540 SMITH STREET
FARMINGDALE, NEW YORK 11735
SUFFOLK COUNTY PARCEL ID: 0100-006.00-01.00-025.000
NYSDEC SITE NO. 1-52-147

BIOREMEDIATION PROGRAM
WORK PLAN

SUBMITTED TO:

New York State Department of Environmental Conservation
Division of Environmental Remediation
Remedial Bureau A
625 Broadway, 12th Floor
Albany, New York 12233-7020

PREPARED FOR:

Minmilt Realty Corp.
352 Carnation Drive
Farmingdale, New York 11735

PREPARED BY:

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PWGC Project Number: MIN2004

AUGUST 2020

P.W. GROSSER CONSULTING, INC.
PROJECT No. MIN2004

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BIOREMEDIATION PROGRAM WORK PLAN
THE MINMILT REALTY SITE
NYSDEC SITE NO: 1-52-147

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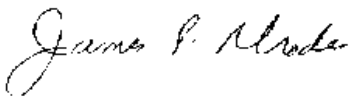
APPENDICES

ACRONYM	DEFINITION
ASP	Analytical Services Protocol
CAMP	Community Air Monitoring Plan
CFR	Code of Federal Regulations
DER	Division of Environmental Remediation
DER-10	Technical Guidance for Site Investigation and Remediation
EDD	Electronic Data Delivery
EIMS	Environmental Information Management System
ELAP	Environmental Laboratory Accreditation Program
EM	Electromagnetic
ESA	Environmental Site Assessment
GPR	Ground Penetrating Radar
HASP	Health and Safety Plan
HSM	Health and Safety Manager
IDW	Investigative Derived Waste
IRM	Interim Remedial Measure
LDC	Laboratory Data Consultants
MDL	Method Detection Limit
mg/kg	milligram per kilogram
mL	milliliter
msl	mean seal level
MS/MSD	Matrix Spike / Matrix Spike Duplicate
NYCRR	New York Codes, Rules, and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OM&M	Operation Monitoring and Maintenance
PCE	Tetrachloroethylene
PID	Photo-ionization Detector
PM-10	10 micrometers in size
PPE	Personal Protective Equipment
ppm	parts per million
PWGC	P.W. Grosser Consulting, Inc.
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance / Quality Control
QEP	Qualified Environmental Professional
RI	Remedial Investigation
RL	Reporting Limit
SCDHS	Suffolk County Department of Health Services
SCG	Standards, Criteria, and Guidance
SCO	Soil Cleanup Objective
SOP	Standard Operating Procedure
SVE	Soil Vapor Extraction
SVOC	Semi-volatile Organic Compound
ug/l	Micrograms per liter
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

CERTIFICATION

I, James P. Rhodes, PG, certify that I am currently a Qualified Environmental Professional (QEP) as defined in 6 New York Codes, Rules, and Regulations (NYCRR) Part 375 and that this Bioremediation Program Work Plan was prepared in accordance with applicable statutes and regulations and in substantial conformance with the New York State Department of Environmental Conservation's (NYSDEC's) Division of Environmental Remediation's (DER's) Technical Guidance for Site Investigation and Remediation (DER-10).

I certify that the information and statements in this certification are true. I understand that a false statement made herein is punishable as Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law.



August 19, 2020

Signature | Date

It is a violation of Article 145 of New York State Education Law for any person to alter this document in any way without the express written verification of adoption by any New York State licensed engineer in accordance with Section 7209(2), Article 145, New York State Education Law.

1.0 INTRODUCTION

P.W. Grosser Consulting, Inc. (PWGC) has prepared the following Bioremediation Program Work Plan to outline procedures and a scope of work associated with proposed bioremediation chemical injection activities at 540 Smith Street, Farmingdale, New York (Suffolk County Parcel ID: 0100-006.00-01.00-025.000), referred to herein as ("the Minmilt Realty Site" or "the site"). An on site leaching pool was previously reported to have received periodic discharges of tetrachloroethylene (PCE) prior to 1994 as the result of historical operations at the Minmilt Realty Site. A soil and groundwater investigation performed in 1994 identified significant PCE contamination in subsurface soils on the east side of the site, in the vicinity of the leaching pool. Remedial measures to address this source area and associated groundwater contamination have been ongoing since the mid-1990s, and as a result, detected groundwater impact is currently limited to the on site recovery wells, which are located on the southeastern portion of the site.

The scope of this work plan is based on the findings of a May 2020 soil investigation performed at the site. This additional soil investigation of the historical source area on the eastern side of the property by the leaching pool identified PCE impacted soils at depth below the water table. The findings of the May 2020 investigation are further detailed in the site history section (Section 2.4) of this work plan. The goal of the activities detailed in this work plan are to address the PCE impact identified at depth beneath the eastern portion of the site and to reduce PCE concentrations in the recovery wells to a level that will warrant closure of the remedial systems in place at the site. The scope of work for this project was developed with input from Regenesis, Inc. of San Clemente, California, a bioremediation chemical supplier, in an effort to plan for the use of bioremediation chemicals designed to address chlorinated solvent contamination.

2.0 SITE DESCRIPTION AND HISTORY

2.1 Site Description

The Minmilt Realty Site is a 2.28-acre industrial property located at 540 Smith Street, East Farmingdale, New York. The site is identified in the Suffolk County Tax Map as 0100-006.00-01.00-025.000 and is located in the Town of Babylon. The site is bounded by Smith Street to the north, a commercial building (50 Engineers Lane, formerly Cantor Brothers) to the south, a commercial building (550 Smith Street, formerly Great Neck Saw) to the east, and to the west by commercial buildings. The site is improved with a 47,104 square-foot building

situated in the center of the property. The eastern, western, and southern exterior portions of the site are paved driveways and parking lots, and the northern exterior of the site is landscaped. The current building tenant undertakes light manufacturing activities.

A Vicinity Map is included as **Figure 1**. A Site Plan outlining the boundaries of the site is included as **Figure 2**.

2.2 Regional Geology/Hydrogeology

The geologic setting of Long Island is well documented and consists of crystalline bedrock composed of schist and gneiss overlain by layers of unconsolidated deposits. Immediately overlying the bedrock is the Raritan Formation, consisting of the Lloyd sand confined by the Raritan Clay Member. The Lloyd sand is an aquifer and consists of discontinuous layers of gravel, sand, sandy and silty clay, and solid clay. The Raritan Clay is a solid and silty clay with few lenses of sand and gravel, abundant lignite and pyrite, and is gray, red, or white in color.

Above the Raritan Clay lies the Magothy Formation. The Magothy Aquifer consists of layers of fine to coarse sand of moderate to high permeability, with interbedded lenses of silt and clay of low permeability resulting in areas of preferential horizontal flow; therefore, this aquifer generally becomes more confined with depth. The Magothy Aquifer is overlain by the Upper Glacial Aquifer. The Upper Glacial Aquifer is the water-table aquifer at this location and is comprised of medium to coarse sand and gravel with occasional thin lenses of fine sand and brown clay. This aquifer extends from the land surface to the top of the Magothy Aquifer; therefore, is hydraulically connected to the Magothy Aquifer. These aquifers are considered Sole Source Aquifers for Long Island.

2.3 Site Geology/Hydrogeology

Based upon drilling and geologic logging performed during previous investigations of the Minmilt Realty Site, Upper Glacial deposits, generally consisting of fine- to medium-grained sands with some gravel, are approximately 105 feet thick beneath the site. These sand deposits extend from land surface (approximately 100 feet above mean sea level [msl]) to a depth of approximately 105 feet (-5 feet msl), where the Magothy Aquifer is encountered. The Magothy Formation is several hundred feet thick and includes the Magothy Brown Clay unit. Beneath the Site, the first Magothy deposits encountered consist predominantly of fine to medium sands approximately 80 feet thick (-5 to -85 feet msl) with a discontinuous layer of very fine sand, silt, and clay

present from approximately -55 to -60 feet msl. The Magothy Brown Clay unit is present from approximately -85 to -95 feet msl and is mapped as a continuous layer beneath the site. The Brown Clay is a low permeability layer and considered an aquitard, effectively prohibiting the vertical flow of groundwater through this unit. Beneath the Brown Clay unit, the Magothy consists of fine sands and clays. A geologic cross section is shown in **Figure 4**.

The depth to groundwater is approximately 38 to 40 feet below land surface and general groundwater flow direction is toward the south-southeast. The estimated groundwater velocity/flow rate of the Upper Glacial aquifer is approximately 0.93 feet per day. The underlying Magothy aquifer consists of very fine sands with an estimated groundwater velocity/flow rate of 0.49 feet per day (NYSDEC, March 2002).

2.4 Site History

The site was used for agricultural purposes prior to 1965. The on site building, currently owned by Minmilt Realty, was constructed in 1965 and the property was subsequently occupied by Hygrade Metal Mouldings (Hygrade). Hygrade manufactured metal mouldings from strip metals used in construction of windows and other finish products. Prior to 1983, Hygrade used a vapor degreaser, which included a PCE component, to clean metal parts. The use of this vapor degreaser was terminated in 1983.

An Order on Consent (No. IW-91-0021) was issued to Minmilt Realty by the Suffolk County Department of Health Services (SCDHS) in January 1992. SCDHS alleged that Minmilt Realty caused or permitted the discharge of toxic or hazardous material to an onsite leaching pool in violation of Section 760-1205 of Article 12 of the Suffolk County Sanitary Code. The referenced leaching pool has been reported to have received periodic discharges from the vapor degreaser, which contained PCE.

In response to the SCDHS Order on Consent, a soil and groundwater investigation was conducted by PWGC under subcontract to Middleton, Kontokosta Associates (MKA) in 1994. The objective of the investigation was to identify on site contamination and associated source areas resulting from the alleged discharges. The soil and groundwater investigation identified significant soil contamination present in the subsurface on the east side of the building. The contamination was primarily PCE and was detected at concentrations high enough to classify some of the soil material as hazardous. PCE concentrations were found to increase with depth towards the

water table. At the time, it was estimated that approximately 5,500 cubic yards of soil had been impacted. In addition, PCE was detected in the groundwater beneath the site in excess of permissible NYSDEC standards. Contaminated soils were suspected to be the primary source of PCE in the groundwater. The PCE plume was determined to extend down-gradient to at least the southern property line of Hygrade and vertically to at least 80 feet below grade (40 feet below the water table). The soil and groundwater investigation also determined that background and up-gradient groundwater quality in the vicinity of the site was also degraded, indicating the presence of other up-gradient sources of contamination.

In 1995, under the oversight of the NYSDEC, a Remedial Investigation (RI) was performed. No additional sources of PCE were identified by the remedial investigation at the Site. The vertical extent of the groundwater plume was determined to extend into the Magothy Aquifer to a depth of approximately 185 feet below grade, where it is contained by the Brown Clay layer. In addition, on site monitoring well MW-3, located on the southeastern portion of the property, was found to contain a mixture of fuel oil and PCE in a non-aqueous state.

To expedite the clean-up of the site and minimize further degradation of groundwater quality, an interim remedial measure (IRM) was proposed consisting of a soil vapor extraction (SVE) and groundwater remedial combination system to remove the contamination. Implementation of the IRM began in August 1996 and completed in February 1997. Subsequently, the Final Offsite RI was completed and the Record of Decision (ROD) signed, accepting the IRM as the final remedy. The ROD identified three site goals:

- Goal No. 1 - Eliminate, to the extent practicable, off-site migration of groundwater that does not attain NYSDEC Class GA Ambient Water Quality Criteria;
- Goal No. 2 - Eliminate, to the extent practicable, exposures to on site contamination through the remediation of volatile organic compounds (VOCs) in subsurface soils; and
- Goal No. 3 - Eliminate, to the extent practicable, the migration of site contamination into the groundwater.

The groundwater treatment system installed at the Site included two recovery wells which were placed in the southeastern corner of the site and downgradient of the leaching pool which had historically received PCE discharges. One recovery well was screened within the Upper Glacial aquifer and one screened within the

Magothy aquifer. The influent groundwater is treated by being pumped to the top of an air-stripper tower before being discharged to a Town of Babylon recharge basin located adjacent to the site. Originally, this treatment system included granulated activated carbon (GAC) units as part of the treatment mechanisms, however the GAC units were removed in 1999 with approval from NYSDEC. PWGC prepared a modified Operation Monitoring and Maintenance (OM&M) plan based upon the offsite RI and the ROD. Minmilt Realty Corp. signed a new Order on Consent on October 24, 2003 addressing the continuing groundwater and soil monitoring at the site.

To further assess the nature of the remaining impacts at the site, PWGC conducted a vertical profile investigation south of MW-3 in 2009. This investigation identified PCE at concentrations up to 84,000 µg/L in groundwater. High concentrations were primarily observed in the Magothy Aquifer between 120 feet and 130 feet below grade and were mostly limited to this area, with concentrations rapidly dropping off in each of the surrounding step-out borings conducted by PWGC. The results of the vertical profile investigation documented that the greatest groundwater impacts were located within the Magothy Aquifer, just south of MW-3.

PWGC oversaw installation of a new Magothy well (Magothy Extraction Well No. 4) to the south of MW-3 during the first quarter of 2012 to target the contamination identified in the 2009 vertical profile investigation. The well was installed with 6-inch diameter casing and screened from 103 to 163 feet below grade. PWGC subsequently determined that Magothy Extraction Well No. 4 had replaced Magothy Extraction Well No. 2 in remedial capacity, rendering Magothy Extraction Well No. 2 unnecessary. After receiving permission from the NYSDEC, original Magothy Extraction Well No. 2 was placed out of operation during the first half of 2014. During June and July 2015, a new on site Upper Glacial well (Upper Glacial Extraction Well No. 3) was installed and placed into operation. This well was screened from 68.5 to 98.5 feet below grade. This depth coincides with, and targets, the highest remaining impacts in the Upper Glacial aquifer, based upon the results of PWGC's 2014 vertical profile investigation. System mass removal rates increased to the highest since 2008 indicating that the new extraction wells (Upper Glacial Extraction Well No. 3 and Magothy Extraction Well No. 4) are effectively treating the remaining groundwater impact. In March 2015, both off-Site extraction wells (Upper Glacial Extraction Well No. 1 and Magothy Extraction Well No. 2) were decommissioned and abandoned. Due to a drop in the PCE removal rate, the on site SVE system was put on a pulsed pumping schedule (i.e., 2 weeks on, 2 weeks off) in 2016.

A soil investigation of the historical source area on the eastern side of the property was conducted in May 2020 which included two soil borings installed to a depth of 170 feet below grade and one to 180 feet below grade. These borings were installed in the vicinity of the leaching pool that historically received discharges of PCE. The results of this investigation identified PCE contamination from 80 to 90 feet below grade at each of the three boring locations. The highest concentration of PCE was 4,700,000 ppb detected at the 85 to 90 foot interval from the boring installed adjacent to the leaching pool which historically received periodic PCE discharges and is referred to as the "hot spot." Concentrations of PCE within the 80 to 90 foot interval at the two downgradient boring locations were found to be significantly lower and is referred to as the "downgradient barrier zone." A second and less significant zone of PCE contamination was detected at 120 to 125 feet below grade where thin layers of clay were encountered in the upper Magothy Formation.

2.4.1 Previous Environmental Reports/Remedial History Timeline

The following narrative provides a remedial history timeline and brief summary of the available project records to document key investigative remedial milestones for the Minmilt Realty Site. Full titles for each of the reports referenced below are provided in Section 9.

1992: Order on Consent No. IW-91-0021 issued to Minmilt Realty by SCDHS.

1994: The Site was listed as a class 2 Site in March 1994.

PWGC, under contract to MKA, conducts an on site soil and groundwater investigation. A preliminary report was generated entitled *Investigation Report for Hygrade Metals* (PWGC, 1994).

1995: Remedial Investigation performed under NYSDEC oversight. PCE in groundwater extends vertically into the Magothy aquifer down to the Magothy Brown Clay (~185 feet below grade). Non-aqueous phase liquid containing a mixture of fuel oil and PCE was present in MW-3. No additional PCE sources were identified at the Site (*Remedial Investigation Report,* PWGC, October 1995, revised February 1996).

1996: Two Interim Remedial Measures (IRMs) were implemented: 1) a groundwater extraction and treatment system and 2) a soil vapor extraction system (*Interim Remedial Measure to be Conducted at the Hygrade Metal Moulding Facility, East Farmingdale, New York - An Evaluation of Alternatives and Design,* PWGC, January 1994, revised December 1995 and April 1996).

1997: IRM construction completed in February (*Construction Completion Report for the Interim Measure at Minmilt Remedial Site, East Farmingdale, New York,* PWGC, July 1997). Upper Glacial Extraction Well No. 1 and Magothy Extraction Well No. 2 begin pumping. PWGC submits the revised version of *Operation and Maintenance Program for the Interim Remedial Measure at Minmilt Realty, East Farmingdale, New York, October 1996, revised March 1997.* Quarterly SVE system sampling and monitoring well sampling begins.

1999: NYSDEC approves removal of the Granular Activated Carbon (GAC) treatment from the SVE system since the SVE air effluent is consistently below NYSDEC discharge limits. SVE effluent is routed directly to atmosphere on April 16.

2001: Minmilt Realty completed the offsite remedial investigation (*Offsite Remedial Investigation and Feasibility Study,* PWGC, October 2001).

2002: The Hygrade Metals Moulding (Minmilt Realty) Record of Decision (ROD) was published in March 2002 accepting the IRM as the final remedy (NYSDEC, March 2002).

2002 to Present: Operation, Maintenance and Monitoring (OM&M) of the treatment systems continues. NYSDEC approves removal of GAC treatment from the air stripper tower air effluent since the groundwater influent is consistently below NYSDEC discharge limits that GAC treatment of the vapor was no longer required. Air stripper effluent is routed directly to atmosphere on April 17, 2002.

2003: Minmilt Realty signs new Order on Consent on October 24, 2003.

2004: NYSDEC approves suspension of system Semivolatile Organic Compound (SVOC) sampling, a reduction in the number of monitoring wells sampled quarterly from 23 to 13 and streamlining the quarterly report.

2005: January 31, 2005, NYSDEC approves the *Operation, Maintenance and Monitoring (OM&M) Program for the Minmilt Realty Site* (PWGC, January 2005), replacing the *Operation and Maintenance Program* (PWGC, 1997).

2006: PWGC completes four quarters of indoor air monitoring (540 & 550 Smith Street) and reports that PCE concentrations have been non-detect or near non-detect (<5 µg/m^3) since September

28, 2005, more than an order of magnitude below the New York State Department of Health (NYSDOH) Guidance Value of 100 µg/m^3 for PCE (PWGC, June 2006).

2007: NYSDEC submits minor changes to the Minmilt Realty ROD to remove the requirements for 1) existing use and development restrictions on groundwater use and 2) deed restrictions to restrict the further use of the Site for industrial use only. Other than standing town ordinances and SCDHS typical requirements, the only ICs in place for the Site are that all ECs must be operated and maintained as specified in the OM&M Plan, and that all ECs must be inspected in a manner and at a frequency specified in the OM&M Plan. These changes are accepted, and the Site Classification changed from 2 to 4 (NYSDEC, May 10, 2007 and November 9, 2007; NYSDOH, March 22, 2005).

2009: PWGC conducts a vertical profile investigation south of MW-3 and delineates high concentrations of PCE in the Magothy aquifer from 120 to 130 feet below grade.

2012: Magothy Extraction Well No. 4 installed on Site south of MW-3 in 2011 (screened from 103 to 163 feet below grade) goes into operation to target high concentrations of PCE.

2013: Report to NYSDEC after 16 years of O&M indicates that an estimated 33,600 pounds of total volatile organic compounds (TVOCs) have been removed by the groundwater treatment system and an additional 5,300 pounds of TVOCs have been removed by the SVE system (*2013 Remedial Status Report,* PWGC, September 2013). Magothy Extraction Well No. 2 was recommended for shutdown and removed from service during the fourth quarter of 2013 (*January – September 2015 Minmilt Groundwater Sampling Report,* PWGC, 2015).

2014: OM&M is modified to reduce groundwater sampling of monitoring wells from quarterly to every fifth quarter. Quarterly sampling of groundwater remedial system influent and SVE system influent to continue; monthly monitoring well gauging and groundwater system influent and effluent sampling to continue.

2015: Upper Glacial Extraction Well No. 3 was installed with the screened depth (68.5 to 98.5 feet below grade) designed to coincide with the highest PCE concentrations remaining in the Upper Glacial aquifer. The well was placed into operation in July 2015. System mass removal rates increased to the highest level since 2008 indicating that the new extraction wells (Upper Glacial

Extraction Well No. 3 and Magothy Extraction Well No. 4) are located within the area of greatest groundwater impacts. In March 2015, both off-Site extraction wells (Upper Glacial Extraction Well No. 1 and Magothy Extraction Well No. 2) were decommissioned and abandoned (*January – September 2015 Minmilt Groundwater Sampling Report,* PWGC, 2015).

2016: SVE system put on a pulsed pumping schedule (2 weeks on, 2 weeks off) due to drop in PCE removal rate.

2018: NYSDEC approves eliminating quarterly reporting requirement. O&M activities, system repairs, monitoring well gauging and treatment system review and trending will be detailed in the Periodic Review Report (PRR)

NYSDEC begins converting the OM&M Plan into a Site Maintenance Plan (SMP).

2019: NYSDEC approves amending monthly groundwater level gauging frequency requirement from monthly to quarterly, and SVE sampling requirement from quarterly to biannually (twice annually).

PWGC submitted a draft of the SMP on February 5th, 2020.

2020: A subsurface investigation performed in May 2020 which included three soil borings to a depth ranging from 170 to 180 feet below grade delineates the vertical extent of PCE contamination on the eastern side of the property.

The groundwater treatment system at the site remains operational and routine sampling of the system is currently conducted on a monthly basis in accordance with the OM&M Plan requirements.

3.0 BIOREMEDIATION PROGRAM TASKS

The objective of the actions detailed in this work plan will be to apply bioremediation chemicals within the defined "hot spot" of PCE contamination located on the eastern side of the site, as well as in the less impacted "down-gradient barrier zone." The chemicals applied to the "hot spot" will be used for the goal of enhancing biodegradation of PCE compounds entrained in the subsurface and to reduce contamination to the extent that the remediation systems operating at the site are no longer warranted. The chemicals applied to the "down-gradient barrier zone" will be used with the goal of forming a secondary zone of bioremediation activity to limit the capacity for PCE to migrate off-site and to address the less severe PCE impact documented at this location.

The locations of the "hot spot" and "down-gradient barrier zone" in relation to the borings performed during the May 2020 investigation are illustrated on **Figure 3**, and a cross-section illustrating the depths of these zones along with PCE concentrations identified at the three boring locations performed in May 2020 is included on **Figure 4**.

3.1 Geophysical Survey

Prior to initiating drilling and injection activities, a ground-penetrating radar (GPR) survey will be performed to ensure proposed boring/injection locations are clear of buried utilities, including those associated with on site remedial systems. The results of the GPR survey may slightly alter locations of proposed injection points to avoid damaging subgrade utilities.

The GPR method is based upon the transmission of repetitive, radio-frequency electromagnetic (EM) pulses into the subsurface. When the transmitted energy of down-going wave contacts an interface of dissimilar electrical character, part of the energy is returned to the surface in the form of a reflected signal. This reflected signal is detected by a receiving transducer and is displayed on the screen of the GPR unit as well as being recorded on the internal hard drive.

The received GPR response remains constant if the electrical contrast between media is present and constant. Lateral or vertical changes in the electrical properties of the subsurface result in equivalent changes in the GPR responses. The system records a continuous image of the subsurface by plotting two-way travel time of the reflected EM pulse versus distance traveled along the ground surface. Two-way travel time values are then converted to depth using known soil velocity functions. Each radar profile will be examined for characteristic GPR signatures that may indicate the presence of buried targets.

The findings of the geophysical survey may be used to alter the locations of the proposed injection points. If the relocation of an injection point is deemed necessary, the relocated injection point will still be placed within the "Hot Spot" or "Downgradient Barrier Zone," whichever zone it was originally proposed to be located in. All attempts will be to skew the relocated injection point as close to and immediately down-gradient from the original leaching pool.

3.2 Pre-Bioremediation Program Sampling

Prior to bioremediation injection activities, samples will be collected from each of the four sampling ports associated with the groundwater treatment system on site in accordance with the site's OM&M Plan. The four sampling ports associated with the groundwater treatment system include taps to access the influent water of the Upper Glacial and Magothoy recovery wells, the combined influent water from the recovery wells, and the post-treatment effluent water. Samples will be submitted for laboratory analysis for the following parameters in accordance with the OM&M Plan:

- Iron (Fe)
- pH
- Toluene
- M+P Xylene
- 1,1-Dichloroethene
- Chloromethane
- Chloroform
- 1,1,1-Trichloroethene
- 1,2-Dichloroethene
- Tetrachloroethene
- Trichloroethylene

The collection of pre-injection activity samples from the groundwater treatment system is to establish a baseline of pre-bioremediation conditions and will be used to gauge the effectiveness of the bioremediation program.

3.3 Bioremediation Program Injection Activities

To address PCE contamination at the site, an in-situ enhanced bioremediation program will be implemented. As documented in the May 2020 soil investigation, the main area of PCE impact was located on the eastern portion of the site and defined within a "hot spot" located approximately 80 to 95 feet below grade, and a multi-tier-zone of lesser PCE impact was observed approximately 70 feet downgradient of the southern edge of the "hot spot." The downgradient area referred to as the "downgradient barrier zone" included PCE impact at 80 to 95 feet below grade as well as 115 to 135 feet below grade.

Prior to implementation of the bioremediation program, the groundwater treatment system on site will be shut off, and remain off, for the duration of injection activities to prevent artificially enhanced groundwater flow

velocities influenced by the treatment system's recovery wells from interfering with the bioremediation chemicals and its effects on the treatment areas, and to avoid drawing out bioremediation chemicals after they are introduced to the subsurface. The groundwater treatment system will be reactivated no less than one week following the conclusion of injection activities.

Bioremediation injections will be performed through 40 temporary injection points installed in the "hot spot" area and 15 temporary injection points installed in the "downgradient barrier zone" area using a direct-push drill rig (Geoprobe®, or similar). Injections will be performed in 5-foot intervals within 80 to 95 feet below grade at the "hot spot," and in five-foot intervals within 80 to 95 feet below grade and 115 to 135 feet below grade at the "downgradient barrier zone." The locations of the injection points are illustrated on **Figure 3** and a cross-section illustrating the depths of the injection zones and borings is included on **Figure 4**.

The bioremediation program will include the use of three different chemicals to be provided by Regenesis, who was consulted as part of the preparation of this work plan. These three chemicals were recommended by Regenesis to be effective products for addressing chlorinated solvent contamination in soil and groundwater. The three bioremediation chemicals to be used as part of this program are as follows:

- Regenesis Microemulsion Factory Emulsified – 3DME is an injectable liquid material designed for in-situ remediation products via anaerobic biodegradation of chlorinated compounds through the enhanced reductive dechlorination (ERD) process. ERD is the primary anaerobic biological process by which chlorinated solvents, such as PCE, in groundwater are biologically transformed into less harmful end-products such as ethene.
- Chemical Reducing Solution – CRS is an iron-based amendment for in-situ chemical reduction (ISCR) of halogenated hydrocarbon contaminants such as chlorinated ethenes and ethanes. CRS is a pH neutral, liquid iron solution that is mixed with 3DME before injection into contaminated media. CRS is a soluble, food-grade source of ferrous iron (Fe^{2+}), designed to precipitate reduced iron sulfides, oxides, and/or hydroxides. These Fe^{2+} minerals are capable of destroying chlorinated solvents via chemical deduction pathways, thus improving the efficiency of the overall reductive dechlorination process by providing multiple pathways for contaminant degradation in groundwater.
- Dechlor INOCLUM Plus – BDI Plus is designed for use at sites where chlorinated contaminates are present and unable to be completely biodegraded via existing microbial communities. BDI Plus is an enriched, natural microbial consortium containing species of Dehalococcoides sp. (DCH) which are capable of dechlorinating contaminants during in-situ anaerobic bioremediation processes. BDI Plus has been shown to stimulate the rapid dechlorination of chlorinated compounds such as PCE.

The specification sheets provided by Regenesis for each of these three products are included in **Appendix A**.

These chemicals will be mixed with water as per the manufacture's specifications and injected through an industrial grade pump into the temporary injection points. The injections will be performed using a bottom-up approach which entails starting the injections at each location at the terminal depth and pulling up the injection point to its final shallow depth. The quantities of remediation chemicals to be applied to each zone is as follows:

Hot Spot Zone – 80 to 95 feet Bgs:

- Bioremediation chemicals:
  - 3DME – 11,600 Lbs.
  - CRS – 4,800 Lbs.
  - BDI Plus - 34 liters.
- Injection points – 40.
- Estimated total injection volume – 26,171 gallons.

Downgradient Barrier Zone 1 – 80 to 95 feet Bgs.

- Bioremediation Chemicals:
  - 3DME – 1,200 lbs.
  - CRS – 800 lbs.
  - BDI Plus – 6 liters.
- Injection points – 15.
- Estimated total injection volume – 2,767 gallons.

Downgradient Barrier Zone 2 – 115 to 135 feet Bgs.

- Bioremediation Chemicals:
  - 3DME – 1,200 lbs.
  - CRS – 800 lbs.
  - BDI Plus – 4 liters.
- Injection points – 15.
- Estimated total injection volume – 2,747 gallons.

Bioremediation chemicals will be mixed to form an injectable solution and applied in accordance with manufacturer specifications.

3.4 Post-Bioremediation Program Sampling and Monitoring

Approximately two weeks after the conclusion of injection activates at the site, samples will be collected from the sampling ports associated with the groundwater treatment system and analyzed for the parameters

discussed in section 3.2 of this work plan. Samples will be collected from the four sampling ports on a monthly basis for a period of six months following injection activities to monitor groundwater conditions at the site. Monthly sampling of the groundwater treatment system will be performed as part of the routine OM&M activities which are included as part of the OM&M Plan requirements.

4.0 QUALITY ASSURANCE PROJECT PLAN

This Quality Assurance Project Plan (QAPP) presents the objectives, functional activities, methods, and QA/QC requirements associated with the bioremediation program. The QAPP follows requirements detailed in DER-10, Section 2.

4.1 Project Organization

The efforts defined in this work plan will be implemented by PWGC on behalf of Minmilt Realty Corp. The following identifies the responsibilities of various organizations supporting the bioremediation program:

- The NYSDEC Project Manager (Steven Scharf) will be responsible for reviewing and approving this work plan, coordinating approval of requested modifications, and providing guidance on regulatory requirements, if necessary.
- The PWGC Program Manager (James Rhodes and/or Paul Boyce) will provide technical expertise for review of the project plans, reports and ongoing field activities.
- The PWGC QA Manager (Andrew Lockwood) will confirm the quality of work associated with the project is in accordance with all project plans.
- PWGC Project Manager (Ryan Morley) will be responsible for the day-to-day project management, task leadership, and project engineering support and for the planning and implementation of injection activities. The Project Manager is responsible for ensuring that the requirements of this work plan are implemented. The project manager will also act as the Site Health and Safety Manager (HSM).
- PWGC Field Team Leader (Kaitlyn Crosby or designee) will be responsible for directing field activities, oversight of subcontractor personnel, and coordination of daily field activities. The Field Team Leader will act as the Site Health and Safety Officer ensuring implementation of the Site Health and Safety Plan.
- A NYSDOH Environmental Laboratory Accreditation Program (ELAP) certified laboratory (Alpha Analytical Laboratories of Westborough, Massachusetts ELAP ID 11148 and 11627) will be contracted to perform required analyses and reporting for pre- and post-injection activity groundwater treatment system samples.
- Subcontractors will perform surveying, drilling, and injection activities at the direction of the Field Team Leader in accordance with this work plan.

Qualifications for the project team are included in **Appendix B**.

4.2 Equipment Decontamination

In order to minimize the potential for cross-contamination, non-dedicated drilling and sampling equipment shall be properly decontaminated prior to and between sampling/drilling locations.

4.2.1 General Procedures

Drilling and injection equipment will be decontaminated in a designated area as necessary. Waste material generated during decontamination activities will be containerized, stored and disposed of in accordance with the procedures detailed in **Section 4.3**. Personnel directly involved in equipment decontamination shall wear appropriate personal protective equipment (PPE).

4.2.2 Drilling and Injection Equipment

Drilling and injection equipment shall be decontaminated prior to performance of the first boring and between all subsequent borings. This shall include hand tools, drill rods, and other related tools and equipment. Water used during drilling and/or steam cleaning operations shall be from a potable source.

4.3 Management of Bioremediation Program Derived Waste

Waste materials generated from field activities may consist of soil cuttings, decontamination water, and miscellaneous solid materials such as PPE and supplies. Wastes generated during field activities will be disposed of in accordance with applicable regulations, if necessary.

Soil cuttings generated from drilling and injection activities will be stored in 55-gallon drums, if necessary. Drums will be labeled to indicate the source of the material and will be stored in a designated area on site. Drummed material will be sampled in accordance with the prospective disposable facility's requirements prior to removal from the site. Following receipt of the analytical results, recommendations for disposal of the drummed material will be provided to the NYSDEC.

