating the samples and tubes. The samples and colorimetric tubes should not be heated in excess of 40°C/104°F.

Given the size of the heating pan and VOA rack, generally only 3 sets of samples are heated at the same time. When a pair of VOAs is removed from the heating rack and placed on the pump stand, it can be replaced with a new pair for heating. After collection, samples should remain in a cool place until ready to be heated and analyzed. It is recommended to avoid heating the samples for more than about 2 minutes to avoid loss of CVOCs. Section 2.6 below, provides detailed water bath set-up and heating procedures.

2.5 Carbon Pre-Filter

Because ambient air is used to purge the samples, a carbon pre-filter is provided for attachment to the purge needle to prevent volatile airborne contaminants from passing through the sample and entering the detector tube during the purging process. To use the carbon pre-filter, break both tips of a carbon filter tube and insert the end of the tube onto the carbon lure assembly (make sure the air-flow arrows on the carbon tube point toward the carbon lure assembly), then tightly insert the male lure fitting on the carbon lure assembly into the female lure fitting on the purge needle (see Figure 2). At sites where little or no ambient air contamination is expected, a single pre-filter tube may be reused for several days. However, at sites where high concentrations of airborne chlorinated compounds are suspected or have been confirmed in the ambient air, the pre-filter tubes may need to be replaced more frequently. For most situations, one carbon filter per 10 samples is more than sufficient. Section 2.6 below, provides detailed carbon filter set-up and use procedures.



2.6 Color-Tec Work-Station Set-up

Pump Stand Set-up

1. Place the pump stand up-right on a flat stable surface.
2. Place the ® piston-pump into the curved tray on the top of the pump stand as shown.

Corning® Hot Plate Set-up

1. Connect the AC power cord to the back of the hot plate.
2. Connect the other end of the AC power cord to a USA 120VAC electric outlet.
3. Place the hot plate on a flat stable surface.
4. Set the hot plate thermostat control to between dial setting 4 and 5.

Hot Water Bath Set-up

1. Fill the stainless-steel water bath pan with tap water to approximately 1.5-inches from the rim.

2. Insert the VOA rack into the water-filled, stainless-steel, water bath pan.

3. Remove the cap from a 40ml VOA vial, fill the VOA vial with tap water and place it into the VOA Rack as shown. *Note: The bottom of the water-filled VOA vial should be slightly submersed in the water in the stainless-steel pan.*

4. Place the stainless-steel water bath pan onto the heating surface of the hot-plate.

5. Open a box of low-level (133LL) Gastec® tubes and place several tubes into the water-filled VOA vial. Insert the yellow reagent end of the tubes into the bottom of the VOA vial. Note: Do not place tubes with broken tips in the water bath – heating must be accomplished before breaking the tube tips.

6. Turn on the Oakton® digital thermometer and place the steel probe into the water-filled VOA vial with the colorimetric tubes.

7. Once the water bath reaches a temperature of approximately 100ºF, the colorimetric tubes and VOA vials containing samples can be heated. *Note: The temperature of the water bath should not exceed 100ºF.*

Heating Samples

1. Place both VOA vials containing the sample into the hot water bath for approximately 1 to 2 minutes.

2. Be sure that the VOA vials are tightly sealed before heating. *Note: When properly heated, the VOA vials should feel warm in the hand – DO NOT OPEN VOA VIALS AFTER HEATING.*

Carbon Filter/Purge Needle Set-up

1. Break both ends of a carbon filter tube using the tip breaker on the piston pump.

2. Connect a carbon filter luer assembly to the carbon filter tube by sliding the open end of the vinyl tubing over the broken end of the carbon filter tube. Note: The carbon filter is re-used for multiple purge cycles.

3. Attach the carbon filter assembly to a purge needle by inserting the carbon filter assembly luer fitting into the purge needle luer fitting.

4. The purge needles are re-used after decontamination. Thoroughly clean and rinse the purge needle between each sample analysis to avoid contaminant carryover.

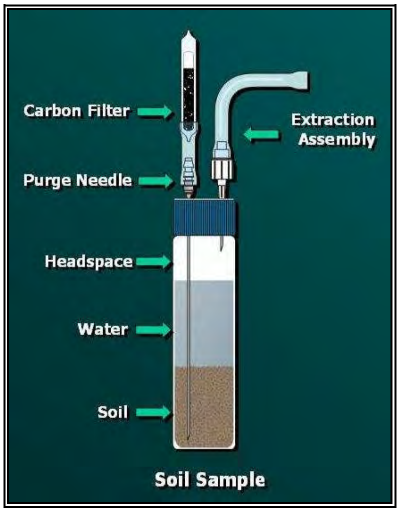
3.0 Sample Collection and Preparation

3.1 Liquid Sample Media

Collect the water or other liquid sample media directly from your sampling device into two 40 ml VOA vials by filling each vial to ~75% capacity (i.e. to about 1-inch below the shoulder of each vial). Tightly secure the caps onto the partially-filled VOA vials. The VOA vials containing the liquid sample to be tested must contain an air-filled headspace to accommodate purging. The caps must be tightened sufficiently to prevent loss of CVOHs during the time between sample collection and analysis (which includes the heating process) and to prevent air leakage during the purging process.

3.2 Solid Sample Media

Place about 1.5 inches of soil (or other solid sample media) into the bottom of each of two VOA vials (i.e. approximately 30 grams in each vial). Immediately after inserting the soil (or other solid sample media) into the two vials, add organic-free or other “clean” water to each VOA vial until they are both ~70 % full (i.e. to approximately 1-inch below the shoulder of each vial). Tightly secure the caps onto the partially-filled VOA vials. Once the caps are secure, shake the VOA vials vigorously for approximately for 5 to 10 seconds to thoroughly mix the soil and water. Additional mixing may be necessary for soil matrices comprised of clay-sized particles. The purpose of the mixing is to transfer any chlorinated compounds suspended in the soil matrix to the water to facilitate more effective purging.



IMPORTANT NOTE: The VOA vials containing the solid sample media and “clean” water must contain an air-filled headspace to accommodate purging. The caps must be tightened sufficiently to prevent loss of CVOHs during the time between sample collection and analysis (which includes the heating process) and to prevent air leakage during the purging process.

3.3 Purpose of the Second VOA Vial

The Color-Tec method is designed for use with two VOA vials (an original and a duplicate) for each sample collected. In certain situations, the duplicate sample may not be used in the performance of the method. However, the duplicate sample should always be collected in the event that it is needed to complete the analysis process. The duplicate sample may be used in either of the following situations:

- When the initial test does not induce a color change in the colorimetric tube, the second VOA vial containing the duplicate sample, may be purged (using the same colorimetric tube) to increase the probability of detecting very low (< 10 µg/L) concentrations.

- When the initial test induces a color change that exceeds the upper limit of the LL tube (a tube reading > 3), the extra VOA vial can be used to analyze the sample using higher range colorimetric tubes (133L or 133M) to tentatively quantify the higher concentration of chlorinated compounds in the sample.

4.0 Sample Analysis Procedure

1. Place both heated VOA vials (original & duplicate sample) into the two VOA holders on the pump-stand.

2. Remove a low-level tube from the hot water bath and wipe it dry.

3. Break both ends of the colorimetric tube using the tip breaker on the piston pump.

4. Insert the colorimetric tube into the pump inlet with the flow arrow (printed on the tube) toward the pump. ***Note:*** *Tube orientation is critical – the yellow reagent end of the tube is inserted in the pump.*

5. Connect a new extraction needle assembly to the colorimetric tube by sliding the open end of the vinyl tubing over the broken end of the colorimetric tube. This step must be completed before inserting the needle into the VOA (Prior to step 6).

6. Remove the protective cap from the extraction needle and insert the needle into the septa of the first VOA vial. ***Note:*** *Be sure that the tip of the extraction needle is positioned within the headspace of the VOA vial (above the water level). Do not insert the extraction needle as far as it will go into the headspace of the VOA vial, but rather only to a point slightly beneath the inside of the septa to reduce the possibility of sample water entering the extraction needle assembly and colorimetric tube during the purging process.*

7. Insert the purge needle (with carbon filter assembly) into the septa of the first VOA vial and push the tip of the needle to the bottom of the VOA vial.
   IMPORTANT NOTE: Do not insert the purge needle before completing steps 5 and 6.

8. Align the 50ml label and red dot on the pump handle with the red dot on the pump shaft.

9. Pull the handle sharply until it locks in the 50ml (half pull) position.

10. Confirm that air is purging through the sample in the VOA vial.

11. Purge for approximately 30 seconds.

12. Check the yellow reagent in the tube for a color-change.

13. If no color-change reaction is visible or if the color reading is less than 1.5, rotate the pump handle ½ turn and pull the handle out to lock in the 100ml position.

14. Continue the 100ml purge until the flow cycle is complete. Note: Flow is complete when the end-of-flow indicator (located on the back of the pump handle) returns to its full brightness.

15. Check the yellow reagent phase in the tube for a color change.

16. If no color-change is visible, remove the extraction needle from the VOA with the vinyl tubing still attached to the low-level tube, rotate the pump handle ¼ turn and push the plunger back into the pump, remove the extraction needle from the first VOA vial and inject it into the septa of the second VOA (duplicate sample), then remove the purge needle from the first VOA vial and inject it into the septa of the second VOA (duplicate sample) - now re-pull the pump handle to lock into the 100ml position.

17. When the second 100ml purge cycle is complete, read and record the results.

For samples containing high concentrations (>150 µg/L) the resulting color-change may exceed the calibrated limit of the low-level tube, requiring the second VOA vial (duplicate sample) to be purged and analyzed by repeating steps 3 through 13 using a medium range (133L) or a high range (133M) tube.

For samples containing low (<5 µg/L) concentrations the color change does not usually begin until 100 CCs of air have purged through the sample. Furthermore, the color change induced at these low concentrations is very slight (below 0.5 on the tube scale) and appears as a slight darkening or light purple hue at the entrance of yellow reagent layer in the LL tube. When the sample contains higher concentrations (>10 µg/L) of chlorinated compounds, the resulting color change is an obvious light to dark purple, which propagates through the yellow reagent layer toward the pump end of the colorimetric tube. The tube reading (Color-Tec response) is obtained by matching the linear extent of the discolored reagent inside the tube to the calibration scale printed on the outside of the tube. Table 1 presents a troubleshooting matrix with causes and solutions potential problems.

Important Procedural Notes:

The disposable extraction needle assembly is intended for one use only. Decontamination and re-use of this part is highly discouraged because of the risk of contaminant carryover from the tubing and other plastic parts which can harbor contaminants from the previous analysis. Purge needles may be reused following decontamination using water and isopropanol.

Carbon filters should be discarded if they become wet from contact with sample water.

Never insert the purge needle into the VOA before the extraction needle assembly has first been connected to the colorimetric tube and inserted into the VOA headspace. If the purge needle is inserted first, the pressure inside the sealed VOA may force sample water up though the purge needle and into the carbon filter. Sample volatiles may be lost if the extraction needle assembly is inserted into the VOA headspace before connecting the tubing to the colorimetric tube.

To prevent clogging of the purge needle when inserting the purge needle into VOA vials containing soil samples, do not immediately push the bottom of the needle through the soil to the bottom of the vial; but rather temporarily position the base of the purge needle in the water above the soil until the pump handle has been pulled to begin air flow through the sample. Once air flow has been initiated, slowly extent the purge needle through the soil to the base of the vial. The air flow from the tip of the purge needle should reduce the potential for clogging as the needle moves through the soil. This procedure is especially helpful when working with clayey soils.

Troubleshooting Guide

Problem	Possible Cause	Solution
Sample does not appear to be purging (bubbling) after the pump handle has been pulled.	Clogged/blocked purge (long) needle.	Use the decontamination syringe to check the purge needle for clogs. If clogged, clean the needle or use a new purge needle.
	Clogged/blocked extraction (short) needle.	Use decontamination syringe to check the extraction needle for clogs. Use decontamination syringe to clean the needle or use a new extraction needle.
	Colorimetric tube is not securely connected to hand pump.	Remove and re-insert the colorimetric tube from the hand pump. If the fit seems loose, replace the hand pump inlet gasket.
	Colorimetric tube is not securely connected to extraction needle tubing.	Check the connection between the extraction needle tubing and the colorimetric tube. If loose, insert the colorimetric tube further into the extraction needle tubing.
	VOA cap is not tightly sealed.	Check the tightness of the VOA cap. Tighten if necessary.
	Colorimetric tube tips were not broken before connecting to hand pump and tubing.	Break both tips of the colorimetric tube before connecting to hand pump and tubing.
	Broken/bad plunger seal in hand pump.	Check the pump seal by holding your finger over the hand pump inlet while pulling the pump handle and lock into the 50cc position. If no vacuum is apparent, open the pump, remove the plunger, replace the plunger seal, and grease the new seal. Re-assemble the pump.
The colorimetric tube shows no reaction after purging a sample that contains chlorinated compounds. (False Negative)	Colorimetric tube is below the optimum operating temperature.	Heat the colorimetric tube to 40°C/104° F before using. It is also recommended to heat the sample. The recommended temperature for tubes and samples when using the Color-Tec Method is 40°C/104° F.
	Colorimetric tube was connected using reversed flow direction.	Use the flow direction arrows to properly align the tube. The purged air must pass through the black oxidizer phase and the white catalyst phase before entering the yellow reagent phase.
	The sample also contains a detectable concentration of xylenes or toluene.	Samples can be tested for the presence of xylenes and toluene using the **Gastec® 122L** colorimetric tube. The detection of chlorinated compounds may be diminished when xylenes or toluene are present in a sample.
The colorimetric tube indicates a reaction after purging a sample that contains no chlorinated compounds. (False Positive)	Chlorinated compounds are present at detectable concentrations the ambient air.	Test the ambient air using an LL tube to determine if chlorinated compounds are present at detectable concentrations. Attach the charcoal filter to the purge needle prior to purging samples.
	HCl vapor is present in the sample VOA or in the ambient air.	Avoid use of HCl in the area where Color-Tec is in use. Use only unpreserved VOAs for samples to be screened with Color-Tec.
	Water vapor has entered the yellow reagent phase of the tube indicating a positive reaction	Avoid purging more that 200 CCs through any sample. Stop purging before condensation inside the tube reaches the end of the black oxidizer phase. Avoid drawing any water from the sample VOA into the colorimetric tube.

5.0 Sample Purging and Detection Methodology

Samples may be purged using 50 cubic centimeters (cc), 100cc, or 200cc purge volumes. These various purge volumes are used in succession to maximize the low-level detection capability and detection range of each tube, thereby reducing the number of tubes needed to tentatively quantify the concentration of total chlorinated compounds in the sample. The pump stand is equipped with two VOA-vial holders to accommodate a second (duplicate) sample to be collected from each sampling location. This duplicate sample (collected and prepared in the same manner as the original sample) serves the following two potential purposes:

1. When purging the initial VOA vial does not induce a color change in the colorimetric tube, the second VOA vial containing the duplicate sample, may be purged (using the same colorimetric tube) to increase the probability of detecting very low (< 10 µg/L) concentrations.
2. When the initial test induces a color change that exceeds the upper limit of the LL tube (a tube reading > 3), the extra VOA vial can be used to analyze the sample using higher range colorimetric tubes (133L or 133M) to tentatively quantify the higher concentration of chlorinated compounds in the sample.

5.1 50cc Purge Volume

Initially, all samples are analyzed using a Gastec® 133-LL tube with a 50cc purge cycle. If the 50cc purge induces a color change reading of 1.5 to 3.0, read the calibration scale value aligned with the stained/unstained interface in the tube and use the pump stroke correction factors provided on Table 1 to determine the correct reading for a 50cc purge volume. If the concentration in the sample exceeds the upper detection limit of the tube (i.e. the color change moves beyond the upper limit of the calibration scale printed on the tube), repeat the analysis using duplicate samples and higher range tubes (133-L, 133-M, and 133-HA) until the color change reaction stops within the calibration scale on the tube. If the color change reaction exceeds the upper limit of the calibration scale of the HA tube, the sample contains a concentration of chlorinated compounds above the upper detection capability of the Color-Tec Method.

5.2 100cc Purge Volume

Following completion of the 50cc purge cycle, if the concentration in the sample has induced a color change in the tube which traveled less than half the distance of the calibrated portion of the reagent phase of the tube (less than a reading of approximately 1.5), pull the pump handle outward and lock it into the 100cc position to complete a full purge cycle. Record the value aligned with the stained/unstained interface on the tube. No correction factor is needed for a 100cc purge.

5.3 200cc Purge Volume

Following completion of the 100cc purge cycle, if the concentration in the sample has induced no color change reaction, remove the purge needle and extraction needle assembly from the VOA vial containing the original sample and insert them into the VOA vial containing the duplicate sample (which has also been pre-heating) and perform another 100cc purge cycle **using the same colorimetric tube**. To perform the transfer to the second vial, remove both needles from the original VOA vial and immediately insert both needles into the septa of the duplicate sample VOA vial. Before re-inserting the pump handle, temporarily remove the colorimetric tube from the tip of the hand pump and re-insert the pump handle completely into the pump while the tube is un-attached. Re-attach the colorimetric tube into the pump tip and pull the pump handle and lock it into the 100cc position. Following the complete second purge cycle, read the calibration scale value aligned with the stained/unstained interface in the tube and use the pump stroke correction factors provided on Table 1 to determine the correct reading for a 200cc purge volume.

Table 1
Purge Volume Correction Factors for 133-Series Tubes

Colorimetric Tube	Purge Volume	Quantity of Pump Pulls	Correction Factor
133-LL	50cc	Half Pull	Tube Reading x 3
133-LL	100cc	Full Pull	Tube Reading x 1
133-LL	200cc	Two Pulls	Tube Reading x 0.5
133-L	50cc	Half Pull	Tube Reading x 3
133-L	100cc	Full Pull	Tube Reading x 1
133-L	200cc	Two Pulls	Tube Reading x 0.5
133-M	50cc	Half Pull	Tube Reading x 2.5
133-M	100cc	Full Pull	Tube Reading x 1
133-M	200cc	Two Pulls	Tube Reading x 0.4
133-HA	50cc	Half Pull	Tube Reading x 3
133-HA	100cc	Full Pull	Tube Reading x 1
133-HA	200cc	Two Pulls	Tube Reading x 0.3∞

6.0 Reading the Tubes

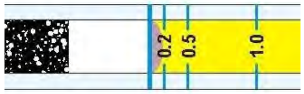
The basic Color-Tec method procedures are simple and intuitive; however, contaminant detection and semi-quantitative values are obtained through visual observation of the colorimetric reaction in the tubes, which is inherently subjective (especially in samples containing very low [<5 µg/L] total CVOHs). These low-level samples induce only a slight color change (i.e. slight darkening or light purple hue) prior to the 0.5ppm line on the tube scale at the entrance of yellow reagent layer in the LL tube. Samples containing concentrations of total chlorinated compounds above 5 µg/L usually induce a more apparent reaction within the LL tube.

6.1 Very Low Concentrations

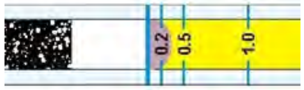
When a sample contains very low concentrations (<10µg/L) of chlorinated compounds, the resulting color change is not immediate or distinct. At these low concentrations the color change does not usually begin until between 100 and 200 CCs of air have purged through the sample into the tube. Furthermore, the color change induced at these low concentrations is very slight (below 0.5 on the tube scale) and appears as a slight darkening or light purple hue at the entrance of yellow reagent layer in the LL tube.

6.2 Low to Medium Concentrations

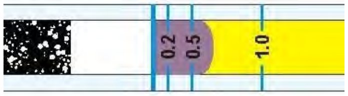
When the sample contains higher concentrations (>10 µg/L) of chlorinated compounds, the resulting color change is an obvious light to dark purple, which propagates through the yellow reagent layer toward the pump end of the colorimetric tube. The detected concentration level is obtained by matching the linear extent of the discolored reagent inside the tube to the calibration scale printed on the outside of the tube.



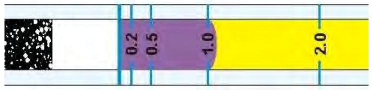
Tube Reading = 0.1
Estimated Concentration = 3 µg/L



Tube Reading = 0.2
Estimated Concentration = 15 µg/L



Tube Reading = 0.6
Estimated Concentration = 45 µg/L



Tube Reading = 1.0
Estimated Concentration = 70 µg/L

Tube Reading = 2.0
Estimated Concentration = 145 µg/L

6.3 High Concentrations

When the sample contains high concentrations (>100 µg/L) of chlorinated compounds, the color change reaction occurs quickly and usually exceeds the upper detection level of the Gastec® 133LL tube. The higher the concentration of chlorinated compounds in the sample, the faster the color change reaction occurs and the further it propagates through colorimetric tube. Samples containing very high concentrations (>1000 µg/L) of chlorinated compounds, often discolor the entire yellow reagent layer in the LL tube before the pump handle has been fully extended. In these cases, the purging can be discontinued to allow for the current sample bottle to be re-tested using a higher range detector tube. There is no need to continue purging the sample when the detection level of the tube is exceeded. Each subsequently higher range tube (133L, 133M, or 133HA) is used to purge each new duplicate sample in succession until the color change reaction does not exceed the calibration range of the tube being used.

6.4 Recording Tube Readings

It is recommended to record the observed concentration value (tube reading), the range of the colorimetric tube (LL, L, M, or HA) and the final purge volume when logging Color-Tec results. For example, a reading of 2.5 observed on an LL tube using a 100 ml purge should be recorded as **2.5/LL/100**. Purge volume correction factors must be applied for Color-Tec values which were obtained using any purge volume other than 100cc. For example, a reading of 0.2 observed on an LL tube using a 200 ml purge should be recorded as **0.1/LL/200**. A reading of 60 observed on an M tube using a 50 ml purge should be recorded as **150/M/50.**

7.0 Estimating Sample Concentrations (Conversion Table)

The Color-Tec reading (the distance that the color change travels through the tube) is a **<u>relative response</u>** to the amount of chlorinated-compound molecules that have been purged from the sample and directed into the tube. Therefore, the units printed on the tubes are used only to record the **<u>relative response</u>** for each analysis in order to facilitate comparison to laboratory GC/MS methods.

To provide a field-ready estimate of the total chlorinated solvent concentration in liquid and solid samples based on the colorimetric tube reading, The developer of the Color-Tec method created a conversion table (see Table 2) based on statistical comparison of water samples collected from chlorinated solvent sites in which the Color-Tec and GC/MS methods were used to analyze split samples. An estimated concentration may be obtained by matching the Color-Tec tube response to either the *<u>median expected GC/MS concentration</u>* or the *<u>range of expected GC/MS concentrations</u>* provided on the comparison table. The potential range of corresponding analytical values associated with each positive tube reading increases significantly as the sample concentration increases. The estimated concentrations presented on Table 2 represent the central tendency of the comparison data. The actual analytical values obtained by laboratory analysis of split samples may differ substantially from this estimate and may fall outside of the corresponding ranges provided on Table 2.

The expected GC/MS concentrations presented in Table 2 are based on comparison of water sample data only. These conversion values may also be used for soil data; however, the potential range in expected GC/MS concentrations may be increased as a result of the difference in soil volumes used in the two methods and in the inherent heterogeneity of most soil matrices. However, the potential deviation factors included in the *<u>range of expected GC/MS concentrations</u>* column should be sufficient to account for the intrinsic analytical variability of most soil sample results.

THE COLOR-TEC TUBE READING IS NOT THE SAMPLE CONCENTRATION!

The tube reading is a <u>unit-less</u> value which must be compared to laboratory results from split samples in order to yield an estimate of the actual concentration present in the sample. This conversion table provides a reasonable estimate of the expected sample concentration based on the tube reading.

Table 2
Conversion of AQR Color-Tec Readings (Relative Responses) to Expected GC/MS Total Chlorinated Volatile Organic Halocarbon Concentrations

Gastec® Colorimetric Tube	Color-Tec Tube Reading (relative response) (unit-less)	Median Expected GC/MS (Laboratory) Concentration (µg/L or µg/kg)	Range of Expected GC/MS Concentrations (µg/L or µg/kg)	
			Low	High
133-LL	0	3	>0	5
	0.1	7	5	10
	0.2	15	10	20
	0.5	35	25	45
	0.8	55	40	75
	1	70	50	95
	1.5	110	75	140
	2	145	105	190
	2.5	190	130	245
	3	230	160	290
	5	380	260	490
	9	900	630	1,160
133-L	25	2,500	1,250	3,750
	35	4,400	2,200	6,600
	45	7,700	3,850	11,550
	55	15,000	7,500	22,500
	75	17,200	8,600	25,800
133-M	100	21,100	10,500	31,600
	200	46,000	23,000	69,000
	300	85,000	42,500	127,500
133-HA	500	225,500	112,800	338,300
	700	598,300	299,200	897,500
	900	1,587,500	793,800	2,381,300

Notes:
The **Color-Tec Tube Reading** (Color-Tec units) is the value printed on the colorimetric tube at the interface between the reacted and un-reacted reagent (the extent of the color change in the tube for a positive result).

The **Median Expected GC/MS Concentration** is the estimated concentration in micrograms per liter (µg/L) of total chlorinated volatile organic halocarbons (CVOHs) present in the sample for the corresponding Color-Tec tube response.

The **Range of Expected GC/MS Concentrations** is an estimated range of potential concentrations (µg/L or µg/kg) of total chlorinated volatile organic halocarbons (CVOHs) for the for the corresponding Color-Tec tube response.

The **Median Expected GC/MS Concentration** was obtained using statistical comparison of Color-Tec Method data and GC/MS (EPA Method 8260B) data. Comparison data were obtained from 5348 water samples collected from 152 chlorinated solvent (primarily PCE) sites in which the Color-Tec Method was used to analyze the samples in the field and either a laboratory-based or mobile GC/MS was used to analyze split samples.

The **Range of Expected GC/MS Concentrations** reflects the potential deviation in the **Median Expected GC/MS Concentration** based on Color-Tec Method/EPA Method 8260B comparison results. The potential error increases as the concentration increases. The initial deviation factor used for a Color-Tec Reading of zero is +/- 30% and increases to +/- 400% at a Color-Tec Reading of 900 units.

The **Median Expected GC/MS Concentrations** presented in this table are based on comparison of water sample data only. These conversion values may also be used for soil data; however, the potential error or range in expected GC/MS concentrations may be increased as a result in the difference in soil volumes used in the two methods and in the inherent heterogeneity of many soil matrices. The potential deviation factors included in the **Range of Expected GC/MS Concentrations** data should be sufficient to account for the intrinsic analytical variability of most soil sample results.

The expected GC/MS concentrations in this table are provided only to give Color-Tec Method users an approximate concentration for the Color-Tec Tube Response. Actual GC/MS results on split samples may be outside of the stated range for a given Color-Tec Tube Response.

Refer to the **AQR Color-Tec Manual** for detailed information regarding general method principals and potential analytical variables.

8.0 Proposed QA/QC Procedures

As with any analytical method, standard sample preparation and quality assurance/quality control (QA/QC) procedures tailored to the specific project goals should be developed and followed precisely and consistently throughout the sampling and analysis program to insure consistent results and the lowest possible detection levels for all samples analyzed using the Color-Tec method. This section is intended to provide the Color-Tec user with a basic methodology for conducting QA/QC procedures which address various potential operational and procedural issues, such as analytical confidence, method performance, false positives/negatives, replicate accuracy, and contaminant carryover. Users of the Color-Tec method are encouraged to use the information provided in this section to develop project-specific QA/QC and sample handling procedures that insure the level of consistency and accuracy required for the user's sampling program.

8.1 Analytical Confidence and Method Performance

Using Color-Tec to analyze prepared sample spikes containing known concentrations of chlorinated compounds provides confidence that the method procedures are being performed properly performed and may provide a basis for estimating concentrations based on the low-range (133LL) colorimetric tube responses. Spiked sample concentrations should range between 10 µg/L and 200 µg/L to cover the detection range of the low-range (133LL) colorimetric tube. Most analytical laboratories will prepare spiked samples in VOA vials with specified compounds at specified concentrations. Conduct Color-Tec analyses on the spiked samples using the same procedures described in Sections 3 and 4 and record the results in your field log as described in Section 5.3. A 200cc purge using two VOA vials (as described in Section 4.3) may be required to produce a positive Color-Tec reading when testing spiked samples containing 10 µg/L or less of total CVOHs may require a 200cc purge to produce a positive Color-Tec reading.

Performance/confidence testing of the higher range tubes (133L, 133M, and 133HA) using high-concentration spiked samples is unnecessary because the high range tubes are usually not used unless the sample being tested has already exceeded the upper range of the low range tube, thus revealing that the sample being tested contains a sufficient quantity of chlorinated compounds to evoke a positive reaction from the next higher range tube. Given the inherent extreme variability of estimating high concentrations based on tube responses on the high range tubes (133L, 133M, and 133HA), comparison of high concentration (>500 µg/L) spiked samples generally

8.2 Chemical Inhibitors (False Negatives)

The presence of Toluene and Xylenes inhibits/diminishes the ability of the colorimetric tubes to detect CVOHs. At sites where the presence of these compounds is suspected to be present in the soil or water samples, QA procedures may include periodic testing of groundwater or soil samples and ambient air for the presence of toluene and xylenes using a Gastec® Toluene tube (the Toluene tube also detects xylenes). To conduct a test for the presence of compounds which could inhibit the detection of CVOHs use the Toluene (122L) tube to analyze a duplicate soil or water sample using the procedures described in Sections 2 through 4.

8.3 Positive Interference (False Positives)

Chlorinated Volatile Organic Halocarbons. The Gastec® 133-series colorimetric tubes used to perform the Color-Tec method detect all chlorinated volatile organic halocarbons (CVOHs) present in each sample. Thus, individual CVOH compounds cannot be identified/isolated using this method. But rather, each positive tube reading represents the sum total of all CVOH compounds present in the sample as "total CVOHs". This detection of the entire class of compounds is an inherent effect of the colorimetric tube design and thus may not be avoided by any alteration of method procedures.

Water Vapor. A build-up of water vapor in the colorimetric tube in the oxidizer stage (black portion of the tube) and through the catalyst stage (white portion of the tube) can induce a subtle color change similar to that of a low-level positive result if the moisture reaches the reagent stage (yellow portion of the tube). This problem is easily avoided by observing the build-up of condensation inside the tube in the oxidizer stage during purging, and stopping the airflow before the condensation reaches the white catalyst stage. This condition rarely occurs before the maximum required purge volume of 200 CCs is achieved and contaminant presence or absence has been determined.

Hydrogen Chloride Vapor. Hydrogen chloride vapor is the reactant that causes the color change in the yellow reagent used in the PCE colorimetric tubes. The HCl vapor is formed when chlorinated halocarbons pass through the oxidizer and catalyst stages of the tube. Free HCl vapor can also be formed when strong hydrochloric acid comes into contact with air or calcium carbonate. Any source of free hydrogen chloride vapor which enters the colorimetric tube will cause a strong positive reaction. To minimize the risk of false positives from hydrogen chloride vapor, avoid the use of pre-preserved VOAs when using the Color-Tec method. Natural sources of hydrogen chloride vapor are rare.

Free Chlorine. Very high (>20,000 ppm) concentrations of free chlorine can cause a low-level positive reaction in the 133LL colorimetric tube. The conditions necessary for this positive interference rarely occur in groundwater or soil samples.

Contaminant Carryover. It is highly recommended that VOA vials and extraction needle assemblies be discarded following each test. Re-use of these expendable items may cause sufficient carryover of contaminants to cause a false positive result in subsequent samples.

8.4 Ambient Air Interference

Because the Color-Tec method uses ambient air as the purge gas, airborne chlorinated compounds at low concentrations can enter the sample and cause a positive reaction in the detector tube. Conversely, low concentrations of either toluene or xylenes present in the ambient air may enter the colorimetric tube and inhibit/diminish the tube's ability to detect CVOHs. To prevent airborne contaminants from entering the sample and detector tube during sample purging and analysis, the method is used with a carbon pre-filter attached to the purge needle. To determine whether airborne chlorinated contaminants are present, a PCE (133LL) colorimetric tube may be used periodically to test the ambient air at the location where the field testing is being performed. If airborne contaminants are present and the carbon filter is being used, the carbon filters can also be tested periodically using a colorimetric tube to determine if breakthrough is occurring. The ambient air may be similarly tested for the presence of xylenes or toluene using the PCE (133LL) colorimetric tube.

To conduct a test for the presence of chlorinated VOHs in the ambient air, break the tips of a PCE (133LL) or PCE (133LL) colorimetric tube and properly insert it into the hand pump. Pull and lock the pump handle into the 100cc position allowing ambient air to enter the colorimetric tube. *Note: Do not attach an extraction needle assembly to the colorimetric tube while performing this test.* Once the 100cc flow cycle is completed, carefully read the tube and record the results. A positive result indicates the presence of CVOCs in the ambient air at concentrations detectable by Color-Tec which would affect sample results unless the carbon filter assembly is attached to the purge needle (see Section 9). A negative result indicates that CVOCs are not present in the ambient air at concentrations detectable by Color-Tec and therefore will not affect sample results. It is recommended that the carbon filter assembly is used regardless of the ambient air testing results.

8.5 Duplicate Sample Testing Procedure

Duplicate or replicate samples are collected from the same sampling location, at the same time, using the same collection methods, and analyzed using the same procedures as the original samples for the purpose of determining both sampling and analytical method variability. Since a second (duplicate) VOA vial is always collected for the Color-Tec method, a duplicate or replicate analysis may be performed on the second (duplicate) VOA vial any time that a positive result (color change) is evoked by the original sample (first VOA vial) without exceeding the upper limit of the low-level colorimetric tube. In those cases, the duplicate or replicate analysis is simply performed by using a new low-level colorimetric tube to analyze the duplicate sample in the second (unused) VOA vial. If sampling and method variability is low, the result of the duplicate test will be the same or similar to the results obtained from the original test. The relative percent difference (RPD) may be calculated to quantify any variability in the results.

8.6 Collection of Split Samples for Laboratory Analysis

It is recommended that sample splits be collected for laboratory comparison analysis from 5 to 20 percent of the total quantity of samples analyzed using the Color-Tec method. Given a sufficient quantity of split sample pairs and sufficient range of concentration values, the GC/MS-to-Color-Tec comparison data may be used to obtain estimated concentrations for samples in the data set which were analyzed only using the Color-Tec method. This can be achieved using linear regression analysis of the comparison data. Statistical analysis of the comparison data can also be performed to determine site-specific Color-Tec method performance data.

9.0 Safety Precautions

As with the use of any product, it is recommended that the user carefully review all product manuals and Material Safety Data Sheets (MSDS) provided with this product prior to use. Several components of the Color-Tec kit are products obtained from other manufacturers which have manuals including safety precautions. Users of the Color-Tec method should carefully review the manuals and safety precautions and should become familiar with the proper use of all components included in the Color-Tec kit. It is recommended that the procedures involved with the method be incorporated into the user's Site-specific Safety and Health Plan (SSHP). MSDSs for all chemicals provided as part of the Color-Tec kit are available upon request. The following precautions should be considered to reduce potential user safety risks associated with the performance of the Color-Tec method.

Activity	Potential Risk	Precaution
Breaking tube tips	eye injury, dermal puncture	safety glasses
Accidental tube breakage	dermal cuts, exposure to reagent	safety gloves
Use of purge/extraction needles	dermal puncture	use caution
Use of the hot plate	dermal burns, electric shock	limited setting
Use of PCE standards	dermal contact, dermal cuts	safety gloves

Additional Safety Notes:

- Use skin and eye protection while breaking colorimetric and carbon filter tubes;
- The thermostat dial setting of the Corning® Hot Plate should never be set above 5 for any heating purposes required by the Color-Tec method;
- Do not over-fill the water bath pan while heating the samples and tubes;
- Always conduct sample and tube heating activities on a flat, stabile, surface.
- Keep all flammable or combustible materials away from the Corning® Hot Plate during sample and tube heating activities.

- Always use the stainless-steel water-bath pan properly filled with water for heating the samples and tubes – do not heat samples or tubes directly on the surface of the Corning® Hot Plate;
- Do not use any heat source to heat the water-bath, tubes, or samples other than the Corning® Hot Plate provided in the hardware kit.

<u>Disposal of Expendable Materials:</u>

- Re-cap all needles before disposal;
- After re-capping each extraction needle, dispose of the extraction needle assembly while leaving the vinyl tubing attached to the colorimetric tube – Do not attempt to remove the extraction needle assembly from the tip of the colorimetric tube for disposal;
- Dispose of all sharps (needles and broken glassware) in accordance with any and all applicable local and/or federal rules or guidance.
- Dispose of all colorimetric tubes as specified in the Gastec® MSDS and/or in accordance with any and all applicable local and/or federal rules or guidance.
- Dispose of all VOA vials used to contain sample materials in accordance with any and all applicable local and/or federal rules or guidance.

Product Warranty

AQR warrants that the goods sold herein will be free from defects in material and workmanship. This warranty shall be limited to the replacement of defective parts. It is expressly agreed that this warranty shall be in lieu of all warranties of fitness and in lieu of the warrant of merchantability.

EPA Guidance Document References

Using Dynamic Field Activities for On-Site Decision Making
May 2003; OSWER No. 9200.1-40 EPA/540/R03/002; Chapter 5;
http://www.epa.gov/superfund/programs/dfa/download/guidance/40r03002.pdf

Site Characterization Technologies for DNAPL Investigations September 2004; EPA 542-R-04-017;
http://www.clu-in.org/download/char/542r04017.pdf

Understanding Procurement for Sampling and Analytical Services under a Triad Approach June 2005, EPA 542-R-05-022;
http://www.epa.gov/swertio1/download/char/procurement.pdf

Conducting Contamination Assessments at Drycleaning Sites EPA Technology Innovation Program; State Coalition for Remediation of Drycleaners; http://www.drycleancoalition.org/download/assessment.pdf

EPA Triad Implementation References

Using AQR Color-Tec for Source Identification and Delineation
Naval Construction Battalion Center Davisville North Kingstown, RI - 2008 Triad Conference;
http://www.umass.edu/tei/conferences/Triad_PDF/Anderson.pdf

Fast Track to Reducing Conceptual Site Model Uncertainty CH2MHill; Storage Tank Site ST-123 POL Fuel Yard;
http://www.Triadcentral.org/user/includes/dsp_profile.cfm?Project_ID=25

Best Practices in Triad Approach to Characterize TCE, National Laboratory Environmental Sciences Division Argonne, IL;
http://www.triadcentral.org/user/doc/TPP-Hurlburt-BestPractices.pdf

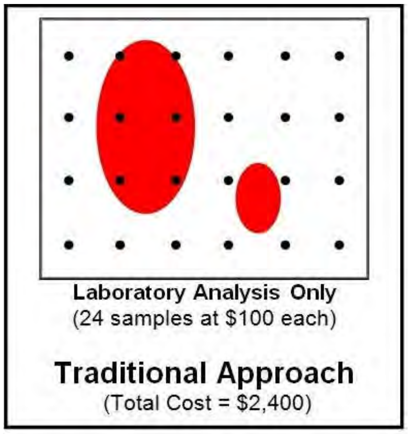
Adaptations to Triad as a Basis for Exit Strategy Development Decision Logic Flow Chart 2006 Triad Poster Session; CH2MHill; http://www.triadcentral.org/user/doc/TPP-Hurlburt-TriadAdaptations.pdf

Successful Triad Implementations at Federal Sites AQR Color-Tec Method locates source areas at Calloway Drum Recycling Site, Auburndale, Florida http://www.triadcentral.org/user/doc/TPP-Callaway-Field_Based_Decision_Approach.pdf

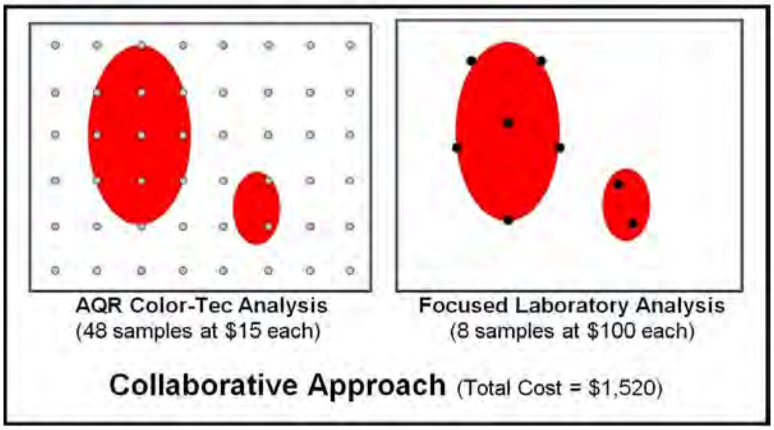
Color-Tec Method Applications

Source Area Identification at chlorinated solvent sites is highly complex given the low solubility of these compounds in water. Chlorinated solvent source zones often persist as suspended residual in unsaturated and saturated subsurface sediments for many decades. Surface water infiltration and groundwater flowing through the source zones slowly dissolves the suspended residual solvent leading to substantial aqueous phase contaminant plumes. Given the high volatility of most chlorinated compounds, residual solvents suspended in the unsaturated soil often leads to significant vapor phase contamination. The Color-Tec method is ideal for locating chlorinated solvent source areas by combining low level detection of all chlorinated compounds with low per sample cost to allow for significant expansion of sampling coverage compared to assessment approaches where only definitive analytical (laboratory) methods are employed to locate source areas. Definitive laboratory analysis provides high analytical accuracy, but sampling quantity is often limited to control costs, resulting in data gaps, sampling uncertainty, and low overall data quality. The low per-sample cost of Color-Tec method offers a 6:1 increase in analysis volume over laboratory methods, allowing for five times the sampling coverage for the same cost.

The illustrations below compare the traditional approach of source identification which uses only definitive laboratory analysis, to a collaborative approach which uses a high volume of Color-Tec data combined with a low quantity of definitive laboratory data. This collaborative approach combines high volume/low accuracy with low volume/high accuracy to achieve higher overall data quality than either method alone.



The diagram to the left shows the traditional site investigation scenario in which all samples collected are analyzed using only definitive analytical methods. The red areas represent previously unidentified source areas and black dots represent sampling locations intended to locate and delineate the contaminant plumes. Although this definitive-analysis only approach provides high analytical accuracy, the sampling quantity is often limited in order to control costs, resulting in data gaps, sampling uncertainty, and low overall data quality – and in this example the smaller source area remains undetected.



The two diagrams to the right show an investigation scenario in which a real-time measurement method, such as Color-Tec, is used to increase the overall sampling coverage, resulting in reduced sampling uncertainty and increased overall data quality. In this example, the smaller source area is identified and the Color-Tec data is verified and confirmed by focusing a reduced quantity of definitive, laboratory-based, analysis of split-samples onto the most critical areas of the site. Combining Color-Tec with focused laboratory analysis in this manner provides increased overall data quality and analytical accuracy at significantly lower costs than conventional approaches which rely only on definitive laboratory-based analysis.

Groundwater Profiling is the collection of discrete samples at multiple depths and locations working outward from known source areas to define the lateral and vertical extent of a dissolved groundwater contaminant plume. The technique is used in conjunction with the Color-Tec method at chlorinated solvent sites to allow for immediate decisions regarding subsequent vertical and lateral sampling locations.

Soil Matrix Profiling is similar to groundwater profiling, but uses sampling of the unsaturated soil to define the lateral and vertical extent of the vapor phase contamination.

Groundwater Matrix Profiling (Residual Zone Mapping) is similar to groundwater or soil profiling, but uses sampling of saturated unconsolidated aquifer matrix to define the lateral and vertical extent of suspended residual DNAPL.

Surface Water/Sediment/Pore Water Impact Evaluation is the collection and analysis of sediment, sediment pore water, and surface water to locate and characterize groundwater impacts on surface water.

AQR Color-Tec®

Contact and Ordering Information

- **For more information visit http://www.aqrcolor-tec.com/**
- **For kit orders contact Phil Pecevich at 919-918-7191**
  Email: pecevica@bellsouth.net
- **For technical support and training contact Perry Kelso at pkelso@ene.com**

Equipment and Expendables

- **Hardware kit includes piston pump, pump stand, and heating equipment in a Pelican® hard case**
- **Expendables provided in 20-sample packs**
- **Expendables for QA/QC tests sold separately**
- **Cost per sample is $19.95**
- **Volume discounts available**
- **Professional technical support is included with every purchase**
- **Professional in-house or web-based training is available**

Hardware Kit

20-Sample Pack

USEPA Underground Injection Control Inventory Form

Type or print all information. See reverse for instructions.

OMB No. 2040-0042 Approval Expires 11/30/2014

INVENTORY OF INJECTION WELLS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF GROUND WATER AND DRINKING WATER

(This information is collected under the authority of the Safe Drinking Water Act)

1. DATE PREPARED *(Year, Month, Day)*
13-04-22

2. FACILITY ID NUMBER
10603/NYD987032380

PAPERWORK REDUCTION ACT NOTICE

The public reporting burden for this collection of information is estimated at about 0.5 hour per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or any other aspect of this collection of information, includingsuggestions for reducing this burden, Director, Collection Strategies Division (2822), U.S. Environmental Protection Agency, 1200 Pennsylvania Avenue, NW, Washington, DC 20460, and to the Office of Management and Budget, Paperwork Reduction Project, Washington, DC 20503.