Decontamination water or other water generated during the drilling activities will be stored in a portable holding tank and/or 55-gallon drums. Drums will be labeled to indicate the source of the fluid and will be stored in a designated area on site. Drummed decontamination or drilling water will be pumped through the groundwater treatment system on site once it has been reactivated. Following receipt of the water sampling results, recommendations for disposition of the water will be provided to NYSDEC.

4.4 Field Documentation

Documentation will take place on either appropriate forms or in a dedicated site logbook. Permanent black or blue ink will be used to record information in the logbook. Errors in field documentation will be lined through, initialed, dated, and corrected. Forms will be kept by the PWGC Field Team Leader during the field activities. Field activities will be documented in the field logbook. The logbook will contain pages that are consecutively numbered and be permanently bound with a hard cover. Upon completion of daily activities, unused portions of pages will be lined-through and initialed.

The primary purpose of the field logbook is to document the daily field activities and to provide descriptions of each activity. All entries in the field logbook will be recorded and dated by person making the entry.

5.0 BIOREMEDIATION PROGRAM COMPLETION REPORT

The Bioremediation Program Completion Report will be prepared following the conclusion of field activities. The report will include documentation of field activities, a breakdown of chemicals and solution volumes applied at each injection point, presentation of pre-injection and post-injection activity sampling results in accordance with Section 3.2 of this work plan, and deviations from this work plan, if warranted. This report will be submitted to NYSDEC for review.

6.0 HEALTH AND SAFETY

Employees at the site may be exposed to bioremediation program derived waste and/or bioremediation chemicals at the Minmilt Realty Site during field activities. PWGC's policy is to minimize the possibility of work-related exposure through awareness and qualified supervision, health and safety training, use of appropriate PPE, and the activity-specific safety protocols contained the project Health and Safety Plan (HASP). PWGC has established a guidance program to implement this policy in a manner that protects personnel to the maximum reasonable extent.

This HASP describes emergency response procedures for actual and potential chemical hazards. Persons are to acknowledge that they understand the potential hazards and the contents of this Health and Safety policy by signing off on receipt of their individual copy of the document. Contractors and suppliers are retained as independent contractors and are responsible for ensuring the health and safety of their own employees as it relates to general construction practices.

The HASP for the scope of work specified in this work plan is provided as **Appendix C**.

7.0 COMMUNITY AIR MONITORING PLAN (CAMP)

Real-time air monitoring for volatile organic vapors at the immediate perimeter of the work area will be performed using a hand-held photoionization detector (PID). Continuous monitoring will be performed for ground intrusive activities (i.e., installation of injection points).

Periodic monitoring during drilling and injection activities will consist of taking a reading upon arrival at the work-zone, monitoring while drilling and injection activities are ongoing, and taking a reading prior to leaving the work-zone. Depending upon the proximity of potentially exposed individuals, continuous monitoring may be performed during drilling and injection activities. Exceedances of action levels observed during performance of the CAMP will be reported to the NYSDEC Project Manager.

7.1 Volatile Organic Vapor Monitoring, Response Levels, and Actions

Volatile organic vapors will be monitored at the downwind perimeter of the immediate work area on a continuous basis during invasive work using a hand-held PID. Upwind concentrations will be measured at the

start of each workday and periodically thereafter to establish background conditions. The monitoring work will be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment will be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment will be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

- If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 ppm greater than background for the 15-minute average, work activities will be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) less than 5 ppm over background, work activities will resume with continued monitoring.
- If total organic vapor levels at the downwind perimeter of the work area persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities will resume provided that the total organic vapor level 200 feet downwind of the work area or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is less than 5 ppm over background for the 15-minute average.
- If the organic vapor level is above 25 ppm at the perimeter of the work area, activities will be shutdown.

Air monitoring will be conducted in accordance with the HASP included as Appendix C.

7.2 Particulate Monitoring, Response Levels, and Actions

Airborne particulates are not anticipated to be an issue for this scope of work; therefore, particulate monitoring will not be performed as part of the CAMP. If airborne particulates become an issue during bioremediation program activities, or if particulate monitoring is requested by the NYSDEC, concentrations will be monitored continuously at the immediate upwind and downwind perimeters of the work area at temporary particulate monitoring stations. The particulate monitoring will be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment will

be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during work activities.

- If the downwind PM-10 particulate level is 100 micrograms per cubic meter (µg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques will be employed. Work will continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 µg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.
- If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 µg/m^3 above the upwind level, work will be stopped, and a re-evaluation of activities initiated. Work will resume if dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 µg/m^3 of the upwind level and in preventing visible dust migration.

Readings will be recorded and be available for NYSDEC personnel to review.

7.3 Odor and Dust Control

7.3.1 Odor Control

It is not anticipated that odor control will be needed during drilling and injection activities. If necessary, methods will be employed to prevent on and offsite odor nuisances. At a minimum, those procedures will include: (a) limiting the area of open boreholes; (b) shrouding open boreholes with tarps and other covers; and (c) use of foams to cover exposed odorous soils. If odors develop and cannot otherwise be controlled, additional means to eliminate odor nuisances will include: (d) use of chemical odorants in spray or misting systems.

This odor control plan is capable of controlling emissions of nuisance odors. If nuisance odors are identified, work will be halted, and the source of odors will be identified and corrected. Work will not resume until nuisance odors have been abated. NYSDEC will be notified of odor complaint events. Implementation of odor controls will be the responsibility of the contractor.

7.3.2 Dust Control

Dust is not anticipated to be an issue during drilling and injection activities. If dust management during invasive work is deemed necessary, associated procedures will include, at a minimum:

- Use of a dedicated water spray methodology for roads and stockpiles, as necessary.
- Exercise extra care during dry and high-wind periods.
- Use of gravel or RCA on egress and other roadways as necessary to provide a clean and dust-free road surface.

This dust control plan is capable of controlling emissions of dust. If nuisance dust emissions are identified, work will be halted, and the source of dusts will be identified and corrected. Work will not resume until nuisance dust emissions have been abated. NYSDEC will be notified of dust complaint events. Implementation of dust controls will be the responsibility of the contractor.

8.0 PROJECT SCHEDULE

Field work is anticipated to be completed in September and October of 2020, following approval of this work plan by NYSDEC. A draft Bioremediation Program Completion Report should be submitted to the NYSDEC by November 2020.

9.0 REFERENCES

NYSDEC, Division of Environmental Restoration, 6 NYCRR Part 375 Subpart 6, Remedial Program Soil Cleanup Objectives

NYSDEC, March 2002. Record of Decision, Minmilt Realty Site, Town of Babylon, Suffolk County, Site Number 1-52-147.

NYSDEC, Division of Environmental Remediation, May 2010, Draft DER-10, Technical Guidance for Site Investigation and Remediation.

NYSDEC, January 31, 2005. Letter to Frank Castellano, PWGC, approving the *Operation, Maintenance and Monitoring (OM&M) Program for the Minmilt Realty Site* (PWGC, January 2005).

NYSDEC, May 10, 2007. Memorandum to Chittibabu Vasudevan, PE, Chief, Remedial Bureau A thru John Swartwout, PE Section Chief from Steven M. Scharf, PE, Project Engineer regarding modifications to ROD.

NYSDEC, November 9, 2007. Letter to Richard Cole, Minmilt Realty from Kelly A. Lewandowski, PE, Chief, Site Control Section regarding change in site classification from 2 to 4.

NYSDOH, March 22, 2005. Letter to Kelly Lewandowski, Bureau of Hazardous Site Control, Division of Environmental Remediation, NYSDEC regarding change in site classification from 2 to 4.

PWGC, 1994. Investigation Report for Hygrade Metal Moulding Corp., March 1993, Revised January 1994.

PWGC, February 1996. Remedial Investigation Report for Hygrade Metal Moulding Corp., East Farmingdale, Suffolk County, New York, October 1995, revised February 1996.

PWGC, April 1996. Interim Remedial Measure to be conducted at Hygrade Metal Moulding, An Evaluation of Alternatives and Design, January 1994, revised December 1995 and April 1996.

PWGC, July 1997. Construction Completion Report for the Interim Measure at Minmilt Remedial Site, East Farmingdale, New York.

PWGC, March 1997. Operation and Maintenance Program for the Interim Remedial Measure at Minmilt Realty, East Farmingdale, New York, Revised March 1997.

PWGC, 2001. Offsite Remedial Investigation and Feasibility Study, October 2001.

PWGC, January 2005. Operation, Maintenance and Monitoring Plan for the (OM&M) Program for the Minmilt Realty Site.

PWGC, March 2005. Letter to Steve Scharf, NYSDEC, regarding Minmilt OM&M Plan Addendum, Indoor Air Monitoring, Site 1-52-147.

PWGC, June 2006. First Quarter 2006 Monitoring Report for the Interim Remedial Measure at Minmilt Realty, East Farmingdale, New York.

PWGC, September 2013. 2013 Remedial Status Report.

PWGC, 2015. January-September 2015 Minmilt Groundwater Sampling Report.

PWGC, May 2020. Soil Investigation of Historical Source Area Report

PWGC
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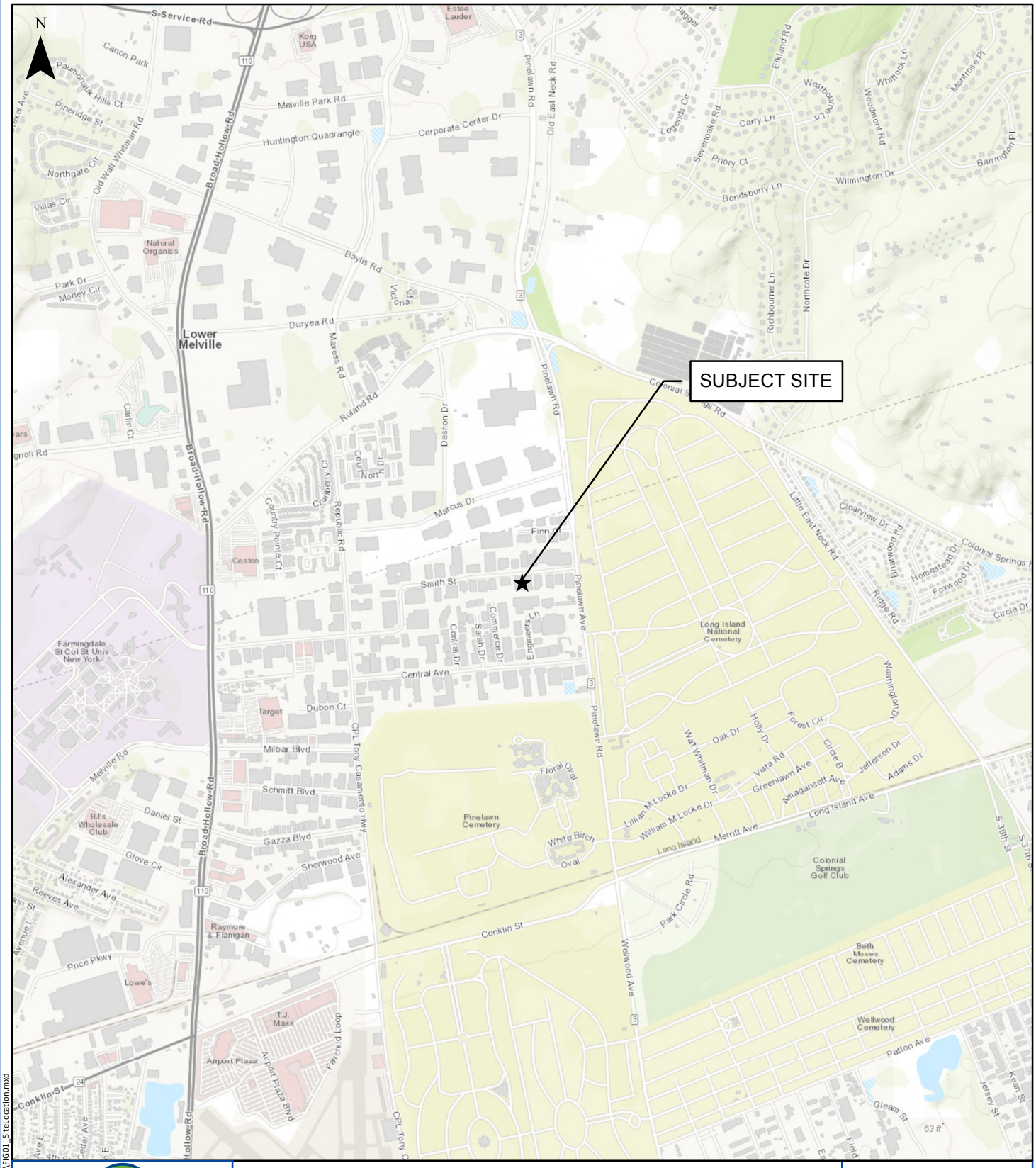
FIGURES



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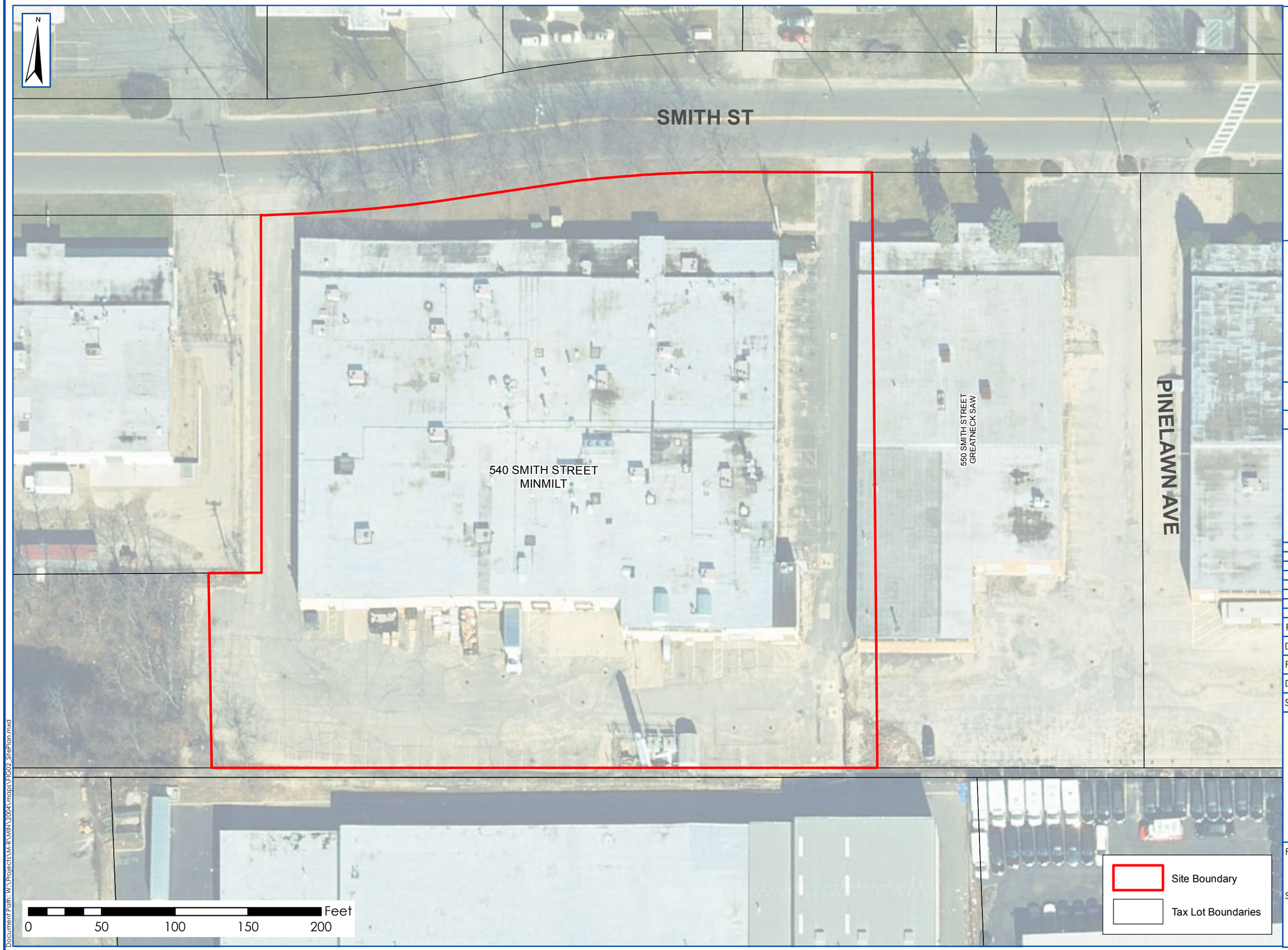
SITE LOCATION

540 Smith Street
Farmingdale, NY

0 ¼ ½ ¾ 1 Miles

Project:	MIN2004
Date:	8/14/2020
Designed by:	RM
Drawn by:	PH
Approved by:	RM
Figure No:	1



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DRAWING PREPARED FOR:

PERIODIC REVIEW REPORT
MINMILT REALTY CORP.
352 CARNATION DRIVE
FARMINGDALE, NY 11735

REVISION	DATE	INITIAL	COMMENTS

DRAWING INFORMATION:

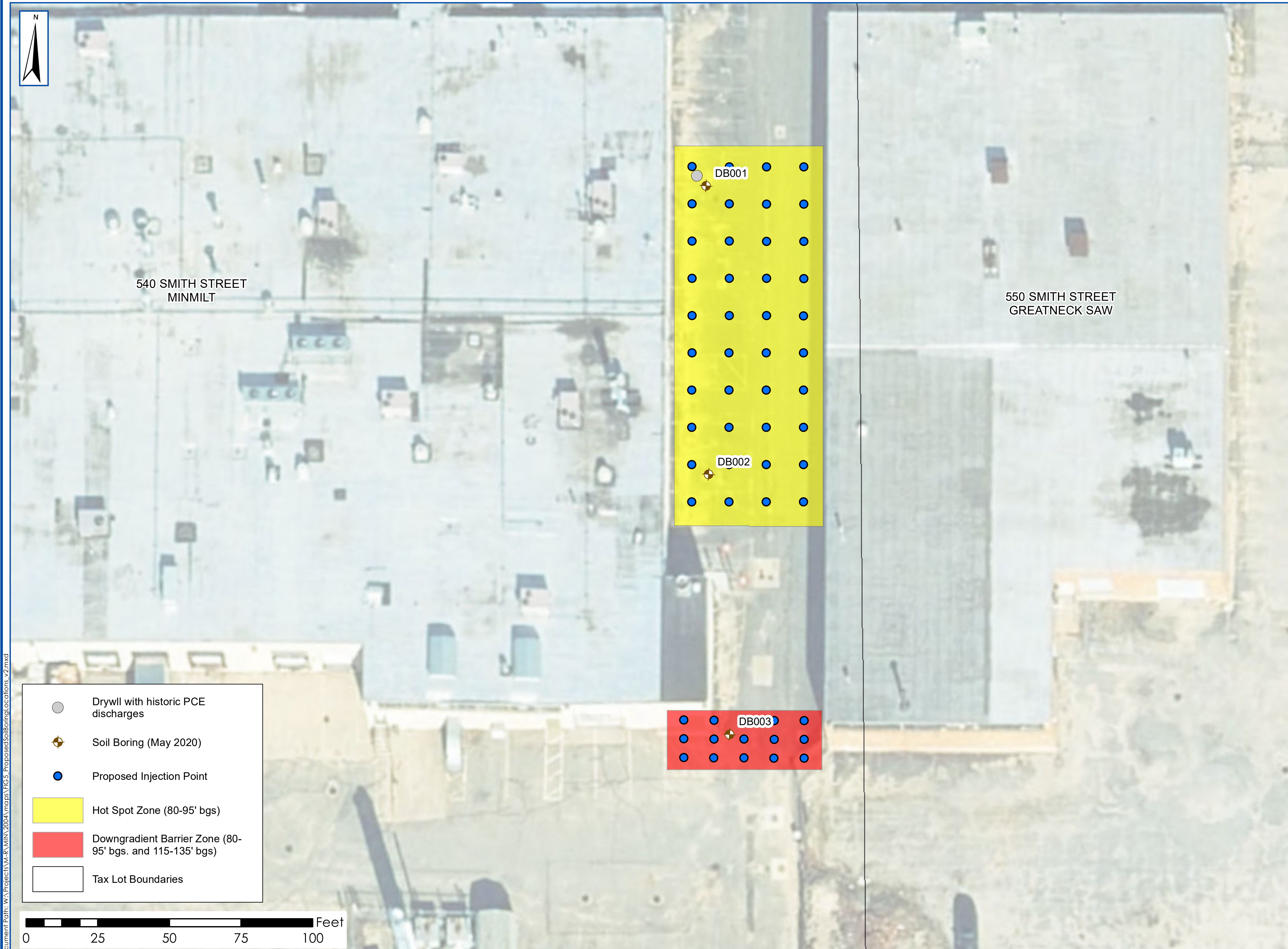
Project:	MIN2004	Designed by:	RM
Date:	8/14/2020	Drawn by:	PH
Scale:	AS SHOWN	Approved by:	RM

SITE PLAN

540 SMITH ST
EAST FARMINGDALE, NY

FIGURE NO:
2

SHEET:



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DRAWING PREPARED FOR:

PERIODIC REVIEW REPORT
MINMILT REALTY CORP.
352 CARNATION DRIVE
FARMINGDALE, NY 11735

REVISION	DATE	INITIAL	COMMENTS

DRAWING INFORMATION:

Project:	MIN2004	Designed by:	RM
Date:	8/17/2020	Drawn by:	PH
Scale:	AS SHOWN	Approved by:	RM

PROPOSED INJECTION POINTS

540 SMITH ST
EAST FARMINGDALE, NY

FIGURE NO: 3

SHEET:

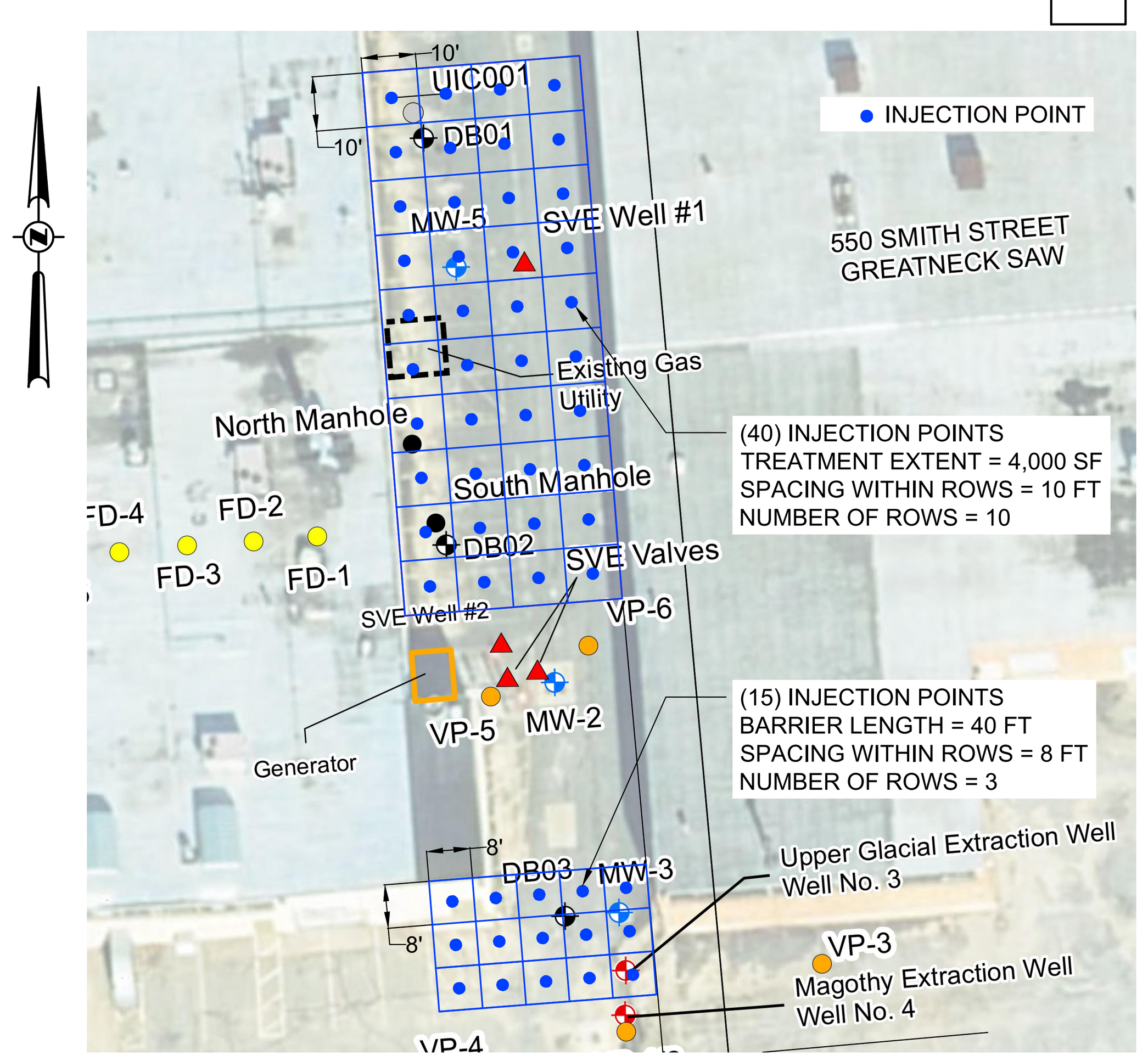
LEGEND

SYMBOL	NOTES
	SAND
	SAND W/ SILT
	SAND W/ CLAY
	SAND W/ GRAVEL
	SILT W/ GRAVEL
	SILT W/ CLAY
	CLAY
	INTERBEDDED SAND SILT AND CLAY
	INFERRED CLAY LAYER
	INFERRED GROUNDWATER LEVEL
	SAMPLE INTERVALS WITH PERC CONC. (PPB)

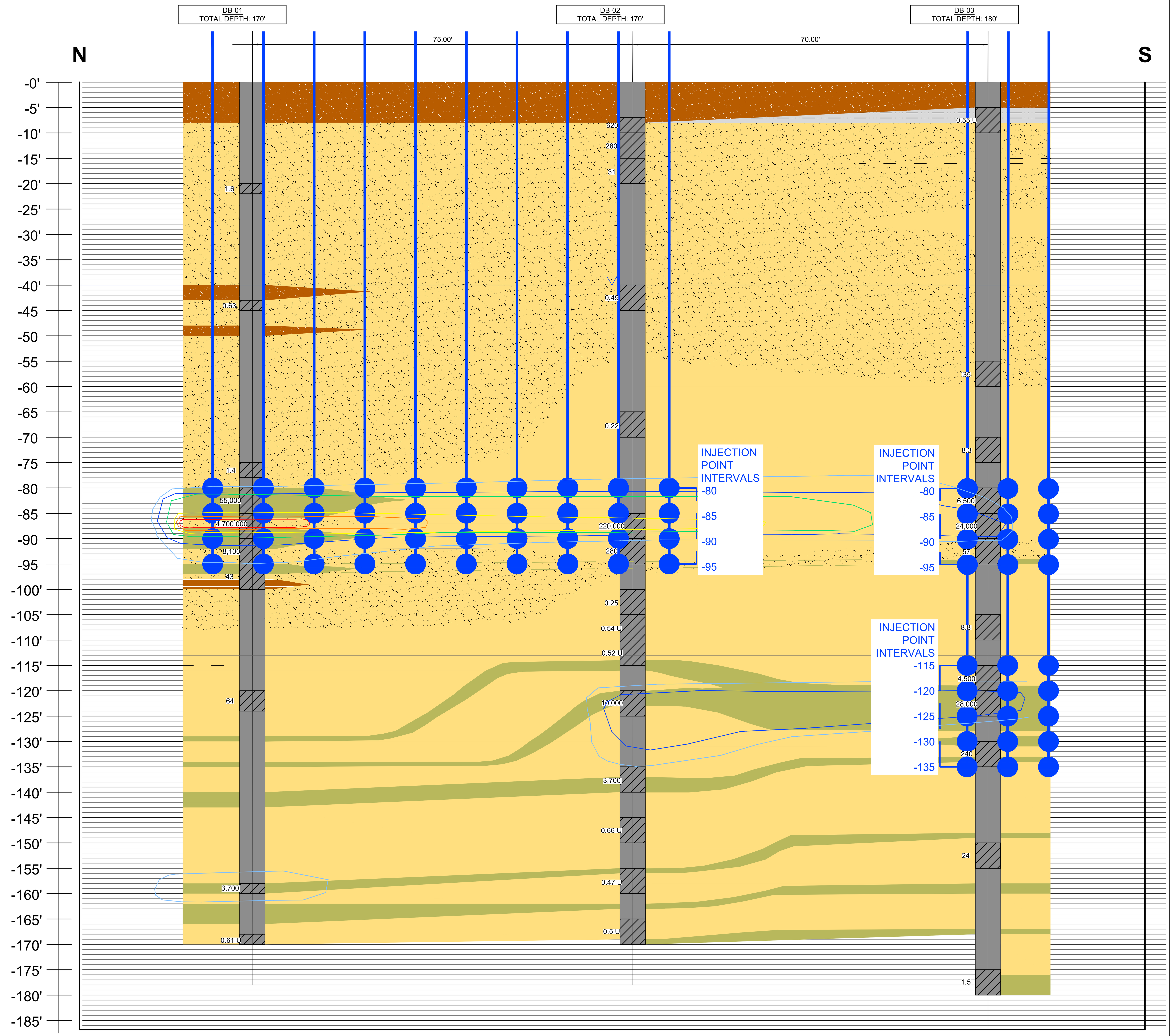
PERC. CONCENTRATION CONTOURS BASED ON MAY 2020 INVESTIGATION

- 4,000,000 PPB
- 1,000,000 PPB
- 100,000 PPB
- 50,000 PPB
- 10,000 PPB
- 5,000 PPB

NOTES:
1. SOIL BORINGS PERFORMED BY ADT DRILLING USING A SONIC DRILLING RIG FROM MAY 18, 2020 TO MAY 21, 2020.
2. SAMPLING PERFORMED BY PWGC VIA TERA-CORE SAMPLING.
3. U = NOT DETECTED AT THE REPORTED DETECTION LIMIT FOR THE SAMPLE.



INJECTION POINTS PLAN VIEW
NOT TO SCALE



INJECTION POINT INTERVALS
VERTICAL SCALE: 1" = 10'
HORIZONTAL SCALE: 1" = 10'

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CONSULTANTS

Number	Revision Description	Revision Date
7		
6		
5		
4		
3		
2		
1		

Designed By	HS/RN	Date Submitted	8/18/2020
Drawn By	HS/RN	Date Created	8/18/2020
Approved By	RM	Scale	AS SHOWN

Client:
MINMILT REALTY CORP.
352 CARNATION DRIVE
FARMINGDALE, NEW YORK 11735

Project:
BIOREMEDIATION OF HISTORICAL SOURCE AREA

Project Address:
540 SMITH STREET
EAST FARMINGDALE, TOWN OF BABYLON
SUFFOLK COUNTY, NEW YORK

County Tax Map Number:
Contract Number:
Regulatory Reference Number:
Title of Drawing:

FIGURE 4
GEOLOGIC CROSS SECTION AND INJECTION POINT INTERVALS

Drawing Number:
Sheet 4 of

PWGC Project Number: **MIN2004**

PWGC FILE NAME: J:\Projects M-R\MIN MILT REALTY\2004 - Chemical Injection Activities\C3D\CROSS SECTION_8-18-2020.dwg (PROFILE B)
PLOT DATE/TIME: Aug 18, 2020-12:57pm By: NASH

APPENDIX A
BIOREMEDIAION CHEMCIAL SPECIFICATION SHEETS

3-D Microemulsion® Installation Instructions

Introduction

3-D Microemulsion® (3DME), a form of HRC Advanced®, should ONLY be applied as a high- volume, microemulsion. In this form it offers greater physical distribution of the 3DME material across a larger potential radius from a single injection point. The production of a 3DME emulsion involves the on-site, volumetric mixing of 10 parts water with 1 part delivered 3DME concentrate to form the injection-ready 3DME. This microemulsion suspension can then be injected directly or further diluted to a predetermined ratio of 3DME to water. The following instructions provide details in the production and installation of 3DME.

Material Overview Handling and Safety

3DME concentrate is shipped and delivered in 4.25-gallon buckets. Each bucket has a gross weight of approximately 32 pounds. Each bucket contains 30 pounds of 3DME concentrate (net weight) and a nominal volume of 3.7 gallons. At room temperature, 3DME concentrate is a liquid material with a viscosity of approximately 500 centipoise, roughly the equivalent of pancake syrup. The viscosity of 3DME is not temperature sensitive above 50 °F (10 °C). However, below 50 °F the viscosity may increase significantly. If the user plans to apply the product in cold weather, consideration should be given to heating the material to above 60 °F so that it can be easily handled. 3DME concentrate should be stored in a warm, dry place that is protected from direct sunlight. It is common for stored 3DME concentrate to settle somewhat in the bucket, a quick pre-mix stir by a hand held drill with a paint or "jiffy mixer" attachment will rapidly re-homogenize the material. 3DME concentrate is non-toxic, however field personnel should take precautions while handling and applying the material. Field personnel should use appropriate personal protection equipment (PPE) including eye protection. Gloves should be used as appropriate based on the exposure duration and field conditions. A Material Safety Data Sheet is provided with each shipment. Personnel who operate field equipment during the installation process should have appropriate training, supervision, and experience and should review the MSDS prior to site operations.