3. TRANSACTION TYPE *(Please mark one of the following)*

☐ Deletion ☑ First Time Entry
☐ Entry Change ☐ Replacement

4. FACILITY NAME AND LOCATION

A. NAME *(last, first, and middle initial)*: One Holland Avenue Development, Inc.

B. STREET ADDRESS/ROUTE NUMBER: 1-5 Holland Avenue

C. LATITUDE

DEG	MIN	SEC
41	02	57.32

D. LONGITUDE

DEG	MIN	SEC
73	46	21.24

E. TOWNSHIP/RANGE

TOWNSHIP	RANGE	SECT	1/4 SECT
	N/A		

F. CITY/TOWN: White Plains

G. STATE: NY

H. ZIP CODE: 10603

I. NUMERIC COUNTY CODE: 119

J. INDIAN LAND *(mark "x")*: ☐ Yes ☒ No

5. LEGAL CONTACT:

A. TYPE *(mark "x")*: ☒ Owner ☐ Operator

B. NAME *(last, first, and middle initial)*: Pucket, Karen

C. PHONE *(area code and number)*: (513) 247-4041

D. ORGANIZATION: One Holland Avenue Development, Inc.

E. STREET/P.O. BOX: 11280 Cornell Park Drive

F. CITY/TOWN: Cincinnati

G. STATE: Ohio

H. ZIP CODE: 45242 1812

I. OWNERSHIP *(mark "x")*

☒ PRIVATE ☐ PUBLIC ☐ SPECIFY OTHER
☐ STATE ☐ FEDERAL

6. WELL INFORMATION:

A. CLASS AND TYPE		B. NUMBER OF WELLS		C. TOTAL NUMBER OF WELLS	D. WELL OPERATION STATUS				
		COMM	NON-COMM		UC	AC	TA	PA	AN
V	G		36	36		36			
				0					
				0					
				0					
				0					
				0					
				0					

COMMENTS *(Optional)*:
36 3/4-inch diameter remediation injection wells to be installed as part of NYSDEC Brownfield Cleanup Program. BCP Site No. 360115. See attached IRM Work Plan for additional details.

KEY:

DEG = Degree
MIN = Minute
SEC = Second
SECT = Section
1/4 SECT = Quarter Section

COMM = Commercial
NON-COMM = Non-Commercial
AC = Active
UC = Under Construction
TA = Temporarily Abandoned
PA = Permanently Abandoned and Approved by State
AN = Permanently Abandoned and not Approved by State

HASP Amendment

HEALTH AND SAFETY PLAN

BROWNFIELD CLEANUP PROGRAM NO. C360115
1-5 HOLLAND AVENUE SITE
WHITE PLAINS, NEW YORK

APRIL 16, 2013

PREPARED FOR

O'BRIEN & GERE
22 SAW MILL RIVER ROAD/FIRST FLOOR
HAWTHORNE, NEW YORK 10532

PREPARED BY

IN-SITU OXIDATIVE TECHNOLOGIES, INC.
11 PRINCESS ROAD, SUITE A
LAWRENCEVILLE, NEW JERSEY 08648

ISOTEC PROJECT NO. 801830

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ATTACHMENT J	Operational Guidelines for On Site Personnel
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HEALTH AND SAFETY PLAN/CONTINGENCY PLAN

DISCLAIMER

THIS SITE HEALTH AND SAFETY/CONTINGENCY PLAN HAS BEEN DEVELOPED FOR THE USE OF IN-SITU OXIDATIVE TECHNOLOGIES, INC. (ISOTEC) AND ITS EMPLOYEES. PROPERLY TRAINED AND EXPERIENCED ISOTEC SUB-CONTRACTORS MAY ALSO USE IT AS A GUIDANCE DOCUMENT. HOWEVER, ISOTEC DOES NOT GUARANTEE THE HEALTH OR SAFETY OF ANY PERSON ENTERING THE SITE.

DUE TO THE POTENTIALLY HAZARDOUS NATURE OF THIS SITE AND THE ACTIVITY OCCURRING THEREON, IT IS NOT POSSIBLE TO DISCOVER, EVALUATE AND PROVIDE PROTECTION FOR ALL POSSIBLE HAZARDS, WHICH MAY BE ENCOUNTERED. STRICT ADHERENCE TO THE HEALTH AND SAFETY GUIDELINES SET FORTH HEREIN WILL REDUCE, BUT NOT ELIMINATE, THE POTENTIAL FOR INJURY AT THIS SITE. THE HEALTH AND SAFETY GUIDELINES IN THIS PLAN WERE PREPARED SPECIFICALLY FOR THIS SITE AND SHOULD NOT BE USED ON ANY OTHER SITE WITHOUT PRIOR RESEARCH BY TRAINED HEALTH AND SAFETY SPECIALISTS.

ISOTEC CLAIMS NO RESPONSIBILITY FOR USE OF THE PLAN BY OTHERS. THE PLAN IS WRITTEN FOR THE SPECIFIC SITE CONDITIONS, PURPOSES, DATES AND PERSONNEL SPECIFIED AND MUST BE AMENDED IF THESE CONDITIONS CHANGE.

Section 1 PROJECT IDENTIFICATION

CLIENT NAME:	O'Brien & Gere
CLIENT ADDRESS:	22 Saw Mill River Road/First Floor Hawthorne, New York 10532
ISOTEC PROJECT No.:	801830
PROJECT NAME:	1-5 Holland Avenue Site
LOCATION/ADDRESS:	1-5 Holland Avenue Site White Plains, New York
ISOTEC TECHNICAL MANAGER:	Prasad Kakarla
ISOTEC PROJECT MANAGER:	Mike Temple
ISOTEC SITE MANAGER:	Kevin O'Neal, Mike Temple or Tom Musser
ISOTEC SITE SAFETY OFFICER:	Kevin O'Neal, Mike Temple or Tom Musser
PLAN VALID FROM:	April 2013
PLAN EXPIRES:	December 2014

– End of Section –

Section 2 INTRODUCTION

In-Situ Oxidative Technologies, Inc. (ISOTEC) has been retained by O'Brien and Gere (OBG) for remediation services at the 1-5 Holland Avenue site (Holland Avenue site) located in White Plains, New York. The purpose of this Health and Safety Plan (HASP) is to identify, evaluate and control health and safety hazards, and to provide for emergency response during in-situ chemical oxidation remedial field activities at the site. All employees of ISOTEC, as well as its contractors and subcontractors who have agreed to abide by this HASP and who are involved in field activities on this project will be bound by these provisions.

This site-specific HASP is based on a review and evaluation of the potential hazards and risks associated with this project. It outlines the health and safety procedures, and the equipment required, needed to minimize the potential for harm to field personnel and site visitors. Since work activities, site conditions and exposures to various combinations of contaminants, which may be present, are variable, the potential for adverse health effects associated with field activities on this site cannot be predicted with confidence.

2.1 Site Description & History

The Holland Avenue site is located at 1-5 Holland Avenue in White Plains, New York. The site is currently vacant. Constituents of concern (COCs) at the site are chlorinated volatile organic contaminants (VOCs) primarily consisting of tetrachloroethene (PCE), and associated degradation products; trichloroethene (TCE), cis-1,2-dichloroethene (cis-DCE) and vinyl chloride. Target treatment area encompasses the suspected source area at the site in the vicinity of two floor drains (FD-2 and FD-3), monitoring wells (MWs) MW-4S and MW-4D, and numerous soil boring and membrane interface probe (MIP) locations. COC groundwater impacts exist within the overburden and shallow bedrock aquifers at the site. Based on May 1, 2012 groundwater sampling data from MW-4S and MW-4D, PCE levels as high as 1,020 and 6,140 micrograms per liter (ug/l), respectively, were encountered in on-site groundwater. PCE concentrations in both on-site and off-site downgradient wells exceed the NYS Class GA groundwater standards. When detected in downgradient off-site wells, TCE, cis-DCE and vinyl chloride generally exceed the NYS Class GA groundwater standards. Soil impacts are not considered to be an ongoing source of mass at the site with majority of concentrations detected occurring within regulatory criteria. Although no PCE sources have been identified within source area soils, the continued presence and magnitude of PCE in both on-site and off-site MWs suggests that a residual unidentified source of PCE exists. Dense non-aqueous phase liquid (DNAPL) is suspected of being present at the site (either currently or in the past) but has not been encountered thus far during previous sampling events, MIP investigations and well installations.

General subsurface lithology at the Holland Avenue site consists of a thin overburden cover of sandy fill, mixed sand and gravel, and sandy till that overlies an Inwood Marble formation. The sand and gravel units are the product of proglacial outwash and alluvial deposition by the nearby Bronx River and act as the principal zone of groundwater transport in the overburden. The Inwood Marble is characterized as a calcitic-dolomitic marble with majority of fractures occurring in the upper 10 feet that act as the principal pathway for horizontal groundwater flow through the bedrock. Bedrock becomes increasingly competent and unfractured with depth. Overburden materials occur from ground surface down to approximately 21-22 feet below ground surface (bgs) within the target area. Groundwater is generally encountered at approximately 12-15 ft bgs with primary flow from the east to the west/northwest. Average hydraulic conductivity values within the overburden are approximately 3.1 E-03 centimeters per second (cm/sec) or 8.8 feet per day (ft/day), and approximately 5.8 E-05 cm/sec or 0.2 ft/day, within the shallow bedrock. Data from source area wells show hydraulic conductivity to be approximately 9.81 ft/day for MW-4S and approximately 4.93 ft/day for MW-44, which are both higher than the averages calculated for the site suggesting that the formations within the treatment area will be able to accept injected reagents at a somewhat reasonable flow rate. Based on hydraulic conductivity data averaged across the site however, low permeability is anticipated within the shallow bedrock formation.

ISCO, utilizing base activated sodium persulfate (BASP) technology will be implemented at the site for treatment within the suspected source area within the vicinity of abandoned floor drains FD-2 and FD-3; and MW-4S/D well cluster. OBG has estimated an approximately 1,100 square foot (ft^2) area to be targeted during the ISCO treatment program. The anticipated target treatment interval is from approximately 10-20 ft bgs within the overburden aquifer and from 20-45 ft bgs within the shallow bedrock aquifer (to be divided into 2 approximately 10 ft thick vertical intervals from 23-33 and 35-45 ft bgs). The activation of sodium persulfate is generally achieved at pH greater than 10.5-11.

See Attachments A and B for the site location and street maps that identify the location and possible routes to the nearest hospital.

2.2 Key Personnel

2.2.1 ISOTEC Project Manager: Prasad Kakarla or Mike Temple

The ISOTEC Project Manager has the following responsibilities:

- To provide the ISOTEC Director of Health and Safety with project-related health and safety information.
- To have a site-specific Health & Safety Plan (HASP) prepared.
- To implement the HASP.
- To see that the project is performed in a manner consistent with applicable local, state and federal regulations.
- To monitor compliance with the HASP.

ISOTEC Project Manager has the authority to take the following actions:

- To suspend field activities, if the health and safety of field personnel are endangered.
- To suspend an individual from field activities for infractions of the HASP, pending further consideration by the ISOTEC DHS.

2.2.2 ISOTEC Director of Health and Safety: Thomas Andrews

The ISOTEC DHS has the following responsibilities, although he will not be on-site during the work:

- To consult with the ISOTEC Project Manager in project-related matters of health and safety.
- To monitor compliance with the HASP.
- To assist the ISOTEC Project Manager in complying with the terms of this HASP, and applicable regulations.
- To verify that on-site personnel are properly trained and medically qualified to carry out their duties.

The ISOTEC DHS has the authority to take the following actions:

- To suspend work or otherwise limit personnel exposure if a HASP appears to be unsuitable or inadequate.
- To direct personnel to modify any work practices that are deemed to be hazardous to health and safety.
- To remove field personnel from the project if their physical actions or mental condition endangers their own health and safety, or that of their coworkers.

2.2.3 ISOTEC Site Safety Officer: Kevin O'Neal, Mike Temple or Tom Musser

The ISOTEC Site Safety Officer (ISOTEC SSO) will be present on-site during work. The SSO and ISOTEC Alternate Site Safety Officer(s) (Alternate ISOTEC SSO) have the following responsibilities:

- To direct on-site health and safety activities.
- To report safety-related incidents to the ISOTEC Project Manager and ISOTEC DHS.
- To assist the ISOTEC Project Manager in all aspects of implementing the HASP.
- To maintain an adequate supply of health and safety equipment on-site, as specified in the HASP.
- To observe on-site health and safety activities, as specified in the HASP, and report results to the ISOTEC Project Manager and the ISOTEC DHS.

The ISOTEC SSO has the authority to take the following actions:

- To suspend field activities, if the health and safety of field personnel are endangered.
- To suspend an individual from field activities for infractions of the HASP, pending further consideration by the ISOTEC DHS.

2.2.4 ISOTEC Injection Technicians: Sean Collins, Ken Stewart, Stefan Brooks and Mark Ratner

The ISOTEC Injection Technicians have the following responsibilities:

- To report safety-related incidents to the ISOTEC SSO.
- To comply with the HASP while working.

The ISOTEC Injection Technicians have the authority to take the following actions:

- To suspend field activities, if the health and safety of field personnel are endangered.

– End of Section –

Section 3 GENERAL HEALTH AND SAFETY REQUIREMENTS

3.1 Personnel Medical Clearance

Prior to working at this site, ISOTEC assigned employees must: 1) have been certified by a licensed, ISOTEC-approved physician as being physically able to perform their assigned field work, and to use the Personal Protective Equipment (PPE) which will be required for this project, in accordance with the provisions of OSHA Regulation 29 CFR 1910.120(f); 2) have successfully completed an ISOTEC 40-hour basic health and safety training course (Level C) for field personnel or its equivalent. Site managers and supervisors must have successfully completed an 8-hour managers' health and safety course, in addition to the other clearance requirements.

ISOTEC subcontractor employees must also have similar medical, training, and respirator fit clearances and they will be required to provide proof of clearance before beginning work.

3.2 Hazard Training

All personnel working on-site who have potential exposures to health or safety hazards shall be thoroughly trained as specified in OSHA Regulations 29 CFR 1910.120(e). This training will include: (1) Attendance at an initial 40-hour basic health and safety training course off the Site; (2) At least three days of actual field experience under the direct supervision of a trained, experienced supervisor; (3) On-site, site-specific training; and (4) an 8-hour annual update in the basic health and safety training course. ISOTEC personnel may also receive specific topic training throughout the year. This training may include blood-borne pathogen training, low-level radioactivity safety, ergonomics updates, and newsletters/bulletins with pertinent or applicable information.

In addition to the above, on-site Managers and supervisors who are directly responsible for, or who supervise employees engaged in hazardous waste operations must also receive: (1) 8-hours of site supervisor training; and (2) additional training at the time of job assignment on such topics as, but not limited to, the company's safety and health program and the associated employee training program; personal protective equipment program; spill containment program; air quality monitoring; emergency response; monitoring equipment usage and calibration; and, health hazard monitoring procedures and techniques.

At the time of job assignment, special training will be provided to on-site personnel who may be exposed to unique or special hazards not covered by the initial 40-hour basic health and safety course. If unique or special hazards are unexpectedly encountered, specialized training will be provided before work proceeds.

3.3 Incident Reporting

An ISOTEC Health & Safety Incident Report will be filed for any incident involving personnel working at this Site. Situations covered by this policy include, but are not limited to, fires, explosions, illnesses, injuries and motor vehicle collisions. These reports must be sent to the ISOTEC DHS within 24 hours of the incident. Worker's Compensation Insurance reports for ISOTEC employees must be filed within 48 hours (or 2 working days) of each incident or illness that results from work-related activities and requires medical attention. See Attachment C for a copy of the ISOTEC Health & Safety Incident Report. The ISOTEC SSO or Project Manager will complete this form if needed.

3.4 Illumination, Sanitation and Confined Space Entry

3.4.1 Illumination

All major work tasks will occur inside (with active lighting in the building) during daylight hours. The illumination requirements set forth by OSHA Regulations 29 CFR 1910.120 (m) will be met.

3.4.2 Sanitation

The sanitation requirements regarding potable and non-potable waters, toilet facilities and washing facilities will be followed as set forth in OSHA Regulations 29 CFR 1910.120(n).

3.4.3 Confined Space Entry

Confined Space Entries will not be conducted under this HASP.

3.5 Respirator Maintenance, Fitting and Decontamination

Respirators will only be used when deemed necessary by the ISOTEC SSO. In the event that respirators are used, the respirators will be cleaned daily according to procedures described below. Cartridges will be replaced when breakthrough is detected at any time while in use. An increased resistance to breathing will determine breakthrough for HEPA cartridges. The following checks will be performed daily, in addition to the above:

- Exhalation valve - pull off plastic cover and check valve for debris or for tears in the neoprene valve, which could cause leakage.
- Inhalation valves - screw off both cartridges and visually inspect neoprene valves for tears. Make sure that the inhalation valves and cartridge receptacle gaskets are in place.
- Make sure a protective lens cover is in place.
- Make sure you have the proper HEPA cartridges.
- Make sure that the face piece harness is not damaged. The serrated portion of the harness can fragment which will prevent proper face seal adjustment.
- Make sure the speaking diaphragm retainer ring is hand tight.

NOTE: The respirator MUST be Leak-Tested before each use.

Test the respirator for leakage by using both the positive- and the negative-pressure method. Lightly place your palm over the exhalation valve cover. Exhale gently. The body of the respirator should bulge slightly outward from your face. If any leakage is detected around the face seal, readjust the head harness straps and repeat the test until there is no leakage. If leakage is detected other than in the face seal, the condition must be investigated and corrected before another test is made. The negative pressure test must also be made. Lightly place your palms or some impervious material, like Saran Wrap® over the cartridges or filter holders. Inhale gently. The face-piece should collapse against the face. The respirator must pass these two tightness tests before the respirator is used. The respirator will not furnish protection unless all inhaled air is drawn through suitable cartridges or filters.

NOTE: Respirators provide no protection in oxygen-deficient atmospheres!

After use, follow these steps to clean your respirator:

- Wash with Alconox® solution and brush gently. (This step will remove any soil/solid particulate matter that may have been collected on the respirator during field activities.)
- Rinse with distilled/de-ionized water, making sure that the inhalation and exhalation valves are clean and unobstructed.
- Rinse with distilled/de-ionized water.
- Wipe with sanitizing solution. (This step will assure the sterility of the respirator.)
- Allow your respirator to air dry.
- Place the respirator inside a sealed bag or a clean area away from extreme heat or extreme cold.

3.6 ISOTEC Project Manager Notification

All field personnel must sign-in on a sheet maintained by the ISOTEC SSO or the Alternate ISOTEC SSO before entering the Site.

IF ANY PREVIOUSLY UNIDENTIFIED POTENTIAL HAZARDS ARE DISCOVERED DURING ANY FIELD WORK, LEAVE THAT AREA OF THE SITE IMMEDIATELY AND CONTACT THE ISOTEC SSO FOR FURTHER INSTRUCTIONS.

3.7 OSHA Information Poster

In accordance with the Occupational Safety and Health Act of 1970, a copy of the OSHA information poster must be present at the Site. It will be posted at full size (11" x 17") in a permanent structure or temporary field office, or will be communicated to on-site personnel via Attachment E.

3.8 Prohibitions

Smoking, eating, drinking, chewing tobacco or toothpicks, applying cosmetics, storing food or food containers, and having open fires will be permitted only in designated areas that will be established by the ISOTEC SSO. Under no circumstances will any of the above activities be permitted within the Exclusion or Contamination Reduction Zones. Good personal hygiene should be practiced by field personnel to avoid ingesting contaminants.

3.9 Initial Site Safety Meeting and Signing of Health and Safety Plan Compliance Agreement

The ISOTEC SSO will hold an initial site safety meeting with ISOTEC, subcontractor and contractor field personnel before work activities begin at the Site. At this meeting, it will be verified that all personnel have been provided with or have reviewed a HASP for the work activities to be performed at this Site. For ISOTEC personnel, its subcontractor’s personnel, and contractor personnel whose employer(s) have adopted this HASP, the HASP shall be reviewed, discussed and questions will be answered. Signed Health and Safety Plan Compliance Agreement Forms of personnel who will be following this HASP will be collected by the ISOTEC SSO and filed. Individuals refusing to sign the Form will not be allowed to work on the Site.

3.10 Daily Site Safety Briefings

During field operations, site safety briefings will be held at the start of each day by the ISOTEC SSO to review and plan specific health and safety aspects of scheduled work. All field personnel who are following this HASP are required to attend these briefings. These meetings and their content shall be documented by the ISOTEC SSO or Project Manager. Each company will have a SSO. SSO’s will meet each day to discuss accidents and relative risk and safety issues. Each SSO is responsible for their personnel. SSO’s will agree on communication methods when health and safety actions occur. Potential subjects that may be discussed are presented below:

1. Preliminary
    - Medical clearances.
    - Training requirements.
    - Written HASP availability.
    - Designation of responsibilities for on-site personnel.
    - Identification of on-site personnel trained and certified to administer First Aid.
2. Training topics
    - Review of HASP including: types of hazards; pathways of exposure; levels of protection; contamination avoidance; prohibitions; work procedures; work zones; emergency response procedures; and, specific on-site area/work tasks of concern.
    - Decontamination.
    - Personnel Protective Equipment.
    - Air Quality Monitoring Program.
3. Questions and Answers

3.11 ISOTEC Material Handling and Storage

ISOTEC employees will handle and store concentrated oxidants (i.e. sodium persulfate.) and sodium hydroxide to complete this project. ISOTEC employees, the injection/mixing technicians and the SSO, have received training in the proper handling and storage of these chemicals. ISOTEC employees have also received specific training in the PPE required to handle and inject these chemicals safely into the subsurface.

For this project, sodium persulfate with 25% sodium hydroxide activation has been proposed. Sodium persulfate will be delivered to the site in 55-pound bags. The bags will be stored on pallets or within enclosed drums in the vicinity of the chemical mixing area (to be determined by ISOTEC/OBG at the site) and will only be opened as needed for mixing. The mixing of powdered sodium persulfate will be completed in either 55-gallon drums or 100-gallon poly mixing tanks. The mixing tanks will be used to mix the persulfate with water to a starting concentration of ~10%. Once the persulfate is thoroughly mixed, a pre-determined volume of 25% sodium hydroxide will then be pumped into the mixing tanks to activate the persulfate and the final solution will be injected into the designated injection wells.

Once the persulfate is diluted safety hazards associated with the reagents are minimal. Technicians should avoid contact with the liquids during injection. If contact occurs flush the affected area with water and follow the procedures outlined in the MSDS sheet.

– End of Section –

Section 4 HAZARD ASSESSMENT

An assessment of the known or suspected chemical, physical and biological hazards has been made for each of the activities specified below.

4.1 Approved Work Activities

Work activities, which may be performed under this HASP, are limited to the following:

- In-situ chemical oxidation treatment consisting of a mixture of sodium persulfate activated by sodium hydroxide conveyed into subsurface via injection wells.
- Sampling of nearby wells for process parameters.

This HASP does not cover any site activities beyond those specifically listed above. Work activities not described above may be conducted only after an appropriate Addendum to this HASP has been issued by the ISOTEC DHS.

4.2 Hazards

Potential hazards associated with the project are discussed below. Specific hazards associated with ISOTEC reagent handling and storage are discussed in Section 3.11.

4.2.1 Well Installation

Injection well installation will be completed by OBG prior to ISOTEC arriving on site. No further drilling or well installation is planned for the site based on the current scope of work for ISOTEC personnel.

4.2.2 Environmental Contaminants

The following chemical information presents the significant contaminants that have been previously identified or routinely encountered during groundwater sampling activities within the site boundaries.

4.2.2.1 Chemical Hazards

The following chemical hazards have been identified, based on documented prior site uses, initial site investigations and/or proposed remedial action.

1. VOCs; primarily PCE, TCE, DCE and VC.
2. Sodium persulfate (~10%)
3. Sodium hydroxide (25%)

4.2.2.2 Chemical Exposure Controls

Contaminants usually enter the body through the mouth (ingestion), the lung (inhalation) or by absorption through the skin and mucous membranes. Chemical exposure through these routes will be controlled by limiting eating, drinking, and smoking to uncontaminated areas; through the use of hygiene practices and decontamination procedures; and by the use of appropriate engineering controls and personal protective equipment (PPE). There are four levels of personal protection (Levels A, B, C, and D), according to the degree of protection they afford, with Level A providing the greatest degree of protection. The initial level of personal protective equipment to be used while performing activities at the Site will be Modified Level D.

There is a potential for a small percentage of the COCs to become airborne during the subsurface injection of reagents. However, the potential health hazard to field personnel caused by VOC vapors is minimum since the field activities will take place in an open environment. Therefore, air monitoring is not required. The monitoring program outlined in Section 5, if deemed necessary, is considered to be protective of the surrounding areas, outside of the work zone.

4.2.3 Physical Agents

Physical agents include noise, electro-magnetic fields, ionizing and non-ionizing radiation and thermal stress. There is also a risk of physical injury from slips, trips, falls, cuts, sprains, etc., when working in the field with sampling tools and when near heavy equipment, operating machinery and vehicular traffic. Field personnel should be able to recognize these hazards and take steps to avoid injurious contact with them. The following precautions must be observed whenever heavy equipment is in use:

- Personal protective equipment (PPE) such as steel-toed shoes, safety glasses or goggles, and hard hats must be worn whenever such equipment is present.
- Personnel must at all times be aware of the location and operation of heavy equipment, and take precautions to avoid getting in the way of its operation. Never assume that the equipment operator sees you; make eye contact and use hand signals to inform the operator of your intent, particularly if you intend to work near or approach the equipment. Keep all non-essential personnel out of the work area.
- Never walk directly in back of or to the side of, heavy equipment without the operator’s acknowledgment.
- When an equipment operator must operate in tight quarters, the equipment subcontractor should provide a person to assist in guiding the operator’s movements.
- Any heavy equipment that is used in the exclusion zone should remain in that zone until its task is completed. The equipment subcontractor should completely decontaminate such equipment in the designated equipment decontamination area as required prior to moving the equipment outside of the Exclusion Zone.

Noise Exposure

Work at the site may be conducted with high noise levels from equipment such as pumps, drill rigs and mixing equipment. ISOTEC standards require that hearing protection be used when noise levels exceed 85 dBA, averaged over an 8-hour day. Hearing protection will be required at this site for noise exposures greater than 85 dBA for **any** length of time. Hearing protection will be worn anytime a normal conversation cannot be heard. ISOTEC and subcontractor personnel shall have hearing protection on-site and available for use at all times.

Thermal Stress

Depending on the altitude, geographic location and the season, the use of required PPE may cause heat or cold related stress on the wearer. The Heat Stress Casualty Prevention Plan as specified in Attachment-F will be referred to for dealing with this health hazard during warm weather. The Plan outlines heat stress identification, treatment, prevention and monitoring. Fluids will be provided at all times during work periods, in order to maintain adequate body fluid levels for field personnel.

Electro-magnetic fields

Field activities may include the use of electricity via a portable generator supplied by ISOTEC. To protect on-site personnel from the risk of shock/electrocution, the portable generator shall be equipped with a ground fault circuit interrupter (GFCI).

Radiation Exposures

Radiation is used to mean ionizing and non-ionizing, laser and microwave emissions. No sources of these forms of radiation are known to exist on-site.

4.2.3.1 Controls for Physical Agents

No physical hazards, as defined, are known or believed to be present.

4.2.4 Biological Agents

Biological agents may be viral, fungal, bacterial, or of higher orders: insects (including ticks and stinging insects), wild animals (especially snakes) and domesticated animals. Any mammal encountered on-site should be considered potentially rabid. In many parts of the northeast United States, tick-borne diseases pose a significant health risk during warm months (see Attachment H, ticks and Tick-Borne Diseases). Field personnel are encouraged to use insect repellents before donning PPE. To avoid snakebites check for snakes before walking through grassy or debris strewn areas. The presence of medical waste suggests the possibility that pathogenic micro-organisms may be present. A fully stocked first aid kit, insect and tick repellent (wear appropriate) must be available for use in the field.

4.2.4.1 Biological Agent Controls

No biological agents, as defined, are known or believed to be present.

4.2.5 Safety Hazards

Use of steel-toed work boots, safety glasses or goggles, and nitrile gloves will be required when in an Exclusion Zone. Personnel should be aware that when PPE such as respirators, gloves, and protective clothing are worn, visibility, hearing, and manual dexterity are impaired.

4.2.6 Pressurized Injection

Field activities will involve reagents to be conveyed into subsurface with some form of mechanical equipment. Based on subsurface permeability at a site, a pressurized delivery system will probably be required while injecting into the overburden and shallow bedrock aquifers. It is being anticipated that higher injection pressures may be needed while performing injections into the shallow bedrock aquifer compared to injections within the overburden aquifer. When a pressurized system is used, extreme caution must be exercised to prevent serious personal injury or property damage as with the use of any pressure operated equipment or pressurized systems. Safety procedures are outlined in Attachment I.

4.2.7 Spill Control and Countermeasures

During implementation of in-situ chemical oxidation, large volumes of reagents are typically transported, stored, mixed and injected. The reagents for this project include sodium persulfate, sodium hydroxide (25-50%) and potable water. The sodium persulfate will be transferred from the 55-pound bags into bulk poly containers (55-100 gallon tanks/drums). Sodium hydroxide (pre-determined volume) will then be pumped out of the DOT approved storage drums and mixed in with the sodium persulfate solution. Once completely mixed, the solution will then be pumped from the mixing tanks out to the designated wells to be introduced into the subsurface though injections. The hose carrying the activated persulfate will be fastened at each connection to ensure that no leakage occurs. The connections will be checked daily before any chemical pumping. If a spill or release occurs on the ground surface, the affected area will be surrounded by a soil containment berm or dri-zorb containment berm. The solution will be containerized, and then transferred to an empty drum to be re-injected back into the subsurface. A shop-vac will be onsite to vacuum up any leaked material if necessary.

– End of Section –

Section 5 AIR QUALITY MONITORING AND MEASURES FOR THE CONTROL OF EMISSIONS

5.1 Air Quality Monitoring Instrument

ISOTEC personnel will not monitor air quality during the in-situ chemical oxidation remedial field activities. Any air monitoring required for the site will be the responsibility of OBG. Instruments which may be used to monitor air quality are discussed below:

Photoionization Detector

The HNu Systems Model PI-101 Photoionization Detector (PID) or equivalent will be used to detect trace concentrations of certain organic gases and a few inorganic gases in the air. Methane, ethane, and the major components of air are not detected by the HNu PID. PID readings reflect total (readable) vapors in the air. PID readings must be given as "PID units", rather than "ppm". The PID detects mixtures of compounds simultaneously. PID readings do not measure concentrations of any individual compound when a mixture of compounds is present.

The PID will be calibrated twice each day (before start of work and after the conclusion of work) using an isobutylene standard (molecular weight = 56.2) for calibration. Calibrations will be logged. PID readings should be measured in the breathing zone of the most highly exposed worker (i.e., the person who is closest to the source of known or suspected contamination) at least hourly.

Flame-Ionization Detector

The Foxboro Model-108 Flame-Ionization Detector (FID) or equivalent will be used to detect trace concentrations of certain organic gases in the air. The FID is capable of detecting methane, ethane, and similar compounds in air that are not detected by a PID. The FID detects mixtures of compounds simultaneously. FID readings do not measure concentrations of any individual compound when a mixture of compounds is present.

The FID will be calibrated twice each day (before start of work and at the conclusion of work) using an isobutylene standard for calibration. Calibrations will be documented. FID readings should be measured in the breathing zone of the most highly exposed worker (i.e., closest to the source) at least hourly.

Combustible Gas Indicator/Oxygen/Hydrogen Sulfide Meter

An approved Combustible Gas Indicator/Oxygen Meter, which may have a separate hydrogen sulfide detector, may be used, at the discretion of the ISOTEC SSO, to measure the concentration of flammable vapors and gases, oxygen, and hydrogen sulfide in the air during field activities. Flammable gas concentrations are measured as percentages of the Lower Explosive Limit (LEL). Oxygen content is measured as a percentage of air. Hydrogen sulfide concentration (which includes sulfur dioxide) is measured in parts per million.

Multigas Detector Tubes

Draeger Multigas Detector Tubes may be used at the discretion of the ISOTEC SSO to detect and semi-quantify the concentration of selected contaminants in the air. The tubes must be able to detect concentrations at or below the OSHA Permissible Exposure Limit (PEL) for the contaminant in question. It should be realized that most detector tubes will also respond to chemically similar organic vapors.

Personal Monitor for Aerosol and Dust

The MIE, Inc. Model PDM-3 MiniRAM Personal Monitor for Aerosol and Dust (MiniRAM Monitor), or equivalent, will be used at the discretion of the ISOTEC SSO to detect and quantify the concentration of fugitive respirable dust that may be created during ground-disrupting operations. The instrument is capable of measuring fugitive respirable dust at concentrations as low as 0.1 mg/m^3. The miniRAM may be used to estimate the concentration of metals or other non-gaseous contaminants, if their soil concentrations are known. Soil levels are normally reported as milligrams per kilogram of soil (mg/kg). This is equivalent to 10^{-6} mg of contaminant per mg of soil. Since the miniRAM readout is milligrams of total (soil) dust per cubic Meter of air (M^3), the soil analysis concentration can be divided by 'one million' and multiplied by the miniRAM reading in order to estimate the contaminant concentration in air.

5.2 Air Quality Response Levels

In the event that air monitoring is required, the Site Safety Officer will decide when to change protection levels in response to air monitoring results. The ISOTEC DHS will be notified of any upgrades from initial protection levels, as soon as is practical. ISOTEC Action Levels for this project are described in detail in Table 5-1, at the end of this Section. These Action (Response) Levels apply to the work activities covered by this HASP.

5.3 Monitoring Guidelines

5.3.1 Background Organic Vapor Monitoring

In the event that air monitoring is required, background organic vapor and combustible gas readings may be taken at least twice daily: before the start, and after the conclusion of work activities. Background levels will be taken at locations surrounding the site that are unaffected by on-site work. Once work at the site begins, reselection of the original background location may be required.

5.3.2 Air Monitoring Protocol

In the event that air monitoring is required, at least one series (series=PID and CGI) of readings will be taken every 15 minutes during intrusive work activities (i.e. drilling, excavation). If no increase in readings, above action levels, are observed after one hour of monitoring, the frequency will be reduced to once every 30 minutes. If no increase in readings, above action levels, are observed after one hour of monitoring, the frequency will be reduced to once each hour. During non-intrusive work activities, one series will be performed at the start of work, one series at some point during the work, and one near the conclusion of the work. This will be in addition to the background monitoring described in the previous section.

5.3.3 Documenting Monitoring Results

A calibration log will be kept for each of the monitoring instruments used, which describes the calibration method(s) used, and the readouts obtained. Should work at the site require respiratory protection, the need for a personal exposure monitoring program will be evaluated by the ISOTEC DHS. Details of this program and any monitoring equipment required for its implementation will be specified in an Addendum to this HASP prepared by the ISOTEC DHS. Records of exposure measurements will be maintained in the Health and Safety file for this project.

5.4 Emission Control Measures

Vapor or dust emissions resulting from field operations do not usually exceed either regulatory or ISOTEC action levels. If the action levels are **significantly** exceeded, measures to suppress the responsible emissions should be investigated. Appropriate measures would include cessation of operations until the exact cause of the emission is identified and corrected. Vapor control may include the use of vapor suppression foams, covering exposed soil piles with plastic sheeting and/or spraying exposed soil piles and drilling sites with water or enzyme solutions. Fugitive dust emission control may require water spraying. In addition, calcium chloride may be needed.

TABLE 5-1

ISOTEC RESPONSE ACTIONS

ISOTEC Air Quality Measurements and Response Actions

Air Quality Measurement(1)	**Response Action**
PID reading less than 3 units above background (averaged over 1 minute) CGI reading less than 10% LEL Oxygen Meter reading between 19.5% and 25%	Level D Protection or Modified Level D Protection (at the discretion of the ISOTEC SSO)

(1) All Air Quality Measurements, with the exception of CGI measurements for flammable vapors and gases, should be made in the breathing zone of personnel who, in the opinion of the ISOTEC SSO, are most exposed to airborne contaminants. Measurements of flammable vapor and gas levels should be made in the vicinity of the nearest ignition source.

Air Quality Measurement	**Response Action**
PID reading greater than 3 units, and less than 8 units above background (averaged over at least 1 minute) CGI reading 10-25% of LEL Oxygen Meter reading between 19.5% and 25%.	Level C Protection

Air Quality Measurement	**Response Action**
PID reading 8 units or more above background (avg. over at least 1 minute) CGI reading > 25% LEL Oxygen Meter reading less than 19.5%	Suspend all work activities in immediate area and notify ISOTEC Director of Health and Safety and ISOTEC Project Mgr. Continue air monitoring until readings indicate that work may resume.

NOTE: CGI readings are unreliable in atmospheres with less than 19.5% oxygen!!

- End of Section -

Section 6 PERSONAL PROTECTIVE EQUIPMENT

6.1 Description of Levels of Protection

The personal protection equipment specified in this HASP will be available to all ISOTEC field personnel. The following requirements will also be met, in accordance with OSHA regulations:

1. Facial hair may not interfere with the proper fit of respirators;
2. Contact lenses will not be worn on-site, without exception.
3. Eyeglasses that interfere with the proper fit of full-face respirators will not be worn.
4. No eating, drinking or smoking will be allowed in any area where respiratory protection is required.

Level D Personal Protective Equipment

- Safety glasses or goggles
- Steel-toed leather or rubber work boots
- Hearing protection (if warranted)
- Traffic vest (if warranted)

Modified Level D Personal Protective Equipment

- Hard hat(1)
- Safety glasses or goggles
- Steel-toed leather work boots
- Rubber overboots, steel-toed rubber boots, or disposable "booties" (1)
- Nitrile-butadiene rubber outer gloves
- Latex surgical gloves (to be worn underneath outer gloves)
- Dust Mask (1)
- Face Shield (1)
- Polyethylene coated or Saranex impregnated Tyvek coveralls(1) (taped at cuffs)
- Hearing protection (if warranted)
- Traffic vest(1)

(1) Optional, at the discretion of ISOTEC SSO.

Level C Personal Protective Equipment (not called for under this plan)

- Hard hat
- Half-face Air-Purifying Respirator with applicable chemical cartridge combined with a HEPA filter
- Steel-toed leather work boots
- Rubber overboots, steel-toed rubber boots, or disposable "booties"
- Nitrile-butadiene rubber outer gloves
- Nitrile surgical gloves (to be worn underneath outer gloves)
- Polyethylene coated or Saranex impregnated Tyvek coveralls (taped at cuffs)
- Hearing protection if warranted.

A first aid kit, multi-purpose dry chemical UL Class 10A-10B-C fire extinguisher, eye wash station, appropriate barricades/cones and access to running water will be present and maintained at the Site.

Selection of the PPE specified for this project is based on a review of known or suspected hazards, routes of potential exposure (inhalation, skin absorption, ingestion, and skin or eye contact) and the effectiveness of personal protective equipment in providing a barrier to these hazards. In addition, PPE has been selected to match the work requirements and task-specific conditions of the job, and to provide adequate protection without causing unnecessary discomfort or physical impairment to the worker.

6.2 Initial PPE Levels for Specific Work Tasks

The selection of Initial Levels-of-Protection takes into consideration the physical, biological and chemical hazards posed by the site as well as those posed by the various pieces of personnel protective clothing. Initial Levels-of-Protection are established so as to obtain acceptable levels of protection while not imposing an unacceptable level of physical stress on the wearer.

The following initial PPE levels have been established for the tasks described in Section 4.1, Approved Work Activities:

Work Activity	Level of Protection
Sodium persulfate preparation	Modified Level D
Sodium hydroxide dilution/transfer	Modified Level D
Process Monitoring	Modified Level D
Chemical Injections	Modified Level D

- End of Section -

Section 7 DESIGNATION OF WORK ZONES

This section of the Health & Safety Plan applies to excavation projects where contaminated soils are exposed and may release their contaminants to the air, or come in contact with field personnel. To minimize the migration of contaminant from the Site to uncontaminated areas, three work zones will be set up:

Zone 1:	Exclusion Zone
Zone 2:	Contamination Reduction Zone
Zone 3:	Support Zone

The Exclusion Zone is the area where contamination occurs or could occur. Initially, the Exclusion Zone should extend a distance of 25 ft from the edge of intrusive activity unless conditions at the Site warrant either a larger or smaller distance as determined by the ISOTEC SSO. All persons entering the Exclusion Zone must wear the applicable level of protection as set forth in Section 6.1, Personal Protective Equipment and Section 6.2, Initial PPE Levels for Specific Work Tasks. It is anticipated that work zones will be established at each individual area of intrusive work rather than encompass the entire Site.

The Support Zone is the area of the Site where significant exposure to contamination is not expected to occur during non-intrusive activities. The Support Zone is considered to be the "clean area" of the Site.

Between the Exclusion Zone and Support Zone is the Contamination Reduction Zone, which provides a transition zone between the contaminated and clean areas of the Site. The Contamination Reduction Zone will be located directly outside of the Exclusion Zone. All personnel must decontaminate when leaving the Exclusion Zone. A Contamination Reduction Zone (decontamination area) will be established adjacent to each individual area of intrusive work.

- End of Section -

Section 8 DECONTAMINATION PROCEDURES

Contamination reduction procedures appropriate for the existing work area will be developed and specified by the SSO. Such procedures must be in place before site operations begin, and they must remain in place (modified as necessary) throughout the period of activity. Wherever possible, the need for decontamination should be reduced through work practices that minimize contact with contaminants. Personnel should avoid walking through heavily contaminated areas, should not kneel or directly touch contaminated materials, and should use remote handling and sampling techniques when feasible.

Decontamination will be performed only in designated areas. Separate areas may be set up for equipment and personnel.

8.1 Personnel Decontamination

Personnel who have been in contact with contaminated materials will decontaminate themselves in the following manner:

- Deposit contaminated equipment on plastic drop cloths.
- Stand in wash tub containing Alconox® and water, wash boots and outer gloves with long handled brush.
- Rinse boots and outer gloves with long handled brush in a wash tub containing clear water or use a sprayer to rinse off boots and gloves.
- Remove ankle and wrist tapes; place in disposal drum.
- Remove outer gloves and place in disposal drum.
- Remove Tyvek® suit and place in disposal drum.
- Remove respirator and place on table to be decontaminated.
- Remove inner gloves and place in disposal drum.
- Wash hands and face.

8.2 Equipment Decontamination

Equipment which might require decontamination includes heavy equipment, tools, monitoring equipment, sampling equipment, and sample containers; trucks and trailers; and the decontamination equipment itself when the decontamination is closed down. Before entering the site, all equipment will be cleaned to remove grease, oil, encrusted dirt, or other potential contaminants. **Because drilling activities will be performed prior to ISOTEC arriving on site, we are not anticipating much (if any) equipment that would require decontamination. Individual bailers will be used to collect grab samples from nearby wells and will be disposed of at the end of the treatment program.**

All tools or equipment, which have been in contact with contaminated materials, must be decontaminated after leaving the Exclusion Zone. This decontamination is to be performed using a high pressure/hot water "steam type" cleaner or a spray/rinse decontamination sequence as described in Section 3.5, Respirator Maintenance, Fitting and Decontamination, as appropriate.

Contaminated liquids from the decontamination area and contaminated clothing will be disposed of in accordance with site protocols. If any liquids are collected, OBG will handle the proper disposal.

8.3 Disposal of Decontamination Wastes

Solid and liquid decontamination waste will be containerized. Solids may be double bagged, or placed in a sealed drum or similar container. Liquids will be collected during decontamination and placed in sealed containers or pumped into holding tanks for future testing and disposal. Containers must be clearly labeled for content, the operation from which they were filled, and the dates.

- End of Section -

Section 9 EMERGENCY RESPONSE PLAN

9.1 Emergency Response

Emergencies addressed by this plan include:

- Fire;
- Chemical over-exposures;
- Physical injuries to site personnel; and,
- Chemical spills.

NOTE: Check to see if emergency services will be provided by OBG or if outside, municipal/volunteer providers must be contacted once an emergency occurs.

The ISOTEC Health & Safety Officer and Project Manager must be notified as soon as possible of any on-site emergency or potential emergency including fire, explosive conditions or OSHA-recordable physical injury.

9.2 Emergency Recognition and Prevention

9.2.1 Fires

Fires are possible if oxygen and flammable gases or vapors are mixed together in proper proportions and an ignition source is present. Potential for on-site fires and explosions is minimum due to the nature of field activities (i.e. few ignition sources exist at the site during the pilot/treatment programs) and a fire extinguisher (minimum 20 lb ABC) is stored in ISOTEC's on-site trailer for emergency use in case that a fire or explosion occurs.