Micro-Emulsion Production 3DME to Water Ratio

3DME concentrate should be mixed with water on a volume to volume (v/v) basis to produce a micro-emulsion starting at 10 parts water: 1 part 3DME. Although microemulsions can be easily produced using greater water volumes than 10 parts, e.g. 20 to 50 parts water to 1 part 3DME, the initial microemulsion should never be produced below a ratio of less than 10 parts water: 1 part 3DME v/v.

WARNING: Do not attempt to produce a microemulsion at less than 10 parts water to 1 part 3DME ratio v/v. This will produce an undesirable and unstable solution. The field production of 3DME is a very simple procedure; however, it is critical that the user follow the mixing directions outlined below. Never attempt to add water to the 3DME as this will produce an undesirable and unstable large emulsion. Always add the 3DME to a large volume of water.

As indicated previously the 10:1 ratio of water to 3DME v/v is the minimum water ratio that can be used, a greater ratio (more dilute solution) can easily be achieved and is governed by: A) the volume of

3DME required to treat the estimated contaminant mass, B) the pore volume in which the material is applied, C) the time available for installation (gallons/pump rate), and C) the estimated volume of 3DME that the target zone will accept over the time period allocated for installation.

Conceptually, although a higher volume of water to volume of 3DME will produce a larger volume of the suspension, it will lower the concentration of 3DME per gallon of solution. Thus, the benefit of using a high water/3DME v/v ratio in order to affect a greater pore volume of the subsurface aquifer is offset by the dilution of the 3DME per unit volume of suspension as well as by the limitations of the subsurface hydraulic conductivity and effective porosity (capacity of the aquifer to accept the volume of 3DME microemulsion).

It is important that the user plan in advance the v/v 3DME/water ratio to be employed at a project site. The resulting volume of solution will dictate the site water requirements and the time required for injection, etc. If upon injection of greater than 10:1 3DME microemulsion, the subsurface does not readily accept the volume of solution as designed, the user can adjust downward the v/v water to 3DME ratio until a more concentrated suspension is produced (this solution should never drop below the required 10 parts water: 1 part 3DME v/v production ratio).

For more information on designing a 3DME/water ratios to meet specific site conditions, please contact REGENESIS Technical Services.

Direct Push Application Requirements

One of the best methods to deliver the 3DME microemulsion into the subsurface is to pressure inject the solution through direct-push rods using hydraulic equipment, or to pressure inject/gravity feed the microemulsion into the dedicated injection wells. The use of low cost push points or temporary injection points allows the applier to more cost effectively distribute the 3DME material across shallow sites by employing multiple points per site. In the case of treating deep aquifer sites, the use of the microemulsion applied via dedicated injection wells is likely to be the most cost effective remediation approach. Please note that this set of instructions is specific to direct-push equipment. Please contact REGENESIS Technical Services to assist you with dedicated injection well applications.

In general, REGENESIS strongly recommends application of the 3DME microemulsion using an injection pump with a minimum delivery rate of three gallons per minute (gpm) and a pressure rating of between 150 to 200 pounds per square inch (psi).

Note: The injection pump requirements are different than the requirements of the mixing pump (see Mixing to Generate 3DME Microemulsion). High pressure, positive displacement pumps and progressive cavity pumps are appropriate for injecting 3DME. For low permeability lithologies (clay, silt) higher pressure pumps (800-1600 psi) may be necessary, while for more permeable lithologies (gravel, sand) a lower pressure pump may be adequate.

Examples of appropriate pumps are: Rupe Models 6-2200, 9-1500 and 9-1600 (positive displacement), Geoprobe® GS- 2000 (positive displacement) and DP-800 (progressive cavity), Yamada (air diaphragm), Moyno (progressive cavity), and Wilden (air diaphragm). Delivery rate is a critical factor in managing installation time and costs. Generally, higher delivery rates (>6 gpm) are more cost effective for these types of applications but pump selection should be on a site specific basis and account for the volume of 3DME solution and specific aquifer conditions present at the site.

The installation of the 3DME microemulsion should span the entire vertical contaminated saturated thickness. If the vertical extent of the application is confined to a limited interval, then the microemulsion should be placed across a vertical zone extending a minimum of one-foot above and one-foot below the screened interval of monitoring wells that are being used to evaluate the performance of the project.

Producing the 3DME Microemulsion

The application of 3DME requires the creation of a microemulsion. Technically the optimal suspension is an 3DME-in-water suspension containing microemulsions. Before beginning the mixing procedure the user should have in mind the desired water to 3DME ratio v/v desired.

It is critical that the microemulsion be produced using a high-shear apparatus such as a high speed centrifugal pump. The shearing provided by the vanes in these types of pumps is sufficient to form and maintain a homogeneous milky emulsion. This pump will be a different pump than that used to inject the 3DME microemulsion into the subsurface. If the user is uncertain as to requirements for the pump or the applicability of a certain pump, please contact REGENESIS Technical Services. REGENESIS typically suggests using a water trailer/pump apparatus commonly found at equipment rental facilities. REGENESIS recommends using a Magnum Products LLC model MWT500 or equivalent water trailer (fitted with centrifugal recirculation pump). This "trash pump" or transfer pump is an ideal high shear pump and the water tank (400 gallons) serves as an excellent mixing tank.

To ensure that proper microemulsion suspension is generated REGENESIS suggests a two-step process that simply requires mixing at least 10 parts water to 1 part 3DME concentrate using water at a temperature ≥ 60 °F.

Step 1. REGENESIS recommends that the 3DME concentrate in each bucket be re- homogenized using a drill equipped with a paint or "jiffy" mixer attachment as minor settling may have occurred during shipment.

Step 2. To calculate the volume of water necessary to produce a 10:1 v/v microemulsion, each bucket of 3DME concentrate containing 3.7 gallons of material should be mixed with 37 gallons of water.

Example: 6 buckets x 3.7 gallons 3DME concentrate/bucket yields a total of 22.2 gallons of 3DME concentrate. Thus, a 10:1 v/v solution will require 222 gallons of water (22.2 gallons 3DME concentrate x 10 gallons water yields 222 gallons of water). A nominal total volume microemulsion would result from the summation of the 3DME concentrate volume (22.2 gallons) and the water volume (222 gallons). This yields a total fluids delivery volume of approximately 244 gallons.

The previously calculated water volume (222 gallons) should be transferred into an appropriately sized mixing tank. The water should be circulated by the high shear centrifugal pump and each of the six 3DME buckets slowly poured into the tank. Each bucket of 3DME concentrate should be poured at a slow rate (approx. 1 minute per bucket) and the contents of the tank continually recirculated using the high hear centrifugal pump. A period of 1-2 minutes should be allowed between addition of each subsequent bucket of 3DME concentrate to allow the centrifugal pump to continue to shear and mix the water/3DME concentrate. Upon addition of the entire volume of 3DME concentrate the pump

should remain on to allow the solution mixture to recirculate. The recirculation of the 3DME microemulsion should continue until the material is injected to maintain microemulsion consistency.

Application of microemulsion Using Direct-Push Methods

1. Prior to the installation of the microemulsion, any surface or overhead impediments should be identified as well as the location of all underground structures. Underground structures include but are not limited to: utility lines, tanks, distribution piping, sewers, drains, and landscape irrigation systems.
2. Planned installation locations should be adjusted to account for all impediments and obstacles.
3. Pre-mark the installation locations, noting any points that may have different vertical application requirements or total depth.
4. Set up the direct-push unit over each specific point and follow the manufacturer's standard operating procedures (SOP). Care should be taken to assure that probe holes remain vertical.
5. For most applications, REGENESIS suggests using drive rods with an O.D. of at least 1.25-inches and an I.D. of at least 0.625-inches I.D (Geoprobe or equivalent). However, the lithologic conditions at some sites may warrant the use of larger 2.125-inch O.D./1.5-inch I.D. drive rods.
6. The most typical type of sub-assembly currently being used is designed for 1.25-inch direct-push rods and is manufactured by Geoprobe. Other brands of drive rods can also be used but require the fabrication of a sub-assembly that allows for a connection between the pump and drive rod.
7. For mixing large volumes of the microemulsion, REGENESIS recommends using a Magnum Products LLC model MWT500 water trailer (fitted with centrifugal recirculation pump) or equivalent unit. However, single large volume poly tanks are adequate. We suggest filling the tank with an appropriate quantity (e.g. from the example above 222 gallons) of water before start of mixing operations. The tank should be configured so that both a hose and a fire hydrant or larger water tank can be connected to it simultaneously and filled with water quickly and easily. This will dramatically reduce the time needed to fill the tank with mixing water.
8. REGENESIS highly recommends preparing the microemulsion before pushing any drive rods into the subsurface. NOTE: best if the microemulsion is produced a single day application volumes.
9. After the microemulsion mixing/shearing step has been completed as described above, the microemulsion is ready to be applied. Check to see if a hose has already been attached to the inlet side of the centrifugal pump. If this has not been done, do so now.
10. If a non-water trailer tank is being used for mixing the microemulsion a stand alone centrifugal pump and hose system should be used for the shearing and mixing operations.
11. Advance drive rods through the ground surface, as necessary, following SOP.
12. Push the drive rod assembly with an expendable tip to the desired maximum depth. REGENESIS suggests pre-counting the number of drive rods needed to reach depth prior to starting injection activities to avoid any miscalculations.
13. After the drive rods have been pushed to the desired depth, the rod assembly should be withdrawn three to six inches. The expendable tip can be dropped from the drive rods, following SOP.
14. If an injection tool is used instead of a direct-push rod with an expendable tip, the application of material can take place without any preliminary withdrawal of the rods.
15. In some cases, introduction of a large column of air may be problematic. This is particularly the case in deep injections (>50 ft) with large diameter rods (>1.5-inch O.D.). To prevent the injection of air into the aquifer during the application, fill the drive rods with 3DME emulsion after they have been pushed to the desired depth and before the disposable tip has been dropped or before the injection tip is operational.

16. Transfer the appropriate quantity of the microemulsion from the water trailer to the working/ application pump hopper or associated holding tank.
17. A volume check should be performed prior to the injection of the microemulsion. Determining the volume discharged per unit time/stroke using a graduated bucket and stopwatch or stroke counter.
18. Start the pump and use the graduated bucket to determine how many gallons of micro- emulsion are delivered each minute or stroke per unit volume.
19. Connect the 1.25-inch O.D., 1-inch I.D. delivery hose to the pump outlet and the appropriate sub-assembly. Circulate the microemulsion through the hose and the sub-assembly to displace any air present in the system.
20. Connect the sub-assembly to drive rod. After confirming that all of the connections are secure, pump the microemulsion through the delivery system to displace water or other fluids in the rods.
21. The pump engine RPM and hydraulic settings should remain constant throughout the day to maintain a constant discharge rate.
22. The material is now ready to be installed in the subsurface. Use the pumps discharge rate as calculated in step 18 to determine the withdrawal rate of the drive rods needed for the application.
23. Slowly withdraw the drive rods using Geoprobe Rod Grip or Pull Plate Assembly (Part AT1222-For 1.25-inch drive rods). While slowly withdrawing single lengths of drive rod (3 or 4 feet), pump the pre-determined volume of microemulsion into the aquifer across the desired treatment interval.
24. Remove one or two sections of the drive rod at a time. The drive rod may contain some residual material, REGENESIS suggests placing it in a clean, empty bucket and allowing the material to drain. Eventually, the material recovered in the bucket should be returned to pump hopper for reuse.
25. Observe any indications of aquifer refusal such as "surfacing" around the injection rods or previously installed injection points. If aquifer acceptance appears to be low, allow enough time for the aquifer to equilibrate prior to removing the drive rod.
26. Repeat steps 19-25 until treatment of the entire contaminated vertical zone has been achieved.
27. Install an appropriate seal, such as bentonite, above the microemulsion injection zone. The seal should span across the entire vadose zone. Depending on soil conditions and local regulations, a bentonite seal using chips or pellets can be used. If the injection hole remains open more than three or four feet below the ground surface sand can be used to fill the hole and provide a base for the bentonite seal. The installation of an appropriate seal assures that the microemulsion remains properly placed and prevents contaminant migration from the surface. If the microemulsion continues to "surface" up the direct-push borehole, an oversized disposable drive tip or wood plug/stake can be used to temporarily plug the hole until the aquifer equilibrates and the material stops surfacing.
28. Remove and clean the drive rods as necessary.
29. Finish the borehole at the surface as appropriate (concrete or asphalt cap, if necessary).
30. Periodically compare the pre- and post-injection discharge rates of the microemulsion in the pump hopper or holding tank using any pre-marked volume levels. If volume level indicators are not on the pumps hopper or holding tank use a pre-marked dipstick or alternatively temporary mark the hopper or holding tank with known quantities/volumes of water using a carpenter's grease pencil (Kiel crayon).
31. Move to the next probe point, repeating steps 11-29.

Helpful Hints

1. Application in Cold Weather Settings

As discussed in the Material Overview, Handling, and Safety section, cold weather tends to increase the viscosity of 3DME as well as decrease the ease of microemulsion formation.

To optimize an application in cold weather settings REGENESIS recommends maintaining the 3DME concentrate and the associated water at a temperature ≥60oF (16oC). The following procedures can be used to facilitate the production and installation of a 10:1 v/v 3DME microemulsion.

- Raise and maintain the temperature of the HRC-A to at least 60 °F (16 °C) prior to mixing with water. A hot water bath can be used to heat up the 3DME concentrate buckets. A Rubbermaid fiberglass Farm Trough Stock Tank (Model 4242-00-GRAY) has been used for this process. This trough can hold up to 16 buckets of 3DME concentrate.
- Hot water (approximately 130-170 °F or 54-77 °C) should be added to the tank after the buckets of 3DME have been placed inside. The hot water should be delivered from a heated pressure washer (Hotsy® Model No. 444 or equivalent) or steam cleaner unit.
- It is equally critical that a moderate water temperature (>60 °F or 16°C) be used in the production of the microemulsion. If on-site water supply is below 60 °F use a hot water or steam cleaner to generate a small volume (e.g. 5-10% of total water volume) of hot water (130–170 °F/54-77 °C). This small volume of hot water should be added to remaining cold water volume to raise the total volume temperature to >60 °F. When the 3DME concentrate and water each reach a minimum temperature of 60 °F or 16 °C the two materials are ready for mixing.
- Upon achieving a minimum temperature of 60 °F or 16 °C (approximately 10-20 minutes). When the 3DME and the associated water volumes have reached a minimum temperature of 60 °F or 16 °C (approximately 10-20 minutes) they are ready for mixing.
- In exceptionally harsh winter temperature settings use of a separate insulated pump containment structure and insulated delivery hoses may be necessary.
- Use a pump with a heater unit.
- Periodically check the temperature of the material in the hopper.
- Re-circulate the 3DME microemulsion through the pump and hose to maintain temperature adequate temperatures.
- Care should be taken to avoid the re-circulation of material volumes that exceed the volume of the pump hopper or holding tank.

Table 1: Equipment Volume and 3DME microemulsion Weight per Unit Length of Hose (Feet)

Equipment	Volume	Product Weight
1-inch OD; 0.625-inch ID hose (10 feet)	0.2 gallon	1.6 lbs.
1.25-inch OD; 0.625-inch ID drive rod (3 feet):	0.05 gallon	0.4 lbs.
1.25-inch OD; 0.625-inch ID drive rod (4 feet):	0.06 gallon	0.5 lbs.

2. Pump Cleaning

For best results, use a heated pressure washer to clean equipment and rods periodically throughout the day. Internal pump mechanisms and hoses can be easily cleaned by re-circulating a solution of hot water and a biodegradable cleaner such as Simple Green through the pump and delivery hose. Further cleaning and decontamination (if necessary due to subsurface conditions) should be performed according to the equipment supplier's standard procedures and local regulatory requirements.

Note: Before using the Rupe Pump, check the following:

- Fuel level prior to engaging in pumping activities (it would be best to start with a full tank)
- Remote control/pump stroke counter LCD display [if no display is present, the electronic counter will need to be replaced (Grainger Stock No. 2A540)]
- Monitor pump strokes by observing the proximity switches (these are located on the top of the piston).

3. Bedrock Applications

When contaminants are present in competent bedrock aquifers, the use of direct-push technology as a delivery method is not possible. REGENESIS is in the process of developing methods for applying 3DME via boreholes drilled using conventional rotary techniques. To develop the best installation strategy for a particular bedrock site, it is critical that our customers call the Technical Services department at REGENESIS early in the design process.

The microemulsion can be applied into a bedrock aquifer in cased and uncased boreholes. The microemulsion can be delivered by simply filling the borehole without pressure or by using a single or straddle packer system to inject the material under pressure. Selection of the appropriate delivery method is predicated on site-specific conditions. The following issues should be considered in developing a delivery strategy:

- Is the aquifer's hydraulic conductivity controlled by fractures?
- Backfilling may be the better delivery method in massive, unfractured bedrock. This is particularly true in an aquifer setting with high permeability and little fracturing (such as that found in massive sandstone).
- Down-hole packer systems may be more advantageous in fractured bedrock aquifers.
- In this case the fracture type, trends, and interconnections should be evaluated and identified.
- Are the injection wells and monitoring wells connected by the same fractures?
- Determine if it is likely that the injection zone is connected to the proposed monitoring points.
- If pressure injection via straddle packers is desired, consideration should be given to the well construction. Specific issues to be considered are:
- Diameter of the uncased borehole (will casing diameter allow a packer system to be used under high pressures?).
- Diameter of the casing (same as above).
- Strength of the casing (can it withstand the delivery pressures?).
- Length of screened interval (screened intervals greater than 10 feet will require a straddle packer system).

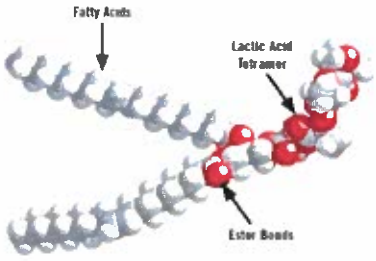
For further assistance or questions please contact REGENESIS Technical Services at 949.366.8000

3-D Microemulsion® Factory Emulsified Technical Description

3-D Microemulsion (3DME®) is comprised of a patented molecular structure containing oleic acids (i.e., oil component) and lactates/polylactates, which are molecularly bound to one another (figure 1). The 3DME molecule contains both a soluble (hydrophilic) and insoluble (lipophilic) region. These two regions of the molecule are designed to be balanced in size and relative strength. The balanced hydrophilic/lipophilic regions of 3DME result in an electron donor with physical properties allowing it to initially adsorb to the aquifer material in the area of application, then slowly redistribute via very small 3DME "bundles" called micelles. These 3DME micelles spontaneously form within sections of the aquifer where concentrations of 3DME reach several hundred parts per million. The micelles' small size and mobility allow it to move with groundwater flow through the aquifer matrix, passing easily through the pore throats in between soil grains resulting in the further redistribution of 3DME within the aquifer. This allows for advective distribution of the oleic acids which are otherwise insoluble and unable to distribute in this manner, allowing for increased persistence of the lactate/polylactates component due to their initial attachment to the oleic acids.

Example of 3-D Microemulsion

FIGURE 1: THE 3-D MICROEMULSION MOLECULAR STRUCTURE



Due to its patented molecular structure, 3DME offers far greater transport when compared to blended emulsified vegetable oil (EVO) products, which fail to distribute beyond the limits of pumping. 3DME also provides greater persistence when compared to soluble substrates such as lactates or simple sugars. The 3DME molecular structures capitalize on the best features of the two electron-donor types while at the same time, minimize their limitations. 3DME is delivered to the site as a ready-to-apply emulsion that is simply diluted with water to generate a large volume of a 3DME colloidal suspension.

Suspension of 3DME generated by this mixing range from micelles on the order of .02 microns to .05 microns in diameter, to "swollen" micelles, (termed "microemulsions") which are on the order of .05 to 5 microns in diameter. Once injected into the subsurface in high volumes, the colloidal suspension mixes and dilutes in existing pore waters. The micelles/microemulsions on the injection front will then begin to sorb onto the surfaces of soils as a result of zeta potential attraction and organic matter within the soils themselves. As the sorption continues, the 3DME will "coat" pore surfaces developing a layer of molecules and in some cases a bilayer. This sorption process continues as the micelles/microemulsion moves outward and disassociates into their hydrophilic/hydrophobic components. The specialized chemistry of 3DME results in a staged release of electron donors: free lactate (immediate); polylactate esters (mid-range) and free fatty acids & fatty acid esters (long-term). Material longevity of three years or greater has been seen at most sites as determined from biogeochemical analyses.

For a list of treatable contaminants with the use of 3DME, view the Range of Treatable Contaminants Guide.

3-D Microemulsion® Factory Emulsified Technical Description

Chemical Composition

- Fatty acid esters
- Water
- Lactate oligomers
- Sodium lactate
- Proprietary surfactants

Properties

- Density – Approximately 1.0 grams per cubic centimeter (relative to water)
- pH – Neutral (approximately 6.5 to 7.5 standard units)
- Solubility – Soluble in Water
- Appearance – White emulsion
- Odor – Not detectable
- Vapor Pressure – None
- Non-hazardous

Storage and Handling Guidelines

Storage

Store in original tightly closed container

Store in a cool, dry, well-ventilated place

Store away from incompatible materials

Recommended storage containers: plastic-lined steel, plastic, glass, aluminum, stainless steel, or reinforced fiberglass

Handling

Avoid contact with eyes, skin, and clothing

Provide adequate ventilation

Wear appropriate personal protective equipment

Observe good industrial hygiene practices

Applications

- 3DME is diluted with water prior to application. Resulting emulsion has viscosity similar to water.
- Easily injects into formation through direct push injection points, injection wells or other injection delivery systems.

Application instructions for this product are contained in the 3DME FE Application Instructions.

Health and Safety

Material is food grade and relatively safe to handle. We recommend avoiding contact with eyes and prolonged contact with skin. OSHA Level D personal protection equipment including vinyl or rubber gloves, and eye protection are recommended when handling this product. Please review the 3DME FE Material Safety Data Sheet for additional storage, usage, and handling requirements.

REGENESIS

www.regenesis.com
1011 Calle Sombra, San Clemente CA 92673
949.366.8000

REGENESIS
Technology-Based Solutions for the Environment

SAFETY DATA SHEET

1. Identification

Product identifier **3-D Microemulsion®**

Other means of identification None.

Recommended use Remediation of soils and groundwater.

Recommended restrictions None known.

Manufacturer/Importer/Supplier/Distributor information

Company Name Regenesis

Address 1011 Calle Sombra
San Clemente, CA 92673

Telephone 949-366-8000

E-mail CustomerService@regenesis.com

Emergency phone number CHEMTREC® at 1-800-424-9300 (International)

2. Hazard(s) identification

Physical hazards Not classified.

Health hazards

Skin corrosion/irritation	Category 2
Serious eye damage/eye irritation	Category 1

OSHA defined hazards Not classified.

Label elements

Signal word Danger

Hazard statement Causes skin irritation. Causes serious eye damage.

Precautionary statement

Prevention Wash thoroughly after handling. Wear protective gloves. Wear eye/face protection.

Response If on skin: Wash with plenty of water. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a poison center/doctor. If skin irritation occurs: Get medical advice/attention. Take off contaminated clothing and wash before reuse.

Storage Store away from incompatible materials.

Disposal Dispose of waste and residues in accordance with local authority requirements.

Hazard(s) not otherwise classified (HNOC) None known.

3. Composition/information on ingredients

Mixtures

Chemical name	CAS number	%
HRC-PED	823190-10-9	48-53
Fatty Acids (neutralized)	61790-12-3 or 112-80-1	30-35
Glycerol Tripolylactate	201167-72-8	<10

Composition comments All concentrations are in percent by weight unless otherwise indicated.

4. First-aid measures

Inhalation	Move to fresh air. Call a physician if symptoms develop or persist.
Skin contact	Remove contaminated clothing. Wash with plenty of soap and water. If skin irritation occurs: Get medical advice/attention. Wash contaminated clothing before reuse.
Eye contact	Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention immediately.
Ingestion	Rinse mouth. Never give anything by mouth to a victim who is unconscious or is having convulsions. Do not induce vomiting without advice from poison control center. Get medical attention if symptoms occur.
Most important symptoms/effects, acute and delayed	Severe eye irritation. Symptoms may include stinging, tearing, redness, swelling, and blurred vision. Permanent eye damage including blindness could result. Skin irritation. May cause redness and pain.
Indication of immediate medical attention and special treatment needed	Provide general supportive measures and treat symptomatically. Keep victim under observation. Symptoms may be delayed.
General information	Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

5. Fire-fighting measures

Suitable extinguishing media	Water spray. Carbon dioxide (CO2). Dry chemical powder. Foam.
Unsuitable extinguishing media	Do not use water jet as an extinguisher, as this will spread the fire.
Specific hazards arising from the chemical	During fire, gases hazardous to health may be formed. Combustion products may include: carbon oxides, phosphorus compounds and metal oxides.
Special protective equipment and precautions for firefighters	Self-contained breathing apparatus and full protective clothing must be worn in case of fire.
Fire fighting equipment/instructions	Move containers from fire area if you can do so without risk. Water spray should be used to cool containers.
Specific methods	Use standard firefighting procedures and consider the hazards of other involved materials.
General fire hazards	No unusual fire or explosion hazards noted.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures	Keep unnecessary personnel away. Keep people away from and upwind of spill/leak. Surfaces may become slippery after spillage. Wear appropriate protective equipment and clothing during clean-up. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Ensure adequate ventilation. Local authorities should be advised if significant spillages cannot be contained. For personal protection, see section 8 of the SDS.
Methods and materials for containment and cleaning up	Spilled product may create a slipping hazard. The product is immiscible with water and will spread on the water surface. Large Spills: Stop the flow of material, if this is without risk. Use water spray to reduce vapors or divert vapor cloud drift. Dike the spilled material, where this is possible. Cover with plastic sheet to prevent spreading. Absorb in vermiculite, dry sand or earth and place into containers. Following product recovery, flush area with water. Flush area clean with lots of water. Be aware of potential for surfaces to become slippery. Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination. Never return spills to original containers for re-use. For waste disposal, see section 13 of the SDS.
Environmental precautions	Avoid discharge into drains, water courses or onto the ground.

7. Handling and storage

Precautions for safe handling	Do not get this material in contact with eyes. Avoid contact with eyes, skin, and clothing. Provide adequate ventilation. Wear appropriate personal protective equipment. Observe good industrial hygiene practices.
Conditions for safe storage, including any incompatibilities	Store in original tightly closed container. Store in a cool, dry, well-ventilated place. Store away from incompatible materials (see Section 10 of the SDS). Recommended storage containers: plastic lined steel, plastic, glass, aluminum, stainless steel, or reinforced fiberglass.

8. Exposure controls/personal protection

Occupational exposure limits	No exposure limits noted for ingredient(s).
Biological limit values	No biological exposure limits noted for the ingredient(s).
Appropriate engineering controls	Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. Eye wash facilities and emergency shower must be available when handling this product.

Individual protection measures, such as personal protective equipment

Eye/face protection	Wear approved, tight fitting indirect vented or non-vented safety goggles where splashing is probable. Face shield is recommended.
Skin protection	
Hand protection	Wear appropriate chemical resistant gloves. Rubber or vinyl-coated gloves are recommended.
Other	Wear appropriate chemical resistant clothing.
Respiratory protection	If engineering controls do not maintain airborne concentrations below recommended exposure limits (where applicable) or to an acceptable level (in countries where exposure limits have not been established), an approved respirator must be worn.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
General hygiene considerations	Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

Appearance	
Physical state	Liquid.
Form	Semi-solid.
Color	Amber.
Odor	Odorless.
Odor threshold	Not available.
pH	Not available.
Melting point/freezing point	Not available.
Initial boiling point and boiling range	Not available.
Flash point	> 200.0 °F (> 93.3 °C) Closed Cup
Evaporation rate	Not available.
Flammability (solid, gas)	Not available.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	Not available.
Flammability limit - upper (%)	Not available.
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Relative density	0.9 - 1.1
Solubility(ies)	
Solubility (water)	Insoluble.
Solubility (other)	Slightly soluble in acetone.
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	Not available.

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Undergoes hydrolysis in water to form lactic acid, glycerol and fatty acids.
Possibility of hazardous reactions	No dangerous reaction known under conditions of normal use.
Conditions to avoid	Avoid temperatures exceeding the flash point. Contact with incompatible materials.
Incompatible materials	Strong oxidizing agents. Bases. Acids.
Hazardous decomposition products	Thermal decomposition or combustion may produce: carbon oxides, phosphorus compounds, metal oxides.

11. Toxicological information

Information on likely routes of exposure

Inhalation	May cause irritation to the respiratory system.
Skin contact	Causes skin irritation.
Eye contact	Causes serious eye damage.
Ingestion	Ingestion may cause irritation and malaise.
Symptoms related to the physical, chemical and toxicological characteristics	Severe eye irritation. Symptoms may include stinging, tearing, redness, swelling, and blurred vision. Permanent eye damage including blindness could result. Skin irritation. May cause redness and pain.

Information on toxicological effects

Acute toxicity	Not available.
Skin corrosion/irritation	Causes skin irritation.
Serious eye damage/eye irritation	Causes serious eye damage.

Respiratory or skin sensitization

Respiratory sensitization	Not a respiratory sensitizer.
Skin sensitization	This product is not expected to cause skin sensitization.
Germ cell mutagenicity	No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.
Carcinogenicity	This product is not considered to be a carcinogen by IARC, ACGIH, NTP, or OSHA.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

Reproductive toxicity	This product is not expected to cause reproductive or developmental effects.
Specific target organ toxicity - single exposure	Not classified.
Specific target organ toxicity - repeated exposure	Not classified.
Aspiration hazard	Not an aspiration hazard.

12. Ecological information

Ecotoxicity	The product is not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.
Persistence and degradability	Material is readily degradable and undergoes hydrolysis in several hours.
Bioaccumulative potential	No data available.
Mobility in soil	The product is immiscible in water.
Other adverse effects	None known.

13. Disposal considerations

Disposal instructions	Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Dispose of contents/container in accordance with local/regional/national/international regulations.
Local disposal regulations	Dispose in accordance with all applicable regulations.
Hazardous waste code	The waste code should be assigned in discussion between the user, the producer and the waste disposal company.

Waste from residues / unused products	Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).
Contaminated packaging	Empty containers should be taken to an approved waste handling site for recycling or disposal. Since emptied containers may retain product residue, follow label warnings even after container is emptied.

14. Transport information

DOT

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code	Not established.

15. Regulatory information

US federal regulations

This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.
One or more components are not listed on TSCA.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories	Immediate Hazard - Yes Delayed Hazard - No Fire Hazard - No Pressure Hazard - No Reactivity Hazard - No

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical	Yes

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Not regulated.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA)	Not regulated.

US state regulations

US. Massachusetts RTK - Substance List

Not regulated.

US. New Jersey Worker and Community Right-to-Know Act

Not listed.

US. Pennsylvania Worker and Community Right-to-Know Law

Fatty Acids (neutralized) (CAS 61790-12-3 or 112-80-1)

US. Rhode Island RTK

Not regulated.

US. California Proposition 65

California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65): This material is not known to contain any chemicals currently listed as carcinogens or reproductive toxins.

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	No
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

Issue date 22-April-2015

Revision date -

Version # 01

Further information HMIS® is a registered trade and service mark of the American Coatings Association (ACA).

HMIS® ratings

Health: 3
Flammability: 1
Physical hazard: 0

NFPA ratings

Disclaimer

Regenesis cannot anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use. The information in the sheet was written based on the best knowledge and experience currently available.

CHEMICAL REDUCING SOLUTION

Chemical Reducing Solution (CRS®) Installation Instructions:

General Guidelines

CRS® is a liquid amendment to 3D Microemulsion® that provides ferrous iron (Fe^{2+}) to the reductive dechlorination process, thus enabling *In situ* Chemical Reduction (ISCR) pathways for contaminant destruction. The material is added in a prescribed ratio to the 3D Microemulsion mixture before injection. Exact ratios and mixing quantities should be obtained from your REGENESIS® representative.

Material Handling and Safety

CRS is a neutral-pH material made from very low toxicity ingredients. However, as with all chemicals, CRS should be handled, used, and disposed of safely in accordance with its Material Safety Data Sheet (MSDS) and in compliance with local and federal regulations.

Product Mixing and Application

CRS contains reduced ferrous iron (Fe^{2+}) and will oxidize slowly to ferric iron (Fe^{3+}) in air. To maximize the reducing capacity of the solution, exposure to air should be minimized prior to injection of the material. Therefore, it is important that the drums CRS is delivered in stay closed and air-tight until CRS is ready to be added to 3D Microemulsion.

Two methods are recommended for mixing and application of CRS with 3D Microemulsion:
1) Direct batch mixing
2) Controlled metering with a Dosatron™ chemical dispenser

These two options are outlined below.