9.2.2 Chemical Exposures

Work should always be performed in a manner that minimizes exposure to contaminants through skin or eye contact, inhalation or ingestion. Work practices to reduce the risk of chemical exposure include:

- PPE, as specified in Section 6.0, will be used by all field personnel covered by this HASP. A formal revision to the HASP must be made by the ISOTEC DHS to modify the PPE specifications.
- Keep hands away from face during work activities.
- Minimize all skin and eye contact with contaminants.

Early recognition of the signs and symptoms of chemical exposure is essential for the prevention of serious chemical exposure incidents. Symptoms of exposure to the compounds present at the Site include the following:

Sodium persulfate: Airborne dust may be irritating to eyes, nose, lungs, throat and skin upon contact. Exposure to high levels of persulfate dust may cause difficulty in breathing in sensitive persons.

Sodium hydroxide: Skin contact and inhalation are expected to be the primary routes of occupational exposure. Sodium hydroxide is a strong alkali that can be destructive to tissue producing severe burns, possibly with deep ulceration and scarring on contact with body tissues. Concentrations as low as 2-3% can cause injury. High levels of dusts or mists may be corrosive to the mucous membranes producing eye or lung injury and chemical pneumonia. Lower concentrations may produce irritation of eyes, nose or upper respiratory tract with coughing, sore throat and shortness of breath.

VOCs: Primarily PCE, TCE, DCE and VC.

Inhalation – Causes headache, dizziness, drowsiness and nausea. Affects may lead to unconsciousness.

Ingestion – Causes abdominal pain, burning sensation. Symptoms parallel those following inhalation exposure.

Skin Contact – Causes mild skin irritation. Symptoms include redness, itching and pain. May be slowly absorbed through the skin with possible systemic effects.

Eye contact – Vapors cause mild eye irritation. Splashes cause severe irritation, possible corneal burns and eye damage.

If a person experiences any of these acute symptoms, or recognizes any of them in a fellow worker, the person experiencing the symptoms will stop work immediately and report to the ISOTEC SSO. If the symptoms persist or affect performance in any way, the ISOTEC SSO will arrange for medical treatment. If the symptoms are serious, or affect several people, work activities in the exposure area will be discontinued until more is known about the cause(s). Incident reporting procedures as specified in Section 3.3 will be initiated.

9.2.2.1 Eye Wash Station and or Bottle

In the event of hazardous chemical contact with eyes, portable eye wash station and or bottles will be available for immediate treatment. Prior to field activities, all personnel to be entering the Exclusion Zone will be instructed on the location of the eye wash bottles and its operating procedure by the Site Safety Officer during the Site Safety Meeting.

Any personnel involved in a hazardous chemical eye contact incident requiring use of the site eye wash station and or bottles may be required to seek further medical assistance/evaluation as directed by the Site Safety Officer.

9.2.3 Physical Injuries

Site personnel should be on the lookout for potential safety hazards such as holes or ditches; improperly positioned objects, such as drums or equipment that may fall; sharp objects, such as nails, metal shards, and broken glass; protruding objects at eye or head level; slippery surfaces; steep grades; unshored steep entrenchments, uneven terrain or unstable surfaces, such as walls that may cave in or flooring that may give way. Site personnel should inform the ISOTEC SSO of any potential hazards observed so that corrective action can be taken.

9.2.4 Spill Prevention

Site personnel should be aware of potential conditions that could cause a spill and take preventative measures before a spill occurs. Concentrated oxidants (i.e. sodium persulfate) and sodium hydroxide will be stored in such a way that if a spill of either were to occur the two would not come into contact with each other. Safe storage and handling procedures are discussed further in Sections 3.11 and 4.2.6. The tanks used to store and mix the reagents are oversized to prevent spillage from the tanks. Whenever possible, a closed system will be utilized when transferring any chemical. Any spill or leak that occurs on the pavement will be contained by a soil or dri-zorb berm, then collected and injected back into the subsurface.

9.3 Emergency Alerting Procedures

The ISOTEC SSO will alert the appropriate work groups when an emergency occurs. The appropriate phone numbers for key project personnel are listed below in Section 9.5. The ISOTEC SSO and any isolated work group will carry radios if direct contact cannot be maintained. If direct contact cannot be maintained, an air horn will be used to signal workers to stop work and assemble in the Contamination Reduction Zone. If evacuation of the Site is necessary, a pre-arranged signal from the air horn will be sounded.

9.4 Evacuation Procedures and Routes

Normally, personnel should evacuate through the Contamination Reduction Zone, and from there, to the Support Zone. Evacuation from the Contamination Reduction Zone will proceed in an upwind direction from the emergency. If evacuation to the Support Zone does not provide sufficient protection from the emergency, personnel will be advised to evacuate the Site proper.

9.5 Telephone Numbers for Emergency Services and Contacts

The telephone numbers of local emergency services are given below:

Emergency Service	Telephone Number
Ambulance	911
Fire Department	911
Police Department	911
Hospital	White Plains Medical Center @ 914-681-0600
Poison Control Center	(800) 222-1222
USEPA National Response Center	(800) 424-8802
OBG PM	Guy Swenson – Cell Phone @ (315) 956-6342
OBG PM	Mark Randazzo – Cell Phone @ (781) 883-6432
OBG PM	Office Phone @ (914) 345-1616, extn. 13
ISOTEC Office	(609) 275-8500
ISOTEC Technical Director	Prasad Kakarla – Cellular Phone @ (609) 902-1334
ISOTEC DHS	Tom Andrews – Cellular Phone @ (908) 537-0037
ISOTEC Project Manager	Mike Temple – Cellular Phone @ (732) 278-0809
ISOTEC Field Manager	Kevin O'Neal – Cellular Phone @ (609) 558-7692
ISOTEC Field Manager	Tom Musser – Cellular Phone @ (267) 767-7309

These telephone numbers must be verified by the ISOTEC SSO before the start of field work.

9.6 Emergency Response Personnel

The ISOTEC SSO will have the primary role in responding to all emergencies at the Site. The ISOTEC SSO, or the Alternate ISOTEC SSO, will be present at the Site during all work activities. If any emergency such as a fire, chemical exposure, or physical injury occurs, the ISOTEC SSO shall be notified immediately. The ISOTEC SSO will direct all site personnel in cases of emergency.

After an emergency has occurred at the Site, the causes and responses to that emergency shall be thoroughly investigated, reviewed and documented by the ISOTEC Project Manager and ISOTEC SSO; this documentation is to be submitted to the ISOTEC DHS within 48 hours of the incident.

9.7 Decontamination Procedures During an Emergency

Decontamination of an injured or exposed worker or during a site emergency shall be performed only if decontamination does not interfere with essential treatment or evacuation.

If a worker has been injured or exposed and decontamination can be done: Wash, rinse, and/or cut off protective clothing and equipment.

If a worker has been injured or exposed and cannot be decontaminated:

- Wrap the victim in blankets, plastic or rubber to reduce contamination of other personnel;
- Alert emergency and off-site medical personnel to potential contamination; and,
- Have the ISOTEC SSO or other personnel familiar with the incident and contaminants at the Site accompany the victim to the hospital. If possible, send a copy of the appropriate MSDS(s) with the victim.

9.8 Emergency Medical Treatment and First Aid Procedures

Emergency medical treatment or First Aid may be administered at the Site by the ISOTEC SSO or other personnel who have been certified in First Aid.

General emergency medical and First Aid procedures are as follows:

- Remove the injured or exposed person(s) from immediate danger.
- Render First Aid as needed; decontaminate affected personnel, if necessary.
- Call an ambulance for transport to local hospital immediately. <u>This procedure shall be followed even if there is no apparent serious injury.</u>
- Evacuate other personnel at the Site to safe places until the ISOTEC SSO determines that it is safe for work to resume.
- Report the accident to the ISOTEC DHS immediately.

Emergency Medical Treatment and First Aid Procedures are presented in Attachment-G.

9.9 Directions to the Hospital from Site

The route and/or directions to the hospital from the Site are in Attachment-B. The directions to the hospital from the site must be verified by the ISOTEC SSO prior to the start of field work.

- End of Section -

Section 10 PERSONNEL ASSIGNMENTS

10.1 Project Personnel

ISOTEC personnel authorized to enter the Site and work on this project, subject to compliance with provisions of the HASP, are:

ISOTEC Project Manager	Prasad Kakarla or Mike Temple
ISOTEC Site Manager	Kevin O'Neal, Mike Temple or Tom Musser
ISOTEC Site Safety Officer	Kevin O'Neal, Mike Temple or Tom Musser
ISOTEC Director of Health and Safety	Thomas Andrews
ISOTEC Injection Personnel	Sean Collins, Ken Stewart, Stefan Brooks and Mark Ratner

Other personnel who meet HASP requirements, including training and participation in a medical surveillance program, may enter and work on the Site subject to compliance with provisions of the HASP.

10.2 Project Safety Responsibilities

Personnel responsible for implementing this Health and Safety Plan are the ISOTEC Project Manager and the ISOTEC Site Safety Officer. Their specific responsibilities and authority are described in the ISOTEC Health and Safety Manual.

- End of Section -

Section 11 HEALTH AND SAFETY PLAN APPROVALS

The authorized signatures below verify that this Health and Safety Plan has been read and approved for the work to be performed at the subject site:

ISOTEC Case Name: OBG/Holland Avenue Site, White Plains, NY

ISOTEC Case Number: 801830

Mike Temple ISOTEC Project Manager	Date
Thomas Andrews ISOTEC Director of Health and Safety	Date

- End of Section -

Section 12 HEALTH AND SAFETY PLAN COMPLIANCE AGREEMENT

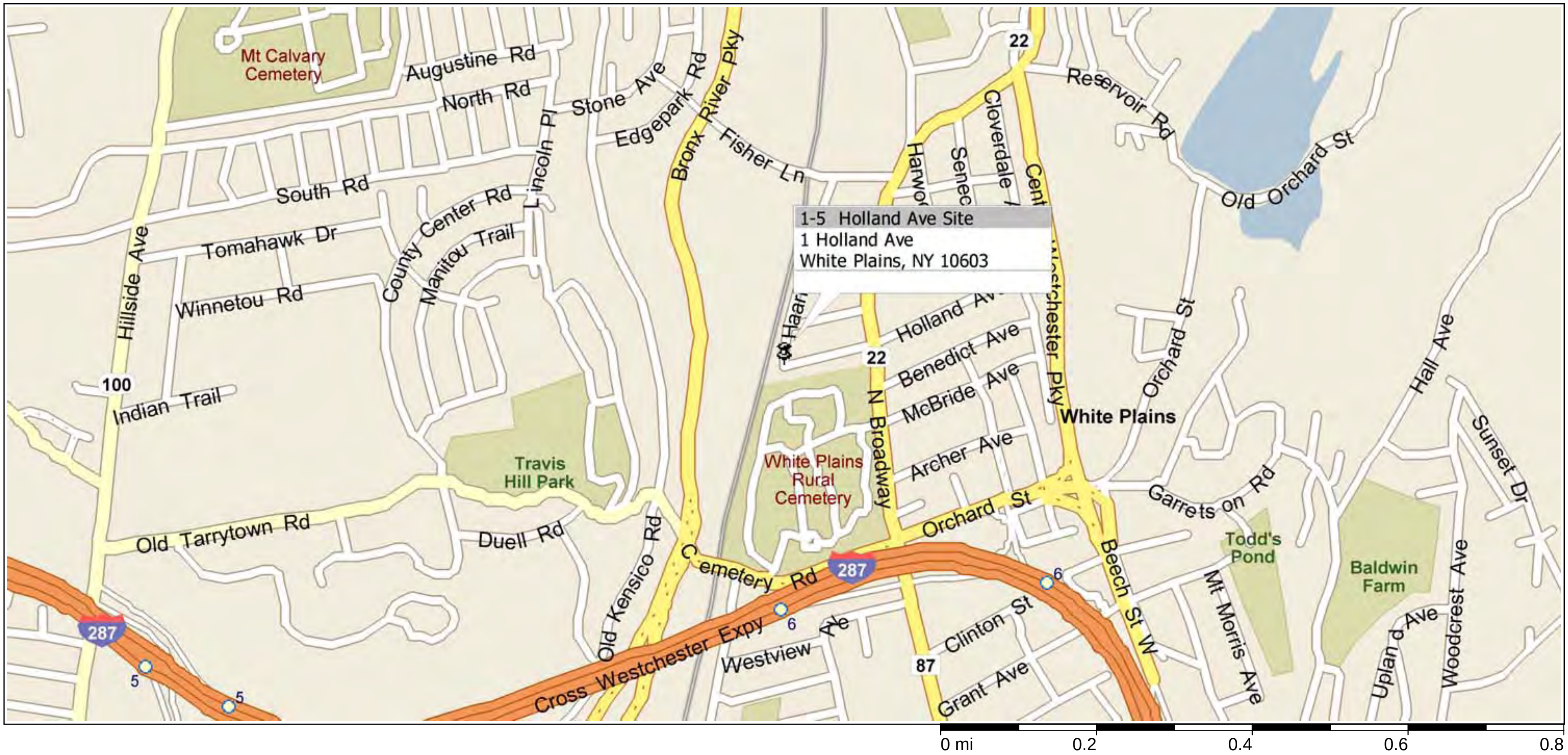
I have reviewed a copy of the Health and Safety Plan for OBG/Holland Avenue Site, White Plains, NY site, dated April 16, 2013. I have read the HASP, understand it, and agree to comply with all of its provisions. I understand that I could be prohibited from working on the project for violating any of the safety requirements specified in the Health and Safety Plan.

Name (print)	Company
Signature	Date
Name (print)	Company
Signature	Date
Name (print)	Company
Signature	Date
Name (print)	Company
Signature	Date
Name (print)	Company
Signature	Date
Name (print)	Company
Signature	Date

ATTACHMENT A

SITE LOCATION MAP

Site Map



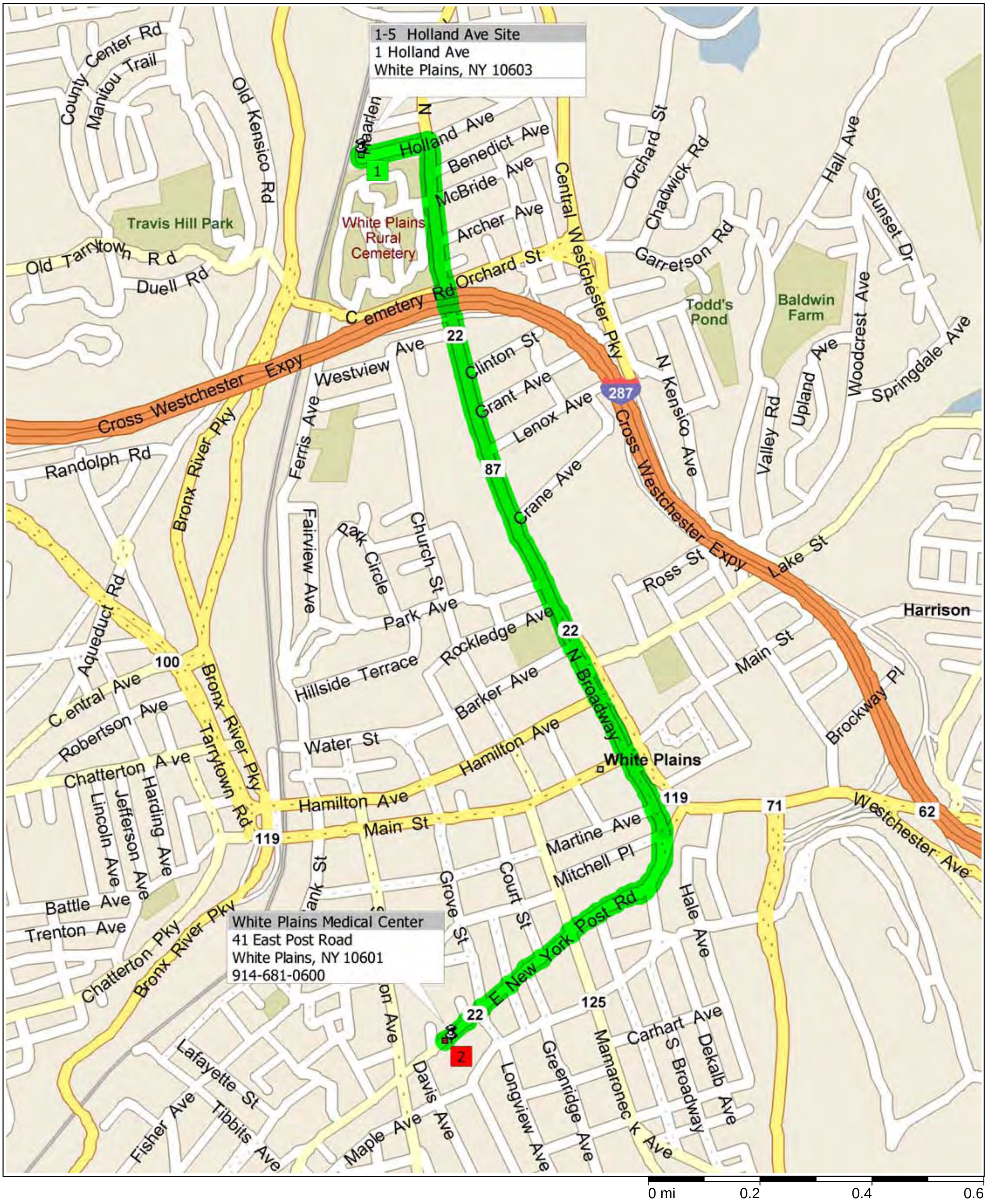
1-5 Holland Ave Site
1 Holland Ave
White Plains, NY 10603
Mt Calvary Cemetery
Augustine Rd
North Rd
Stone Ave
Edgepark Rd
Bronx River Pky
Fisher Ln
Lincoln Pl
South Rd
County Center Rd
Manitou Trail
Tomahawk Dr
Winnetou Rd
Hillside Ave
100
Indian Trail
Travis Hill Park
Old Tarrytown Rd
Duell Rd
Old Kensico Rd
Cemetery Rd
White Plains Rural Cemetery
N Broadway
22
Holland Ave
Benedict Ave
McBride Ave
Archer Ave
Orchard St
Cloverdale
Central Westchester Pky
Reservoir Rd
Old Orchard St
Orchard St
White Plains
Garretson Rd
Hall Ave
Sunset Dr
Todd's Pond
Baldwin Farm
Beech St W
Mt Morris Ave
Upland Ave
Woodcrest Ave
287
Cross Westchester Expy
Westview Ave
Clinton St
87
Grant Ave
5
6
0 mi
0.2
0.4
0.6
0.8

ATTACHMENT B

EMERGENCY ROUTE MAP

Site _ Hospital Map

2.0 miles; 4 minutes



9:00 AM	0.0 mi	1 Depart 1-5 Holland Ave Site [1 Holland Ave, White Plains, NY 10603] on Holland Ave (South-East) for 0.1 mi
9:00 AM	0.1 mi	Turn RIGHT (South) onto SR-22 [N Broadway] for 1.2 mi
9:02 AM	1.3 mi	Keep STRAIGHT onto SR-119 [SR-22] for 0.2 mi
9:02 AM	1.5 mi	Keep STRAIGHT onto SR-22 [S Broadway] for 164 yds
9:03 AM	1.6 mi	Bear RIGHT (South-West) onto SR-22 [E New York Post Rd] for 0.5 mi
9:04 AM	2.0 mi	2 Arrive 41 E Post Rd, White Plains, NY 10601

ATTACHMENT C

HEALTH & SAFETY INCIDENT REPORT

IN-SITU OXIDATIVE TECHNOLOGIES, INC

HEALTH & SAFETY INCIDENT REPORT

Form HS-102

Date/Time of Incident:____

Project Name: **OBG/ Holland Avenue Site**

Project Location: **White Plains, NY**

Project Number: **801830**

DESCRIPTION OF INCIDENT (Describe what happened and possible cause, identify individuals involved, witnesses, and their affiliations, and describe emergency or corrective action taken.)

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Reporter: ____________	____________	____________
Print Name	Signature	Date

Reporter must deliver this report to the ISOTEC Director of Health and Safety within one day of the date of incident for medical treatment cases or vehicle accidents and within five days for other incidents.

Reviewed By: **Thomas Andrews**	____________	____________
Print Name	Signature	Date

ATTACHMENT D

PROJECT SAFETY LOG

IN-SITU OXIDATIVE TECHNOLOGIES, INC

PROJECT SAFETY LOG

Form HS-106

ISOTEC SSO:______________________________**Date**:__________________________

Weather:____

Personnel:

Personnel Present	Affiliation	Work Activities	Level of Protection

PID (ppm)

Reading	Time	Reading	Time	Reading	Time

CGI/O_2 (%LEL)

Reading	Time	Reading	Time	Reading	Time

CGI/O_2 (O_2%)

Reading	Time	Reading	Time	Reading	Time

PROJECT SAFETY LOG (cont. – page 2)

Form HS-106

Colormetric Tubes (ppm)

Reading	Time	Reading	Time	Reading	Time

MiniRam (mg/m^3)

Reading	Time	Reading	Time	Reading	Time

Notes and Comments:____

____

____

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ATTACHMENT E

OSHA POSTER

You Have a Right to a Safe and Healthful Workplace.

IT'S THE LAW!

- You have the right to notify your employer or OSHA about workplace hazards. You may ask OSHA to keep your name confidential.
- You have the right to request an OSHA inspection if you believe that there are unsafe and unhealthful conditions in your workplace. You or your representative may participate in the inspection.
- You can file a complaint with OSHA within 30 days of discrimination by your employer for making safety and health complaints or for exercising your rights under the *OSH Act*.
- You have a right to see OSHA citations issued to your employer. Your employer must post the citations at or near the place of the alleged violation.
- Your employer must correct workplace hazards by the date indicated on the citation and must certify that these hazards have been reduced or eliminated.
- You have the right to copies of your medical records or records of your exposure to toxic and harmful substances or conditions.
- Your employer must post this notice in your workplace.

The *Occupational Safety and Health Act of 1970 (OSH Act)*, P.L. 91-596, assures safe and healthful working conditions for working men and women throughout the Nation. The Occupational Safety and Health Administration, in the U.S. Department of Labor, has the primary responsibility for administering the *OSH Act*. The rights listed here may vary depending on the particular circumstances. To file a complaint, report an emergency, or seek OSHA advice, assistance, or products, call 1-800-321-OSHA or your nearest OSHA office: • Atlanta (404) 562-2300 • Boston (617) 565-9860 • Chicago (312) 353-2220 • Dallas (214) 767-4731 • Denver (303) 844-1600 • Kansas City (816) 426-5861 • New York (212) 337-2378 • Philadelphia (215) 861-4900 • San Francisco (415) 975-4310 • Seattle (206) 553-5930. Teletypewriter (TTY) number is 1-877-889-5627. To file a complaint online or obtain more information on OSHA federal and state programs, visit OSHA's website at **www.osha.gov**. If your workplace is in a state operating under an OSHA-approved plan, your employer must post the required state equivalent of this poster.