I. Method 1 - Direct batch mixing of CRS

1. Obtain recipe for emulsion preparation and CRS addition from REGENESIS
2. Dilute 3D Microemulsion with the prescribed quantity of water
3. Stir drum of CRS for 30 seconds with a vortex mixer at a mild turbulence setting to ensure solution homogeneity without air entrainment
4. Transfer the prescribed quantity of CRS into the 3D Microemulsion batch
5. Mix the emulsion and CRS batch using a vortex mixer – note: care should be taken to:
    i. Minimize direct exposure and entrainment of air
    ii. Mix periodically to maintain homogeneity of batch
6. Inject the final mixture directly into the treatment zone

CHEMICAL REDUCING SOLUTION

II. Method 2- Controlled Metering using a Dosatron™ chemical dispenser

1. Obtain recipe for emulsion preparation and CRS addition from REGENESIS
2. Dilute 3D Microemulsion with the prescribed quantity of water
3. Stir drum of CRS for 30 seconds with a vortex mixer at a mild turbulence setting to ensure solution homogeneity without air entrainment
4. Assemble injection setup to incorporate the Dosatron chemical metering system
5. Inject the diluted batch of 3D Microemulsion using the Dosatron unit to meter the CRS solution into the 3D Microemulsion at the prescribed ratios

For direct assistance or answers to any questions you may have regarding these instructions, contact REGENESIS Technical Services at 949.366.8000.

REGENESIS
Technology-Based Solutions for the Environment

SAFETY DATA SHEET

1. Identification

Product identifier **Chemical Reducing Solution (CRS®)**

Other means of identification None.

Recommended use Soil and Groundwater Remediation.

Recommended restrictions None known.

Manufacturer/Importer/Supplier/Distributor information

Company Name Regenesis

Address 1011 Calle Sombra
San Clemente, CA 92673

Telephone 949-366-8000

E-mail CustomerService@regenesis.com

Emergency phone number CHEMTREC® at 1-800-424-9300 (International)

2. Hazard(s) identification

Physical hazards Not classified.

Health hazards Not classified.

OSHA defined hazards Not classified.

Label elements

Hazard symbol None.

Signal word None.

Hazard statement The mixture does not meet the criteria for classification.

Precautionary statement

Prevention Observe good industrial hygiene practices.

Response Wash hands after handling.

Storage Store away from incompatible materials.

Disposal Dispose of waste and residues in accordance with local authority requirements.

Hazard(s) not otherwise classified (HNOC) None known.

3. Composition/information on ingredients

Mixtures

The manufacturer lists no ingredients as hazardous according to OSHA 29 CFR 1910.1200.

Chemical name	CAS number	%
Water	7732-18-5	85-92
Ferrous Gluconate	299-29-6	8-15

Composition comments All concentrations are in percent by weight unless otherwise indicated.

4. First-aid measures

Inhalation Move to fresh air. Call a physician if symptoms develop or persist.

Skin contact Remove contaminated clothing and shoes. Wash off with soap and water. Get medical attention if irritation develops and persists.

Eye contact Rinse with water. Get medical attention if irritation develops and persists.

Ingestion Rinse mouth. Never give anything by mouth to a victim who is unconscious or is having convulsions. Do not induce vomiting without advice from poison control center. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs. Get medical attention if symptoms occur.

Most important symptoms/effects, acute and delayed	Direct contact with eyes may cause temporary irritation.
Indication of immediate medical attention and special treatment needed	Treat symptomatically.
General information	If you feel unwell, seek medical advice (show the label where possible). Show this safety data sheet to the doctor in attendance.

5. Fire-fighting measures

Suitable extinguishing media	Small fires: Dry chemical powder. Larger fires: Water spray, fog or foam.
Unsuitable extinguishing media	None known.
Specific hazards arising from the chemical	During fire, gases hazardous to health may be formed. Combustion products may include: carbon monoxide, carbon dixoide, iron oxides.
Special protective equipment and precautions for firefighters	Use protective equipment appropriate for surrounding materials.
Fire fighting equipment/instructions	Move containers from fire area if you can do so without risk.
Specific methods	Use standard firefighting procedures and consider the hazards of other involved materials. Use water spray to keep fire-exposed containers cool.
General fire hazards	No unusual fire or explosion hazards noted. The product itself does not burn.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures	Keep unnecessary personnel away. Avoid contact with spilled material. For personal protection, see section 8 of the SDS.
Methods and materials for containment and cleaning up	This product is miscible in water. Large Spills: Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Cover with plastic sheet to prevent spreading. Absorb in vermiculite, dry sand or earth and place into containers. Following product recovery, flush area with water. Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination. Never return spills to original containers for re-use. For waste disposal, see section 13 of the SDS.
Environmental precautions	Avoid discharge into drains, water courses or onto the ground.

7. Handling and storage

Precautions for safe handling	Avoid contact with eyes, skin, and clothing. Avoid prolonged exposure. Avoid breathing spray mist. Use with adequate ventilation. Observe good industrial hygiene practices. Wear appropriate personal protective equipment (See Section 8).
Conditions for safe storage, including any incompatibilities	Store in original tightly closed container. Store in a cool, dry, well-ventilated place. Store away from incompatible materials (see Section 10 of the SDS). Keep away from extreme heat and strong oxidizing agents.

8. Exposure controls/personal protection

Occupational exposure limits	No exposure limits noted for ingredient(s).
Biological limit values	No biological exposure limits noted for the ingredient(s).
Appropriate engineering controls	Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. Provide eyewash station and safety shower.

Individual protection measures, such as personal protective equipment

Eye/face protection	Use safety glasses. Where contact with eyes is likely, use chemical goggles. Use a face shield as needed.
Skin protection	
Hand protection	Wear appropriate chemical resistant gloves.
Other	Wear suitable protective clothing. Wear appropriate chemical resistant gloves.

Respiratory protection	In case of insufficient ventilation, wear suitable respiratory equipment. If engineering controls do not maintain airborne concentrations below recommended exposure limits (where applicable) or to an acceptable level (in countries where exposure limits have not been established), an approved respirator must be worn. Wear respiratory protection during operations where spraying or misting occurs. If respirators are used, a program should be instituted to assure compliance with OSHA 29 CFR 1910.134.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
General hygiene considerations	Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

Appearance	
Physical state	Liquid.
Form	Liquid.
Color	Dark green to black.
Odor	Odorless.
Odor threshold	Not available.
pH	6 - 8
Melting point/freezing point	Not available.
Initial boiling point and boiling range	Not available.
Flash point	Not flammable.
Evaporation rate	Not available.
Flammability (solid, gas)	Not applicable.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	Not available.
Flammability limit - upper (%)	Not available.
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Relative density	1 - 1.2
Solubility(ies)	
Solubility (water)	Miscible
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	Not available.

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	A component of this product can oxidize in air: iron (II) to iron (III).
Possibility of hazardous reactions	No dangerous reaction known under conditions of normal use.
Conditions to avoid	Contact with incompatible materials. Keep from freezing.
Incompatible materials	Oxidizing agents.
Hazardous decomposition products	Thermal decomposition can produce oxides of carbon and iron.

11. Toxicological information

Information on likely routes of exposure

Inhalation	Prolonged inhalation may be harmful.
Skin contact	Prolonged or repeated skin contact may result in minor irritation.
Eye contact	Direct contact with eyes may cause temporary irritation.
Ingestion	Expected to be a low ingestion hazard.
Symptoms related to the physical, chemical and toxicological characteristics	Direct contact with eyes may cause temporary irritation.

Information on toxicological effects

Acute toxicity	Not expected to be acutely toxic.
Skin corrosion/irritation	Prolonged skin contact may cause temporary irritation.
Serious eye damage/eye irritation	Direct contact with eyes may cause temporary irritation.
Respiratory or skin sensitization	
Respiratory sensitization	Not a respiratory sensitizer.
Skin sensitization	This product is not expected to cause skin sensitization.
Germ cell mutagenicity	No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.
Carcinogenicity	This product is not considered to be a carcinogen by IARC, ACGIH, NTP, or OSHA.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

Reproductive toxicity	This product is not expected to cause reproductive or developmental effects.
Specific target organ toxicity - single exposure	Not classified.
Specific target organ toxicity - repeated exposure	Not classified.
Aspiration hazard	Not an aspiration hazard.
Chronic effects	Prolonged inhalation may be harmful.
Further information	Ferrous Gluconate Dihydrate (6047-12-7) is Generally Recognized as Safe (GRAS) (21 CFR §184.1308).

12. Ecological information

Ecotoxicity	The product is not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.
Persistence and degradability	No data is available on the degradability of this product.
Bioaccumulative potential	No data available.
Mobility in soil	Expected to be highly mobile in soil.
Other adverse effects	None known.

13. Disposal considerations

Disposal instructions	Collect and reclaim or dispose in sealed containers at licensed waste disposal site.
Local disposal regulations	Dispose in accordance with all applicable regulations.
Hazardous waste code	The waste code should be assigned in discussion between the user, the producer and the waste disposal company.
Waste from residues / unused products	Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).
Contaminated packaging	Empty containers should be taken to an approved waste handling site for recycling or disposal. Since emptied containers may retain product residue, follow label warnings even after container is emptied.

14. Transport information

DOT

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not available.

15. Regulatory information

US federal regulations

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories Immediate Hazard - No
Delayed Hazard - No
Fire Hazard - No
Pressure Hazard - No
Reactivity Hazard - No

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical No

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Not regulated.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA) Not regulated.

US state regulations

US. Massachusetts RTK - Substance List

Not regulated.

US. New Jersey Worker and Community Right-to-Know Act

Not listed.

US. Pennsylvania Worker and Community Right-to-Know Law

Not listed.

US. Rhode Island RTK

Not regulated.

US. California Proposition 65

Not Listed.

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No

Country(s) or region	Inventory name	On inventory (yes/no)*
China	Inventory of Existing Chemical Substances in China (IECSC)	No
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	Yes
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	No
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

Issue date 26-February-2015

Revision date -

Version # 01

Further information HMIS® is a registered trade and service mark of the American Coatings Association (ACA).

HMIS® ratings
Health: 1
Flammability: 0
Physical hazard: 0

NFPA ratings

Disclaimer Regenesis cannot anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use. The information in the sheet was written based on the best knowledge and experience currently available.

BIO-DECHLOR INOCULUM

Bio-Dechlor INOCULUM PLUS (BDI PLUS®) Installation Instructions:

General Guidelines

Bio-Dechlor INOCULUM PLUS (BDI PLUS®) is an enriched natural microbial consortium containing species of Dehalococcoides. This microbial consortium has since been enriched to increase its ability to rapidly dechlorinate contaminants during *in situ* bioremediation processes. BDI PLUS has been shown to stimulate the rapid and complete dechlorination of compounds such as tetrachloroethene (PCE), trichloroethene (TCE), dichloroethene (DCE), and vinyl chloride (VC). BDI PLUS also contains microorganisms capable of degrading chloromethanes (carbon tetrachloride and chloroform) as well as chloroethanes like trichloroethane (TCA).

Recent trends in engineered bioremediation indicate that the treatment of chlorinated solvent contamination sometimes results in slow or incomplete degradation of the intermediate compounds. When faced with this circumstance, bioaugmentation with a microbial consortium such as BDI PLUS offers a solution to accelerate or simply make possible the complete dechlorination of these otherwise recalcitrant compounds.

REGENESIS® believes that the best approach to install BDI PLUS into the subsurface is by direct-push methods. This allows for the BDI PLUS solution to be applied directly into the aquifer material and provides greater coverage/treatment over the life of the project. As a minimum, the following equipment will be needed to perform this type of installation:

- Direct-push drilling unit
- Grout pump (e.g. Geoprobe GS 2000)
- Appropriate hose assembly including a fitting that links a hose from the grout pump to the direct-push rods (provided by REGENESIS with shipment)
- One or more 55+ gallon water drums, fitted with an appropriate lid that has at least one bung hole (number of drums depends on size of application)
- Rotary transfer pump (or equivalent) with appropriate amount of hose to connect from 55-gal drum to hopper of grout pump (similar to Grainger No. 1P893, Fill-Rite model #FR112GR)
- Compressed Nitrogen gas tank with appropriate regulator (0 to 15 pounds per square inch (psi). A 300-ft^3 tank should be sufficient for discharge of concentrated or non-concentrated kegs and for nitrogen sparging to deoxygenate batch water.
- Pressure washer (or equivalent) for cleaning

Material Packaging and Safety

BDI PLUS is a mixture of living bacteria including members of the Dehalococcoides genus that are capable of anaerobically degrading chlorinated contaminants. The culture has been tested to ensure that it is free of the most common pathogenic bacteria, but like all living cultures it should be handled with due care to prevent contamination of work surfaces or field personnel.

During installation activities, REGENESIS recommends that field personnel use at least level "D" personal protection equipment (PPE). A Materials Safety Data Sheet (MSDS) is sent with each shipment and should be reviewed before proceeding with installation activities.

BIO-DECHLOR INOCULUM

Warning

- The BDI PLUS container is pressurized to 10 to 15 psi with nitrogen before shipping
- Wear suitable eye protection, gloves, respirator and protective clothing
- Gas cylinders used to dispense culture MUST be equipped with a proper pressure regulator
- During operation DO NOT exceed the containers maximum working pressure of 15 psi

Unpacking

1. Carefully remove the container from shipping cooler and stand upright. DO NOT use the plastic sight tube as a handle.
2. Carefully check the container, connectors, valves and tubing for any damage or defects. If defects or damage is observed, do not use. Report any damage to REGENESIS at 949.366.8000. A back up set of quick connects is provided in the packaging material.
3. Check and ensure that all valves are in the CLOSED position.

Storage

If the schedule of bacteria application requires adding the bacteria over a period of more than one day, the keg(s) should be stored at a temperature 2-4 °C, but freezing must be avoided. This can normally be achieved by storing the kegs under ice in the provided coolers. Keg should be pressurized with Nitrogen to pressure 10- 15 psi. before storing to ensure a tight seal on the keg cap.

Culture Keg in Cooler

Shipping

After completion of operation, please, ship cooler with keg and all attachments back to the following address:

Shaw Environmental, Inc.
17 Princess Road, Lawrenceville, NJ 08648

Specific Installation Procedures

1. The BDI PLUS must be added to the previously prepared "oxygen-free" water before it is installed in the subsurface. The desired amount of BDI PLUS should be carefully discharged into the 55-gal drum containing the appropriate amount of "oxygen free" water. The tables provided below indicates the amount of water that a given amount of BDI PLUS should be mixed with.
   The BDI PLUS must be added to "oxygen-free" water before it is installed in the subsurface. To ensure that the water has reached the desired anoxic state prior to mixing with BDI PLUS an appropriate amount of nitrogen sparging into the 55-gal drum containing a given amount of water at least one hour prior to adding the BDI PLUS. To ensure that a sufficient quantity of "oxygen free" water is available throughout the day, a large trough of "nitrogen sparged" water can be prepared and additional 55-gal drums can be filled from this trough. The water in the trough can be transferred to the 55-gal drums where the BDI is mixed with the water using a primed transfer pump.

Nitrogen sparging is accomplished by a gas sparging device equivalent to a fish tank aerator. Adjust the 300ft³ nitrogen tank pressure regulator to 3-5 psi and immerse the gas sparger to the bottom of the drum or trough. By internal convection and oxygen stripping processes, the oxygen levels should diminish within an hour. Be careful to not consume too much gas and not have nitrogen to empty the kegs. Keeping an eye on tank pressure loss and dissolved oxygen level will indicate when one can trim down on the sparge pressure and conserve the nitrogen.

BDI PLUS Dilution Chart

Volume of BDI PLUS	Volume of Water
5 liters	50 gal
1 liter	10 gal

Volume of BDI PLUS Concentrate	Volume of Water
0.5 liters	50 gal
0.1 liter	10 gal

2. The drive rod assembly should be fitted with a disposable tip on the first drive rod and pushed down to the desired depth. This process should be done in accordance with the manufacturer's standard operating procedure (SOP).
3. A sub-assembly connecting the delivery hose to the drive rods and pump should be used. The sub-assembly should be constructed in a manner that allows for the drive rods to be withdrawn while the material is being pumped.
4. Prior to connecting the hose to the sub-assembly a volume check should be completed to determine the volume and weight of product displaced with each pump stroke.
5. After the drive rods have been pushed to the desired depth, the rod assembly should be with drawn three to six inches so that the disposable tip has room to be dropped.
   a. If an injection tool is used instead of an expendable tip, the application of material can take place without any preliminary withdrawal of the rods.
6. Fill the annular space of the drive rods with water. This will minimize the amount of air introduced to the system.
7. Insert the telescoping suction pipe on the rotary transfer pump into a bung hole on the lid of the 55-gal drum and make sure that the pipe reaches the bottom of the drum. If possible, attach the suction pipe to the bung hole with the 2" bung adapter to ensure that the pump remains securely in place while pumping the Bio-Dechlor INOCULUM mixture from the drum to the pump hopper.
8. Attach the hose to the outlet of the rotary transfer pump making sure that the opposite end of the hose reaches the pump hopper. Open the opposite bung hole on the drum lid to prevent a vacuum then pump the desired amount of BDI PLUS solution into the hopper of the pump.
9. Connect the hose from the grout pump to the drive rod assembly.
10. Start pumping the BDI PLUS product solution.
11. The initial volume of BDI PLUS solution pumped should only be enough to displace the water within the drive rods. Once this is done the actual injection can start.
12. Begin withdrawing the drive rods, in accordance with the manufacturer's SOP, and start pumping the BDI PLUS solution simultaneously. The dosage should be 0.1 liter per vertical foot or 1 gallon per vertical foot if prepared using the BDI dilution chart. The withdrawal rate should be such that it allows theappropriate quantity of material to be injected into each vertical foot of aquifer being

treated. The withdrawal rate should be slow to avoid creating a vacuum. This vacuum can potentially pull a small volume of material to the surface if the drive rods are withdrawn too quickly.

13. In less permeable soils such as clays and silts, there may be difficulty accepting the volume of estimated material. In this case REGENESIS recommends using a "step-wise" application approach. For this approach we suggest withdrawing the drive rods in one-foot increments and then injecting the quantity of material required per vertical foot.
14. Look for any indications of aquifer refusal such as:
    - Excessive pump noise or application pressure spikes (e.g. squealing)
    - Surfacing of material through the injection point ("blow-by") If acceptance appears to be an issue it is critical that the aquifer is given enough time to equilibrate before breaking down the drive rods and/or removing the hose. The failure to do this can lead to excessive back flow of the BDI PLUS material on personnel, equipment, and the ground surface.
15. If BDI PLUS solution continues to "surface" after the drive rods have been completely removed from the borehole a plug may be necessary. Large diameter disposable tips or wood stakes have been used successfully for this purpose.
16. Drive rods should be disconnected after one rod (typically 4 feet in length) has been withdrawn. The drive rods should be placed in a bucket (or equivalent) after they have been disconnected.
17. Complete the installation of the BDI PLUS solution at the designated application rate across the entire targeted vertical interval.
18. After the injection is completed, an appropriate seal should be installed above the vertical interval where the BDI PLUS solution has been placed to prevent contaminant migration. Typically, bentonite powder or chips are used to create this seal. However, consultants should review local regulations before beginning field installation activities to confirm that this approach can be used.
19. Complete the borehole at the surface as appropriate using concrete or asphalt.
20. Repeat steps 7 through 19 until the entire application has been completed. If additional drums of de-oxygenated water are required, prepare as suggested in Step 1.
21. Prior to the installation of BDI PLUS, all surface and overhead impediments should be identified as well as the location(s) of any underground structure(s). Underground structures include but are not limited to: utility lines (gas, electrical, sewer, etc), drain piping, and landscape irrigation systems.
22. The planned injection locations should be adjusted in the field to account for impediments and obstacles.
23. The actual injection locations should be marked prior to the start of installation activities to facilitate the application process.
24. Using an appropriate pump to install the BDI PLUS product is very critical to the success of the application as well as the overall success of the project. Based on our experience in the field, REGENESIS strongly recommends using a pump that has a pressure rating of at least 1,000 psi and a delivery rate of at least 3 gallons per minute. If the application involves both HRC and BDI PLUS, two separate pumps may be required to facilitate the process. The pump used to deliver HRC to the subsurface should be in accordance with the specifications outlined in the General Guidelines section of the HRC Installation Instructions.

Additional Information

The internal workings of the grout pump can be cleaned easily by recirculating a solution of hot water and a biodegradable cleaner (e.g. Simple Green) through the pump and delivery hose(s). If additional cleaning and decontamination is required it should be conducted in accordance with the manufacturer's SOP and local regulatory requirements.

Note: REGENESIS assumes that all of the material (microorganisms) sent to a site for installation purposes will be used for that particular project and that no material (microorganisms) will be left over at the conclusion of the installation activities.

REGENESIS
Technology Based Solutions for the Environment

SAFETY DATA SHEET

1. Identification

Product identifier	**Bio-Dechlor INOCULUM® Plus**
Other means of identification	DHC microbial consortium (SDC-9).
Recommended use	Soil and Groundwater Remediation.
Recommended restrictions	None known.

Manufacturer/Importer/Supplier/Distributor information

Company Name	Regenesis
Address	1011 Calle Sombra San Clemente, CA 92673
Telephone	949-366-8000
E-mail	CustomerService@regenesis.com
Emergency phone number	CHEMTREC® at 1-800-424-9300 (International)

2. Hazard(s) identification

Physical hazards	Not classified.
Health hazards	Not classified.
OSHA defined hazards	Not classified.

Label elements

Hazard symbol	None.
Signal word	None.
Hazard statement	The mixture does not meet the criteria for classification.
Precautionary statement	
Prevention	Observe good industrial hygiene practices.
Response	Wash hands after handling.
Storage	Store away from incompatible materials.
Disposal	Dispose of waste and residues in accordance with local authority requirements.
Hazard(s) not otherwise classified (HNOC)	None known.

3. Composition/information on ingredients

Mixtures

The manufacturer lists no ingredients as hazardous according to OSHA 29 CFR 1910.1200.

Chemical name	CAS number	%
DHC microbial consortium comprised of microorganisms of the genus Dehalococcoides	Not Applicable	100

Composition comments All concentrations are in percent by weight unless otherwise indicated.

4. First-aid measures

Inhalation	Move to fresh air. Call a physician if symptoms develop or persist.
Skin contact	Wash off with soap and water. Get medical attention if irritation develops and persists.
Eye contact	Rinse with water. Get medical attention if irritation develops and persists.
Ingestion	Rinse mouth. Get medical attention if symptoms occur.
Most important symptoms/effects, acute and delayed	Direct contact with eyes may cause temporary irritation.
Indication of immediate medical attention and special treatment needed	Treat symptomatically.

General information	If you feel unwell, seek medical advice (show the label where possible). Show this safety data sheet to the doctor in attendance.

5. Fire-fighting measures

Suitable extinguishing media	Carbon dioxide (CO2). Water. Foam.
Unsuitable extinguishing media	None known.
Specific hazards arising from the chemical	During fire, gases hazardous to health may be formed.
Special protective equipment and precautions for firefighters	Self-contained breathing apparatus and full protective clothing must be worn in case of fire.
Fire fighting equipment/instructions	Move containers from fire area if you can do so without risk.
Specific methods	Use standard firefighting procedures and consider the hazards of other involved materials. Use water spray to keep fire-exposed containers cool.
General fire hazards	No unusual fire or explosion hazards noted. The product itself does not burn.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures	Keep unnecessary personnel away. Avoid contact with spilled material. For personal protection, see section 8 of the SDS.
Methods and materials for containment and cleaning up	This product is miscible in water. Disinfect the spill area with 5% bleach solution after clean-up. Large Spills: Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Cover with plastic sheet to prevent spreading. Absorb in vermiculite, dry sand or earth and place into containers. Following product recovery, flush area with water. Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination. Never return spills to original containers for re-use. For waste disposal, see section 13 of the SDS.
Environmental precautions	Avoid discharge into drains, water courses or onto the ground.

7. Handling and storage

Precautions for safe handling	Avoid prolonged exposure. Observe good industrial hygiene practices. Wear appropriate personal protective equipment (See Section 8).
Conditions for safe storage, including any incompatibilities	Store in original tightly closed container. Recommended storage containers: plastic lined steel, plastic, glass, aluminum, stainless steel, or reinforced fiberglass. Store away from incompatible materials (see Section 10 of the SDS). Store in a cool, dry area at 4 - 5°C (39 - 41°F).

8. Exposure controls/personal protection

Occupational exposure limits	No exposure limits noted for ingredient(s).
Biological limit values	No biological exposure limits noted for the ingredient(s).
Appropriate engineering controls	General ventilation normally adequate. Provide eyewash station.
Individual protection measures, such as personal protective equipment	
Eye/face protection	Tightly fitting safety goggles.
Skin protection	
Hand protection	The following glove materials are recommended: vinyl or rubber.
Other	Wear suitable protective clothing.
Respiratory protection	Not normally needed. In case of insufficient ventilation, wear suitable respiratory equipment. If engineering controls do not maintain airborne concentrations below recommended exposure limits (where applicable) or to an acceptable level (in countries where exposure limits have not been established), an approved respirator must be worn.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
General hygiene considerations	Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

Appearance	
Physical state	Liquid.
Form	Liquid.
Color	Murky yellow.
Odor	Musty.
Odor threshold	Not available.
pH	Not available.
Melting point/freezing point	Not available.
Initial boiling point and boiling range	212 °F (100 °C)
Flash point	Not flammable.
Evaporation rate	Not available.
Flammability (solid, gas)	Not applicable.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	Not available.
Flammability limit - upper (%)	Not available.
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Relative density	0.9 - 1.1
Solubility(ies)	
Solubility (water)	Soluble.
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	Not available.

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Material is stable under normal conditions.
Possibility of hazardous reactions	No dangerous reaction known under conditions of normal use.
Conditions to avoid	Contact with incompatible materials. Keep from freezing.
Incompatible materials	Strong oxidizing agents. Bases. Acids.
Hazardous decomposition products	No hazardous decomposition products are known.

11. Toxicological information

Information on likely routes of exposure

Inhalation	Prolonged inhalation may be harmful.
Skin contact	Prolonged or repeated skin contact may result in minor irritation.
Eye contact	Direct contact with eyes may cause temporary irritation.
Ingestion	Ingestion may cause irritation and stomach discomfort.
Symptoms related to the physical, chemical and toxicological characteristics	Direct contact with eyes may cause temporary irritation.

Information on toxicological effects

Acute toxicity	Not expected to be acutely toxic.
Skin corrosion/irritation	Prolonged skin contact may cause temporary irritation.
Serious eye damage/eye irritation	Direct contact with eyes may cause temporary irritation.
Respiratory or skin sensitization	
Respiratory sensitization	Not a respiratory sensitizer.
Skin sensitization	This product is not expected to cause skin sensitization.
Germ cell mutagenicity	No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.
Carcinogenicity	This product is not considered to be a carcinogen by IARC, ACGIH, NTP, or OSHA.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

Reproductive toxicity	This product is not expected to cause reproductive or developmental effects.
Specific target organ toxicity - single exposure	Not classified.
Specific target organ toxicity - repeated exposure	Not classified.
Aspiration hazard	Not an aspiration hazard.
Chronic effects	Prolonged inhalation may be harmful.
Further information	May be harmful by inhalation, ingestion, or skin absorption via bacterial action.

12. Ecological information

Ecotoxicity	The product is not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.
Persistence and degradability	This material will degrade in the environment. Material is readily degradable and undergoes hydrolysis in several hours.
Bioaccumulative potential	No data available.
Mobility in soil	Expected to be highly mobile in soil.
Other adverse effects	None known.

13. Disposal considerations

Disposal instructions	Collect and reclaim or dispose in sealed containers at licensed waste disposal site.
Local disposal regulations	Dispose in accordance with all applicable regulations.
Hazardous waste code	The waste code should be assigned in discussion between the user, the producer and the waste disposal company.
Waste from residues / unused products	Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).
Contaminated packaging	Empty containers should be taken to an approved waste handling site for recycling or disposal. Since emptied containers may retain product residue, follow label warnings even after container is emptied.

14. Transport information

DOT

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code	Not available.

15. Regulatory information

US federal regulations

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories

Immediate Hazard - No
Delayed Hazard - No
Fire Hazard - No
Pressure Hazard - No
Reactivity Hazard - No

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical No

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Not regulated.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA) Not regulated.

US state regulations

US. Massachusetts RTK - Substance List

Not regulated.

US. New Jersey Worker and Community Right-to-Know Act

Not listed.

US. Pennsylvania Worker and Community Right-to-Know Law

Not listed.

US. Rhode Island RTK

Not regulated.

US. California Proposition 65

Not Listed.

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	No
Canada	Domestic Substances List (DSL)	No
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	No
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	No
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	No
Korea	Existing Chemicals List (ECL)	No
New Zealand	New Zealand Inventory	No
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	No

Country(s) or region	Inventory name	On inventory (yes/no)*
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	No

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

Issue date 12-February-2015

Revision date -

Version # 01

Further information HMIS® is a registered trade and service mark of the American Coatings Association (ACA).

HMIS® ratings
Health: 0
Flammability: 0
Physical hazard: 0

NFPA ratings

Disclaimer Regenesis cannot anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use. The information in the sheet was written based on the best knowledge and experience currently available.

PWGC
CLIENT DRIVEN SOLUTIONS

APPENDIX B
PROJECT TEAM RESUMES

Paul K. Boyce, PE, PG • PRESIDENT/CEO

PROFESSIONAL EXPERIENCE
PWGC: 27 years

AREAS OF EXPERTISE
Water Resource/Supply Design
Civil Site Design
Remedial System Design
Geothermal Systems
Groundwater Hydrology
Groundwater Modeling

EDUCATION & TRAINING/CERTIFICATION
MS, Environmental Engineering, Polytechnic University, NY (now NYU)
BS, Civil Engineering, SUNY Buffalo, NY
Professional Engineer, NY, PA
New York State Professional Geologist
OSHA HAZWOPER 40-hr (29CRR 1910.120)

AFFILIATIONS
American Society of Civil Engineers (ASCE)
NYS Society of Professional Engineers
American Council of Engineering Companies (ACEC)
Long Island Professional Geologists Association
American Water Works Association (AWWA)
National Groundwater Association (NGWA)

PROFILE
An environmental engineering professional Mr. Boyce has amassed an impressive portfolio of successful project in the New York Metropolitan region. He is an expert at providing public and private clients with targeted analyses, designs, modeling services, investigations, master planning development, construction oversight, regulatory, and sustainability consulting.

For more than two decades at PWGC, Mr. Boyce has been immersed in some of the most innovative and successful environmental engineering projects on Long Island, playing key roles in developments that have improved the region's economy and environment. Whether using cutting-edge geothermal technology to assist Amneal Pharmaceuticals in the development of its base of operations in Yaphank or conducting detailed groundwater modeling at Brookhaven National Laboratory, his client expertise covers a wide spectrum of applications including targeted design and analysis, groundwater modeling, environmental investigations, construction oversight, and sustainability consulting.

Overall, Mr. Boyce develops project-specific civil and environmental engineering designs, implementation strategies and project management plans. He is an expert on the design and construction oversight related to the application of geothermal technologies. He assists clients with selecting the appropriate system and location, feasibility assessment, design preparation, system development and startup.

In his tenure at PWGC, Mr. Boyce has earned an industry-recognized reputation for his ability to assess project parameters and design and developing economical environmental engineering solutions that meet the stringent demands of our clients.

NOTABLE PROJECTS

Mr. Boyce's responsibilities with regards to lead sampling and analysis include interpretation of regulatory requirements and federal action levels as they pertain to lead in potable systems, investigations into causes for high lead concentrations in drinking water, recommending solutions to remedy high lead levels, cost estimates for lead treatment strategies, designs for remedial solutions involving flushing, plumbing material replacements and chemical treatment and water chemistry modeling. He provided coordination and supervision of field teams performing lead sample collection. Mr. Boyce was the regulatory agency liaison for all parties involved.

NYC School Construction Authority (SCA)
Discolored Water Investigations and Remedies at Numerous Schools across New York City – Notable projects included: 229K, 163K, R062, Q316. Mr. Boyce's responsibilities included aiding STV and SCA in investigating causes, overseeing field investigation services, water quality sampling, metallurgy of pipe sections, water quality/chemistry analyses, recommending remedies, report preparation, oversight of remedy implementation and follow-up samplings.
Disinfection Oversight – Mr. Boyce's responsibilities included overseeing field teams who were responsible for witnessing disinfection of potable water systems at new or renovated school buildings.
Disinfection Specification Update – Mr. Boyce was responsible for updating the SCA's standard disinfection specification for potable water systems.
Brooklyn Army Terminal Pre-K Site – Incoming potable water into the leased space was experiencing bacteriological issues. Mr. Boyce was responsible for investigating the cause and designing a remedy which consisted of new piping system and filtration units.
Lead Sampling – Mr. Boyce served as a lead consultant to SCA for a major sampling program of all schools in the New York City school system. His responsibilities included assembling lead sampling teams, coordinating and scheduling sampling events with STV and SCA, coordinating with analytical laboratories, review sampling results and consulting with SCA regarding results and potential remedies.

Diocese of Rockville Center
Lead Sampling – Mr. Boyce was responsible for overall project management and coordination of sampling for lead in the potable drinking water systems at more than 25 Long Island Catholic schools in Nassau and Suffolk Counties. His responsibilities included coordinating field sampling teams, working directly with individual school staffs, reviewing lead results and recommending remedies. Once a remedy was implemented, Mr. Boyce oversaw follow-up sampling. Mr. Boyce is the primary point of contact for Senior Diocese management staff.