1-800-321-OSHA

www.osha.gov

U.S. Department of Labor • Occupational Safety and Health Administration • OSHA 3165

ATTACHMENT F

HEAT AND COLD STRESS GUIDELINES

HEAT STRESS CASUALTY PREVENTION PLAN

Due to the increase in ambient air temperatures and the effects of protective outer wear decreasing body ventilation, there exists an increase in the potential for injury, specifically, heat casualties. Site personnel will be instructed in the identification of a heat stress victim, the first-aid treatment procedures for the victim and the prevention of heat stress casualties.

IDENTIFICATION AND TREATMENT

- **Heat Exhaustion**

Symptoms: Usually begins with muscular weakness, dizziness, nausea, and a staggering gait. Vomiting is frequent. The bowels may move involuntarily. The victim is very pale, skin is clammy, and may perspire profusely. The pulse is weak and fast, breathing is shallow. The victim may faint unless victim lies down. This may pass, but sometimes it remains and death could occur.

First Aid: Immediately remove the victim to the Contamination Reduction Zone in a shady or cool area with good air circulation. Remove all protective outerwear. Call a physician. Treat the victim for shock. (Make victim lie down, raise feet 6 to 12 inches and keep victim warm but loosen all clothing). If the victim is conscious, it may be helpful to ingest sips of a salt-water solution (1 teaspoon of salt to 1 glass of water). Transport victim to a medical facility as soon as possible.

- **Heat Stroke**

Symptoms: This is the most serious of heat casualties due to the fact that the body excessively overheats. Body temperatures often are between 107 degrees Fahrenheit to 110 degrees Fahrenheit. First there is often pain in the head, dizziness, nausea, oppression, and the skin is dry, red and hot. Unconsciousness follows quickly and death is imminent if exposure continues. The attack will usually occur suddenly.

First Aid: Immediately evacuate the victim to a cool and shady area in the Contamination Reduction Zone. Remove all protective outerwear and all personal clothing. Lay victim on back with the head and shoulders slightly elevated. It is imperative that the body temperature be lowered immediately. This can be accomplished by applying cold wet towels, ice bags, etc., to the head. Sponge off the bare skin with cool water or rubbing alcohol, if available, or even place victim in a tub of cool water. The main objective is to cool victim without chilling. Give no stimulants. Transport the victim to a medical facility as soon as possible.

PREVENTION OF HEAT STRESS

- One of the major causes of heat casualties is the depletion of body fluids. On the site there will be plenty of fluids available. Personnel should replace water and salts loss from sweating. Salts can be replaced by either a 0.1% salt solution, more heavily salted foods, or commercial mixes such as Gatorade. The commercial mixes are advised for personnel on low sodium diets.
- A work schedule should be established so that the majority of the work day will be during the morning hours of the day before ambient air temperature levels reach their highs.
- A work/rest guideline will be implemented for personnel at all anticipated PPE levels. This guideline is as follows:

Level D:

Ambient Temp.	Max. Work Period
Above 90°F	1 hours
80° to 90°F	2 hour
70° to 80°F	4 hours

Level B and C:

Ambient Temp.	Max. Work Period
Above 90°F	1/2 hours
80° to 90°F	1 hour
70° to 80°F	2 hours
60° to 70°F	3 hours
<60°F	4 hours

A sufficient period will be allowed for personnel to "cool down." This may require shifts of workers during operations.

HEAT STRESS MONITORING

For monitoring the body's recuperative ability to excess heat, one or more of the following techniques should be used as a screening mechanism. Monitoring of personnel wearing protective clothing should commence when the ambient temperature is 70 degrees Fahrenheit or above. Frequency of monitoring should increase as the ambient temperature increases or if slow recovery rates are indicated. When temperatures exceed 80 degrees Fahrenheit, workers must be monitored for heat stress after every work period.

- Heart rate (HR) should be measured by the radial pulse for 30 seconds as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 110 beats per minute. If the HR is higher, the next work period should be shortened by 10 minutes (or 33%), while the length of the rest period stays the same. If the pulse rate is 100 beats per minute at the beginning of the next rest period, the following work cycle should be shortened by 33%.
- Body temperature should be measured orally with a clinical thermometer as early as possible in the resting period. Oral temperature (OT) at the beginning of the rest period should not exceed 99 degrees Fahrenheit. If it does, the next work period should be shortened by 10 minutes (or 33%), while the length of the rest period stays the same. However, if the OT exceeds 99.7 degrees Fahrenheit at the beginning of the next period, the following work cycle should be further shortened by 33%. OT should be measured again at the end of the rest period to make sure that it has dropped below 99 degrees Fahrenheit.
- Body water loss (BWL) due to sweating should be measured by weighing the worker in the morning and in the evening. The clothing worn should be similar at both weighings; preferably the worker should be nude. The scale should be accurate to plus or minus 1/4 pound. BWL should not exceed 1.5% of the total body weight. If it does, workers should be instructed to increase their daily intake of fluids by the weight lost.

Ideally, body fluids should be maintained at a constant level during the work day. This requires replacement of salt lost in sweat as well.

Good hygienic standards must be maintained by frequent change of clothing and daily showering. Clothing should be permitted to dry during rest periods. Persons who notice skin problems should immediately consult medical personnel.

COLD EXPOSURE CASUALTY PREVENTION PLAN

Persons working outdoors in temperatures at or below freezing may be frostbitten. Extreme cold for a short time may cause severe injury to the surface of the body, or result in profound generalized cooling, causing death. Areas of the body which have high surface area-to-volume ratio such as fingers, toes, and ear, are the most susceptible.

EFFECTS OF COLD EXPOSURE

Two factors influence the development of a cold injury: ambient temperature and the velocity of the wind. Wind chill is used to describe the chilling effect of moving air in combination with low temperature. For instance, 10 degrees Fahrenheit with a wind of 15 mile per hour (mph) is equivalent in chilling effect to still air at -18 degrees Fahrenheit.

As a general rule, the greatest incremental increase in wind chill occurs when a wind of 5 mph increases to 10 mph. Additionally, water conducts heat 240 times faster than air. Thus, the body cools suddenly when chemical-protective equipment is removed if the clothing underneath is perspiration soaked.

Local injury resulting from cold is included in the generic term frostbite. There are severe degrees of damage. Frostbite of the extremities can be categorized into:

- **Frost nip or incipient frostbite:** characterized by suddenly blanching or whitening of skin.
- **Superficial frostbite:** skin has a waxy or white appearance and is firm to the touch, but tissue beneath is resilient.
- **Deep Frostbite:** tissues are cold, pale, and solid; extremely serious injury.

To administer first aid for frostbite, bring the victim indoors and rewarm the areas quickly in water between 102 degrees Fahrenheit and 105 degrees Fahrenheit. Give a warm drink not coffee, tea or alcohol. The victim should not smoke. Keep the frozen parts in warm water or covered with warm clothes for 30 minutes, even though the tissue will be very painful as it thaws. Then elevate the injured area and protect it from injury. Do not allow blisters to be broken. Use sterile, soft, dry material to cover the injured areas. Keep victim warm and get immediate medical care.

After thawing, the victim should try to move the injured areas a little, but no more than can be done alone, without help.

- Do not rub the frostbitten part (this may cause gangrene).
- Do not use ice, snow, gasoline or anything cold on frostbite.
- Do not use heat lamps or hot water bottles to rewarm the part.
- Do not place the part near a hot stove.

Systemic hypothermia is caused by exposure to freezing or rapidly dropping temperature, it symptoms are usually exhibited in five stages; 1) shivering; 2) apathy, listlessness, sleepiness, and (sometimes) rapid cooling of the body to less than 95 degrees Fahrenheit; 3) unconsciousness, glassy stare, slow pulse, and slow respiratory rate; 4) freezing of the extremities; and, finally, 5) death.

As a general rule, field activities should be curtailed if equivalent chill temperature (degrees Fahrenheit) is below zero unless the activity is of an emergency nature. The ultimate responsibility for proposing on delaying work at a site due to inclement weather rests with the ISOTEC Site Safety Officer.

ATTACHMENT G

EMERGENCY PROCEDURES

EMERGENCY MEDICAL TREATMENT AND FIRST AID PROCEDURES

If an employee working at the Site is physically injured, emergency medical treatment and/or First Aid procedures will be followed. Depending on the severity of the injury, emergency medical response may be sought. If the employee can be moved, they will be taken to the edge of the work area (on a stretcher, if needed) where contaminated clothing will be removed (if possible), emergency first aid administered, and transportation to local emergency medical facility awaited.

If the injury to the worker is chemical in nature (e.g., overexposure), the following procedures are to be instituted as soon as possible:

- Eye Exposure - If contaminated solid or liquid gets into the eyes, wash eyes immediately at the emergency eyewash stations using large amounts of water and lifting the lower and upper lids occasionally. Obtain medical attention immediately. (Contact lenses are not permitted in the Exclusion Areas.)
- Skin Exposure - If contaminated solid or liquid gets on the skin, promptly wash contaminated skin using soap or mild detergent and water. If solids or liquid penetrate through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. Obtain medial attention immediately if symptoms warrant.
- Breathing - If a person breathes in large amounts of organic vapor, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Obtain medical attention as soon as possible.
- Swallowing - If contaminated solid or liquid has been swallowed and the person is conscious, feed the person large quantities of salt water immediately and induce vomiting (unless the person is unconscious). Obtain medical attention immediately.

FIRST AID PROCEDURES

- Remove the injured or exposed person(s) from immediate danger.
- Render first aid if necessary, decontaminate affected personnel, if necessary.
- Call an ambulance for transport to local hospital immediately. This procedure should be followed even if there is no apparent serious injury.
- Evacuate other personnel on-site to a safe place until the ISOTEC Site Safety Officer determines that it is safe for work to resume.
- Report the accident to the ISOTEC Director of Health and Safety immediately.

ATTACHMENT H

TICKS AND TICK-BORNE DISEASES

TICKS AND TICK-BORNE DISEASES

Field personnel should be aware of an increased occurrence of tick-borne disease in the United States. In the northeast, the most likely carriers are the whitefooted mouse and the white-tailed deer. These animals are most prevalent in areas where suburban environments about open fields or woodlands. Although exposure is increased in these areas, other carriers, such as dogs and horses, can be found in a variety of environments.

All field personnel should take proper precautions to limit exposure to ticks and tick-borne diseases. These include:

- Cinching and taping clothing at the ankles and wrists, especially the ankles. Ticks lie low on grass blades and shrubs. They encounter your feet, ankles or lower legs and then crawl upward.
- Wear light-colored clothing to facilitate spotting the ticks, and check your clothing periodically. Be especially careful in terrain with tall grass, bushes or woods.
- Use a tick repellant on skin or clothing. Always read the labels before using. Clothing repellents should never be used on the skin.
- Recognize the signs of a bite or an infection. It takes several hours for a tick to attach and feed; removing it promptly lessens the chance of being infected.

Pregnant women should be particularly careful since the effects of the most common tick-borne disease in the northeast, Lyme disease, upon the fetus is unknown.

If a tick is discovered on the skin, it is important to remove the entire insect as soon as possible. The most effective method is to grasp the tick as close as possible to the mouth with tweezers or thin, curved forceps. Then, without jerking, pull it upward steadily (a small amount of skin may be removed in the process).

After removing the tick, disinfect the bite with rubbing alcohol or povidone iodine (Betadine). Don't handle the tick; spirochetes could enter the body through breaks in the skin. Dispose of it in alcohol or flush it down the drain. And check the bite occasionally for at least two weeks to see if a rash forms. If it does, you've been infected and should seek treatment promptly.

The rash appears at the bite location from two days to a few weeks after the bite. It usually starts as a small red spot that expands as the spirochetes spread beyond the bite. Most commonly, the rash develops into a reddish circle or oval about two to three inches in diameter. It fades with or without treatment after a few weeks.

Much larger rashes - anywhere from 6 to 20 inches in diameter - may also occur, especially on the back. Despite their size, large rashes may be easy to miss because they're often very faint.

Other variants include a rash with a red perimeter and a clear center and the so-called bull's-eye rash, which consists of several concentric red rings. Rashes may vary in shape, depending on where they occur on the body. Frequent sites are the thigh, groin, and armpits. People often develop a rash in more than one place.

Early symptoms may include profound fatigue, a stiff neck, and flu-like symptoms such as headache, chills, fever, and muscle aches. Since tick bites don't always produce a rash, those symptoms alone may warrant a medical check for possible Lyme infection - especially if they occur in summer and you live in an area that is endemic for Lyme disease.

Without treatment, the spirochetes usually multiply and the disease progressively worsens. The second stage, occurring within weeks to months of the bite, may affect the heart and nervous system. Third is the chronic arthritic stage, which begins up to a year or more after the bite.

ATTACHMENT I

PRESSURIZED INJECTION PROCEDURE

STANDARD OPERATION GUIDELINES FOR PRESSURIZED INJECTIONS AND ASSOCIATED EQUIPMENT

These guidelines contain general safety requirements for pressurized injection operations and use of associated equipment.

RESPONSIBILITY AND APPLICABILITY

The ISOTEC Project and Site Manager are responsible for ensuring that employees of ISOTEC and of firms contracted by ISOTEC comply with these guidelines.

PROCESS DESCRIPTIONS/ EQUIPMENT

ISOTEC may employ the use of either permanent injection wells or temporary direct-push injection points to install numerous pathways in the test area during treatment applications. ISOTEC will use a pneumatic diaphragm pump to deliver their reagents into these points.

Standard Operating Procedure for Injections using A DIAPHRAGM pump

- Base of diaphragm pump may be fastened to a structural support to prevent vibration, (if needed).
- Connect transfer hoses. Hose connections, valves, etc. on discharge side of pump must be reinforced and rated for the maximum pressure to be used,
- Approximately 10 gallons of water will be used for test run to confirm proper operation of pump and equipment leak test,
- Hose connections at reagent suction point, pump inlet, pump discharge, and injection point must be “double-valved” (i.e., two gate valves in succession),
- Inspect transfer lines/hoses, valves, and all connections for wear, damage, and security,
- Transfer hoses on the pressure discharge side must be secured to prevent “spraying” in the event of line breach,
- Connect air compressor lines and pressure regulators to diaphragm pumps; air line ball valve and pump pressure regulator valve should be closed (i.e., no pressure),
- Start air compressor, adjust compressor pressure regulator to 120 psi,
- Open ball valve on diaphragm pump air line and increase pressure on pump regulator until pumping begins,
- Confirm operation/leak check of diaphragm pump and transfer hoses using water only,
- Adjust to minimum pressure required to sustain continuous pump flow varying from 25 psi (min.) to 120 psi (max.),
- Upon successful operation/leak check, begin injection of reagents,
- Monitor ground in injection point area, immediately discontinue injection if material surfaces by closing the ball valve located before the diaphragm pump pressure regulator,
- At the completion of a reagent injection cycle, a sufficient volume of water will be injected to rinse the pump, transfer lines and injection point apparatus.
- When finished with an injection sequence, the air compressor will be shut off. The diaphragm pump(s) will continue to operate until the air compressor pressure supply is depleted.
- All exclusion area injection equipment will be disassembled and decontaminated as required.

ATTACHMENT J

OPERATIONAL GUIDELINES FOR ON SITE PERSONELL

OPERATIONAL GUIDELINES FOR ON SITE PERSONNEL

These guidelines are provided to help ensure the safety of all on-site personnel including but not limited to ISOTEC personnel, OBG personnel and any other site visitor who may show up at the site.

- All site personnel will be given a health and safety overview by ISOTEC, or OBG SSO before starting work or entering any exclusion/work zones. Access to the site HASP and MSDS sheets will be provided if necessary.
- A first aid kit, fire extinguisher, eye wash station and access to running water will be provided at the site.
- All proper PPE (safety glasses, steel-toe boots, nitrile gloves, safety vests, etc.) must be worn within the work/exclusion zones by all personnel at the site.
- While injecting/transferring chemicals, only ISOTEC/OBG personnel will be allowed in the work/ exclusion zones. All visitors will be advised of a safe distance to stay away while these activities are being performed and will be alerted when it is safe to enter that area after the mixing/transferring activities are completed.
- All tanks/drums will be labeled as to their contents. No person except for ISOTEC (or trained OBG employees) employees should touch or handle any equipment that contains or may have contained sodium persulfate or sodium hydroxide solutions. If there is a situation where this changes, all personnel should wear proper PPE described above as well as nitrile gloves.
- Injection hoses will be checked daily for leaks and loose fittings and will be replaced if needed.
- All connections will be double valved to allow for safe removal of hoses if necessary.
- All attempts will be made to spread injection hoses out in such a way that they are not impeding the work of the drillers and any other personnel in the work/ exclusion zone.
- Proper PPE will be worn by anyone that is in the vicinity of an injection point.

ATTACHMENT K

JOB SAFETY ANALYSIS

JOB SAFETY ANALYSIS
ISOTEC PROJECT #801830

Work Location:	**1-5 Holland Avenue Site, White Plains, NY**		
Task Title:	**In-Situ Chemical Oxidation - Alkali Activated Persulfate**		
Activity	**Work Group**	**Hazards**	**Hazard Controls**
Mobilization to Site	Field Supervisor (FS), Project Manager (PM), Site Safety Officer (SSO), Field Technicians (FT), Delivery Truck Driver, etc.	Site Security, Electric Power, Tripping Hazards, Mobile Equipment and Vehicular Traffic	Locate and mobilize equipment in secure staging area near water and power sources.
			Review and walk work areas to look for any tripping hazards, overhead hazards, etc.
			Visitors must report to SSO or FS upon arrival.
			All personnel receive site-specific training.
			Mobile equipment will consist of the equipment box truck/trailer, personal vehicles of on-site personnel, and any delivery vehicles. Inform the driver of each vehicle that you will be working in their general vicinity or will be walking behind the vehicle so they are aware of your presence. Assist any driver (traffic control) who is backing up a vehicle in the work area or out into the roadway during delivery activities.
			Ensure that there is a clear pathway before driving your vehicle through into the work area.
			Ensure that there is a clear pathway for any delivery trucks backing into the chemical storage areas. Assist the driver with hand signals in backing up to the area after all personnel are out of the way of the truck.
			ISOTEC box truck containing equipment will be properly chocked for the duration of the project.
On-Site Activities	FS and FT	Field Work Related Hazards	All required PPE (nitrile gloves, steel-toed boots, safety glasses, safety vest) will be worn at all times in the exclusion zone. Additional PPE in the form of hearing protection will be worn when needed.
		Housekeeping – Slips/trips/falls	All sites will be kept clean and free of trash and other debris.
			All trash will be properly contained or staged daily and removed at the end of the event.
			Use proper lifting/moving techniques for heavy items (bend and lift with legs and arms, not back). Use the "buddy system" for moving heavy items (over 60 lbs.). Use drum dolley's, carts, etc if needed.
		Working Hours	Work will be conducted during normal business hours (i.e. 8 AM to 5 PM) Monday through Saturday unless otherwise noted.

JOB SAFETY ANALYSIS
ISOTEC PROJECT #801830

Work Location:	**1-5 Holland Avenue Site, White Plains, NY**		
Task Title:	**In-Situ Chemical Oxidation - Alkali Activated Persulfate**		
Activity	**Work Group**	**Hazards**	**Hazard Controls**
Loading /Unloading Chemicals	Chemical Distributor, FS and FT	Chemical Leakage	Inspect each container before loading and unloading for possible leakage and use proper tools (e.g. lift gate and drum dolley, etc) to load and unload.
		Hand/foot/back injury	Wear proper PPE (such as safety glasses, nitrile gloves, steel-toed boots, safety vest etc., as necessary). Use correct postures.
		Storage	Drums will be stored on a flat even surface within secondary containment provided in the form of bermed poly sheeting (or something similar) in the chemical mixing area.
		Delivery Truck/Driver	Delivery truck drivers will follow all on-site H&S protocol as field personnel if they enter the work areas. As much as possible, their site access will be limited to the chemical drop off area.
Reagent Preparation and Injection	FS and FT	Housekeeping – Slips/trips/falls	All sites will be kept clean and free of trash and other debris.
			All trash will be properly contained or staged daily and removed at the end of the event.
			Use proper lifting/moving techniques for heavy items. Use the "buddy system" for moving heavy items (over 60 lbs.). Use drum dolley's, carts, etc if needed.
			Hoses and wires will be laid out to avoid tangling during injection activities.
		Equipment Inspection	Prior to use all mechanical equipment (i.e. pumps, air compressors, generators, etc.) related to reagent preparation will be inspected daily by injection team.
			Fittings, valves, hoses, etc. will be checked prior to injection activities to ensure no loose connections or holes are observed. Faulty equipment will be replaced as needed.
			All drums/bulk tanks containing liquid reagents will be labeled as either sodium persulfate, sodium hydroxide or as non-potable water.
		Chemical Spills/Splashes	Contain spill and use proper procedures to clean and dispose of chemicals. Chemical sorbent powder/socks will be available along with a shop-vac to contain and clean up any spills.

Work Location:	**1-5 Holland Avenue Site, White Plains, NY**		
Task Title:	**In-Situ Chemical Oxidation - Alkali Activated Persulfate**		
Activity	**Work Group**	**Hazards**	**Hazard Controls**
Reagent Preparation and Injection (continued)	FS and FT	Chemical Preparation	Change gloves frequently to avoid skin contact with chemicals.
			Safety glasses and full-face shields, along with rain gear (or tyvek suits) will be worn during oxidant transfer and preparation. Dust mask will be worn when needed during persulfate preparation (i.e. windy conditions that may spread dry powder chemicals).
		Unauthorized Personnel	Only ISOTEC personnel will be allowed within the chemical mixing area during any mixing/preparation/dilution activities. Chemical mixing area will be surrounded by safety cones and/or caution tape (or a combination of both). Verbal communication between ISOTEC personnel and all other personnel working on-site will be discussed daily at the site regarding this matter.
		Hand injury	Nitrile gloves will be worn during reagent preparation and injection. Kevlar gloves will be worn while utilizing any sharp tools (i.e. cutting instruments, hammers, etc.).
		Foot injury	Leather steel-toed boots will be required at all times on site.
		Eye injury	Safety glasses along with full-face shield will be worn during oxidant transfer and preparation. A portable eye-wash station will be located near the chemical mixing area along with a first-aid kit.
		Fire	Turn off the generator/air compressor and allow it to cool down before refueling.
			Smoking is prohibited within all on-site working areas.
			Field trailer will contain a fire extinguisher with current inspection (rated minimum 20 lb ABC).
			Fuels will be stored in appropriate containers.
		Electrical	A Ground-Fault Circuit Interrupter (GFCI) will be required for generators (If used). If power supply comes from the building, a GFCI pig tail will be utilized.
		Pressurized Injections	All injection set-up areas will occur as close to the injection wells as possible.

Work Location:	1-5 Holland Avenue Site, White Plains, NY		
Task Title:	**In-Situ Chemical Oxidation - Alkali Activated Persulfate**		
Activity	**Work Group**	**Hazards**	**Hazard Controls**
Reagent Preparation and Injection (continued)	FS and FT	Pressurized Injections	Each injection apparatus (well head manifold) will consist of a pressure gauge and 2 ports (1 for chemical injection and 1 for pressure relief if needed). Pressure gauges will be monitored during injections. In the event well head pressure increases above 50 psi, injection activities will be halted and the excess pressure will be vented off before restarting. In some cases injection screens may become fouled (usually occurs during installation) causing the pressure gauge to quickly rise above 100 psi. Because of this, a dose of water is injected at each new location before reagent injection begins. It may be necessary to remove the location, clean the screen and rods and reinstall the injection point.
			A water rinse will be performed at each location as an initial leak test before any alkali activated persulfate reagents are introduced into the subsurface.
		Severe weather	Work will be performed indoors so this will not be encountered.
		Chemical Surfacing/ Well Overflow	Reduce injection rate or stop injection until cessation of surfacing. Contain spill and use proper procedures to clean and dispose of chemicals. Resume injection at a lower rate. Attempt to fill in the exposed pathway (with bentonite). Field sampling activities will stop immediately if chemical leakage/overflow occurs at the monitoring well and will be resumed when it is determined to be safe by the SSO. The monitoring wells may need to be capped off during remainder of injections if this occurs.
		Unauthorized operation	Only trained and authorized personnel will perform reagent preparation and injection activities.
		Asphalt Mounding	If asphalt mounding is observed, injections will be stopped in the vicinity to allow for reagent material to seep back into the subsurface soil. Subsequent injections will resume at a lower flow rate to prevent further mounding.

Work Location:	**1-5 Holland Avenue Site, White Plains, NY**		
Task Title:	**In-Situ Chemical Oxidation - Alkali Activated Persulfate**		
Activity	**Work Group**	**Hazards**	**Hazard Controls**
Reagent Preparation and Injection (continued)	FS and FT	Chemical Reagents (ISCO Chemicals)	Avoid contact with skin (never touch any piece of equipment containing any of the ISCO alkali activated persulfate reagent chemicals without wearing chemical resistant gloves). Safety glasses and nitrile gloves should be worn by all on-site personnel who are required to touch any equipment once chemical reagents are prepared and the injection activities have commenced.
		Chemical Reagents (ISCO Chemicals)	Report any chemical surfacing (daylighting), leaking from the injection point or hoses or any observed off-gassing to ISOTEC personnel immediately. If any surfacing/leaking/off-gassing is observed, the injections in that area will be ceased until the problem is determined and corrected.
		Housekeeping – Slips/trips/falls	Organize tools, materials, equipment and debris to prevent tripping hazards. If injection hoses are present, be careful not to step or drive on them.
		Injection Activities	Once the injections are initiated, only ISOTEC personnel should touch any of the pumps, hoses, valves and associated well-head connections.
			Ensure that all connections are secured tightly and no visible leaks from the valves, hoses or around the injection rod annular space are occurring. An initial water rinse will be pumped through the lines at each location as a safety leak test before any of the ISCO reagents are introduced into the subsurface.
Monitoring Well Sampling	FS and FT	Equipment Inspection	Dedicated bailers will be inspected before each use and properly labeled after each use.
			Sample container will be inspected and clearly labeled prior to sampling.
		Splash hazard	Safety glasses will be worn during sampling.
		Hand injury	Nitrile gloves will be worn during sampling. Kevlar gloves will be worn while utilizing any sharp tools (i.e. cutting instruments).
		Foot injury	Leather steel-toed boots will be required.
		Severe weather	Work will be performed indoors so this will not be encountered.
		Unauthorized operation	Only trained and authorized personnel will perform sampling activities.

Work Location:	**1-5 Holland Avenue Site, White Plains, NY**		
Task Title:	**In-Situ Chemical Oxidation - Alkali Activated Persulfate**		
Activity	**Work Group**	**Hazards**	**Hazard Controls**
Site Clean-UP and Demobilization	FS and FT	Housekeeping – Slips/trips/falls	Organize tools, materials, equipment and debris to prevent tripping hazards. If injection hoses are present, be careful not to step or drive on them. All collected garbage will be removed from the site.
		Mobile Equipment	Mobile equipment will consist of the box-truck and support truck. Inform the driver of each vehicle that you will be working in their general vicinity or will be walking behind the vehicle so they are aware of your presence. Assist any driver (traffic control) who is backing up a vehicle in the work area or out into the roadway during delivery activities. Follow all moving vehicle requirements set forth for the site while demobilization activities are occurring.
			Use a spotter while turning out onto the street if necessary.
		Site Conditions	Ensure that the general site conditions are as good as they were before work was initiated at the site. All garbage and debris should be removed from the site; all equipment and vehicles should be removed from the site when ISOTEC personnel demobilize.

ATTACHMENT L

MATERIAL SAFETY DATA SHEETS (MSDS)

MATERIAL SAFETY DATA SHEET

Klozür™

MSDS Ref. No.: 7775-27-1-12
Date Approved: 02/22/2005
Revision No.: 1

This document has been prepared to meet the requirements of the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200; the Canada's Workplace Hazardous Materials Information System (WHMIS) and, the EC Directive, 2001/58/EC.

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1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME:	Klozür™
SYNONYMS:	Sodium Persulfate, Sodium Peroxydisulfate; Disodium Peroxydisulfate
GENERAL USE:	In situ and ex situ chemical oxidation of contaminants and compounds of concern for environmental remediation applications.

MANUFACTURER

FMC CORPORATION
Active Oxidants Division
1735 Market Street
Philadelphia, PA 19103
(215) 299-6000 (General Information)

EMERGENCY TELEPHONE NUMBERS

(800) 424-9300 (CHEMTREC - U.S.)
(303) 595-9048 (Medical - Call Collect)

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2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

- White, odorless, crystals
- Oxidizer.
- Decomposes in storage under conditions of moisture (water/water vapor) and/or excessive heat causing release of oxides of sulfur and oxygen that supports combustion. Decomposition could form a high temperature melt. See Section 10 ("Stability and Reactivity").

POTENTIAL HEALTH EFFECTS: Airborne persulfate dust may be irritating to eyes, nose, lungs, throat and skin upon contact. Exposure to high levels of persulfate dust may cause difficulty in breathing in sensitive persons.

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3. COMPOSITION / INFORMATION ON INGREDIENTS

Chemical Name	CAS#	Wt.%	EC No.	EC Class
Sodium Persulfate	7775-27-1	>99	231-892-1	Not classified as hazardous

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4. FIRST AID MEASURES

EYES: Flush with plenty of water. Get medical attention if irritation occurs and persists.

SKIN: Wash with plenty of soap and water. Get medical attention if irritation occurs and persists.

INGESTION: Rinse mouth with water. Dilute by giving 1 or 2 glasses of water. Do not induce vomiting. Never give anything by mouth to an unconscious person. See a medical doctor immediately.

INHALATION: Remove to fresh air. If breathing difficulty or discomfort occurs and persists, contact a medical doctor.

NOTES TO MEDICAL DOCTOR: This product has low oral toxicity and is not irritating to the eyes and skin. Flooding of exposed areas with water is suggested, but gastric lavage or emesis induction for ingestions must consider possible aggravation of esophageal injury and the expected absence of system effects. Treatment is controlled removal of exposure followed by symptomatic and supportive care.

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5. FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA: Deluge with water.

FIRE / EXPLOSION HAZARDS: Product is non-combustible. On decomposition releases oxygen which may intensify fire. Presence of water accelerates decomposition.

FIRE FIGHTING PROCEDURES: Do not use carbon dioxide or other gas filled fire extinguishers; they will have no effect on decomposing persulfates. Wear full protective clothing and self-contained breathing apparatus.

FLAMMABLE LIMITS: Non-combustible

SENSITIVITY TO IMPACT: No data available

SENSITIVITY TO STATIC DISCHARGE: Not available

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6. ACCIDENTAL RELEASE MEASURES

RELEASE NOTES: Spilled material should be collected and put in approved DOT container and isolated for disposal. Isolated material should be monitored for signs of decomposition (fuming/smoking). If spilled material is wet, dissolve with large quantity of water and dispose as a hazardous waste. All disposals should be carried out according to regulatory agencies procedures.

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7. HANDLING AND STORAGE

HANDLING: Use adequate ventilation when transferring product from bags or drums. Wear respiratory protection if ventilation is inadequate or not available. Use eye and skin protection. Use clean plastic or stainless steel scoops only.

STORAGE: Store (unopened) in a cool, clean, dry place away from point sources of heat, e.g. radiant heaters or steam pipes. Use first in, first out storage system. Avoid contamination of opened product. In case of fire or decomposition (fuming/smoking) deluge with plenty of water to control decomposition. For storage, refer to NFPA Bulletin 430 on storage of liquid and solid oxidizing materials.

COMMENTS: VENTILATION: Provide mechanical general and/or local exhaust ventilation to prevent release of dust into work environment. Spills should be collected into suitable containers to prevent dispersion into the air.

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8. EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE LIMITS

Chemical Name	ACGIH	OSHA	Supplier
Sodium Persulfate	0.1 mg/m^3 (TWA)		

ENGINEERING CONTROLS: Provide mechanical local general room ventilation to prevent release of dust into the work environment. Remove contaminated clothing immediately and wash before reuse.

PERSONAL PROTECTIVE EQUIPMENT

EYES AND FACE: Use cup type chemical goggles. Full face shield may be used.

RESPIRATORY: Use approved dust respirator when airborne dust is expected.

PROTECTIVE CLOTHING: Normal work clothes. Rubber or neoprene footwear.

GLOVES: Rubber or neoprene gloves. Thoroughly wash the outside of gloves with soap and water prior to removal. Inspect regularly for leaks.

9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR:	None
APPEARANCE:	White crystals
AUTOIGNITION TEMPERATURE:	Not applicable. No evidence of combustion up to 800°C. Decomposition will occur upon heating.
BOILING POINT:	Not applicable
COEFFICIENT OF OIL / WATER:	Not applicable
DENSITY / WEIGHT PER VOLUME:	Not available
EVAPORATION RATE:	Not applicable (Butyl Acetate = 1)
FLASH POINT:	Non-combustible
MELTING POINT:	Decomposes
ODOR THRESHOLD:	Not applicable
OXIDIZING PROPERTIES:	Oxidizer
PERCENT VOLATILE:	Not applicable
pH:	typically 5.0 - 7.0 @ 25 °C (1% solution)
SOLUBILITY IN WATER:	73 % @ 25 °C (by wt.)
SPECIFIC GRAVITY:	2.6 (H_2O=1)
VAPOR DENSITY:	Not applicable (Air = 1)
VAPOR PRESSURE:	Not applicable

10. STABILITY AND REACTIVITY

CONDITIONS TO AVOID:	Heat, moisture and contamination.
STABILITY:	Stable (becomes unstable in presence of heat, moisture and/or contamination).
POLYMERIZATION:	Will not occur
INCOMPATIBLE MATERIALS:	Acids, alkalis, halides (fluorides, chlorides, bromides and iodides), combustible materials, most metals and heavy metals, oxidizable materials, other oxidizers, reducing agents, cleaners, and organic or carbon containing compounds. Contact

	with incompatible materials can result in a material decomposition or other uncontrolled reactions.
HAZARDOUS DECOMPOSITION PRODUCTS:	Oxygen that supports combustion and oxides of sulfur.

COMMENTS: PRECAUTIONARY STATEMENT: Pumping and transport of Klozür persulfate requires appropriate precautions and design considerations for pressure and thermal relief.

Decomposing persulfates will evolve large volumes of gas and/or vapor, can accelerate exponentially with heat generation, and create significant and hazardous pressures if contained and not properly controlled or mitigated.

Use with alcohols in the presence of water has been demonstrated to generate conditions that require rigorous adherence to process safety methods and standards to prevent escalation to an uncontrolled reaction.

11. TOXICOLOGICAL INFORMATION

EYE EFFECTS: Non-irritating (rabbit) [FMC Study Number: ICG/T-79.029]

SKIN EFFECTS: Non-irritating (rabbit) [FMC Study Number: ICG/T-79.029]

DERMAL LD_{50}: > 10 g/kg [FMC Study Number: ICG/T-79.029]

ORAL LD_{50}: 895 mg/kg (rat) [FMC Study Number: ICG/T-79.029]

INHALATION LC_{50}: 5.1 mg/l (rat) [FMC I95-2017]

SENSITIZATION: May be sensitizing to allergic persons. [FMC Study Number: ICG/T-79.029]

TARGET ORGANS: Eyes, skin, respiratory passages

ACUTE EFFECTS FROM OVEREXPOSURE: Dust may be harmful and irritating. May be harmful if swallowed.

CHRONIC EFFECTS FROM OVEREXPOSURE: Sensitive persons may develop dermatitis and asthma [Respiration 38:144, 1979]. Groups of male and female rats were fed 0, 300 or 3000 ppm sodium persulfate in the diet for 13 weeks, followed by 5000 ppm for 5 weeks. Microscopic examination of tissues revealed some injury to the gastrointestinal tract at the high dose (3000 ppm) only. This effect is not unexpected for an oxidizer at high concentrations. [Ref. FMC I90-1151, Toxicologist 1:149, 1981].

CARCINOGENICITY:

NTP:	Not listed
IARC:	Not listed
OSHA:	Not listed
OTHER:	ACGIH: Not listed

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12. ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION:

Bluegill sunfish, 96-hour LC_{50} = 771 mg/L [FMC Study I92-1250]
Rainbow trout, 96-hour LC_{50} = 163 mg/L [FMC Study I92-1251]
Daphnia, 48-hour LC_{50} = 133 mg/L [FMC Study I92-1252]
Grass shrimp, 96-hour LC_{50} = 519 mg/L [FMC Study I92-1253]

CHEMICAL FATE INFORMATION: Biodegradability does not apply to inorganic substances.

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13. DISPOSAL CONSIDERATIONS

DISPOSAL METHOD: Dispose as a hazardous waste in accordance with local, state and federal regulatory agencies.

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14. TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

PROPER SHIPPING NAME:	Sodium Persulfate
PRIMARY HAZARD CLASS / DIVISION:	5.1 (Oxidizer)
UN/NA NUMBER:	UN 1505
PACKING GROUP:	III
LABEL(S):	5.1 (Oxidizer)
PLACARD(S):	5.1 (Oxidizer)
MARKING(S):	Sodium Persulfate, UN 1505
ADDITIONAL INFORMATION:	Hazardous Substance/RQ: Not applicable

49 STCC Number: 4918733

This material is shipped in 225 lb. fiber drums, 55 lb. poly bags and 1000 - 2200 lb. IBC's (supersacks).

INTERNATIONAL MARITIME DANGEROUS GOODS (IMDG)

PROPER SHIPPING NAME:	Sodium Persulfate

INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO) / INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA)

PROPER SHIPPING NAME:	Sodium Persulfate

OTHER INFORMATION:

Protect from physical damage. Do not store near acids, moisture or heat.

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15. REGULATORY INFORMATION

UNITED STATES

SARA TITLE III (SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT)

SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355, APPENDIX A):
Not applicable

SECTION 311 HAZARD CATEGORIES (40 CFR 370):
Fire Hazard, Immediate (Acute) Health Hazard

SECTION 312 THRESHOLD PLANNING QUANTITY (40 CFR 370):
The Threshold Planning Quantity (TPQ) for this product, if treated as a mixture, is 10,000 lbs; however, this product contains the following ingredients with a TPQ of less than 10,000 lbs.: None

SECTION 313 REPORTABLE INGREDIENTS (40 CFR 372):
Not listed

CERCLA (COMPREHENSIVE ENVIRONMENTAL RESPONSE COMPENSATION AND LIABILITY ACT)

CERCLA DESIGNATION & REPORTABLE QUANTITIES (RQ) (40 CFR 302.4):
Unlisted, RQ = 100 lbs., Ignitability

TSCA (TOXIC SUBSTANCE CONTROL ACT)

TSCA INVENTORY STATUS (40 CFR 710):

Listed

RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)
RCRA IDENTIFICATION OF HAZARDOUS WASTE (40 CFR 261):
Waste Number: D001

CANADA

WHMIS (WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM):

Product Identification Number:	1505
Hazard Classification / Division:	Class C (Oxidizer), Class D, Div. 2, Subdiv. B. (Toxic)
Ingredient Disclosure List:	Listed

INTERNATIONAL LISTINGS

Sodium persulfate:
Australia (AICS): Listed
China: Listed
Japan (ENCS): (1)-1131
Korea: KE-12369
Philippines (PICCS): Listed

HAZARD, RISK AND SAFETY PHRASE DESCRIPTIONS:

EC Symbols:	(Not classified as hazardous)
EC Risk Phrases:	(Not classified as hazardous)
EC Safety Phrases:	(Not classified as hazardous)

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16. OTHER INFORMATION

HMIS

Health	1
Flammability	0
Physical Hazard	1
Personal Protection (PPE)	J

Protection = J (Safety goggles, gloves, apron & combination dust & vapor respirator)

HMIS = Hazardous Materials Identification System

Degree of Hazard Code:
4 = Severe

3 = Serious
2 = Moderate
1 = Slight
0 = Minimal

NFPA

Health	1
Flammability	0
Reactivity	1
Special	OX

SPECIAL = OX (Oxidizer)

NFPA = National Fire Protection Association

Degree of Hazard Code:
4 = Extreme
3 = High
2 = Moderate
1 = Slight
0 = Insignificant

REVISION SUMMARY:
New MSDS

Klozür and FMC Logo - FMC Trademarks

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Revision Date 23/11/2012

Revision 4

Supersedes date 24/09/2008

ReAgent

Visit Our Website
www.reagent.co.uk

CALL: 0800 990 3258 | EMAIL: ENQUIRIES@REAGENT.CO.UK

SAFETY DATA SHEET
SODIUM HYDROXIDE 25% W/W

According to Regulation (EC) No 1907/2006

SECTION 1: IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1. Product identifier

Product name	SODIUM HYDROXIDE 25% W/W
Product No.	6119
REACH Registration number	Not applicable
REACH Registration notes	Product is a mixture

1.2. Relevant identified uses of the substance or mixture and uses advised against

Identified uses	General chemical reagent Intermediate
Uses advised against	Processes involving incompatible materials. Processes that would lead to over-exposure of the operators.

1.3. Details of the supplier of the safety data sheet

Supplier

Reagent Chemical Services
18 Aston Fields Road
Whitehouse Industrial Estate
Runcorn
Cheshire WA7 3DL
T: 01928 716903 (08.30 - 17.00)
F: 01928 716425
E: info@reagent.co.uk

1.4. Emergency telephone number

NHS Direct. Tel. 0845 4647 (24 Hours)

SECTION 2: HAZARDS IDENTIFICATION

2.1. Classification of the substance or mixture

Classification (EC 1272/2008)		
	Physical and Chemical Hazards	Met. Corr. 1 - H290
	Human health	Skin Corr. 1A - H314
	Environment	Not classified.
Classification (1999/45/EEC)	C;R35.	

The Full Text for all R-Phrases and Hazard Statements are Displayed in Section 16.

Human health

Will cause severe burns. The product will cause serious burns to eyes which can result in blindness. Ingestion will cause burns to the mouth, stomach and gastrointestinal tract. Irritation of the respiratory system. High concentrations of vapours or prolonged exposure may lead to burns of the respiratory tract. Inhalation of vapour or mist may cause lung oedema.

Environment

Due to the alkalinity of the product it may produce a local pH change in water systems which can have a damaging effect on aquatic organisms. Discharge to soil may produce a local pH change which can have a damaging effect on crops and soil dwelling organisms.

Physical and Chemical Hazards

Strongly alkaline solution. Very corrosive to skin and eyes. Will corrode metal surfaces on sustained or repeated contact. May produce an exothermic reaction with acids.

2.2. Label elements

Contains SODIUM HYDROXIDE

Label In Accordance With (EC) No. 1272/2008

Signal Word	Danger	
Hazard Statements		
	H290	May be corrosive to metals.
	H314	Causes severe skin burns and eye damage.
Precautionary Statements		
	P280	Wear protective gloves/protective clothing/eye protection/face protection.
	P305+351+338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
	P310	Immediately call a POISON CENTER or doctor/physician.
	P314	Get medical advice/attention if you feel unwell.
	P501	Dispose of contents / container to hazardous waste depot.
Supplementary Precautionary Statements		
	P234	Keep only in original container.
	P260	Do not breathe vapour/spray.
	P264	Wash contaminated skin thoroughly after handling.
	P321	Specific treatment (see medical advice on this label).
	P301+330+331	IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
	P303+361+353	IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
	P304+340	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
	P363	Wash contaminated clothing before reuse.
	P390	Absorb spillage to prevent material damage.
	P405	Store locked up.
	P406	Store in corrosive resistant/… container with a resistant inner liner.

2.3. Other hazards

This product does not contain any PBT or vPvB substances.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

3.2. Mixtures

SODIUM HYDROXIDE		10-30%
CAS-No.: 1310-73-2	EC No.: 215-185-5	
Classification (EC 1272/2008) Skin Corr. 1A - H314	Classification (67/548/EEC) C;R35	

The Full Text for all R-Phrases and Hazard Statements are Displayed in Section 16.

REACH Registration number	Not applicable
REACH Registration notes	Product is a mixture
Composition Comments	

An aqueous sodium hydroxide mixture.

SECTION 4: FIRST AID MEASURES

4.1. Description of first aid measures

General information

CAUTION! First aid personnel must be aware of own risk during rescue! First aid personnel must protect themselves with all necessary personal protective equipment during the assistance of casualties. Always consider any dangers in the vicinity before approaching to treat the casualty. Check airway for any blockages. When breathing is difficult, properly trained personnel may assist the casualty by administering oxygen. If breathing has stopped perform CPR. Place unconscious person on the side in the recovery position and ensure breathing can take place. Never give anything by mouth to an unconscious person. If medical assistance is needed take as much detail as possible about the incident and hazardous materials involved with the casualty.