Northwell Health – Long Island Jewish Medical Center (LIJMC), New Hyde Park, NY
Environmental Policy & Procedures for the Prevention of Legionella Contamination
Mr. Boyce's responsibilities for this project included researching local, state, and federal legionella standards and guidelines and updating a pre-existing environmental policy and procedures manual for the prevention of legionella contamination in LIJMC healthcare facilities. Mr. Boyce coordinated with the New York State Health Department to determine the present status of legionella updates on the state level. Following extensive research on revisions undertaken to various guidelines and standards pertinent to legionella, Mr. Boyce updated the routine legionella sampling program, disinfection procedures, maintenance and long-term control measures to prevent legionellae contamination and the requirements for the development of a water safety management program.

Water Resource Management

Ross School, East Hampton, NY
Master Planning & Campus Design - Mr. Boyce provided civil engineering design services to develop a master plan for the private school campus, which was to be a "one of a kind," transforming the school into a state-of-the-art learning institution, situated in a rural, wooded groundwater recharge area.
Civil Engineering Services - Civil engineering and consulting were provided for grading, drainage, utility layout, roadways, parking, site lighting, athletic playing fields, irrigation, water supply, sanitary, wastewater collection, and open loop geothermal heating/cooling water systems. Throughout the project, Mr. Boyce collaborated with other project consultants, foremost planners, architects, landscape architects, MEP engineers, surveyors, contractors, the construction manager and the school administration. He oversaw and participated in the conceptualization and preliminary design of the campus' proposed layout, which included eco-friendly engineering designs consulting/development and integration of civil engineering design aspects with other important features such as academic programs, architecture, landscaping and pedestrian walkways.
Environmental Engineering Services - The campus was to be as green as possible utilizing available eco-friendly technologies for the most environmentally sensitive and appealing design. The campus' sensitive environmental location as well as sanitary density issues required a sewage treatment plant. Mr. Boyce investigated and evaluated different sewage treatment technologies capable to meet the school's projected needs functionally, aesthetically and academically. Mr. Boyce took into consideration some sustainability goals and follow regulatory requirements.
Environmental Consulting/Conceptual Design Services After researching the latest sewage treatment technologies, Mr. Boyce recommended to the master planning team and school administration a wastewater treatment system that naturally treats sewage and industrial waste to re-use quality that met the Master Plan goals: aesthetics, economic/environmental advantages and well below regulatory discharge standards. The panel accepted his recommendation and he created conceptualized layouts, sited for possible plant locations and designed a preliminary ecologically engineered sewage collection system.
Geothermal Well System Design – Mr. Boyce managed the site assessment, design, construction oversight and preparation of O&M manuals for the systems and conducted a feasibility study of using open-loop geothermal systems to heat and cool two of the school's most prominent buildings - The Center for Well Being (Bldg. 5) and the Media Pavilion (Bldg. 2). He researched local hydrogeological and groundwater quality conditions and analyzed the effects of required flow rates on a nearby Suffolk County Water Authority (SCWA) well field. Mr. Boyce employed Groundwater Vistas by ESI, to create a detailed 3-dimensional model for the area. His analysis illustrated the potential effects of supply and recharge wells on (1) each other, (2) nearby neighboring shallow wells, (3) the SCWA well field, and (4) the local water table (The model also took into account of the local groundwater divide). Once he had demonstrated that operating two separate open-loop geothermal well systems in close proximity would not have an impact, he prepared the engineering report for the NYS Department of Environmental Conservation, along with the appropriate Long Island Well permit applications for approval.

Northwell Health – Glen Cove Hospital, Glen Cove, NY

Northwell Health – Glen Cove Hospital, Glen Cove, NY, Geothermal Wells Project – As project manager, Mr. Boyce prepared the feasibility study, well permits, construction documents, oversaw the construction and fieldwork for the installation of a 400 GPM open-loop groundwater heat pump system. Before design, Mr. Boyce conducted the study to assess the feasibility of augmenting the AC's geothermal well system; he investigated size and location options for new wells and prepared construction cost estimates based on minimizing potential conflicts with existing site constraints and the likelihood of regulatory agency approval. He determined that expansion to the existing system would be feasible based on cost, local hydrogeology, and his modeling results. He advised the client that construction would cause significant disruptions to the hospital's daily operations. In accordance with NYSDEC guidelines, he investigated the potential effects of the proposed project on a nearby inactive hazardous waste site, obtained baseline water quality data, estimated aquifer characteristics to refine and calibrate the model and drafted a design and construction plan of a test and monitoring well to determine local geologic conditions. As liaison between NSUH, the NYSDEC, and the local regulatory agencies, Mr. Boyce established that a scaled-down, relocated system would have negligible effects on the hazardous waste site, and consequently, obtained approval for the proposed construction. NSUH selected Mr. Boyce to design, plan, and oversee the construction of the new system, which involved developing the design and strategy for a supply and recharge well system with inter-connecting process piping, detailed hydraulic analyses, sizing the various system components, and coordination with other project consultants on the installation of piping and process equipment.

Water Supply & Treatment

Suffolk County Department of Public Works, Yaphank, NY

Timber Point Country Club, Great River, Water Supply System & Irrigation Well Upgrades - Mr. Boyce directed the well's condition assessment, including pump test, to determine capacity and water quality and prepared specifications/plans to upgrade supply well with new pump and motor. Further, he designed new piping configurations to integrate an irrigation well with distribution and cross-connection to the Suffolk County Water Authority and specified new variable frequency drive for well pump motor.

West Sayville Golf Course, Sanitary System Improvements – Mr. Boyce oversaw construction phases through completion including, supervised design, development of permitting, bidding and administrative buildings sub-surface sanitary disposal system.

Peconic Dunes Park, Peconic, NY, Water Distribution System Improvements – Mr. Boyce supervised design/development of permitting, bidding, and construction documents to upgrade the existing water distribution system's components including backflow prevention devices water mains/meters, hydrants, and internal plumbing. Further, he oversaw construction phase services through to completion.

BOMARC Police Firing Range Westhampton, Drainage Improvements - Mr. Boyce directed design/development of permitting, bidding, and construction documents for drainage conditions improvements (i.e. stormwater collection/conveyance systems, new recharge system), and oversaw construction phase services through to completion.

Suffolk County Fire Academy, Yaphank, Water Supply Well Improvements - Mr. Boyce supervised design/development of bidding and construction documents for the re-circulated supply system. This included: physical/chemical rehabilitation, electrical service upgrades, a new motor starter, and replacement of a diesel driven booster pump with an electrically operated one, as well as the deep well vertical turbine pump and motor with a new submersible pumping unit. He managed construction phase services (administration, observation) to project completion.

SUNY Stony Brook, Sewer District 21, Groundwater Modeling Study, Stony Brook NY - Mr. Boyce performed a 3-d numerical groundwater modeling to estimate flow path and travel time of sewage treatment plant effluent from recharge basins to the Long Island Sound and prepared an engineering report documenting findings and modeling results.

Water Authority of Great Neck North, Nassau County, NY

Weybridge Road Clearwell Design - Mr. Boyce prepared a design for a new air stripper clearwell, upgraded the booster pump, piping, controls modifications, coordinated with NCDOH, and performed cost estimates. The design is completed and NCDOH has approved it, however, funding constraints have put the project on hold.

SCADA System Design - Mr. Boyce prepared a design for a new Supervisory Control and Data Acquisition System. He prepared bidding and construction documents, providing construction administration and observation services, and cost estimates.

Emergency Water Main Replacement, Berkshire Road - Mr. Boyce prepared design, construction and bidding documents for emergency water main replacements, expedited NCDOH review and approval, and provided PE certification services.

Air Stripper Cap at Watermill Lane – Mr. Boyce coordinated with contractor and WAGNN regarding design and sizing of appropriate air exit cap atop existing air stripper at Watermill Lane treatment plant.

Valve Book Review/Updates – Mr. Boyce updated valve location sketches as new valves are being installed in the distribution system.

Municipal Supply Well Design, Well #14 – Mr. Boyce oversaw the design services for the new 1,400 gpm municipal supply well. The design included an engineering report for NYSDEC and NCDOH review/approval, preparation of plans and specifications for a new well, associated piping, well house, electric, controls, instrumentation, chemical treatment, safeties, etc. Project is just underway as of Sept 2007. Construction phase services will also be provided.

Weybridge Road Ground Storage Tank Replacement – Mr. Boyce lead the project team charged with designing a new 500,000-gallon steel ground storage tank to replace a deteriorated and dilapidated existing 400,000-gallon ground storage tank. The team prepared bidding/construction documents, inclusive plans and specifications, obtained NCDOH approval, provided construction administration and oversight services.

General Consulting Services – Mr. Boyce attended Board of Directors meetings to present monthly engineering report, assist with hydrogeological issues, contaminant fate and transport concerns, well maintenance, water main rehabilitation, etc.

Hampton Bays Water District, Suffolk, NY

Well Field Construction & Integration – Mr. Boyce prepared the structural, mechanical, and electrical designs for a new well field including two pump stations. In addition to construction plans and specifications, Mr. Boyce oversaw the integration of a new well field with an existing distribution system via hydraulic analyses and guided the client through the regulatory agency review and approval process. In a subsequent project phase, he partook in creating the layout of several residential water main projects, for which he analyzed the proposed water main layouts and prepared conceptual designs based on Health Department and ISO requirements.

Caustic Feed Systems Design - Mr. Boyce was responsible for the design of caustic feed systems at all eight District supply wells. He prepared existing conditions drawings by conducting field visits to obtain the necessary information. He then designed caustic feed systems consisting of double-walled underground storage tanks, piping, metering pumps, safety interlocks, controls, alarms and injection equipment to raise the ambient pH of the groundwater withdrawn from the shallow aquifer system to between seven and eight and a half. He was responsible for preparing plans and specifications, obtaining Health Department approval, and then overseeing the construction administration and observation aspects of the project.

Isolated Pressure Zone Design - Mr. Boyce was responsible for designing an isolated pressure zone in an area that was experiencing chronic low-pressure conditions within the District's distribution system. He worked with existing distribution system maps and survey data to identify the boundaries of the proposed zone, he worked with available hydraulic data to estimate pressure conditions and developed a planned approach on how to isolate the zone and create a booster pumping station to raise pressures within the zone to acceptable levels. Mr. Boyce was responsible for preparing the project plans and specifications that included a new packaged booster pumping station, water main and valve work, electrical service and site work. The SCDHS approved the plans and the pressure zones were constructed closely to his design and construction cost estimate.

Good Samaritan Hospital, West Islip NY

Well Turbidity Study – After review of existing water quality data, Mr. Boyce recommended sampling and analyses for additional parameters. He applied a water quality model, using the existing raw water quality data. To achieve optimal water quality pH-level, hardness, and alkalinity, he performed trial and error solutions using a numerical model. Different treatment chemicals were included in the model in various combinations or by themselves. Concluding modeling efforts led to a realistic chemical concentration.

Copper & Lead Desktop Study – The results of the study Mr. Boyce performed served to identify the possible cases for turbid water condition and proposing alternative options for corrective actions to restore acceptable water quality. He presented each alternative for evaluation and comparison to determine most advantageous choice, based on potential for success, technical complexity, and cost. In addition, he prepared a treatment specification and coordinated with an experienced well driller, resulting in a successful chemical treatment, and restoration of the water quality to acceptable conditions.

Town of Oyster Bay, Syosset, NY

Potable Water Supply System Upgrade Design & Compliance Management Services – As Project Manager, Mr. Boyce coordinates inspection and assessment services for the town's Tobay Beach Park & Marina potable water supply system. PWGC focuses on the water supply system's status of compliance with NYSDOH, NCDOH, 10-State Standards, and provides feasible engineering designs to in response to the town's objectives: Safe, potable water for Tobay Beach patrons, in an economically sound fashion. Mr. Boyce managed the authoring of a feasibility report and selected/recommended minimum corrections and system upgrades. In addition, he prepared the design of a dry-briquette calcium hypochlorite chlorination system and other upgrades at Well House 3 of the Tobay Beach Park & Marina. To date, he continues to provide engineering services and design specifications for wellhead improvements. He also directs PWGC water quality monitoring and assessment services at the beach to determine compliance with local and state health department water quality and equipment guidance.

Civil Site

Three Mile Harbor Boat Yard, East Hampton, NY

Site Planning Analysis – After evaluating site conditions, Mr. Boyce recommended feasible improvements to enhance an existing boat yard facility. He investigated local zoning/building codes, sized/located sanitary facilities, sized/designed layout and arrangement of parking facilities, sized/located/orientated a new proposed structure to house a marine shop, offices, storage, and industrial space. He effectively addressed critical issues such as the site's location in a harbor protection area and no public water access, which put severe constraints on sizing and locating the sanitary facilities. He prepared plans and reports delineating suitable site alternatives and requirements for implementation in compliance with regulatory agencies and utility companies.

Inlet Seafood, East Hampton, NY

Site Plan Application - As senior engineer, Mr. Boyce designed and coordinated the preparation of site-plan application drawings for the commercial/industrial fishing marina looking to expand the site from a commercial to a multiple use area that included retail, restaurant, and commercial fishing. He managed civil/site concerns, which included grading, drainage, sanitary, water supply, utilities, parking, traffic controls, site lighting, and building locations/elevations. Mr. Boyce worked with the owners and other project consultants to conceptualize and plan the site layout for optimum use and compliance with local zoning and building codes. In addition, he prepared site-plan application drawings for the Town Planning Board and local regulatory

agencies. He supervised development of designs and bidding/construction documents for new water mains/services/flow meters, hydrants, and drinking water fountains. Mr. Boyce oversaw construction, and supervised wetlands delineation and permitting with the NYSDEC through to project completion.

Jay Construction Corp, NY
Pile Foundation Designs for Residential Homes - Mr. Boyce was responsible for designing foundations for four residential homes in Patchogue, New York. The design included investigating existing soil conditions, reviewing architectural plans, sizing piles based on soil conditions, locating piles based on architectural layout, determining number of piles based on loads including self-weight, building dead, live, snow and wind load, and worst-case combination of loads based on building code. He created designs for reinforced concrete pile caps in accordance with ACI requirements and created foundation walls to serve as grade beams between pile caps. In addition, Mr. Boyce prepared construction documents including plans and specifications and acted as the primary client contact throughout the project.

Times Square Construction, New York, NY
Geotechnical Report for 47 East 34th Street Building Construction – Mr. Boyce oversaw a rock core boring program, characterized rock core samples and developed a geotechnical report based upon findings of the rock core boring program. He provided foundation recommendations for a new 38 story residential building being erected upon Manhattan schist on the east side of midtown Manhattan. Mr. Boyce assisted with the rock anchor design and specification. He supervised and managed field observation services for rock anchor testing. Supervised and managed the September 2007 design and development of a foundation waterproofing system.

Storm Water Management

Benjamin Beechwood, LLC, Arverne Urban Renewal Area (URA), Far Rockaway, NY
Design/Engineering Management Services, Stormwater Collection & Conveyance System - Mr. Boyce managed the design and siting of a stormwater collection and conveyance system for an 80+ acre development along the south shore of Queens County. He coordinated catch basins locating, grading design, sizing interconnected piping networks and tie-ins with the local NYC storm sewer system. Mr. Boyce was also responsible for incorporating BMP's in the system design.
Stormwater Quality Impact Assessment on Local Surface Water Body - Mr. Boyce was responsible for determining stormwater roadway run-off concentrations for TPH's, suspended solids, metals, coli forms, pH, and dissolved oxygen. To estimate the influence of these parameters on the nearby canal basins into which they were to be discharged, he employed chemical and mathematical relations using chemical properties and mass balances based on flow rates and tidal flushing volumes to estimate potential effects. Subsequently, he assisted in preparing the stormwater portion section of a Draft Environmental Impact Statement.

NYSDOT, Kensico Reservoir Route, Westchester, NY
120 Expansion Stormwater Management System Stormwater Quality Pre-Construction Baseline Assessment – Mr. Boyce directed the roadway run-off sampling of 15 storm events and 5 outfalls along the Reservoir. He oversaw installation of automated sampling equipment to monitor weather conditions, sampling events, and system/statistical data analyses for a stormwater-runoff quality report.

Allied Aviation Services, LaGuardia Airport, NY
Storm water Sediment & pH Control Investigation, LaGuardia Airport, Queens, NY – Mr. Boyce was responsible for reviewing and investigating an ongoing problem of storm water discharge to a surface water body with a too high solids content level. Storm water runoff collected at the fuel tank farm for LGA is passed through a treatment system to remove oils and organic contaminants. Under severe rainfall events, the treated storm water effluent had been discharged to the adjacent harbor with unusually high amounts of suspended solids, which were temporary violations of the facility's State Pollutant Discharge Elimination System permit. To find a cost-effective solution for the continuing problem, he evaluated various alternatives from in line cartridge filters, to settling tanks, to storm drain separators. Aside from cost, he considered other restrictions, such as limited space for installation, maintenance, durability, and reliability. Mr. Boyce studied peak hydrologic events and recommended the most efficient and effective treatment option for the owner to implement. Elevated pH of the discharged treated storm water effluent presented an unexpected, and separate, water quality issue. In addition, he was responsible for investigating the cause of the problem and recommending a course of corrective action.

AIL Systems Inc, Deer Park, NY
Recharge Basin Size Analysis – To assess the feasibility of reclaiming land used for recharge purposes, to sell or alter its land use, Mr. Boyce analyzed the industrial facility's existing cooling water recharge system. His analysis included an investigation of the facility's hydrological and drainage characteristics, and the existing storm water handling facilities' capability to accommodate various storm events. Mr. Boyce reviewed local building codes to make sure any proposed alterations could handle the minimum required storm events. He investigated the cooling water discharge rates to the recharge basins, to determine how much of the existing basins were required to handle the cooling water. With his report, AIL Systems was able to effectively evaluate its real estate options.

Groundwater Remediation

Brookhaven National Laboratory, Upton, NY

Engineering Services for the Glass Holes & Animal Chemical Pits CERCLA Remedial Excavation - Mr. Boyce prepared the excavation plan and design drawings for a remedial excavation of over 50 individual waste pits at the client's site. He managed the waste pits' initial delineation, oversaw the geophysical survey using electromagnetic survey equipment, and prepared the excavation plan detailing technical guidelines for the hazardous waste site's remediation. The plan provided direction for the removal/recovery of organic, inorganic, biological and radioactive buried wastes, as well as explosive, reactive, and corrosive materials. His engineering drawings detailed excavation layout, work/stockpiling areas, grading, drainage, haul routes, utilities, and site restoration. He acted as a field engineer during the field operations, oversaw excavation/waste removal, stockpiling, characterization and segregation of excavated materials, and monitored daily logistics for field crews.

Mercury-Contaminated Soil Treatment Alternatives Evaluation Report - Mr. Boyce's report evaluated various appropriate remedial treatment technologies, including visual and technical system descriptions, a comparison study of each alternative's technology, treatment process efficiency in the types, quantities and concentrations of mercury present in the soil, as well as the overall economics and cost effectiveness. He called attention to the presence of other contaminants such as organics and radioactive parameters and studied the available technologies. He also presented recommendations for a soil stabilization process and options for the remediated soil's disposal.

OUIII Western South Boundary Remedial System Design - Mr. Boyce was responsible for assisting in selecting the appropriate remedial technology for a groundwater pump treatment system for a volatile organic contaminant plume clean up. He suggested appropriate technologies and reviewed them from a feasibility standpoint. He recommended the most applicable one, based on effectiveness, available capital and O&M costs, implementation, reliability, operation, and maintenance. Mr. Boyce was then responsible for preparing a portion of the design of the recommended treatment technology, which included sizing and optimizing the primary treatment equipment (4-foot diameter x 35-foot tall air stripping tower).

Ash Pits Capping –Mr. Boyce was responsible for preparing the design of a capping system for an area formerly used as incinerator ash repository. He conducted the initial investigation to assess the area's extent by reviewing old aerial photographs, digging test pits, and conducting interviews with BNL personnel. Once he had delineated and surveyed the area, Mr. Boyce designed a soil-cap cover system in accordance with NYSDEC regulations to prevent surface exposure to ash and to minimize rainfall infiltration through the area. He was responsible for repairing design/construction drawings that included grading, drainage, slope stabilization details, limits of clearing and coverage and site restoration work such as fencing, roadways, signage, etc.

Minmilt Realty, Farmingdale NY

Groundwater & Soil Remediation Systems Design - Mr. Boyce evaluated, selected and designed appropriate remediation systems to cleanup a large industrial solvent plume that had contaminated nearby soil and groundwater. The chosen groundwater remediation consisted of an air-stripping tower, granular activated carbon (GAC) filters for off gas treatment and recharge structures; the soil treatment system was a soil-vapor extraction system (SVE) and GAC filters. Mr. Boyce's design responsibilities included sizing and selecting remediation system equipment, structural, mechanical, electrical, hydraulic, well, controls and instrumentation design. Mr. Boyce also performed three-dimensional numerical groundwater modeling to evaluate the effectiveness of the proposed groundwater remediation system and to size and locate a series of deep and shallow wells. Mr. Boyce prepared plans and specifications, a technical report for the NYSDEC detailing the choice of the specific components overall design process. He was involved in the construction administration and oversight of the remediation systems and was responsible for reviewing and approving shop drawings and performing routine construction observation services.

Brentwood Water District (BWD) Air Stripper, Plant No. 2, Brentwood, NY

Treatment Alternatives Study & System Design – As Project Engineer, Mr. Boyce conducted the treatment alternatives study for a VOC contaminated well field at BWD. The study ultimately recommended air stripping as the most effective and cost efficient technology to treat groundwater withdrawn from Plant No. 2. Upon the study's completion and acceptance, he prepared the design for the treatment system, which encompassed mechanical, electrical, structural, hydraulic, architectural and site components. Specific design components included an 11′ diameter by 30′ packed bed depth aluminum air stripper, a 100,000-gallon ground storage clearwell, and booster pumps. Specific design aspects include restaging an existing well pump, electrical service upgrade, a new natural gas engine generator set, stripping tower enclosure and three existing pumping stations refinish. Mr. Boyce prepared the plans and specifications, which were approved by the SCDHS and ultimately used to construct the air stripper and related facilities. Following the design phase of the project Mr. Boyce was responsible for providing construction administration and observation services.

Nitrate Study & Analysis - Mr. Boyce prepared a statistical analysis to compare increasing groundwater nitrate concentrations with pumpage from Plant No. 2 of the BWD. The analysis involved compiling water quality data to measure levels in three wells of Plant No. 2, reviewing the data, and using statistical methods to forecast the water quality of pumpage from the aquifers utilized by the BWD. He superimposed pumpage data from Plant No. 2 over his water quality findings to create a trend analysis, which showed nitrate concentrations fluctuated in the different wells based on pumpage. Mr. Boyce recommended available treatment technologies which eventually would be necessary to slow the deterioration rate of water quality caused by nitrate level changes. He advised that, based on the statistical analysis, establishing pumping sequences would slow the rate of water quality deterioration. His report also included estimates for when treatment of nitrate will become necessary and appropriate treatment technologies available.

Roanoke Sand & Gravel, Mid Island, NY
Sand Mining Design and Permitting – As the primary client contact, Mr. Boyce oversaw the application submittal to the Town of Brookhaven and NYSDEC to expand mining operations at an existing sand and gravel mine. The scope of services included assembling engineering drawings for proposed mining operations by excavating deeper through the bottom; preparing an engineering report addressing environmental, geotechnical and hydrogeological issues; preparing volume estimates to determine how much more sand and gravel could be mined by expanding the operations at the existing site and acting as regulatory liaison for the client.

PUBLICATIONS

- Not Just a Chemical Interaction: Complementary Roles of Geologist & Engineer on a Hazardous Waste Remediation Project at BNL (5th Conference: Metropolitan & Long Island Association of Prof'l Geologists (M/LIPAG, 04/98, SUNY Stony Brook)
- Much Ado About Mercury: Evaluation of Treatment Options for Mercury Contaminated Soil at Brookhaven Nat'l Laboratory (BNL) (6th Conference, M/LIPAG, 04/99, SUNY Stony Brook)
- Open-Loop Geothermal Well Systems on Long Island (10th Conference, M/LIPAG, 04/03, SUNY Stony Brook)

James Rhodes, PG • COO

PROFESSIONAL EXPERIENCE
PWGC: 27 years
PRIOR: 5 years

AREAS OF EXPERTISE
Brownfields/Redevelopment Management
Environmental Compliance Management
Property/Real Estate Due Diligence Expert – Transaction & Environmental
Site Assessment & Reuse Analysis
Environmental & Remedial Investigations - Soil/Groundwater and Air Quality

EDUCATION & TRAINING/CERTIFICATION
MS, Earth Science/Hydrogeology, Adelphi University, NY
BS, Geology, SUNY Oneonta, NY
Executive Education (ACEC)
Leading Professional Service Firms - Harvard Business School
Licensed Professional Geologist - NYS
Phase I Environmental Inspector - Environmental Assessment Association
Professional Geologist - American Institute of Professional Geologists
Licensed Real Estate Salesperson - NY
OSHA HAZWOPER 40-hr.

PROFILE
In 2017, James Rhodes was named PWGC's Chief Operating Officer. In this role Mr. Rhodes is responsible for the operations of the business, working in tandem with the CEO and President. Roles will vary by industry but they will typically be involved in day every-day management, particularly business strategy, business planning and monitoring business performance. The COO provides leadership, management and vision necessary to ensure that the firm has the proper operational controls, administrate and reporting procedures and people systems in place to effectively grow the organization and ensure financial strength and operating efficiency. The position accomplishes this through respectful, constructive and energetic communications styles guided by the objectives of the company.

Prior to his promotion, Mr. Rhodes led PWGC's Environmental Unit. There he utilized his 30 years' experience as an expert in managing environmental concerns unique to the real estate market, serving public and private sectors. Through his tenure he has provided guidance to associates and clients, maintains established working relationships with regulators at multiple levels of government. His expertise enables clear communication on project requirements and speeds the approval process.

Mr. Rhodes' expertise in environmental remediation and redevelopment fields includes environmental site assessments (ESA), such as Phase I/II ESAs, RI/FS, NYS Brownfield studies, NYC "E" Designation Program, and cost to cure estimates for real estate tax purposes. His experience with soil and groundwater investigations, air quality studies and remedial measures has benefitted clients that include attorneys and developers, insurance companies and municipal agencies. His resourcefulness to pinpoint key environmental concerns quickly helps avoid unexpected delays and cost overruns, benefitting the client.

NOTABLE PROJECTS
PWGC Environmental Real Estate Sector Services
Phase I & Phase II Environmental Site Assessment (ESA) Management – As Program Director for Property Transactions & Real Estate Environmental Management Services & Support for PWGC, Rhodes oversees Phase I & II ESA planning, implementation and completion. He ensures that each ESA is tailored to client needs and long-term goals. For each project, a targeted scope of work and relevant documentation is prepared for clients to allow them to make cost-effective business decisions. PWGC typically performs more than 60 Phase I & Phase II ESA's annually with clients that include attorneys, lending institutions and municipalities. Given his experience, Rhodes provides clients workable environmental solutions for real estate issues. Under his management, PWGC Phase I/II reports are recognized by peers and clients for effectively utilizing escrow agreements, environmental insurance and cost-to-cure estimates. Mr. Rhodes acts as the Project Director for these projects and is the main liaison with the SCDHS. As part of his duties, Mr. Rhodes participated in meetings with the New York State Department of Environmental Conservation and collaborated with SCDHS to streamline the brownfield restoration process.

Garvies' Point Redevelopment Project
RXR-Glen-Isle Partners, LLC – Mr. Rhodes has been acting as project director overseeing numerous environmental consulting programs for this major waterfront redevelopment project in the City of Glen Cove. PWGC was brought into the project to perform full spectrum environmental due diligence services for the waterfront area when RXR Realty, LLC entered into the project. The waterfront area includes sites in both the New York State and Federal Superfund programs - including the Li

Tungsten and Captain's Cove sites - and the initial due diligence services, which focused on current remedial status and what needed to be completed in order for the redevelopment to proceed. Over the last several years, PWGC has been working closely with the development team including RXR-Glen-Isle Partners, LLC, the City of Glen Cove, regulatory agencies including the NYSDEC, NYSDOH, NCDH, and USEPA to move the project toward redevelopment. Towards this goal, PWGC continues to work with and coordinate services of other consultants to obtain the necessary information to allow the project to proceed. To accomplish this goal, PWGC has prepared numerous plans and reports including a work plan to address data gaps throughout the multiple parcels along the waterfront. The subsurface investigation performed under this plan included more than 200 soil borings to fully characterize the site to eliminate data gaps, which will allow the project to obtain environmental insurance. PWGC has been involved in all aspects of environmental consulting on this project as it readies for redevelopment including evaluation of site specific soil cleanup objectives, SWPPP preparation and oversight, petroleum remediation oversight, radiological monitoring plan preparation, MARSSIM survey support services, building demolition support services, geotechnical support services, TOGS sampling support services, waste characterization and disposal oversight, and dredge spoil characterization and handling. Project related documents prepared by PWGC include the Data Gap Workplan and Report, Visual Stained Petroleum Soil Remediation Report, Synthetic Precipitation Leachate Procedure (SPLP)/Red Flag Area Characterization Plan and Report. Li Tungsten Existing Condition Report and Captains Cove Existing Condition Report. PWGC continues to provide field oversight services for all aspect of the project, including health and safety and community air monitoring services.

Bellport Gas Station-Bellport, NY
Brownfield's Consulting Support Services – This Suffolk County Brownfields site is currently in the New York State Department of Environmental Conservation (NYSDEC) Environmental Restoration Program. Mr. Rhodes oversaw the preparation of a remedial investigation work plan and the Remedial Investigation/Alternative Analysis report. In addition, an Interim Remedial Measure was performed and a final Remedial Action Plan with NYSDEC was negotiated. He submitted a final site management plan with an environmental easement. The site has been remediated and PWGC continues to monitor the site as required.

Avalon Bay Communities - Rockville Center, NY
Brownfields Project Management -& Planning – As project director, Mr. Rhodes provided technical support and acted as a liaison between the New York State Department of Environmental Conservation (NYSDEC), the Village of Rockville Centre, the site's previous owner and new owner, Avalon Bay Communities. He was an advocate for Avalon Bay's needs and goals to redevelop the former industrial site as residential in meetings with NYSDEC and collaborated with the client and project team to develop the most effective strategy to streamline the project's representation with the state under the BCP program. Mr. Rhodes provided invaluable guidance in regard to the project's scope of work and documentation preparation, which included work plans, sampling and RI reporting. He was instrumental in obtaining all permits to complete the IRM work plan as well as throughout the performance of the IRM. The site then went to final remedial action work plan, design and oversight of final remediation, completion of site management plan and easement, which was first project of its type on Long Island to obtain COC and was a winner of ACEC Diamond Award for engineering excellence.

Expeditors c/o Cargo Ventures LLC - Inwood, NY
Environmental Site Assessment, Remediation, & Redevelopment – Mr. Rhodes supervised the investigation, remediation and redevelopment of a New York State Department of Environmental Conservation (NYSDEC) designated spill site on 4.25 acres at a former Shell Oil terminal located along Negro Bar Channel in Inwood, NY. As part of this multifaceted project,

Suffolk County Department of Health Services (SCDHS)
Brownfield Program Engineering Consulting Services Agreement – Through a competitive bidding process, PWGC was chosen by SCDHS as its engineering consultant related to County-owned Brownfield sites. Currently, PWGC is working on five sites for SCDHS in various stages of the Brownfield Cleanup Program (BCP). These sites are in both the municipal Environmental Restoration Program (ERP) and BCP in situations where the county assumed responsibility for the site. PWGC prepared a Phase I Environmental Site Assessment and documented historic environmental work performed at the site to satisfy requirements from associated lending institutions. Rhodes oversaw the completion of a subsurface investigation to determine site conditions to prepare appropriate NYSDEC-approved Corrective and Remedial Action Plans. Further, he oversaw the removal of petroleum-impacted soils, which resulted in an excavation measuring 60,000 square feet and more than 40,000 tons of impacted soils processed.

Benjamin Beechwood, LLC, Arverne Urban Renewal Area (URA) - Far Rockaway, NY
Consulting Services, Multi-Site Phase II Planning & Management – As project director, Mr. Rhodes collaborated with representatives from Benjamin Beechwood, LLC and served as liaison to the New York City Departments of Environmental Protection (NYCDEP) and Housing Preservation and Development (HPD) effectively advocating for their project goals. He supervised environmental due diligence for the development of the site – measuring 25 city blocks wide – and prepared the scope of work for a multi-site Phase II investigation. The result was incorporated into project documents along with work plans, health and safety plans, special area management, and submitted to NYCDEP and HPD. Once approved, Rhodes coordinated with NYCDEP on extensive geophysical and geo-probe investigations, test pits and soil pile characterizations. He directed the multi-faceted project, with tank removals and NYSDEC spill closures, successfully clearing the way for the area's redevelopment and revitalization.

Town of Babylon - Wyandanch, NY
Phase II Site Investigation & Redevelopment – Mr. Rhodes worked with the Town of Babylon's Community Development Agency and private interests, which resulted in the first new supermarket built in the hamlet of Wyandanch in more than 20 years. Rhodes developed a soil and groundwater investigation scope that revealed low tetrachloroethane (PCE) levels in the soil and

higher levels in the groundwater generated by a dry cleaner formerly located at the site. Rhodes documented the PCE was degrading naturally and only low-impact levels were migrating off-site. To determine the off-site plumes' real and potential effect, PWGC conducted an extensive well survey down-gradient of the property to identify potential receptors of the off-site groundwater contamination. The results prompted the Town of Babylon to connect potentially affected residences to public water, safeguarding the contaminant pathway and clearing the site for redevelopment.

Groundwater Specialists, Inc. - Ronkonkoma, NY
QA/QC for Phase I & II Engineering Oversight Services – To assure quality of the remedial investigation, Mr. Rhodes reviewed the proposed work plan, analyses; progress and activities monitoring for the soil-boring program; monitoring well installation; groundwater sampling; and spot-checking of field records. He further reviewed the third party's data evaluation, risk assessment, draft report, and results' documentation to assure completeness and rationality; and assisted the client with the sealing of the final report upon approval.

Village of Lindenhurst – Lindenhurst, NY
Environmental Site Assessment for Property Redevelopment – Mr. Rhodes acted as liaison between Village of Lindenhurst officials and the Suffolk County Department of Health Services (SCDHS) representatives during the environmental assessment facet of a condemnation proceeding ordered by the Village as part of the site's proposed redevelopment into a court complex. Faced with access issues during the initial Phase I and II, PWGC collected enough evidence for SCDHS to obtain a court order for gaining entry to the property. Working in conjunction with the SCDHS, Mr. Rhodes finalized a scope of work and tasks, divided between PWGC and SCDHS personnel. Information collected in the joint venture documented the site's environmental integrity allowing for formulating the proper remedial action plan.

Krumenacker Florist and Nursery - Amityville, NY
Phase II Investigation & Site Remediation – After reviewing an existing Phase I report, Mr. Rhodes performed a Phase II investigation and site remediation to bring the facility into regulatory compliance and clear the path for future development. The Phase II strategy focused on specific areas of concern that could negatively affect the client in the form of greater expense and unexpected delays. The environmental concerns focused on an existing Class V Underground Injection Control Well, underground gasoline storage tanks, potential environmental assessment format issues and impacted soils beneath the former greenhouse. During the greenhouse demolition, Rhodes met with regulatory agencies to ensure that on-going soil sampling and health and safety measures met regulatory requirements.

New York City "E" Designation and Voluntary Cleanup Program (VCP)
In response to the rezoning activities in New York City, its Office of Environmental Remediation (NYCOER) oversees environmental investigation and remediation at suspect sites prior to redevelopment. Rhodes develops scopes of work for environmental investigation required to redevelop the "E" designated property. He oversees Phase I & II work plans, Health and Safety Plan and Construction Health and Safety Plan, which NYCOER must approve prior to the start of work. To assess the soil quality he coordinates and oversees subsurface investigations, including geophysical surveys and soil and groundwater sampling programs. Based on the findings, Rhodes develops and implements remedial strategies and prepares Remedial Action Plans for NYCOER approval. Rhodes provides technical oversight and support on vapor intrusion mitigation, such as vapor barriers and sub–slab depressurization systems, and is experienced with New York State Department of Health requirements on evaluating soil vapor intrusions.
Current NYCOER VCP projects Mr. Rhodes is overseeing include a nine-story affordable housing development for Phipps Houses and a 12-story residential complex in Harlem, NY for HAP Investment Developers, which also includes an affordable housing component.
Mr. Rhodes is also currently overseeing sites within the NYCOER "E" Program. He is working with Bizzi & Partners Development, LLC, in NYC's SoHo location, which will be redeveloped into a 25-story, mixed-use, high-end residential building. And in Long Island City, Mr. Rhodes is working with the Lightstone Group on the redevelopment of a former taxi site, which is being developed into a 10-story mixed-use facility.

Sive, Paget & Riesel, PC (SPR) - New York, NY
Expert Evaluation & Analysis, Carnegie Hill, New York, NY – The law firm of Sive, Paget & Riesel, PC contracted Rhodes to provide an environmental engineering evaluation to determine the source of petroleum contamination in a commercial corridor. A previous investigation conducted by the New York State Department of Environmental Conservation (NYSDEC) contractor identified SPR's client as the responsible party for an oil spill negatively affecting an adjacent building. He used the evaluation of previous reports, proper closure of a 10,000 gallon underground storage tank (UST), and cross match analysis of fuel oil to compare chemical fingerprints of several sources. PWGC prepared a comprehensive project document to illustrate hydrogeologic cross sections, a study of the bedrock, UST construction details, hydrographs and photos. The comprehensive document ultimately proved favorable for the client.

Baumann Bus site, Francis S. Gabreski Airport – Westhampton Beach, NY
UIC Investigation/Remediation – Through New York State's "Rebuild Now" Program, Mr. Rhodes oversaw the investigation/remediation for Underground Injection Control (UIC) sites on 58 acres at Suffolk County's Francis S. Grabreski Airport, a 1,500 acre former US Air Force base in Westhampton. A 2004 site investigation revealed elevated levels of semi-volatile organic compounds. Through analysis of historical maps and geophysical methods, a remedial work plan was prepared for the site to properly locate, characterize and close more than 100 UIC sites. Mr. Rhodes provided technical support to verify protocols on local, state and federal levels, corresponded with the County to negotiate the scope of work, provided quality assurance and verified that all work was done in accordance associated guidelines permitting site redevelopment. PWGC's efforts included a supplemental remedial investigation, final remedial design and preparation of a site management plan and

post remedial monitoring, which is allowing for the development of the Hampton Business District business park by Plainview, NY-based Rechler Equities.

In addition to be UIC work, Mr. Rhodes oversaw remediation efforts at Gabreski associated with the Suffolk County Department of Health Services Brownfield Program, which is administered by PWGC. Other projects successfully completed by Mr. Rhodes and PWGC, or nearing completion, under the Brownfield Program include the Blue Point Laundry site in Blue Point, the Canine Kennel at Gabreski Airport and the Ronkonkoma Wallpaper site in Ronkonkoma.

Jain Center of America - Lake Success, NY
Sub-Surface Investigation Review - Mr. Rhodes reviewed a subsurface investigation of a former gasoline station. While adhering to Village of Lake Success requirements to address past environmental problems at the site, he supported client efforts to obtain construction approval for the property. As part of the SEQRA review process, the Village required the client perform a subsurface investigation. After a review of Nassau County records, Mr. Rhodes discovered an open UIC file resulting from an acceptable endpoint result having not been obtained. He designed a subsurface investigation to address the UIC issue, the former gasoline spill, a sanitary system at the site, and other environmental concerns resulting in an expedited review process.

Penetrex Processing, Glenwood Landing - New York
Subsurface Investigation, NYS Class II Inactive Hazardous Waste Site – As project principal, Mr. Rhodes lead the investigation of an inactive hazardous waste site in accordance with a New York State Department of Environmental Conservation (NYSDEC)-approved work plan, which included sub-slab vapor and indoor air sampling and a sub-slab depressurization system. In addition, he oversaw the preparation of a feasibility study for the site that NYSDEC used to prepare a proposed remedial action plan, which lead to a Record of Decision.

Allstate Insurance Services - Hauppauge, NY
Spill Site Project Management – Mr. Rhodes oversees multiple residential fuel oil spills a year in New York City, Westchester, Nassau, and Suffolk Counties and Upstate New York on behalf of Allstate Insurance Services. He directs PWGC's Allstate team in providing technical oversight to document that spill remediation performed by the homeowner's contractor sufficiently addresses the contamination present and to achieve closure by the New York State Department of Environmental Conservation (NYSDEC). He ensures professional representation at all levels, and coordination with the NYSDEC and the environmental contractor. PWGC addresses all spills in a timely fashion, effectively reducing or eliminating Allstate's liability in such cases.

Sub-Surface Investigation Management & Client Representation Texaco Station, NY – Mr. Rhodes reviewed and supervised a sub-surface investigation to determine whether two underground storage tanks at a Texaco gas station were the potential source of soil and groundwater contamination under remediation at the time. He reviewed existing site data and supervised a subsurface investigation to determine the responsible party. The investigation showed the two storage tanks were not the source of contamination and that the current remediation system appeared ineffective.

Water Authority of Great Neck North - Great Neck NY
Groundwater Study – As project manager, Mr. Rhodes directed multiple studies using groundwater models in conjunction with the Nassau County Department of Public Works, to evaluate the pumpage of Great Neck's public water supply wells for potential for saltwater intrusion to determine the most favorable locations for a proposed well field. Rhodes used the results to prepare an aquifer management plan (AMP) for the authority that described short-term and long-term pumping scenarios. By following the AMP, the Authority has indicated the advancement of multiple saltwater wedges has slowed and/or ceased. He also prepared the water supply application and engineering report for the installation of new wells located off of the Great Neck Peninsula, which was part of the Authority's long term plans contained in the AMP.

John deCuevas, et al. v. East Hampton Golf Club, LLC, et al – East Hampton, NY
Expert Evaluation – Mr. Rhodes conducted an investigation to assess the potential environmental impact of a golf course development on the groundwater resource and to provide testimony on behalf of John DeCuevas. He researched and evaluated the hydrogeologic characteristic beneath the site, local groundwater quality concerns and potential chemical usage of the future golf course. The evaluation identified the potential for groundwater impact and the threat to nearby private drinking water wells from the proposed development. The findings prompted the two parties to agree on the development of a groundwater monitoring program to protect the private wells. Further, the golf course implemented an Integrated Pest Management program to control chemical use at the site. After developing the monitoring program that includes two wells required by Suffolk County Department of Health Services (SCDHS), Rhodes reviewed the data to determine if impacts had occurred and submitted his findings with SCDHS for incorporation in the county's database.

Fong and Wong, PC - New York, NY
New Best Cleaners & Tailors, Inc., Centereach, NY, Environmental Investigation & Remediation – He provided professional consulting services and expert testimony for the attorney who represented the site lessee in litigation with the property owner over the environmental condition and a lease buy-out agreement. He oversaw the soil and groundwater study to evaluate potential impacts and determine multiple sources of contamination, and remediation of sources associated with the dry cleaners, and participated in an on-site meeting with the presiding judge to demonstrate the conditions at the site first hand.

Minmilt Realty - East Farmingdale, NY
Remedial Project Management - As field manager, Mr. Rhodes coordinated a full remedial investigation and provided technical direction during the installation of a deep monitoring well - 180 feet - and defined the vertical extent of contamination and

hydrophobic dyes to determine the movement of dense non-aqueous phase liquids (DNAPL) using groundwater quality screening. He prepared the RI/FS report and oversaw the operation and maintenance of the system.

Computer Circuits - Hauppauge, NY
Remedial Investigation and Feasibility Study (RI/FS) – Mr. Rhodes was a project director for a characterization of a contamination's nature and extent at the former Computer Circuits industrial site, a US Environmental Protection Agency Superfund Site. He coordinated the use of multiple geophysical techniques to determine if unknown buried objects such as drums, tanks, or leaching structures existed. Techniques employed during the course of the project were interior/exterior soil borings, multiple drilling/probe methods, EnCore™ sampler, to preserve VOC sample integrity, and off-site groundwater vertical profile sampling to depths in excess of 200 feet below grade. PWGC utilized an on-site laboratory grade gas chromatograph to screen both soil and groundwater samples and followed New York State Department of Environmental Conservation procedures during the investigation.

Brookhaven National Laboratory - Upton, NY
Major Cesspools Closure – Mr. Rhodes coordinated sampling efforts to comply with the EPA and States regulated UIC program for the closure. He monitored closely the full ASP-B protocol and, after analysis of laboratory data, submitted reports to the client.

Village of Sands Point, NY
Hydrogeologic Investigation – To assess the impact of proposed irrigation wells on the surrounding area, Mr. Rhodes determined the potential screen zones of the wells, considered potentially vulnerable to salt water intrusion. In addition, he assessed the impact on nearby public supply wells operated by the Village.

PUBLICATIONS & PRESENTATIONS

The Significance of the New Brownfields Legislation (NY Real Estate Journal, 03/04; Business Industry Connection (BIC), 03/04 issue)

Brownfields: Timing is Everything (Empire State Report, 09/2004)

Watershed Strategy & Management as a Most Valuable Resource (Watershed Conference, 1996)

Watershed Management for a Limited Coastal Aquifer System (North American Water and Environment Congress '96)

Andrew Lockwood, PG, LEP •

SR. VICE PRESIDENT

PROFESSIONAL EXPERIENCE

PWGC: 15 years
PRIOR: 17 years

AREAS OF EXPERTISE

Phase I and Phase II Environmental Site Assessments
PFAS and other emerging contaminants
Petroleum Spill site investigation/remediation
CERCLA sites
NYSDEC Brownfield Cleanup Program/Environmental Restoration Program
Environmental/Regulatory Compliance (Investigation/Remediation Mgmt)
Radiological Characterization & Remediation
Chemical, Radiological/Mixed Waste Management & Disposal
Groundwater Treatment System (Planning, Design, O&M)
Client Representation & Regulatory Liaison
Environmental Program Mgmt (Planning, Monitoring, Safety)

EDUCATION & TRAINING/CERTIFICATION

BA Geology, SUNY Potsdam, NY
Licensed Professional Geologist - NYS
Licensed Environmental Professional (LEP), State of Connecticut
"D&D of Research Reactors & Other Small Nuclear Facilities" Certificate (Argonne Nat'l Laboratory, 11/2001)
DOE Radiological Worker I & III
OSHA Health & Safety 40-hr, Supervision 8-hr
30-hr OSHA Construction Safety Training,2009
Advanced Radioactive Material Shipper Certification Training, 2004
Advanced Hazardous Waste Shipper Certification Training, 2004
ISOCS Measurements Using the Inspector, Canberra Industries, Inc, 1999
Groundwater Pollution & Hydrogeology, Princeton University, 1990
Project Leadership Course, PCI Global Inc., 2001

PROFILE

Mr. Lockwood specializes in planning and managing CERCLA/NYSDEC remedial investigations/Feasibility Studies, Phase I and Phase II ESAs, Brownfields Cleanup Program (BCP) projects, and nuclear facility decontamination & decommissioning (D&D). He has worked at numerous DOE and DOD facilities in more than a dozen states across the country managing remedial investigation/feasibility study projects involving the generation of radiological, hazardous and mixed waste. They include multi-year projects that involved complex investigations, remediation and waste management issues. Mr. Lockwood manages PWGCs environmental group, overseeing a staff of more than 30 professionals.

Mr. Lockwood has over 30 years of experience managing environmental investigation and remediation projects including CERCLA RI/FS sites, NYSDEC BCP sites, NYCDEP "E" sites, Municipal Landfill permitting and closure, and environmental investigations for real estate transactions. Mr. Lockwood's clients range from large governmental agencies to small real estate developers. He has performed work across the eastern United States under numerous federal, state, and local regulatory agencies.

NOTABLE PROJECTS

Suffolk County Fire Training Facility - Yaphank, NY—RI/FS

Mr. Lockwood manages the ongoing RI/FS for the Suffolk County fire training facility in Yaphank, NY. The 28-acre site is in the NYSDEC's inactive hazardous waste site program. The site was listed as a NYS Class 2 Inactive Hazardous Waste Disposal Site in August 2017. The primary contaminants of concern are in a class of chemicals referred to as per and poly fluoroalkyl substances (PFAS). The specific PFAS of interest are primarily perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA). The presence of these compounds is the result of the use of the Aqueous Film Forming Foam (AFFF) at the site. Mr. Lockwood was responsible for the preparation of the Citizens Participation Plan, Records Search Report, RI Work Plan, Quality Assurance Project Plan and Health and Safety Plan. The RI field work included delineation of PFAS in soil on-site and in groundwater both on and off site. In addition, site specific protection of groundwater soil cleanup objectives were calculated (no soil cleanup standards are available in NYS). PWGC is currently preparing a feasibility study with alternatives to address both soil and groundwater contamination at the site.

Wertheim National Wildlife Refuge - Shirley, NY—POET System Design and O&M
Three Point of Entry Treatment (POET) Systems were designed and installed at the refuge, one in a maintenance garage and two in residential buildings located within the refuge. The POET Systems were designed to remove per and poly fluoroalkyl substances (PFAS) that were detected in the groundwater supply wells servicing the three structures. Mr. Lockwood was responsible for the preparation of an Engineering Report and Operations and Maintenance Manuals for the systems. PWGC oversaw the installation and start up testing of the systems and is performing the scheduled system sampling to ensure that the systems are functioning as designed.

Carmans River - Shirley, NY—Surface Water and Biota Monitoring
Mr. Lockwood managed the investigation of per and poly fluoroalkyl substances (PFAS) in surface water and biota within the Carmans River and other water bodies within Suffolk County. Mr. Lockwood prepared a Biota Monitoring Work Plan/QAPP that included the collection of surface water and biota samples (eels, blue crabs, white perch, and clams) for PFAS analysis. He prepared a Biota Monitoring Report detailing the results of the investigation.

Gabreski Airport – Westhampton Beach, NY
Mr. Lockwood managed a field investigation to investigate the presence of per and poly fluoroalkyl substances (PFAS) in groundwater discovered during routine O&M monitoring of a NYSDEC BCP site. Vertical profile wells were installed upgradient and downgradient of the site. The Investigation is ongoing.

Brookhaven National Laboratory - Upton, NY
Mr. Lockwood served over 10 years as Project Manager on various CERCLA projects for BNL Environmental Restoration Division (ERD). He has managed diverse projects for BNL's Groundwater, Surface, and Reactor Groups. On his most recent projects for the Reactor Group, Mr. Lockwood provided project management services on four remediation projects over a 3-year period with budgets totaling more than 15 million dollars. In addition, he has prepared or assisted in the preparation of site-specific project documents such as work plans, sampling and analysis plans, quality assurance project plans, health and safety plans, records of decision (ROD), completion reports, final status surveys, remedial investigations (RI) and feasibility studies (FS). He has prepared contract documents, including request for proposals (RFP's), scopes of work (SOWs), and contract specifications for both large- and small-scale procurements and has acted as the technical representative on multiple contracts, ensuring the contract scope is being completed.

Mr. Lockwood combines his technical background with his in-depth knowledge of BNL's protocols and procedures to prepare schedules and cost estimates for baseline and fiscal year budgeting and tracking, provide short-term assistance to help BNL complete Baseline Change Proposals, and long-term assistance to manage remedial projects.

Project Manager- Fan Houses and Stack Silencer D&D, Underground Utilities Removal, Perimeter Area Soil Remediation Projects – Mr. Lockwood managed multiple remediation projects at BNL between 2008 and 2011. Project involved overseeing demolition of radiologically contaminated above ground and below ground structures, preparation of project documents including Remedial Action Work Plans, Sampling and Analysis Plans, and Completion Reports. The projects involved the disposition of complex waste streams. He was the primary interface with regulatory agencies and DOE. Mr. Lockwood was responsible for completing the projects on schedule and within the allocated budget. All projects were successfully completed.

Project Manager - Chemical Holes Remediation Project - Mr. Lockwood was involved with the Chemical Holes project since 1995. He served as the project Field Engineer performing and/or overseeing the characterization of the site including soil and groundwater sampling as well as geophysical surveys using EM-51, EM-61, Rapid Geophysical Surveyor (RGS) and multiple GPR surveys to locate the 55 individual waste pits. Pilot Testing for selected remedies was conducted and included in-situ vitrification, excavation, and containment using cement/polymer injection. He participated in the selected remedy, large-scale excavation and disposal, overseeing excavations of the waste pits at the site. He served as the Project Manager for the post-excavation characterization and disposal, wastes generated included mixed, waste, cylinders, liquid mixed waste, and mixed waste soil (mercury). More than 15,000 yd3 of waste was successfully transported for disposal and the site released with no radiological controls, he was responsible for the characterization, management, treatment, transport, and disposal of complex waste streams.

Project Manager - Former Hazardous Waste Management Facility Project - Utilizing his knowledge of chemical and radiological characterization, CERCLA, and DOE procedures and protocols, Mr. Lockwood managed the characterization, and implementation, of a remedial design at a 12-acre site formerly used as the primary facility for the storage, treatment, and packaging of hazardous, radioactive, and mixed waste at BNL. His responsibilities included the development of project plans, project scope and detailed schedule, resource needs and budget estimates. The project involved the characterization of buildings with both hazardous and radiological contamination, their D&D and transport and disposal to permitted facilities. In addition, characterization of the 12-acre facility was performed which included soil, groundwater and sediment sampling, at NYS delineated wetland located within the facility, for chemical and radiological contamination. A remedial design was prepared which included the excavation of approximately 11,000 yd3 of radiologically contaminated soil and sediment and the restoration of the site. As project manager, Mr. Lockwood was responsible for the daily management of this project including preparation of contract specifications, procurement documents and budget forecasting and management. He was responsible for the preparation or approval of all project documents from characterization, contracting, through implementation of the remedial action. Mr. Lockwood coordinated the successful completion of the project tasks overseeing subcontractors and support from other BNL divisions.

Project Engineer OU III Strontium-90 Pilot Study Design – Mr. Lockwood prepared a Pre-Design Characterization Work Plan to support the preparation of a Pilot Study Design for the remediation of Strontium-90 (sr-90) contaminated groundwater at BNL. Groundwater south of the former Chemical/Animal Pits had been impacted with sr-90 at concentrations exceeding NYSDEC groundwater standards. The purpose of the investigation was to delineate the concentrations within and extent of the sr-90 plume. Mr. Lockwood implemented
the plan prepared the Pre-Design Characterization Report, and participated in the successful completion of the Pilot Study, which led to the installation of a permanent remedy using resin vessels to remove sr-90 from the groundwater.

Special Projects Manager BNL Waste Management Facility - Mr. Lockwood provided technical services support to the BNL Environmental and Waste Management Services Division. His responsibilities included project planning and implementation of the characterization, packaging, and disposal unknown radioactive sources (including TRU Waste). Mr. Lockwood prepared technical work documents (TWDs) for the D&D of radiologically contaminated equipment including the Building 801 D-Tanks Pipe Removal project and the Building 865 Compactor Repair. He also prepared TWDs for the sampling of low level radioactive liquid wastes in the Bldg. 810/811 storage tanks. Mr. Lockwood prepared maintenance procedures for the facilities infrastructure. Mr. Lockwood prepared and implemented a TWD for the Central Steam Plant Outfall Soil Excavation, Transportation, and Disposal, including preparation of sampling plans, delineation of lead impacted soils, review of contractor deliverables and oversight of the excavation and performance of confirmatory sampling and reporting.

Field Engineer Brookhaven Linear Isotope Producer (BLIP) Investigation - The BLIP facility is used for the production of radio-isotopes used in the medical field. Targets are introduced into the beam line produced by a linear accelerator. The facility was constructed with an earthen beam stop. Mr. Lockwood participated in the preparation of a work plan to characterize the nature and extent of soil and groundwater contamination associated with the operation of the facility. Sodium-22 and tritium were identified as the primary contaminants of concern. The extent of the radiological contaminants was identified and a report detailing the results of the investigation prepared.

Field Engineer OU I Western South Boundary Groundwater Remediation System Design - Mr. Lockwood oversaw the implementation of the Characterization Work Plan installing temporary and permanent groundwater monitoring well points to delineate the extent of contamination within the Western South Boundary groundwater contamination plume at the BNL site. Mr. Lockwood oversaw the preparation of the Remedial Design Documents and construction of the groundwater treatment system identified in the design.

Field Engineer Magothy Characterization Project - Mr. Lockwood oversaw the implementation of the Characterization Work Plan installing temporary and permanent groundwater monitoring well points to delineate the extent of contamination within the Magothy aquifer beneath the BNL site.

Brownfield Cleanup (BCP)/Environmental Restoration Program (ERP)
Mr. Lockwood manages BCP and ERP projects for both private and municipal clients. He prepares applications, technical documents, and interfaces with NYSDEC project managers to ensure project schedule and scope meet NYSDEC's requirements for approval of incentives/reimbursements. These sites require preparation of BCP and ERP applications, technical work plans, RI reports, human health and ecological assessments, remedial alternatives reports (FS), citizens participation plans, public meetings and completion reports. Under contract with the Suffolk County department of Health Services (SCDHS) and the Department of Public Works (DPW), Mr. Lockwood assists the County in managing the technical aspects of County owned sites in the NYSDEC Brownfields Cleanup and Environmental Restoration Programs. These sites include former United State Air Force Disposal Sites and former industrial and gasoline service station sites which are currently vacant or unused because the redevelopment of the sites are hampered by historical site uses which have contaminated soil and groundwater.

New York City "E" Designation Sites
In response to the recent rezoning activities in NYC the NYC Department of Environmental Protection (NYCDEP) oversees environmental investigation and remediation at suspect sites prior to redevelopment. Mr. Lockwood develops scopes of work for environmental investigation required to redevelop the "E" designated property. He prepares work plans and HASP reports; which DEP must approve prior to the start of work. To assess the soil quality, he coordinates and oversees subsurface investigations (including geophysical surveys and soil and groundwater sampling programs). Based on the findings he develops and implements remedial strategies and prepares Remedial Action Plans for NYCDEP approval.

Phase I & Phase II Environmental Site Assessment (ESA)
Project Management – Mr. Lockwood managed Phase I & II ESA's preparation, implementation, and completion. Mr. Lockwood performs these services for a variety of clients including banks, developers and municipalities. For each project, he provides a customized scope of work and relevant documentation to provide clients with pertinent information. He performs Phase I & Phase II ESA's for private clients, environmental attorneys, municipalities, and lending institutions for use in property transactions according to ASTM Standards.

Lowe's Home Center
Mr. Lockwood manages Phase II environmental investigations and remediation for Lowe's Home Centers. Mr. Lockwood is one of a team of consultants who manages site development activities at properties identified by Lowe's as potential development sites. These sites include previously developed sites with past commercial and industrial, including one used as a Municipal Solid Waste Landfill. Each site has a unique environmental issues and regulatory involvement. Mr. Lockwood prepares environmental reports, engineering designs and conducts remedial activities to support redevelopment of the sites.

GTJ-Group/Green Bus Lines, Inc - Queens/Brooklyn, NY
Hydrogeology/Environmental/Civil Engineering Services & Compliance Stipulation Agreement -- Services range from Site Remediation Management & Baseline Environmental Report Preparation (Project Coordination, Oversight, Sample Collection) at large bus facilities.
Mr. Lockwood conducted site/facility investigations and provided, on an accelerated time schedule, site investigations and remedial action planning and design for dissolved and free phase groundwater contamination treatment systems.

NYSDEC Spill Program Compliance - In 2005, an Oil Delivery Company had caused a substantial Oil Spill at one of the client's depots; the new release brought attention to outstanding issues required under an existing Stipulation Agreement, although Cleanup tasks were in compliance. The NYSDEC issued a new Order of Consent, with an accelerated time schedule. Under Mr. Lockwood direction, the PWGC team completed an accelerated Site Assessment (delineating the extent of LNAPL and dissolved contamination at the site) and submitted a Remedial Action Plan and preliminary treatment system design to meet the accelerated schedule. Mr. Lockwood managed PWGC construction oversight of the selected remedy and performed operation/maintenance of the remedial system.

PA, City Industries Superfund Site - Winter Park, FL.
Mr. Lockwood managed the preparation of work plans, health and safety plans, project schedule, and budget estimate. He coordinated and supervised soil boring/monitoring well installations and soil and groundwater sampling activities. Analyses were conducted for volatile organics, semi-volatile organics, and chlorinated compounds. Mr. Lockwood served as the primary author of the PA report.

Department of Transportation Facilities - Nashville, TN.
Managed RIs and prepared RI reports and CAPs at several Department of Transportation facilities in Tennessee. Investigations included preparation of work plans, installation of boring and monitoring well networks, and preparation of an RI report. The CAPs included the performance of aquifer pumping tests. The RI report contained options for recovery and treatment of soil and groundwater contamination with dissolved and free phase petroleum compounds. Mr. Lockwood served as primary author of the RI reports and CAP.

Loring AFB Operable Unit 5 RI - Caribou, ME
Field Team Leader for the RI Investigation, Loring AFB – The field effort extended over six months and included the complete investigation of three separate sites. Field activities included the installation of Geoprobes® (250), soil borings (50), and monitoring wells (25) including three multiport Westbay wells; and groundwater, stormwater, and sediment sampling. Mr. Lockwood's responsibilities included preparation of Statements of Work, client interface, and RI report preparation.

Ryan Morley, PG • PROJECT MANAGER

PROFESSIONAL EXPERIENCE
PWGC: 10 years

AREAS OF EXPERTISE
Water, Soil, Air Sampling
Phase I/II ESA
Field Work (Protocol, Oversight, Documentation)
Site Investigation/Analysis
Health & Safety Monitoring
Soil/Groundwater Investigations, Analysis, Sampling
(Manual; Direct Push Technology Techniques)
UST Remediation Hazardous Waste Site Investigation/Cleanup
Underground Injection Well Monitoring

EDUCATION & TRAINING/CERTIFICATION
BS, Geology, University at Buffalo, NY
Licensed Professional Geologist - NY
40-hr OSHA HAZWOPER, 8-hr Annual Refresher, 10-hr Construction Safety & Health
Confined Space Entry
MTA, LIRR & Staten Island Track Safety Training
CPR/Standard First Aid
OSHA 10-hr Construction Course
SWPPP – Stormwater Pollution Prevention Planning Course

PROFILE
Mr. Morley provides hands-on support to implement field activities according to work plans and project schedule. He works closely with clients, sub-contractors, and regulatory agencies to ensure prompt and accurate data collection/dissemination. Routinely, Mr. Morley monitors drilling operations and collection of groundwater elevation measurements, and performs several methods of groundwater sampling, utilizing numerous field-screening instruments, and sampling tools.

NOTABLE PROJECTS
Phase I/Phase II ESA
Phase I & Phase II Environmental Site Assessment (ESA)
Mr. Melia manages Phase I & II ESA preparation, implementation, and completion. For each project, he provides a customized scope of work and relevant documentation to provide clients with pertinent information. He performs Phase I & Phase II ESAs for private clients, environmental attorneys, municipalities, and lending institutions for use in property transactions according to ASTM Standards.

Avalon Bay Communities, Inc. (Former Darby Drug Facility) Rockville Centre, NY
New York State Department of Environmental Conservation (NYSDEC) Brownfield's Clean-up Program (BCP) Implementation at 80-100 Banks Avenue - Mr. Morley performed soil, water, and concrete sampling on site after demolition activities. He was also responsible for the oversight of the strict Community Air Monitoring Program during the soil excavation of the chlorinated solvent impacted soils in the middle of a residential neighborhood. Mr. Morley also provided oversight and sampling of the dewatering and treatment system to ensure compliance with NYSDEC SPDES requirements. Following completion of the groundwater treatment system, he conducted routine operation, maintence and sampling services for the client to ensure that the plume was stabilized as required by the State approved Remedial Action Work Plan.

GTJ-Group/Green Bus Lines, Inc. - Queens/Brooklyn, NY
Hydrogeology/Environmental Services - Services range from Site Investigation (Oversight, and Sample Collection) at six large bus facilities. Mr. Morley conducted site/facility investigations and provided system operation of a free phase groundwater contamination treatment system.
Residential/Commercial Fuel Oil Spills Oversight & Reporting - Mr. Morley oversees planning, contractor solicitation and implementation, fieldwork and project reporting for projects such as petroleum spill investigations and remediation. He prepares spill investigation reports and closure reports, and coordinates with contractors and the NYSDEC to ensure that the project stays on schedule, is compliant with regulatory guidelines, and meets the client's goals.

The Hudson Companies, Brooklyn, NY
NYCDEP Restrictive Declaration Services at 1490 Dumont Avenue in Brooklyn - Mr. Morley was responsible for making sure job proceedings were within NYCDEP regulations. He prepares and implements community air monitoring during remedial activities, inspects vapor barrier installations, and provides oversight during the impacted soil excavation and site remediation activities.

The Witkoff Group, New York, New York
NYCDEP Restrictive Declaration Services at 303 West 10th Street – Mr. Morley provided oversight of contaminated soil cleanup and enforced the correct disposal of soils being exported from the site. In addition, he was responsible for air monitoring and daily reporting to the New York City Office of Environmental Restoration (NYCOER).

Innovant Group - Islandia, NY
Underground Injection Control (UIC) Remediation – Mr. Morley performs endpoint sampling of storm drains and sanitary systems, coordinates and performs sampling in conjunction with the Suffolk County Department of Health Services (SCDHS) and Nassau County Department of Health (NCDH), and ensures proper soil and sediment removal.

Lakehill Associates, Massapequa, NY
Tank Pull & Oxygen Release Compound (ORC) Injection Reporting at 672 Broadway Avenue in Massapequa, NY – Mr. Morley provided field oversight during the removal of Underground Storage Tanks (UST) that included inspecting the tanks for damage and collection of end-point samples. Following the removal of the tanks, he provided oversight of the backfilling as well as Regenox injections and monitoring of the well installation.

Computer Circuits – Hauppauge, NY
US Environmental Protection Agency (USEPA) Regulated Groundwater Sampling - Mr. Morley conducted quarterly sampling at this Federal Superfund site that has a very strict sampling process.

CDM Federal Programs, Matteo & Sons Site -Thorofare, New Jersey
Remedial Investigation/Feasibility Study – The former Computer Circuits industrial site is a US Environmental Protection Agency Superfund Site. Mr. Morley collected groundwater and soil samples in accordance with USEPA guidelines at this National Priorities List site.