Inhalation

Remove victim immediately from source of exposure. Provide rest, warmth and fresh air. In case of severe exposure or if casualty feels unwell, obtain medical attention.

Ingestion

Do not induce vomiting. Rinse mouth thoroughly with water Get medical attention immediately!

Skin contact

Remove contaminated clothing and wash before re - use. Wash the skin with copious amounts of water. If clothing is difficult to remove or stuck to the skin then leave in place and flush affected area with water. Get medical attention immediately!

Eye contact

May cause permanent damage if eye is not immediately irrigated. Promptly wash eyes with plenty of water or eye wash solution while lifting the eyelids.If possible remove any contact lenses and continue to wash. Get medical attention immediately. Continue to rinse.

4.2. Most important symptoms and effects, both acute and delayed

General information

The severity of the symptoms described will vary dependant of the concentration and the length of exposure.

Inhalation.

Acute: Coughing. Irritation of the respiratory system. Delayed: Can cause pulmonary edemas. Prolonged exposure to vapours or mists can cause damage to the mucous membranes of the respiratory system. Burns to the respiratory system may occur after exposure to high concentrations of vapours or mists.

Ingestion

Acute: Burns in the mouth, throat, stomach and gastrointestinal tract. Risk of perforation. Delayed: Scarring of the digestive system with possible blockages due to internal damage. Coma and death can occur following severe exposure.

Skin contact

Acute: Chemical burns. Delayed: Scarring of the skin.

Eye contact

Acute: Severe burns. Delayed: Permanent eye damage. Possible blindness.

4.3. Indication of any immediate medical attention and special treatment needed

Have eye wash facilities in place close to the operators' work area to provide immediate first aid prior to medical attention. All cases of exposure require immediate medical attention.

SECTION 5: FIREFIGHTING MEASURES

5.1. Extinguishing media

Extinguishing media

The product is non-combustible. Use fire-extinguishing media appropriate for surrounding materials. Small fires: Foam, carbon dioxide or dry powder. Large fires: Dry powder, foam or water spray/mist.

Unsuitable extinguishing media

Do not use water jet as this can spread the fire. Do not use carbon dioxide in enclosed spaces with insufficient ventilation.

5.2. Special hazards arising from the substance or mixture

Hazardous combustion products

The product is not combustible but may decompose in the event of a fire. Corrosive gases/vapours/fumes of: Sodium hydroxide. When the water component has evaporated there is a possibility that sodium oxides may be formed during fire.

Unusual Fire & Explosion Hazards

Contact with metals may form hydrogen gas which is flammable and can result in explosion. Containers of flammable liquids in the area of the fire can explode upon heating.

Specific hazards

Corrosive liquid. Sodium hydroxide mists or vapours will be formed.

5.3. Advice for firefighters

Special Fire Fighting Procedures

Prevent run-off from entering drains and watercourses. Be aware of dangers from other hazardous substances in the immediate area. Use water spray to cool unopened containers. Evacuate and keep non-emergency personnel away from the fire area until it is properly extinguished with no danger of re-ignition.

Protective equipment for fire-fighters

Self contained breathing apparatus and full protective clothing must be worn in case of fire.

SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1. Personal precautions, protective equipment and emergency procedures

Wear protective clothing as described in Section 8 of this safety data sheet. Avoid ingestion, inhalation of vapours and contact with skin and eyes. Have emergency procedures in place for treating spillages, evacuating the area and informing the emergency services if necessary. Restrict access to the area until the spillage is treated, if large amounts of vapours are produced that will be hazardous to others, evacuate the area. When any other effects of spillages will affect the safety of others the area should be evacuated.

6.2. Environmental precautions

Avoid unauthorised discharge to the environment. Do not discharge into drains, water courses or onto the ground. Large spillages or uncontrolled discharge to water systems must be alerted to the Environmental Agency or other regulatory body. If spillages to land cannot be treated safely or if contamination will occur the Environment Agency must be alerted immediately. If the substance has entered a foul drain or sewage system in significant quantity to cause a hazard the local Water Treatment Company must be informed. Clean up any spillages immediately, prevent material from spreading and entering drains or sewage systems.

6.3. Methods and material for containment and cleaning up

Any chemical absorbents used must be compatible with the components of the mixture. Small Spillages: Absorb with sand or other inert absorbent. Large Spillages: Dam and absorb spillages with sand, earth or other inert material. Fit drain covers where they are available if the spillage is likely to enter the drainage system. Collect spillage in containers, seal securely and deliver for disposal according to local regulations. Containers with collected spillage must be properly labelled with correct contents and hazard symbol. Flush area clean with lots of water. Be aware of potential for surfaces to become slippery. Ventilate area and allow to dry before allowing access.

6.4. Reference to other sections

Refer to sections 8 and 13 for additional information.

SECTION 7: HANDLING AND STORAGE

7.1. Precautions for safe handling

Avoid spilling, skin and eye contact. Avoid inhalation of vapours and spray mists. Avoid ingestion of the product. Do not eat, drink or smoke when handling. Ensure emergency procedures are in place to treat spillages and cope with other situations such as evacuation. Do not use in areas close to drainage systems unless measures are in place to prevent access of product. Wash at the end of each work shift, before eating, drinking, smoking and using the toilet. Remove contaminated clothing/footwear/equipment before entering eating areas or other places that would expose others to the substance. Do not mix with incompatible substances or mixtures. Do not dispose of the substance to the environment through unauthorised means. Do not discharge to land or water including the drainage system.

7.2. Conditions for safe storage, including any incompatibilities

Store in closed original container at temperatures between 15°C and 25°C. Store away from heat, direct sunlight and moisture. Store away from incompatible materials. It is advisable to store in a bunded area or use other protective measures such as a sump pallet or storage tray. Store in a stable situation to avoid spillages. Avoid freezing conditions. If the mixture is transferred to another container then this should be made of a compatible material. Consult with the packaging manufacturer about suitability. Do not store in containers made of aluminium or other light metals.

Storage Class

Corrosive storage.

7.3. Specific end use(s)

The identified uses for this product are detailed in Section 1.2.

Usage Description

Use product under conditions described in this datasheet. Avoid exposure of operators and others who may be affected by its use. Avoid overuse of the product which would create waste and potential spillages. Always use recommended personal protective equipment. Only use the product for its intended use in a safe manner, do not use for other purposes.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1. Control parameters

Name	STD	TWA - 8 Hrs		STEL - 15 Min		Notes
SODIUM HYDROXIDE	WEL				2 mg/m3	

WEL = Workplace Exposure Limit.

Biological Limit Values

No information available

No information has been received from the manufacturers of the substance.

DNEL

Industry	Inhalation.	Long Term	Local Effects	1 mg/m3
Consumer	Inhalation.	Long Term	Local Effects	1 mg/m3

Refers to sodium hydroxide as a substance.

No information available for PNEC of constituents.

8.2. Exposure controls

Engineering measures

Provide adequate ventilation, including appropriate local extraction, to ensure that the defined workplace exposure limit (WEL) is not exceeded. If vapours or mists are generated, work in a fume cupboard.
Respiratory equipment

Wear suitable respiratory protection when vapours or mists are generated and there is inadequate ventilation or extraction. When the concentration of atmospheric vapours is sufficient to cause skin irritation it is advisable to wear full face respiratory protection. Use respirator fitted with cartridge suitable for inorganic vapours including the substance of concern, type B is recommended. When a particulate respirator is used it is recommended to use at least Type P2, preferably P3. Consult with the supplier as to the compatibility of the equipment with the chemical of concern. CAUTION: Air purifying respirators do not protect the user in oxygen deficient atmospheres, use air supplied system. Respiratory protection should conform to the following standards. BS EN 136: Full face masks. BS EN 140: Half-face masks. BS EN 143: Particulates. Powered air respirators should meet requirements of EN146 and EN12941. Airline fed respirators should meet the requirements of EN 270 and EN1835. Respiratory protection should be maintained in a proper condition and inspected at the frequency specified by current legislation.
Hand protection

Use full length gloves. Polyvinyl chloride (PVC). Viton rubber (fluor rubber). Butyl rubber. Nitrile. The most suitable glove must be chosen in consultation with the gloves supplier, who can inform about the breakthrough time of the glove material. For gloves involving total immersion 1.0mm thickness (if available) are recommended, at least 0.5mm and breakthrough time of >480 minutes. For splash resistance use minimum 0.5mm thickness and breakthrough time > 240 minutes. Gloves should have a breakthrough time sufficient for the amount of handling but allow dexterity for safe movement and handling. Gloves should conform to EN 374 (Chemical and Micro-organisms hazards). Be aware that the liquid may penetrate the gloves. Frequent change is advisable. When removing used gloves apply proper technique by avoiding skin contact with the outer surface. When packages of the product are being handled during storage or transport it is advisable to wear protective gloves to prevent damage to the skin.
Eye protection

Wear approved chemical safety goggles conforming to EN 166.

Other Protection

Wear suitable protective clothing during transport, handling and storage operations connected with the product. Protective clothing should conform to the general requirements of EN 340:2003. Also consider EN 13034:2005; EN 14605:2005; EN 943:2002 dependent upon the situation resulting in exposure. Wear suitable protective footwear during handling of the product. When treating spillages it is recommended to wear protective boots, consult with the supplier as to the compatibility. Safety footwear should conform to standards EN 344 - 347. Wear plastic apron and full length gloves if handling large amounts. If there is a risk of splashing then wear a face shield. Have facilities in place to wash eyes in case of contact. If handling large amounts it is recommended to have a safety shower.
Hygiene measures

If clothing becomes contaminated with large amounts or would otherwise result in exposure to the mixture, remove and wash before re-use. Do not eat, drink or smoke in the work area. Wash hands at the end of each work shift and before eating, smoking and using the toilet.
Environmental Exposure Controls

See section 6 for details.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1. Information on basic physical and chemical properties

Appearance	Liquid
Colour	Colourless.
Odour	Odourless.
Solubility	Miscible with water
Relative density	Approx. 1.28 @ 20°C
Bulk Density	
Not applicable.	
	Only applicable to solids.
Vapour density (air=1)	
Not determined.	
Vapour pressure	
Not determined.	
Evaporation rate	
Not determined.	
Evaporation Factor	
Not determined.	
pH-Value, Conc. Solution	14
Viscosity	
Not determined.	

Solubility Value (G/100G H2O@20°C)

Not applicable.

The product is completely miscible with water.

Decomposition temperature (°C)

Not determined.

Odour Threshold, Lower

Not applicable.

Odour Threshold, Upper

Not applicable.

Flash point

Not relevant

Auto Ignition Temperature (°C)

Not relevant

Flammability Limit - Lower(%)

Not relevant

The mixture is non-flammable.

Flammability Limit - Upper(%)

Not relevant

The mixture is non-flammable.

Partition Coefficient (N-Octanol/Water)

Not determined.

Explosive properties

The mixture itself is not explosive but can produce hydrogen gas on reaction with metals which is explosive.

Explosive under influence of flame.

No

More sensitive to shock than m-dinitrobenzene.

No.

More sensitive to friction than m-dinitrobenzene.

No.

Solid/Liquid Ignition On Contact With Air.

No.

Solid: Burning time.	Not applicable
Aerosol ignition distance	Not applicable
Aerosol flame height	Not applicable

Oxidising properties

Not applicable.

9.2. Other information

Not available. Not determined.

SECTION 10: STABILITY AND REACTIVITY

10.1. Reactivity

Exothermic and possible violent reaction with concentrated acids and organic halogen compounds. Possible exothermic reaction with dilute acid solutions. Flammable hydrogen gas is produced on reaction with light metals. Aluminium Zinc Tin and tin oxides.

10.2. Chemical stability

Air sensitive. Will form carbonates on reaction with atmospheric carbon dioxide. Stable when stored in sealed container at normal temperatures and in a suitable location.

10.3. Possibility of hazardous reactions

Hazardous reactions as specified in section 10.1. Heat and gaseous products may be formed that would build up pressure in a sealed container, do not mix with incompatible materials.

Hazardous Polymerisation

Will not polymerise.

10.4. Conditions to avoid

Avoid heat, direct sunlight and moisture. Avoid contact with acids. Avoid storage in freezing conditions. Avoid storage with incompatible materials. Avoid exposure to the atmosphere, product is air sensitive. Avoid storage in an unstable manner or in a situation that would result in exposure to the product. Avoid storage near to unprotected drainage systems. It is advisable to store the product within some form of containment to prevent spillages reaching drainage systems.

10.5. Incompatible materials

Materials To Avoid

Aluminium, zinc, tin (formation of hydogen). Acids. Halogenated organic compounds Incompatible packaging materials, the mixture will attack some metals and plastics. Consult with the supplier as to suitability.

10.6. Hazardous decomposition products

None under normal conditions. See section 5 for hazardous combustion products.

SECTION 11: TOXICOLOGICAL INFORMATION

11.1. Information on toxicological effects

Toxicological information

The mixture has not been tested for toxicological properties. Information on toxicological properties has not been received from the manufacturer or supplier.

Acute toxicity:

Acute Toxicity (Oral LD50)

No information available.

No reliable information.

Acute Toxicity (Dermal LD50)

No information available.

No reliable information.

Acute Toxicity (Inhalation LC50)

No information available.

No reliable information.

Skin Corrosion/Irritation:

Dose

0.5ml of 5% w/v solution 2 hr Rabbit

Primary dermal irritation index (PDI)

4.33 after 1 hour to 3.1 after 7 days.

Erythema\eschar score

2.6 at 24 hours

Oedema score

1.5 at 24 hours

Tests on rabbits for up to 8 days showed the solution to be irritating. At or above 5% w/w sodium hydroxide is classed as corrosive to skin causing severe burns. OECD Guideline 404 (Acute Dermal Irritation / Corrosion)
Corrosive to skin.

With a patch test using 1%, 2% and 4% solutions, the concentration found to produce mild to moderate irritation was 2%. Solutions as low as 0.5% can produce significant irritation.
Patch test for 48 hours showed sodium hydroxide to be irritating up to 2%. Above this concentration it is considered to be corrosive.

Serious eye damage/irritation:

Below 2%w/w solutions are irritating. At or above 2% w/w they are corrosive. Tests on rabbits, OECD Guideline 405, Acute eye Irritation / Corrosion.

Respiratory or skin sensitisation:

Respiratory sensitisation

No information available.

Skin sensitisation

Patch Test: Human

Not Sensitising.

Germ cell mutagenicity:

Genotoxicity - In Vitro

Gene Mutation:

No reliable information.

Negative.

Despite information being unreliable the results from all tests were negative for genotoxicity.

Genotoxicity - In Vivo

Chromosome aberration:

Result obtained for micronucleus assay on mouse showed negative results. Chromosome aberration on grasshoppers showed some positive results.

Negative.

Information is unreliable but the majority of test results are negative.

Carcinogenicity:

Carcinogenicity

Scientifically unjustified.

Reproductive Toxicity:

Reproductive Toxicity - Fertility

No information available.

No supplied or registered information.

Reproductive Toxicity - Development

Fetotoxicity: Dose Level: 2 microlitre doses of 0.001M NaOH Mouse

Unreliable information.

2 microlitre doses of 0.001 M sodium hydroxide produced mortality in approx. 46% of fetuses.

Specific target organ toxicity - single exposure:

STOT - Single exposure

No information available.

Specific target organ toxicity - repeated exposure:

STOT - Repeated exposure

No information available.

Unreliable information.

Inhalation

Irritation of the respiratory system. Coughing and difficulties in breathing. Headache. Burns to mucous membranes. May cause pulmonary edema, bronchitis or pneumonitis.

Ingestion

Chemical burns to the mouth, oesophagus and stomach. Stomach pain and vomiting. May cause severe internal injury.

Skin contact

Causes severe burns. Delayed effects may be scarring of the skin.

Eye contact

Strongly corrosive. Causes severe burns. Immediate first aid is imperative. Risk of serious damage to eyes. Lacrimation. Delayed effects can be conjunctivitis, cataracts and glaucoma. Possible blindness.

SECTION 12: ECOLOGICAL INFORMATION

Ecotoxicity

Although not classified as environmentally hazardous, harmful effects cannot be excluded in the event of improper handling or disposal. There is a possibility that the mixture could produce a local alkaline pH shift in the aquatic environment. Do not allow to enter drinking water, waste water or soil.

12.1. Toxicity

Acute Fish Toxicity

The acute effects on fish are the damaging effect on fins due the increase in alkalinity. As pH increases above 9 the mortality rate increases. Outside the range of pH6.5 to 9.0 freshwater fish suffer adverse physiological effects increasing in severity until lethality is reached. Marine life suffers outside pH 6.5 to 8.5 due to the larger buffering capacity of salt water producing a more stable pH and a reduced tolerance to pH change.

Acute Toxicity - Fish

LC50 96 hours < mg/l Cyprinus carpio (Common carp) 180

This was a study on mortality. Unreliable information.

Acute Toxicity - Aquatic Invertebrates

EC50 48 hours 40.4 mg/l

Species: Ceriodaphnia sp. Immobility

Acute Toxicity - Aquatic Plants

Scientifically unjustified.

Acute Toxicity - Microorganisms

Not available.

Unreliable information.

Chronic Toxicity - Fish Early life Stage

Not available.

The registered information is unreliable. Semi-static, freshwater tests on guppies showed adverse effects on survival rate and growth. 25 to 100 mg/l produced significant changes in the biology of the fish.

Short Term Toxicity - Embryo and Sac Fry Stages

Not available.

Chronic Toxicity - Aquatic Invertebrates

Scientifically unjustified.

Acute Toxicity - Terrestrial

Not available.

No supplied or registered information

Toxicity to soil:

No registered or supplied information.

Toxicity to terrestrial plants:

No registered or supplied information.

12.2. Persistence and degradability

Phototransformation

Not relevant

Stability (Hydrolysis)

Scientifically unjustified.

When dissolved in water, sodium hydroxide dissociates to form hydroxide ions. This dissociation is reduced as the pH inreases.

Biodegradation

Scientifically unjustified.

Biological Oxygen Demand

No information available.

No supplied or registered information

Chemical Oxygen Demand

No information available.

No supplied or registered information

12.3. Bioaccumulative potential

Bioaccumulative potential

Scientifically unjustified. Due to its high water solubility, sodium hydroxide is not expected to bioaccumulate. It is an inorganic compound.

Bioaccumulation factor

Not relevant

Partition coefficient

Not determined.

12.4. Mobility in soil

Mobility:

Sodium hydroxide is present in the environment as sodium and hydroxyl ions. The product is miscible with water and will spread in water systems. It will be absorbed into soil with the possibility of travelling into groundwater when large or continuous discharges occur. Sodium hydroxide solutions will penetrate further into the soil as dilution increases. Some ion exchange will occur, sodium will become part of the naturally occuring sodium in the environment. There is the possibility that some hydroxide will remain in solution and travel towards groundwater.

Adsorption/Desorption Coefficient

Scientifically unjustified.

Henry's Law Constant

Not available.

No supplied or registered information

Surface tension

Not available.

No supplied or registered information

12.5. Results of PBT and vPvB assessment

This product does not contain any PBT or vPvB substances.

12.6. Other adverse effects

May create a local pH change in soil which can have a damaging effect on crops. Discharge into a foul drain can be a hazard to operators working on the system. Will affect drinking water supplies.

SECTION 13: DISPOSAL CONSIDERATIONS

General information

Any waste material is classed as hazardous waste, it should only be disposed of through licenced waste handlers and treatment sites. Do not allow unauthorised disposal to the environment. If operators are exposed to vapours during the disposal process then suitable respiratory protection should be worn. All other personal protective equipment as described in section 8 should be worn.

13.1. Waste treatment methods

Dispose of waste and residues in accordance with local authority requirements. Avoid unauthorised disposal. Do not dump illegally onto land or into water. Uncleaned empty containers should be treated as hazardous waste. Waste material should not be disposed of directly to drain. Neutralisation is recommended before disposal, this should be carried out by a reputable waste disposal company. IF WASTE IS NEUTRALISED ON SITE BE AWARE THAT A VIGOROUS AND EXOTHERMIC REACTION MAY OCCUR. When dealing with waste always consider the waste management hierarchy of Prevention, Preparation for re-use, Recycling, Recovery and Disposal. It is advisable to minimise waste at source if possible, then re-use, recover or recycle wherever possible before considering waste disposal options.

SECTION 14: TRANSPORT INFORMATION

14.1. UN number

UN No. (ADR/RID/ADN)	1824
UN No. (IMDG)	1824
UN No. (ICAO)	1824

14.2. UN proper shipping name

Proper Shipping Name	SODIUM HYDROXIDE SOLUTION

14.3. Transport hazard class(es)

ADR/RID/ADN Class	8
ADR/RID/ADN Class	Class 8: Corrosive substances.
ADR Label No.	8
IMDG Class	8
ICAO Class/Division	8

Transport Labels

14.4. Packing group

ADR/RID/ADN Packing group	II
IMDG Packing group	II

ICAO Packing group	II

14.5. Environmental hazards

Environmentally Hazardous Substance/Marine Pollutant

No.

14.6. Special precautions for user

EMS	F-A, S-B
Emergency Action Code	2R
Hazard No. (ADR)	80
Tunnel Restriction Code	(E)

14.7. Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code

Not applicable.

SECTION 15: REGULATORY INFORMATION

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

Statutory Instruments

The Chemicals (Hazard Information and Packaging for Supply) Regulations 2009 (S.I 2009 No. 716). Control of Substances Hazardous to Health.

Guidance Notes

Workplace Exposure Limits EH40. Approved Classification and Labelling Guide (CHIP 4) ECHA Guidance on the Compilation of Safety Data Sheets, September 2011.

EU Legislation

Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC, including amendments. Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006 with amendments. Regulation (EU) 453/2010.

15.2. Chemical Safety Assessment

A chemical safety assessment has not been carried out on the mixture. Information from the manufacturer of the raw material has not been received regarding Chemical Safety Assessments, Exposure Scenarios or a Chemical Safety Report.

SECTION 16: OTHER INFORMATION

General information

Under REACH Material Safety Datasheets (MSDS) are referred to as Safety Datasheets (SDS). This datasheet is not intended to be a replacement for a full risk assessment, these should always be carried out by competent persons.

Information Sources

Raw material safety data sheets. ECHA website.

Revision Comments

General rewrite

Revision Date	23/11/2012
Revision	4
Supersedes date	24/09/2008
SDS No.	10016

Risk Phrases In Full

R35	Causes severe burns.

Hazard Statements In Full

H314	Causes severe skin burns and eye damage.
H290	May be corrosive to metals.

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