Allied Aviation Services of New York, Queens, NY
Sampling - Mr. Morley performs groundwater sampling as well as bimonthly well gauging and product removal at LaGuardia Airport. In addition he assists in the preparation of the status reports quarterly for the submission to the New York State Department of Environmental Conservation (NYSDEC).

105 Metropolitan Ave, LLC, New York, NY
E-Designation Remedial Action Work Plan (RAWP) Implementation - Mr. Morley provided field oversight services at the site which was entered into the NYCOER Voluntary Cleanup Program. Services included reporting to the NYCOER, onsite soil inspection, community air monitoring and coordinating with contractors for the removal of impacted soils to Track 1 standards.

Heather Moran-Botta, SMS •

PROJECT MANAGER/EH&S COORDINATOR

PROFESSIONAL EXPERIENCE

PWGC: 6 years
PRIOR: 5 years

AREAS OF EXPERTISE

Industrial Hygiene
Due Diligence
Subsurface Investigations
Health and Safety
Site Investigation/Analysis
Emerging Contaminants
Remediation

EDUCATION & TRAINING/CERTIFICATION

MS, Environmental Technology, NYIT (In Progress)
BA, Earth Science, Dowling College, NY
AS, Liberal Arts, Suffolk Community College
Board Certified Safety Professional: Safety Management Specialist
New York State Asbestos Project Monitor
New York State Asbestos Inspector
New York State Air Sampling Technician
New York State Asbestos Project Designer
New York State Asbestos Management Planner
New York City Asbestos Investigator
USEPA Lead-Based Paint Risk Assessor
New York State Mold Assessor
American Red Cross, CPR; First Aid; AED
ASTM Phase I / Phase II ESA Training
OSHA HAZWOPER 40-Hr; OSHA HAZWOPER 8-hr refresher
OSHA HAZWOPER Supervisor
OSHA 10-Hour Construction
OSHA Health & Safety Manager
OSHA 30-Hour Construction

PROFILE

Ms. Moran-Botta is a Project Manager with eleven (11) years of experience working as an environmental consultant specializing industrial hygiene/hydrogeology. She has conducted and managed all aspects of due diligence, industrial hygiene, subsurface investigations, health and safety, site investigation and remediation. Most recently Ms. Moran-Botta has managed projects relating to PFAS investigations in groundwater and potable water. Ms. Moran-Botta is actively engaged in all aspects of environmental, health and safety training and is the Chairperson of the PWGC Health and Safety Committee.

NOTABLE PROJECTS

Asbestos Inspections/Investigations – Ms. Moran-Botta has conducted asbestos inspections and investigations throughout New York State and in the five boroughs of New York City for multiple clients, including: major hospitals, international airports and airline carriers, custom home builders, nationwide retail chains, manufacturing facilities, defense contractor facilities, environmental remediation sites, retailers, local shopping centers, real estate developers, banks and insurance companies. Ms. Moran-Botta has 11 years of asbestos-project experience.

Asbestos Project Monitoring – Ms. Moran-Botta has provided project monitoring of asbestos remediation projects for many projects in New York, New Jersey and New York City. Her clients include: major hospitals, international airports and airline carriers, custom home builders, nationwide retail chains, manufacturing facilities, defense contractor facilities, environmental remediation sites, retailers, local shopping centers, real estate developers, retail petroleum stations, local and nationwide banks, facility management companies, and global insurance companies. Additionally, Ms. Moran-Botta has provided air sampling / industrial hygiene support for an on-going Negative Exposure Assessment completed for a major pipeline operating in New Jersey.

Asbestos Project Design – Ms. Moran-Botta has provided project design and development services for asbestos abatement projects at schools and hospitals in New York State, including scoping, schedule, phasing and remediation options. She has developed and implemented work plans that adhere to Federal, State and Local regulations.

Asbestos Management Planner – Developed written plans for managing asbestos-containing materials in schools and facilities in New York State and made recommendations to school officials.

Per- and Polyfluoroalkyl Substances (PFAS) Remedial Investigation (RI) – Project Manager for New York State Class 2 Inactive Hazardous Waste Disposal Site on Long Island, New York. The main contaminants of concern (COC) were PFAS associated with historic use of Aqueous Film-Forming Foam (AFFF). The RI included investigation of soil, groundwater, and stormwater sediment in six areas of concern.

Subject Matter Expert (SME) – Participation as a Subject Matter Expert on a writing panel for the Board of Certified Safety Professional for the Safety Management Specialist Exam. Participation was voluntary and entailed writing, reviewing and revising questions for the 2019 revision to the SMS Exam.

New York City Department of Environmental Conservation E-Designation – Provided management and oversight of a variety of E-Designation properties located in the five boroughs. Projects included coordination with NYCDEP regarding Phase I/II/III.

Mold Investigations – Completed mold investigations at various facilities, including, but not limited to: commercial kitchens, banks, hotels, hospitals, defense contractor facilities, manufacturing facilities, schools and airports. Sampling procedures included swab sampling, air sampling and carpet dust sampling.

Lead-Based Paint Assessments – Conducted and managed lead-based paint assessments per USEPA protocols for private residences, hospitals, airports, and construction projects in New York State.

Phase I Environmental Site Assessments – Responsible for the conduct and preparation of Phase I ESAs in general conformance with the scope and limitations of ASTM Practice E 1527-15 and the recently-promulgated USEPA All Appropriate Inquiry protocols.

Phase II Environmental Site Assessments – Performed various aspects of Phase II ESA scopes of work for commercial and industrial properties, including: reporting and analysis, field work; subcontractor oversight; coordinating daily with assigned laboratories, and; general project coordination and management.

New York City Department of Environmental Protection Community Right-To-Know – Completed Tier II reporting for a major airline carrier, this task included a complete chemical inventory of hangar, maintenance and office facilities; MSDS acquisition and organization, evaluation of chemicals for reporting and; completion of compliance package for NYCDEP.

Corporate Health and Safety Coordinator, 2010 – Acted as a Health and Safety liaison between the corporate office in Maryland and the NY office. Responsible for incident reporting; holding monthly safety meetings; chemical inventory, MSDS, maintenance and Right-To-Know compliance; and participation in monthly Corporate H&S company-wide conference calls.

Brownfield Closure Support and IRM Implementation and Reporting – Provided on-going field and office support for a paint factory closure on Long Island, NY. The site was regulated under the New York State Brownfield Cleanup Program. Responsible for executing Interim Remedial Measures which entailed removing free product from onsite wells; and enforced the site-specific Health and Safety Plan (HASP). The process is documented and a monthly report is written and submitted to NYSDEC.

Stormwater System Field Inspections and Reporting – Performed routine inspections of drainage systems at a national retail chain as part of a national monthly maintenance contract. This included observation of site drainage patterns; review of the mechanical integrity of manhole covers and drywells, and; documentation of inspection in a monitoring report that includes recommendations as necessary for site improvements.

Compliance Sampling for New York City Sewer Effluent Limitations – Responsible for scheduling, coordinating, and executing quarterly field sampling events for several flush truck facilities throughout Manhattan, Brooklyn and Queens.

RCRA Closure Support – Assisted with the coordination and oversight of the environmental closure of a medical manufacturing facility and a former Konica Minolta site. Responsible for conducting rinse-water, soil boring, and sub-slab soil sampling events with the NYSDEC. Provided assistance with the preparation and submission of the final RCRA Closure Report.

Emergency Management – Conducted SPCC inspections and created SPCC plans for a major airline, a national retailer and a public utility company. Also, created and updated Risk Management plans for a major airline at JFK and LGA.

Waterways – Evaluated permitting and compliance issues related to proposed dredging and installation of docking facilities in areas of Jamaica Bay; participated in a bathymetric survey of areas within Jamaica Bay.

Litigation Support – Provided research and support on several MTBE class action suits related to retail petroleum stations in through New York State, Suffolk County PCE litigation, Vermont MTBE and CKD in upstate New York. Key tasks performed included: NYSDEC spill number closure; review of documents; coordination with counsel; research into specific areas pertaining to each case; and, review of reports and expert documents provided by others.

Kaitlyn Crosby • PROJECT HYDROGEOLOGIST/ES

PROFESSIONAL EXPERIENCE
PWGC: 6 years

AREAS OF EXPERTISE
Water, Soil, Air Sampling
Field Work (Protocol, Oversight, Documentation)
Site Investigation/Analysis
Health & Safety Monitoring
Soil/Groundwater Investigations, Analysis, Sampling
(Manual; Direct Push Technology Techniques)
UST Remediation Hazardous Waste Site Investigation/Cleanup
Underground Injection Well Monitoring

EDUCATION & TRAINING/CERTIFICATION
BA, Environmental Studies (Sustainability Studies; Public Policy & Human Impact), Stony Brook University
OSHA HAZWOPER 40-hr; OSHA HAZWOPER 8-hr refresher
OSHA 10-Hour Construction

PROFILE
Kaitlyn Crosby earned her Bachelor of Arts degree in Environmental Studies with a Minor in Sustainability Studies concentrating on Public Policy & Human Impact from Stony Brook University. She proved herself in the realm of hydrogeology, soil sampling and field studies and is continuously improving her skills as a field inspector in the areas of civil, structural, and environmental engineering. She has an excellent record in timely completion and maintenance of project coordination, monitoring, and document preparation, while successfully maintaining communication between clients, government agencies, and other parties involved.

NOTABLE PROJECTS
Computer Circuits, Hauppauge, New York
Ms. Crosby performed groundwater and air sampling in accordance with the USEPA-approved work plan for the investigation at this Federal Superfund site. The investigation consisted of soil, groundwater, and air sampling, and the installation and operation of a soil/vapor extraction system. Ms. Crosby performed sampling activities following the QA/QC procedures detailed in the work plan.

GTJ-Group/Green Bus Lines, Inc. - Queens/Brooklyn, NY
Hydrogeology/Environmental Services - Services range from Site Remediation Management & Baseline Environmental Report Preparation (Project Coordination, Oversight and Sample Collection) at large bus facilities. Ms. Crosby conducted site/facility investigations and provided, on an accelerated time schedule, site investigations, remedial action planning and design for dissolved and free phase groundwater contamination treatment systems.

83 Walker Street, Manhattan, New York
New York City Office of Environmental Remediation (NYCOER) Redevelopment Project – Ms. Crosby provided field oversight services to an "E" Designation site at 83 Walker Street. Her responsibilities included, but were not limited to, soil sampling, groundwater sampling, soil vapor samplings, air monitoring for dust and VOCs during earthwork, and inspection of vapor barrier installations. Ms. Crosby documented daily soil removal and noted any soils that may be contaminated. In addition to these services, she completed daily logs, communicated with the NYCOER, clients, government agencies and other parties involved and ensured proper handling and distribution of the soil samples.

Carco Builders Corp., Freeport, NY
Underground Injection Control (UIC) Remediation - Ms. Crosby performs endpoint sampling of storm drains and sanitary systems, coordinates and performs sampling in conjunction with the Suffolk County Department of Health Services (SCDHS) and Nassau County Department of Health (NCDH), and ensures proper soil and sediment removal.

North Eight NY LLC, Brooklyn, NY
NYCOER "E" Designation Services - Ms. Crosby provided field oversight services to an "E" Designation site at 207 North 8th Street. Her responsibilities included, but were not limited to, soil sampling, groundwater sampling, water level measurement and soil vapor samplings. She conducted site inspections to identify AOCs and physical obstructions and provided oversight on the installation of five soil borings. Ms. Crosby documented daily soil removal and noted any soils and groundwater that may be contaminated. In addition to these services, she completed daily logs, communicated with the NYCOER, clients, government agencies and other parties involved and ensured proper handling and distribution of the soil samples.

APPENDIX C
HEALTH AND SAFETY PLAN

P.W. GROSSER CONSULTING, INC.
P.W. GROSSER CONSULTING ENGINEER & HYDROGEOLOGIST, P.C.
PHONE: 631.589.6353
PWGROSSER.COM
630 JOHNSON AVENUE, STE 7
BOHEMIA, NY 11716
LONG ISLAND • MANHATTAN • SARATOGA SPRINGS • SYRACUSE • SEATTLE • SHELTON

540 SMITH STREET
FARMINGDALE, NEW YORK 11735
BLOCK 400, LOTS 8005 & 208
NYSDEC SITE NO. 1-52-147

BIOREMEDIATION PROGRAM HEALTH & SAFETY PLAN

SUBMITTED TO:

New York State Department of Environmental Conservation
Division of Environmental Remediation
Remedial Bureau A
625 Broadway 12th Floor
Albany, New York 12233-7015

PREPARED FOR:

Minmilt Realty Corp.
352 Carnation Drive
Farmingdale, New York 11735

PREPARED BY:

P.W. Grosser Consulting, Inc.
630 Johnson Avenue, Suite 7
Bohemia, New York 11716
Phone: 631-589-6353
Fax: 631-589-8705

James Rhodes, PG, Sr. Principal JamesR@pwgrosser.com
Ryan Morley, PG, Project Manager RyanM@pwgrosser.com

PWGC Project Number: MIN2004

AUGUST 2020

BIOREMEDIATION PROGRAM HEALTH & SAFETY PLAN
540 SMITH STREET
FARMINGDALE, NY
NYSDEC SITE NO: 1-52-147

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P.W. GROSSER CONSULTING, INC.
PROJECT No. MIN2004
New York State Department of Environmental Conservation
Site ID No. 1-52-147

BIOREMEDATION PROGRAM HEALTH AND SAFETY PLAN

540 Smith Street
Farmingdale, New York 11735

SUBMITTED:

August 2020

PREPARED FOR:

New York State Department of Environmental Conservation
Division of Environmental Remediation
Remedial Bureau A
625 Broadway 12th Floor
Albany, New York 12233-7015

ON BEHALF OF:

Minmilt Realty Corp.
352 Carnation Drive
Farmingdale, New York 11735

PREPARED BY:

P.W. Grosser Consulting, Inc.
630 Johnson Avenue, Suite 7
Bohemia, New York 11716

1.0 STATEMENT OF COMMITMENT

On site employees may be exposed to risks from hazardous conditions related to bioremediation program activities to be performed at 540 Smith Street, Farmingdale, New York. P.W. Grosser Consulting Inc.'s (PWGC's) policy is to minimize the possibility of work-related injury through awareness and qualified supervision, health and safety training, medical monitoring, use of appropriate personal protective equipment, and the following activity specific safety protocols contained in this Health and Safety Plan (HASP). PWGC has established a guidance program to implement this policy in a manner that protects personnel to the maximum reasonable extent.

This HASP, which applies to PWGC personnel actually or potentially exposed to safety or health hazards, describes emergency response procedures for actual and potential physical and chemical hazards. This HASP is also intended to inform and guide personnel entering site work zones. Personnel are to acknowledge that they understand the potential hazards and the contents of this Health and Safety policy by signing off on receipt of their individual copy of the document. Contractors and suppliers are retained as independent contractors and are responsible for ensuring the health and safety of their own employees.

PWGC may require that its personnel take certain precautions in accordance with this HASP, and PWGC requests that others protect their personnel in a manner that they deem necessary or sufficient.

2.0 INTRODUCTION AND SITE ENTRY REQUIREMENTS

This document describes the health and safety guidelines developed by PWGC at the request of the Minmilt Realty Corp. for the proposed bioremediation program to be performed at 540 Smith Street, Farmingdale, New York ("the site") to protect on site personnel, visitors, and the public from physical harm and exposure to hazardous materials or wastes. In accordance with the Occupational Safety and Health Administration (OSHA) 29 CFR Part 1910.120 Hazardous Waste Operations and Emergency Response (HAZWOPER) Final rule, this HASP, including the attachments, addresses safety and health hazards relating to each phase of site operations and is based on the best information available. The HASP may be revised by PWGC at the request of Minmilt Realty Corp., and/or the NYSDEC upon receipt of new information regarding site conditions. Changes will be documented by written amendments signed by PWGC's project director, project manager and/or site safety officer.

2.1 Training Requirements

Personnel entering the exclusion zone or decontamination zone must meet the training requirements for hazardous waste site operations and emergency response operations (HAZWOPER) in accordance with OSHA 29 CFR 1910.120(e).

Each subcontractor and supplier working on the job must provide the site safety officer with training documentation for its personnel upon request.

2.2 Medical Monitoring Requirements

PWGC personnel and visitors entering the exclusion zone or decontamination zone must have completed appropriate medical monitoring required under OSHA 29 CFR 1910.120(f). Medical monitoring enables a physician to monitor each employee's health, physical condition, and his/her fitness to wear respiratory protective equipment and carry out on site tasks.

Evidence of compliance with additional medical monitoring requirements for this site must also be included upon request.

2.3 Fit Test Requirements

Personnel and visitors entering a work zone using a negative pressure air purifying respirator (APR) must have successfully passed a qualitative respirator fit test in accordance with OSHA 29 CFR 1910.134 or the American National Standards Institute (ANSI).

Fit testing documentation is the responsibility of each subcontractor. Documentation of PWGC's personnel fit-testing is maintained on file. PWGC does not anticipate the need for work to be performed using APR's.

2.4 Site Safety Plan Acceptance, Acknowledgement and Amendments

The project manager and the site safety officer are responsible for informing personnel (P.W. Grosser employees and/or owner or owner's representatives) entering a work area of the contents of this plan and ensuring that each person signs the safety plan acknowledging the on site hazards and procedures required to minimize exposure to adverse effects of these hazards. A copy of the Acknowledgement Form is included in **Appendix A**.

Site conditions may warrant an amendment to the HASP. Amendments to the HASP are acknowledged by completing forms included in **Appendix B**.

2.5 Daily Safety Meetings

Each day before work begins; the site safety officer will hold safety (tailgate or toolbox) meetings to ensure that on site personnel understand the site conditions and operating procedures and to address safety questions and concerns. Meeting minutes and attendance will be recorded in a logbook which will be kept on site during bioremediation activities. Personnel eligible to enter a work zone must attend the meetings. Project staff will discuss and remedy health and safety issues at these meetings.

2.6 Key Personnel – Roles and Responsibilities

The following PWGC key personnel are planned for this project:

- PWGC Project Director — Mr. James Rhodes
- PWGC Project Manager — Mr. Ryan Morley
- PWGC Project Health & Safety Coordinator — Ms. Heather Moran-Botta
- PWGC Site Safety Officer — Ms. Kaitlyn Crosby, or assignee

The PWGC project manager/health and safety coordinator is responsible for overall project administration and, with coordination from the PWGC site safety officer, for supervising the implementation of this HASP. The PWGC project manager/ health and safety coordinator must have completed OSHA supervisor training, 29 CFR 1910.120 (e) 4, in addition to HAZWOPER training.

The site safety officer will conduct daily (tail gate or toolbox) safety meetings at the project site and oversee

daily safety issues. Each subcontractor and supplier (defined as an OSHA employer) is also responsible for the health and safety of its employees. If there is any dispute about health and safety or project activities, on-site personnel will attempt to resolve the issue. If the issue cannot be resolved at the site, then the project manager will be consulted.

The PWGC site safety officer is also responsible for coordinating and enforcing health and safety activities on-site. The site safety officer must meet the emergency response and hazardous materials training requirements of OSHA 29 CFR Part 1910.120 and must have appropriate experience to the related site work. The site safety officer, is authorized to suspend the site work based on safety concerns, and is responsible for the following:

1. Educating personnel about information in this HASP and other safety requirements to be observed during site operations, including, but not limited to, decontamination procedures, designation of work zones and levels of protection, air monitoring, fit testing, and emergency procedures dealing with fire and first aid.
2. Coordinating site safety decisions with the project manager.
3. Designating exclusion, decontamination and support zones (work zones) on a daily basis.
4. Monitoring the condition and status of known on site hazards and maintaining and implementing the air quality monitoring program specified in this HASP.
5. Maintaining the work zone entry/exit log and site entry/exit log.
6. Maintaining records of safety problems, corrective measures and documentation of chemical exposures or physical injuries (the site safety officer will document these conditions in a bound notebook and maintain a copy of the notebook on-site).

The person who observes safety concerns and potential hazards that have not been addressed in the daily safety meetings should immediately report their observations/concerns to the site safety officer or appropriate key personnel.

3.0 SITE BACKGROUND AND SCOPE OF WORK

The site is a 2.28-acre industrial property located at 540 Smith Street, East Farmingdale, New York; and is identified as Tax Map 100 Section 6, Block 1 and Lot 25 on the Suffolk County Tax Map.

The site was used for agricultural purposes prior to 1965. The onsite building, currently owned by Minmilt Realty, was constructed in 1965 and the property was subsequently occupied by Hygrade Metal Mouldings (Hygrade). Hygrade manufactured metal mouldings from strip metals used in construction of windows and other finish products. Prior to 1983, Hygrade used a vapor degreaser, which included a tetrachloroethylene (PCE) component, to clean metal parts. The use of this vapor degreaser was terminated in 1983.

An Order on Consent (No. IW-91-0021) was issued to Minmilt Realty by the SCDHS in January 1992. SCDHS alleged that Minmilt Realty caused or permitted the discharge of toxic or hazardous material to an onsite leaching pool in violation of Section 760-1205 of Article 12 of the Suffolk County Sanitary Code. The referenced leaching pool has been reported to have received periodic discharges from the vapor degreaser, which contained PCE.

In response to the SCDHS Order on Consent, a soil and groundwater investigation was conducted by PWGC under subcontract to Middleton, Kontokosta Associates (MKA). The objective of the investigation was to identify on-site contamination and associated source areas resulting from the alleged discharges. The soil and groundwater investigation identified significant soil contamination present in the subsurface on the east side of the building. The contamination was primarily PCE and was detected at concentrations high enough to classify some of the soil material as hazardous. PCE concentrations were found to increase with depth towards the water table. At the time, it was estimated that approximately 5,500 cubic yards of soil had been impacted. In addition, PCE was detected in the groundwater beneath the site in excess of permissible NYSDEC standards. Contaminated soils were suspected to be the primary source of PCE in the groundwater. The PCE plume was determined to extend down-gradient to at least the southern property line of Hygrade and vertically to at least 80 feet below grade (40 feet below the water table). The soil and groundwater investigation also determined that background and upgradient groundwater quality in the vicinity of the site was also degraded, indicating the presence of other upgradient sources of contamination.

In 1995, under the oversight of the NYSDEC, a Remedial Investigation (RI) was performed. No additional sources of PCE were identified by the remedial investigation at the Site. The vertical extent of the groundwater plume was determined to exist into the Magothy Aquifer to a depth of approximately 185 feet below grade, where it is contained by a clay layer. In addition, on-site monitoring well MW-3 was found to contain a mixture of fuel

oil and PCE in a non-aqueous state.

To expedite the clean-up of the Site and minimize further degradation of groundwater quality, an interim remedial measure (IRM) was proposed consisting of a soil vapor extraction and groundwater remedial combination system to remove the contamination. Construction of the IRM was initiated in August 1996 and completed in February 1997. Subsequently, the Final Offsite RI was completed, and the Record of Decision (ROD) signed, accepting the IRM as the final remedy. The ROD identified three site goals:

- Goal No. 1 - Eliminate, to the extent practicable, off-site migration of groundwater that does not attain NYSDEC Class GA Ambient Water Quality Criteria;
- Goal No. 2 - Eliminate, to the extent practicable, exposures to on-site contamination through the remediation of volatile organic compounds (VOCs) in subsurface soils; and
- Goal No. 3 - Eliminate, to the extent practicable, the migration of site contamination into the groundwater.

PWGC prepared a modified Operation Monitoring and Maintenance (OM&M) plan based upon the offsite RI and the ROD. Minmilt Realty Corp. signed a new Order on Consent on October 24, 2003 addressing the continuing groundwater and soil monitoring at the Site.

To further assess the nature of the remaining impacts at the site, PWGC conducted a vertical profile investigation south of MW-3 during 2009. This investigation identified PCE at concentrations up to 84,000 ug/l. High concentrations were primarily observed in the Magothy Aquifer between 120 feet and 130 feet below grade and were rather limited to this area, with concentrations rapidly dropping off in each of the surrounding step-out borings conducted by PWGC. The results of the vertical profile investigation documented that the greatest groundwater impacts were located within the Magothy Aquifer, just south of MW-3.

PWGC oversaw installation of a new Magothy well (Magothy Extraction Well No. 4) onsite and south of MW-3 during the first quarter of 2012 to target the contamination identified in the 2009 vertical profile investigation. The well was installed with 6" diameter casing, screened from 103 to 163 feet below grade. PWGC subsequently determined that Magothy Extraction Well No. 4 had replaced Magothy Extraction Well No. 2 in remedial capacity, rendering Magothy Extraction Well No. 2 unnecessary. After receiving permission from the NYSDEC, original Magothy Extraction Well No. 2 was placed out of operation during the first half of 2014. During June/July 2015, a new onsite Upper Glacial well (Upper Glacial Extraction Well No. 3) was installed and placed into operation. This well was designed with 30 feet of screen set from 68.5 to 98.5. feet below grade. This depth coincides with, and targets, the highest remaining impacts in the Upper Glacial aquifer, based upon the results

of PWGC's 2014 vertical profile investigation. System mass removal rates increased to the highest since 2008 indicating that the new extraction wells (Upper Glacial Extraction Well No. 3 and Magothy Extraction Well No. 4) are effectively treating the remaining groundwater impact. In March 2015, both off-Site extraction wells (Upper Glacial Extraction Well No. 1 and Magothy Extraction Well No. 2) were decommissioned and abandoned. Due to a drop in the PCE removal rate, the onsite SVE system was put on a pulsed pumping schedule (i.e., 2 weeks on, 2 weeks off) in 2016.

A soil investigation of the historical source area on the eastern side of the property was conducted in May 2020 which included two soil borings installed to a depth of 170 feet below grade and one to 180 feet below grade. The results of this investigation identified PCE contamination from 80 to 90 feet below grade at each of the three boring locations. The highest concentration of PCE was 4,700,000 ppb detected at the 85-90 foot interval from the boring installed adjacent to the drywell which historically received periodic PCE discharges. Concentrations of PCE within the 80 to 90-foot interval at the two downgradient boring locations were found to be significantly lower. A second and less significant zone of PCE contamination was detected at 120 to 125 feet below grade where thin layers of clay were encountered in the upper Magothy Formation.

PWGC recommended that a bioremediation program be implemented to address the remaining PCE contamination at the site.

4.0 HAZARD ASSESSMENT

This section identifies the hazards associated with the proposed scope of work, general site operations which may also be conducted at site, and the standard operating procedures (SOPs) that should be implemented to reduce the hazards; identifies general physical hazards that can be expected at most sites; and presents a summary of documented or potential chemical hazards at the site. Every effort must be made to reduce or eliminate these hazards. Those that cannot be eliminated must be guarded against using engineering controls and/or personal protective equipment.

4.1 Activity-Specific Hazards and Standard Operating Procedures

4.1.1 Drilling and Injection Operations

Installation of bioremediation chemical injection points via Geoprobe® direct-push technology will be performed as part of the proposed bioremediation program. PWGC and/or subcontractors shall follow the standard drilling protocols included as **Appendix C** and shall handle bioremediation chemicals in accordance with the manufacturer's instructions.

4.1.2 Work in Extreme Temperatures

Work under extremely hot or cold weather conditions requires special protocols to minimize the chance that employees will be affected by heat or cold stress. As necessary, PWGC shall follow the heat and cold stress safety protocols included as **Appendix D**.

4.1.3 Dust Control and Monitoring

Dust generated during work activities may contain contaminants associated with the site characteristics. Dust generation is not anticipated during the bioremediation program. In the event that fugitive dust is generated, PWGC shall control the dust by wetting the working surface with water, or other approved method of dust suppression.

4.2 Chemical Hazards

Historical environmental investigations at the subject site have identified elevated VOCs in soils and groundwater at the site. The primary routes of exposure to contaminants in soil and groundwater are inhalation, ingestion and absorption.

In addition chemical hazards within the subsurface, the three chemicals that will be used as part of the bioremediation program (3DME, BDI Plus, and CRS) should be handled in accordance with the manufactures specifications and direct contact with the skin, eyes, and mouth must be avoided. During the handling of these

chemicals, gloves and eye protections should be donned in addition to the Level D PPE.

Appendix E includes information sheets for the potential chemicals that may be encountered at the site during bioremediation program activities.

4.2.1 Respirable Dust

The bioremediation program activities are not anticipated to generate significant particulate dust; however, dust may be generated from vehicular traffic. If visible observation detects elevated levels of dust, a program of wetting will be employed by the site safety officer. If elevated dust levels persist, the site safety office will employ dust monitoring using a particulate monitor (MiniRAM Model PDM-3or equivalent). If monitoring detects concentrations greater than 150 µg/m3 over daily background, the site safety officer will take corrective actions as defined herein, including the use of water for dust suppression and if this is not effective, requiring workers to wear APRs with efficiency particulate air (HEPA) cartridges.

Absorption pathways for dust and direct contact with soils will be mitigated with the implementation of latex gloves, hand washing and decontamination exercises when necessary.

4.2.2 Organic Vapors

Based upon historical environmental investigations, the potential for isolated areas of VOCs impacts exists. Therefore, drilling/injection activities may cause the release of organic vapors to the atmosphere. The site safety officer will monitor organic vapors with a Photoionization Detector (PID) during drilling activities to determine whether organic vapor concentrations exceed action levels shown below.

PID Response	Action
Sustained readings of 5 ppm or greater	Shut down drilling equipment and allow area to vent. Resume when readings return to background
Sustained readings of 5 ppm or greater that do not subside after venting	Implement Vapor Release Plan (Section 9.8). Re-evaluate respiratory protection as upgrade may be required.

4.3 General Site Hazards

Applicable OSHA 29 CFR 1910.120(m) standards for illumination shall apply. Work is to be conducted during daylight hours whenever possible.

Electrical power must be provided through a ground fault circuit interrupter. Equipment that will enter an excavation must be suitable and approved (i.e. intrinsically safe) for use in potentially explosive environments.

Applicable OSHA 29 CFR 1926 Subpart K standards for use of electricity shall apply.

Work where there is a fall hazard will be performed using appropriate ladders and/or protection (e.g. body harness and lifeline). All work should be conducted at the ground surface or in trench excavations.

In accordance with 29 CFR 1910.151(c), workers involved in operations where there is the risk of eye injury, (chemical splash, etc.), must have ready access to an approved eye wash unit. Protective eye wear shall be donned in Level D, when directed by the site safety officer.

Operations where there is a potential for fire will be conducted in a manner that minimizes risk. Non-sparking tools and fire extinguishers shall be used or available as directed by the site safety officer when work is in potentially explosive atmospheres. Ignition sources shall be removed from work areas. Explosion-proof instruments and/or bonding and grounding will be used to prevent fire or explosion when the site safety officer directs their use.

Overhead and underground utilities shall be identified and/or inspected and appropriate safety precautions taken before conducting operations where there is potential for contact or interference.

5.0 PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment (PPE) shall be selected in accordance with the site air monitoring program, OSHA 29 CFR 1910.120(c), (g), and 1910.132. Protective equipment shall be NIOSH-approved and respiratory protection shall conform to OSHA 29 CFR Part 1910.133 and 1910.134 specifications; head protection shall conform to 1910.135; eye and face protection shall conform to 1910.133; and foot protection shall conform to 1910.136. The only true difference among the levels of protection from D thru B is the addition of the type of respiratory protection.

PWGC anticipates that work performed under the scope of the proposed Phase II investigation will be conducted in Level D PPE.

5.1 Level D

Level D PPE shall be donned when the atmosphere contains no known hazards and work functions preclude splashes, immersion, or the potential for inhalation of, or contact with, hazardous concentrations of harmful chemicals. Level D PPE consists of:

- Standard work uniform, coveralls, or Tyvek (as needed)
- Steel toe and steel shank work boots (or equivalent)
- Hard hat
- Gloves (as needed)
- Safety glasses
- Hearing protection (as needed)
- Equipment replacements are available as needed

5.2 Level C

Level C PPE shall be donned when the concentrations of measured total organic vapors in the breathing zone exceed background concentrations (using a portable PID, or equivalent), but are less than 5 ppm. The specifications on the APR filters used must be appropriate for contaminants identified or expected to be encountered. Level C PPE shall be donned when the identified contaminants have adequate warning properties and criteria for using APR have been met. Level C PPE consists of:

- Chemical resistant or coated Tyvek coveralls
- Steel toe and steel shank work boots (or equivalent)
- Chemical resistant over boots or disposable boot covers

- Disposable inner gloves (surgical gloves)
- Disposable outer gloves
- Full-face APR fitted with organic vapor/dust and mist filters or filters appropriate for the identified or expected contaminants
- Hard hat
- Splash shield (as needed)
- Ankles/wrists taped with duct tape

The site safety officer will verify if Level C is appropriate by checking organic vapor concentrations using compound and/or class-specific detector tubes.

5.3 Level B

Level B PPE shall be donned when the contaminants have not been identified and/or the concentrations of unknown measured total organic vapors in the breathing zone exceed 5 ppm (using a portable OVA, or equivalent). Level B PPE shall be donned if the IDLH of a known contaminant is exceeded. If a contaminant is identified or is expected to be encountered for which NIOSH and/or OSHA recommend the use of a positive pressure self-contained breathing apparatus (SCBA) when that contaminant is present, Level B PPE shall be donned even though the total organic vapors in the breathing zone may not exceed 5 ppm. Level B shall be donned for confined space entry, and when the atmosphere is oxygen deficient (oxygen less than 19.5%) or potentially oxygen deficient. If Level B PPE is required for a task, at least three people shall be donned in Level B at any one time during that task. PPE shall only be donned at the direction of the site safety officer. Level B PPE consists of:

- Supplied air SCBA or air line system with five-minute egress system
- Chemical resistant or coated Tyvek coveralls
- Steel toe and steel shank work boots (or equivalent)
- Chemical resistant over boots or disposable boot covers
- Disposable inner gloves (surgical gloves)
- Disposable outer gloves
- Hard hat
- Ankles/wrists taped with duct tape

The exact PPE ensemble is decided on a site-by-site basis by the PWGC Health and Safety Officer with the intent to provide the most protective and efficient worker PPE.

5.4 Activity Specific Levels of Personal Protection

The required level of PPE is activity-specific and is based on air monitoring results (Section 7.0) and properties of identified or expected contaminants. It is expected that all site work will be performed in Level D. If air monitoring results indicate the necessity to upgrade the level of protection engineering controls (e.g., facing equipment away from the wind and placing site personnel upwind of excavations, active venting, etc.) will be implemented before requiring the use of respiratory protection.

6.0 DECONTAMINATION PROCEDURES

Equipment and PPE exiting the exclusion zone must be decontaminated or properly discarded upon exit. Personnel must enter and exit the exclusion zone through the decontamination area. The exclusion and decontamination zones may change depending on the nature of the site work. Plastic bags containing personal protective clothing and equipment will be placed in designated receptacles.

Boots and other potentially contaminated garments that have come in contact with hazardous materials will be cleaned in wash tubs with detergent/water solution and rinsed with water and must remain on site. The wash water, rinse water, and residues will be collected and properly stored until sampling results are received and the final method of disposal can be determined. Disposable PPE, including spent respirator cartridges and canisters, will be properly bagged and disposed. Contaminated boots, clothing, and equipment (e.g., leather boots, equipment carrying straps, etc.) that cannot be decontaminated will be disposed of with the disposable garments or left on site in the decontamination area.

The ***minimum*** measures for Level B doffing and decontamination are:

1. Deposit equipment on plastic drop cloths.
2. Scrub outer boots and gloves with a water and detergent solution and rinse.
3. Remove outer boots and outer gloves. Discard disposable outer garments in receptacle provided.
4. Remove SCBA and face piece and place on rack provided.
5. Remove Tyvek/outer garment and place in receptacle provided.
6. Remove inner gloves and deposit in receptacle provided.
7. Shower/wash face and hands.

The ***minimum*** measures for Level C doffing and decontamination are:

1. Deposit equipment on plastic drop cloths.
2. Scrub outer boots and gloves (if worn) with a water and detergent solution and rinse.
3. Remove outer boots and outer gloves. Discard disposable outer garments in receptacle provided.
4. Remove Tyvek/outer garment and place in receptacle provided.
5. Remove first pair of inner gloves.
6. Remove respirator (using "clean" inner gloves) and place on rack provided.
7. Remove last pair of inner gloves and deposit in receptacle provided.

8. Shower/wash face and hands.

The second to last item to be removed is the APR, and the last item to be removed is the last of several pairs of surgical gloves. Wearing several pairs of inner gloves permits layers to be removed as needed during various stages of the doffing procedure, and if the APR inadvertently becomes contaminated, inner gloves guard against bare hands contacting the APR.

Equipment that comes into contact with site contaminants is decontaminated according to manufacturer specifications. Decontamination is done in the exclusion or decontamination zones. Rented equipment is photographed after decontamination.

7.0 AIR MONITORING AND ACTION LEVELS

Air monitoring will be performed for protection for on site workers and the downwind community (i.e., off-site receptors including residences, businesses, and on site workers not directly involved in the investigation work) from potential airborne contaminant releases resulting from investigation activities at the site. Air monitoring will be used to help to confirm that the investigation work will not spread contamination off-site through the air. Work zone air monitoring will be performed for protection for on site workers and the downwind community as described below. A Community Air Monitoring Plan (CAMP) has also been developed for the soil investigation.

7.1 Work Zone Monitoring

Respirable dust will be monitored using a MiniRAM Model PDM-3 aerosol monitor (or equivalent) if necessary, and air will be monitored for VOCs with a MiniRAE 2000 PID (or equivalent) during intrusive activities such as excavation and drilling. Monitoring will be performed continuously during intrusive activities and hourly, at a minimum, otherwise. Upwind readings will be recorded at least twice daily to determine background concentrations at the site.

Monitoring Instrument	**Monitoring Location**	**Monitoring Frequency**	**Action Level (above background)**	**Action**
PID	Work Area	Continuous during intrusive activities; hourly, at a minimum, otherwise	<5ppm* ≥5ppm, ≤50ppm* >50ppm*	Level D PPE, continue work Level C PPE, notify PM/HSM Stop work, notify PM/HSM
Particulate monitor	Work Area	Continuous during intrusive activities; hourly, at a minimum, otherwise	≤150 µg/m3 >150 µg/m3	Continue work Take corrective actions (see below)
*Sustained levels in the breathing zone for a minimum of 5 minutes				

If particulate monitoring detects concentrations greater than 150 µg/m^3 over daily background, the site safety officer will take corrective actions as defined herein, including the use of water for dust suppression and if this is not effective, requiring workers to wear APRs with efficiency particulate air (HEPA) cartridges.

7.2 Air Monitoring Recordkeeping

The field team lead will document air monitoring data in a logbook. Data will include instrument used, calibration date, wind/weather conditions and work activities.

7.3 Calibration Requirements

The PID will be calibrated daily, prior to the start of work. Calibration details (i.e., date, time, span gas, etc.) will be recorded in a logbook.

8.0 SITE CONTROL

8.1 Work Zones

The primary purpose of site controls is to establish the perimeter of a hazardous area, to reduce the migration of contaminants into clean areas, and to prevent access or exposure to hazardous materials by unauthorized persons. When operations are to take place involving hazardous materials, the site safety officer will establish an exclusion zone, a decontamination zone, and a support zone. These zones "float" (move around the site) depending on the tasks being performed on any given day. The site safety officer will outline these locations before work begins and when zones change. The site safety officer records this information in the site logbook. It is expected that for subsurface investigation activities, identification of an exclusion zone, decontamination zone, and support zone will not be necessary.

Tasks requiring OSHA 40-hour HAZWOPWER training are carried out in the exclusion zone. The exclusion zone is defined by the site safety officer but will typically be a 50-foot area around work activities. Gross decontamination (as determined by the site safety officer) is conducted in the exclusion zone; all other decontamination is performed in the decontamination zone or trailer.

Protective equipment is removed in the decontamination zone. Disposable protective equipment is stored in receptacles staged in the decontamination zone, and non-disposable equipment is decontaminated. All personnel and equipment exit the exclusion zone through the decontamination zone. If a decontamination trailer is provided the first aid equipment, an eye wash unit, and drinking water are kept in the decontamination trailer.

The support zone is used for vehicle parking, daily safety meetings, and supply storage. Eating, drinking, and smoking are permitted only in the support zone. When a decontamination trailer is not provided, the eye wash unit, first aid equipment, and drinking water are kept at a central location designated by the site safety officer.

8.2 General Field Safety and Standard Operating Procedures

PWGC's policy is to control hazards at all site areas by limiting entrance to exclusion zones to essential personnel and by implementing the following rules:

- Non-essential (as judged by the site safety officer) personnel and unauthorized persons will not enter the exclusion or decontamination zone.
- Before entering the exclusion or decontamination zones, all personnel must be familiar with emergency

response procedures (Section 9.0), site safety locations, first aid and communication equipment, and the location of the map to the hospital and the list of emergency telephone numbers.

- The buddy system will be used at all times by field personnel in the exclusion zone; no one is to perform work within the exclusion zone alone. When in Level D or C, visual contact or radio contact shall be maintained at all times.
- Contact with contaminated and potentially contaminated surfaces should be avoided. Walk around (not through) puddles and discolored surfaces. Do not kneel on the ground or place equipment on the ground. Protect equipment from contamination.
- Eating, drinking, or smoking is permitted only in designated areas in the support zone.

Each worker must be supplied with and maintain his/her own personal protective equipment.

9.0 CONFINED SPACE

OSHA published a Final Rule on permit-required confined spaces on January 14, 1993, for General Industry at 29 CFR 1910.146 et seq., with an implementation date of April 15, 1993. The rule specifically excludes agriculture, construction, or shipyard employment. Confined space entry and work within confined spaces is not anticipated to be performed under the proposed scope of work. However, if confined space work is conducted it will be performed in accordance with the applicable OSHA regulations. OSHA defines confined space as:

1. is large enough and so configured that an employee can bodily enter and perform assigned work;
2. has limited or restricted areas for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited entry); and
3. is not designed for continuous worker occupancy.

OSHA further requires that an "entry supervisor" (the site designated safety officer) decide at the time of entry whether the space is permit-required or non-permit required space. The site safety officer will monitor the space two hours prior to entry and continuously during work to ensure that the atmosphere is not hazardous. OSHA defines as hazardous atmosphere as:

1. Flammable gas, vapor, or mist in excess of 10 percent of its lower explosive limit (LEL);
2. Airborne combustible dust at a concentration that meets or exceeds its LEL; NOTE: This concentration may be approximated as a condition in which the dust obscures vision at a distance of 5 feet (1.52 m) or less.
3. Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent;
4. Atmospheric concentration of any substance for which a dose or a permissible exposure limit is published in Subpart G, Occupational Health and Environmental Control, or in Subpart Z. Toxic
5. and Hazardous Substances, of this part and which could result in employee exposure in excess of its dose or permissible exposure limit;
6. Any other atmospheric condition that is immediately dangerous to life or health.

A space is non-permit required if none of the above defined hazardous conditions are present. OSHA requires that an attendant (e.g., an individual stationed outside one or more spaces who monitors the entrants and who performs air monitoring of the space(s)) be assigned to each space. The attendant is not allowed to perform any direct rescue related duties, but is there to communicate with the entrant and call for rescue procedures if required.

The following protocol applies when PWGC employees must enter a confined space:

- The site safety officer evaluates the space and site conditions to determine whether the space must be considered "confined".
- If so, the site safety officer monitors the space for hazardous atmospheres prior to entry and fills out a pre-entry checklist (**Appendix F**) to determine whether an entry-permit is required.
- If there is no hazardous atmosphere, the space will be continuously monitored during the entry to assure that the atmosphere remains non-hazardous.
- If the space contains a hazardous atmosphere, an entry permit (**Appendix F**) will be prepared and the space will only be entered in accordance with 29 CFR 1910.146.

10.0 CONTINGENCY PLAN/EMERGENCY RESPONSE PLAN

Site personnel must be prepared in the event of an emergency. Emergencies can take many forms: illnesses, injuries, chemical exposure, fires, explosions, spills, leaks, releases of harmful contaminants, or sudden changes in the weather.

Emergency telephone numbers and a map to the hospital (Figure 1) will be posted in the command post. Site personnel should be familiar with the emergency procedures, and the locations of site safety, first aid, and communication equipment.

10.1 Emergency Equipment On-site

Private telephones:	Site personnel.
Two-way radios:	Site personnel where necessary.
Emergency Alarms:	On-site vehicle horns*.
First aid kits:	On-site, in vehicles or office.
Fire extinguisher:	On-site, in office or on equipment.

* Horns: Air horns will be supplied to personnel at the discretion of the project manager or site safety officer.

10.2 Emergency Telephone Numbers

General Emergencies - Police/Fire Department/Ambulance	911
Local Emergency Medical Center (St. Joseph's Hospital)	1-516-579-6000
National Response Center	1-800-424-8802
Poison Control	1-800-222-1222
NYSDEC Spills Division	1-800-457-7362
NYSDEC Hazardous Waste Division	1-631-444-0375
Suffolk County Department of Health	1-631-787-2200
PWGC Project Director, James Rhodes	1-631-589-6353
PWGC Project Manager, Ryan Morley	1-631-589-6353
PWGC Health and Safety Manager, Heather Moran-Botta	1-631-589-6353
PWGC Site Safety Officer, Kaitlyn Crosby (or assignee)	1-631-664-2016

A copy of this page shall be posted in the office and a copy is provided in **Appendix G**.

10.3 Personnel Responsibilities During an Emergency

The project manager is primarily responsible for responding to and correcting any emergency situations. However, in the absence of the project manager, the site safety officer shall act as the project manager's on site designee and perform the following tasks:

- Take appropriate measures to protect personnel including: withdrawal from the exclusion zone, evacuate and secure the site, or upgrade/downgrade the level of protective clothing and respiratory protection;
- Ensure that appropriate federal, state, and local agencies are informed and emergency response plans are coordinated. In the event of fire or explosion, the local fire department should be summoned immediately. If toxic materials are released to the air, the local authorities should be informed in order to assess the need for evacuation;
- Ensure appropriate decontamination, treatment, or testing for exposed or injured personnel;
- Determine the cause of incidents and make recommendations to prevent recurrence; and,
- Ensure that all required reports have been prepared.

The following PWGC key personnel are planned for this project:

• PWGC Project Director	Mr. James Rhodes
• PWGC Project Manager	Mr. Ryan Morley
• PWGC Health & Safety Manager	Ms. Heather Moran-Botta
• PWGC Site Safety Officer	Ms. Kaitlyn Crosby, or assignee

10.4 Medical Emergencies

A person who becomes ill or injured in the exclusion zone will be decontaminated to the maximum extent possible. If the injury or illness is minor, full decontamination will be completed and first aid administered prior to transport. First aid will be administered while waiting for an ambulance or paramedics. A Field Accident Report (**Appendix G**) must be filled out for any injury.

A person transporting an injured/exposed person to a clinic or hospital for treatment will take the directions to the hospital and information on the chemical(s) to which they may have been exposed (**Appendix E)**.

10.5 Fire or Explosion

In the event of a fire or explosion, the local fire department will be summoned immediately. The site safety

officer or his designated alternate will advise the fire commander of the location, nature and identification of the hazardous materials on-site. If it is safe to do so, site personnel may:

- use firefighting equipment available on site; or,
- remove or isolate flammable or other hazardous materials that may contribute to the fire.

10.6 Evacuation Routes

Evacuation routes established by work area locations for each site will be reviewed prior to commencing site operations. As the work areas change, the evacuation routes will be altered accordingly, and the new route will be reviewed.

Under extreme emergency conditions, evacuation is to be immediate without regard for equipment. The evacuation signal will be a continuous blast of a vehicle horn, if possible, and/or by verbal/radio communication.

- When evacuating the site, personnel will follow these instructions:
- Keep upwind of smoke, vapors, or spill location.
- Exit through the decontamination corridor if possible.
- If evacuation through the decontamination corridor is not possible, personnel should remove contaminated clothing once they are in a safe location and leave it near the exclusion zone or in a safe place.
- The site safety officer will conduct a head count to ensure that all personnel have been evacuated safely. The head count will be correlated to the site and/or exclusion zone entry/exit log.
- If emergency site evacuation is necessary, all personnel are to escape the emergency situation and decontaminate to the maximum extent practical.

10.7 Spill Control Procedures

Spills associated with site activities may be attributed to project specific heavy equipment and include gasoline, diesel and hydraulic oil. In the event of a leak or a release, site personnel will inform their supervisor immediately, locate the source of spillage and stop the flow if it can be done safely. A spill containment kit including absorbent pads, booms and/or granulated speedy dry absorbent material will be available to site personnel to facilitate the immediate recovery of the spilled material. Daily inspections of site equipment components including hydraulic lines, fuel tanks, etc. will be performed by their respective operators as a preventative measure for equipment leaks and to ensure equipment soundness. In the event of a spill, site personnel will immediately notify the NYSDEC (1-800-457-7362), and a spill number will be generated.

10.8 Vapor Release Plan

If work zone organic vapor (excluding methane) exceeds 5 ppm, then a downwind reading will be made either 200 feet from the work zone or at the property line, whichever is closer. If readings at this location exceed 5 ppm over background, the work will be stopped.

If 5 ppm of VOCs are recorded over background on a PID at the property line, then an off-site reading will be taken within 20 feet of the nearest residential or commercial property, whichever is closer. If efforts to mitigate the emission source are unsuccessful for 30 minutes, then the designated site safety officer will:

- Contact the local police;
- Continue to monitor air every 30 minutes, 20 feet from the closest off-site property. If two successive readings are below 5 ppm (non-methane), off-site air monitoring will be halted.
- All property line and off site air monitoring locations and results associated with vapor releases will be recorded in the site safety log book.

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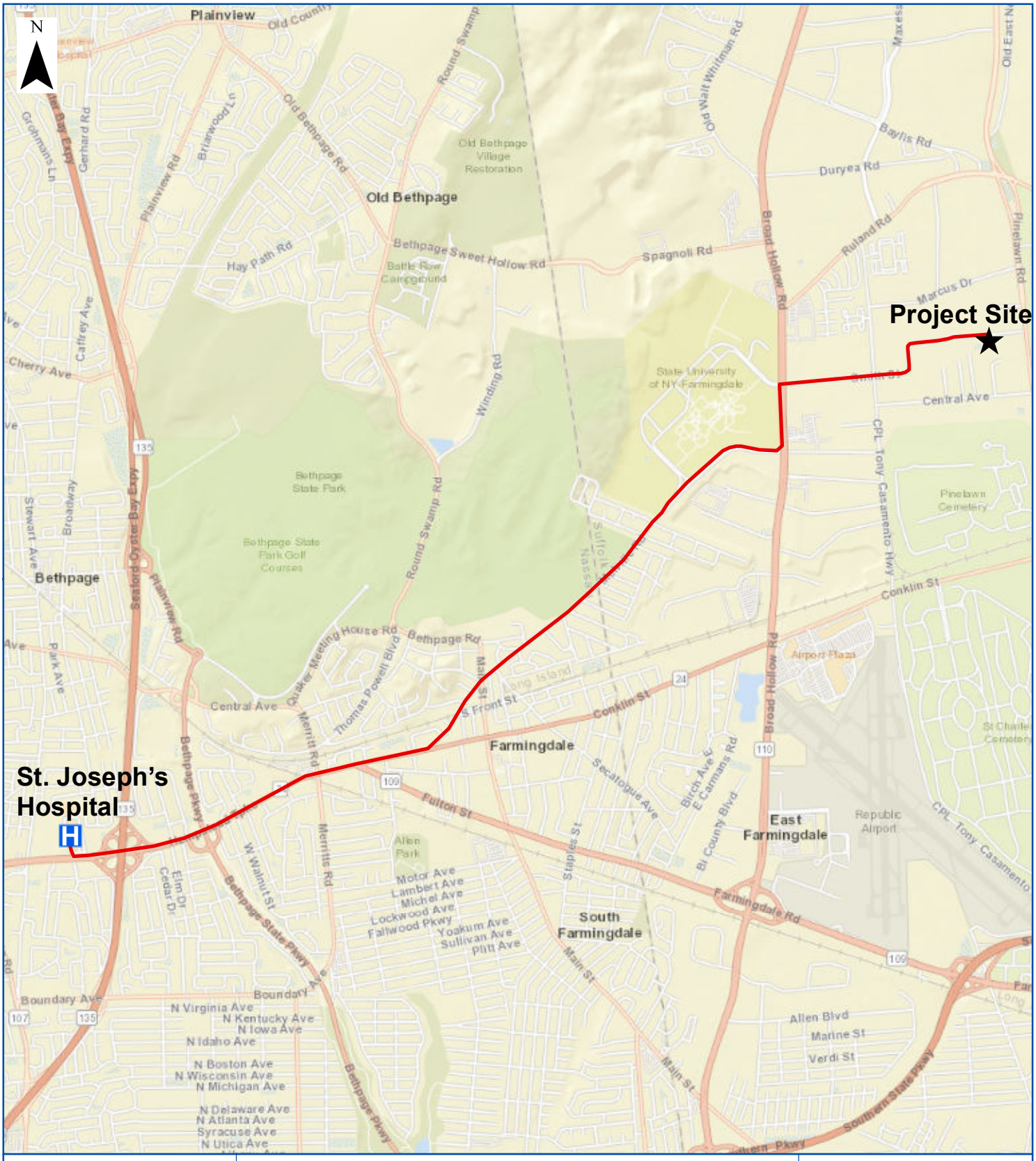
FIGURE



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P.W. Grosser Consulting, Inc.
630 Johnson Ave., Suite 7
Bohemia, NY 11716
Ph: 631-589-6353 • Fax: 631-589-8705
pwgc.info@pwgrosser.com

HOSPITAL ROUTE

St. Joseph's Hospital
4295 Hempstead Turnpike
Bethpage, NY 11714

0 ½ 1 1½ Miles

Site Address:	540 Smith St. Farmingdale, NY
Project: MIN2001	Drawn by: TS
Date: 1/22/2020	Approved by: MM
Coord. Sys:	NAD83 StatePlane NY - Long Island
Figure No:	1

Document Path: W:\Projects\M-R\MIN\2001\maps\HASP\Hospital-Route.mxd

APPENDIX A
SITE SAFETY ACKNOWLEDGMENT FORM

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SITE SAFETY ACKNOWLEDGMENT FORM

This form serves as documentation that field personnel have read, or have been informed of, and understand the provisions of the HASP/EAP. It is maintained on site by the FTL/SHSO as a project record. Each field team member shall sign this section after site-specific training is completed and before being permitted to work on site.

I have read, or have been informed of, the Health and Safety Plan/Emergency Action Plan and understand the information presented. I will comply with the provisions contained therein.

Name (Print and Sign)	Date

APPENDIX B
SITE SAFETY PLAN AMENDMENTS

SITE SAFETY PLAN AMENDMENT FORM

SITE SAFETY PLAN AMENDMENT NUMBER: _____

SITE NAME: _____

REASON FOR AMENDMENT: _____

_____

_____

_____

_____

ALTERNATIVE PROCEDURES: _____

_____

_____

_____

_____

REQUIRED CHANGES IN PPE: _____

_____

_____

_____

_____

_____ _____

SITE SAFETY OFFICER DATE

_____ _____

PROJECT MANAGER DATE

_____ _____

PROJECT DIRECTOR DATE

P.W. GROSSER CONSULTING, INC.
P.W. GROSSER CONSULTING ENGINEER & HYDROGEOLOGIST, P.C.
PHONE: 631.589.6353 PWGROSSER.COM
630 JOHNSON AVENUE, STE 7 BOHEMIA, NY 11716
LONG ISLAND • MANHATTAN • SARATOGA SPRINGS • SYRACUSE • SEATTLE • SHELTON

APPENDIX C
DRILLING PROTOCOLS

SAFETY PROCEDURES DURING THE OPERATION OF DRILLING/PROBING MACHINESINCLUDE, BUT ARE NOT LIMITED TO THE FOLLOWING:

- All site personnel should know the location of the rig emergency shut-off switch prior to beginning operations.
- The rig should be inspected prior to operation to ensure that it is in proper working condition and that all safety devices are functioning.
- Each rig should have a first-aid kit and fire extinguisher which should be inspected to ensure that they are adequate.
- All operators should wear, at a minimum, hard hats, steel-toe safety shoes or boots, gloves and safety glasses. Additional clothing and protective equipment may be required at sites where hazardous conditions are likely. Clothing must be close fitting, without loose ends, straps, draw strings or belts or other unfastened parts that might catch on moving machinery.
- Work areas should be kept free of materials, debris and obstruction, and substances such as grease or oil that could cause a surface to become slick or otherwise hazardous.
- Prior to drilling, the site must be checked to determine whether it can accommodate the rig and supplies and provide a safe working area.
- The drill rig mast (derrick) must be lowered prior to moving between drilling locations.
- The drill rig masts should not be raised if the rig will not be at least 20 feet away from overhead utilities.
- The location of underground utilities should be determined prior to erecting the rig.
- The drill rigs must be properly erected, leveled and stabilized prior to drilling.
- The operator must shut down the vehicle engine before leaving the vicinity of the machine.
- All personnel not directly involved in operating the rig or in sampling should remain clear of the drilling equipment when it is in operation.
- All unattended boreholes must be adequately covered or otherwise protected to prevent trip and fall hazards. All open boreholes should be covered, protected or backfilled as specified in local or state regulations.
- When climbing to or working on a derrick platform that is higher than 20 feet, a safety climbing device should be used.
- The user of wire line hoists, wire rope and hoisting hardware should be as stipulated by the American Iron and Steel Institute Wire Rope User's Manual.
- The rig should be operated in a manner which is consistent with the manufacturers' ratings of speed, force, torque, pressure, flow, etc. The rig and tools should be used for the purposes for which they were intended.

APPENDIX D
HEAT/COLD STRESS PROTOCOLS

HEAT STRESS

Heat Stress (Hyperthermia)

Heat stress is the body's inability to regulate the core temperature. A worker's susceptibility to heat stress can vary according to his/her physical fitness, degree of acclimation to heat, humidity, age and diet.

1. Prior to site activity, the field team leader may make arrangements for heat stress monitoring (i.e., monitoring heart rate, body temperature, and body water loss) during actual site work if conditions warrant. In addition, the FTL is to ensure that each team member has been acclimatized to the prevailing environmental conditions, that personnel are aware of the signs and symptoms of heat sickness, that they have been adequately trained in first aid procedures, and that there are enough personnel on-site to rotate work assignments and schedule work during hours of reduced temperatures. Personnel should not consume alcoholic or caffeinated beverages but rather drink moderate levels of an electrolyte solution and eat well prior to commencing site work.
2. Although there is no specific test given during a baseline physical that would identify a person's intolerance to heat, some indicators are tobacco or medication use, dietary habits, body weight, and chronic conditions such as high blood pressure or diabetes.
3. *Heat cramps*, caused by profuse perspiration with inadequate fluid intake and salt replacement, most often afflict people in good physical condition who work in high temperature and humidity. Heat cramps usually come on suddenly during vigorous activity. Untreated, heat cramps may progress rapidly to heat exhaustion or heat stroke. First aid treatment: remove victim to a cool place and replace lost fluids with water.
4. Thirst is not an adequate indicator of heat exposure. Drinking fluid by itself does not indicate sufficient water replacement during heat exposure. A general rule, the amount of water administered should replace the amount of water lost, and it should be administered at regular intervals throughout the day. For every half pound of water lost, 8 ounces of water should be ingested. Water should be replaced by drinking 2 – 4 ounce servings during every rest period. A recommended alternative to water is an electrolyte drink split 50/50 with water.
5. Heat exhaustion results from salt and water loss along with peripheral pooling of blood. Like heat cramps, heat exhaustion tends to occur in persons in good physical health who are working in high temperatures and humidity. Heat exhaustion may come on suddenly as dizziness and collapse. Untreated, heat exhaustion may progress to heat stroke.

6. Treatment for heat exhaustion: Move the victim to a cool environment (e.g. air-conditioned room/car), lay victim down and fan him/her. If the air-conditioning is not available, remove the victim to a shaded area, remove shirt, and fan. If symptoms do not subside within an hour, notify 911 to transport to hospital.
7. Heat stroke results from the body's inability to dissipate excess heat. A true medical emergency that requires immediate care, it usually occurs when one ignores the signs of heat exhaustion and continues strenuous activities. Working when the relative humidity exceeds 60% is a particular problem. Workers in the early phase of heat stress may not be coherent of they will be confused, delirious or comatose. Changes in behavior, irritability and combativeness are useful early signs of heat stroke.
8. Treatment of heat stroke: Move the victim to a cool, air-conditioned environment. Place victim in a semi-reclined position with head elevated and strip to underclothing. Cool victim as rapidly as possible, applying ice packs to the arms and legs and massaging the neck and torso. Spray victim with tepid water and constantly fan to promote evaporation. Notify 911 to transport to hospital as soon as possible.

SYMPTOMS OF HEAT STRESS

Heat cramps are caused by heavy sweating with inadequate fluid intake. Symptoms include;

- Muscle cramps
- Cramps in the hands, legs, feet and abdomen

Heat exhaustion occurs when body organs attempt to keep the body cool. Symptoms include;

- Pale, cool moist skin
- Core temperature elevated 1-2o
- Thirst
- Anxiety
- Rapid heart rate
- Heavy sweating
- Dizziness
- Nausea

Heat stroke is the most serious form of heat stress. Immediate action must be taken to cool the body before serious injury and death occur. Symptoms are;

- Red, hot, dry skin
- Lack of perspiration
- Seizures
- Dizziness and confusion
- Strong, rapid pulse
- Core temperature of 104o or above
- Coma

HEAT STRESS INDICATORS

Heat stress indicator:	When to measure:	If Exceeds:	Action:
Heart rate (pulse)	Beginning of rest period	110 beats per minute	Shorten next work period by 33%
Oral temperature	Beginning of rest period	99°F (after thermometer is under tongue for 3 minutes) 100.6°F (after thermometer is under tongue for 3 minutes)	Shorten next work period by 33% Prohibit work in impermeable clothing
Body Weight	1. Before workday begins 2. After workday ends		Increase fluid intake

COLD STRESS

Cold stress (Hypothermia)

In hypothermia the core body temperature drops below 95°F. Hypothermia can be attributed to a decrease in heat production, increased heat loss or both.

Prevention

Institute the following steps to prevent overexposure of workers to cold:

1. Maintain body core temperature at 98.6oF or above by encouraging workers to drink warm liquids during breaks (preferably not coffee) and wear several layers of clothing that can keep the body warm even when the clothing is wet.
2. Avoid frostbite by adequately covering hands, feet and other extremities. Clothing such as insulated gloves or mittens, earmuffs and hat liners should be worn. To prevent contact frostbite (from touching metal and cold surfaces below 20°F), workers should wear gloves. Tool handles should be covered with insulating material.
3. Adjust work schedules to provide adequate rest periods. When feasible, rotate personnel and perform work during the warmer hours of the day.
4. Provide heated shelter. Workers should remove their outer layer(s) of clothing while in the shelter to allow sweat to evaporate.
5. In the event that wind barriers are constructed around an intrusive operation (such as drilling), the enclosure must be properly vented to prevent the buildup of toxic or explosive gases or vapors. Care must be taken to keep a heat source away from flammable substances.
6. Using a wind chill chart such as the one included below, obtain the equivalent chill temperature (ECT) based on actual wind speed and temperature. Refer to the ECT when setting up work warm-up schedules, planning appropriate clothing, etc. Workers should use warming shelters at regular intervals at or below an ECT of 20°F. For exposed skin, continuous exposure should not be permitted at or below an ECT of -25°F.

FROSTBITE

Personnel should be aware of symptoms of frostbite/hypothermia. If the following symptoms are noticed in any worker, he/she should immediately go to a warm shelter.

Condition	Skin Surface	Tissue Under Skin	Skin Color
Frostnip	Soft	Soft	Initially red, then white
Frostbite	Hard	Soft	White and waxy
Freezing	Hard	Hard	Blotchy, white to yellow-grey to grey

1. Frostnip is the incipient stage of frostbite, brought about by direct contact with a cold object or exposure of a body part to cool/cold air. Wind chill or cold water also can be major factors. This condition is not serious. Tissue damage is minor and the response to care is good. The tip of the nose, tips of ears, upper cheeks and fingers (all areas generally exposed) are most susceptible to frostnip.
2. Treatment of frostnip: Care for frostnip by warming affected areas. Usually the worker can apply warmth from his/her bare hands, blow warm air on the site, or, if the fingers are involved, hold them in the armpits. During recovery, the worker may complain of tingling or burning sensation, which is normal. If the condition does not respond to this simple care, begin treatment for frostbite.
3. Frostbite: The skin and subcutaneous layers become involved. If frostnip goes untreated, it becomes superficial frostbite. This condition is serious. Tissue damage may be serious. The worker must be transported to a medical facility for evaluation. The tip of the nose, tips of ears, upper cheeks and fingers (all areas generally exposed) are most susceptible to frostbite. The affected area will feel frozen, but only on the surface. The tissue below the surface must still be soft and have normal response to touch. DO NOT squeeze or poke the tissue. The condition of the deeper tissues can be determined by gently palpating the affected area. The skin will turn mottled or blotchy. It may also be white and then turn grayish-yellow.
4. Treatment of frostbite: When practical, transport victim as soon as possible. Get the worker inside and keep him/her warm. Do not allow any smoking or alcohol consumption. Thaw frozen parts by immersion, re-warming in a 100°F to 106°F water bath. Water temperature will drop rapidly, requiring additional warm water throughout the process. Cover the thawed part with a dry sterile dressing. Do not puncture or drain any blisters. NOTE: Never listen to myths and folk tales about the care of frostbite. Never rub a

frostbitten or frozen area. Never rub snow on a frostbitten or frozen area. Rubbing the area may cause serious damage to already injured tissues. Do not attempt to thaw a frozen area if there is any chance it will be re-frozen.

5. General cooling/Hypothermia: General cooling of the body is known as systemic hypothermia. This condition is not a common problem unless workers are exposed to cold for prolonged periods of time without any shelter.

Body Temp (°F)	Body Temp (°C)	Symptoms
99-96	37-35.5	Intense uncontrollable shivering
95-91	35.5-32.7	Violent shivering persists. If victim is conscious, has difficulty speaking.
90-86	32.6-30	Shivering decreases and is replaced by strong muscular rigidity. Muscle coordination is affected. Erratic or jerkey movements are produced. Thinking is less clear. General comprehension is dulled. There may be total amnesia. The worker is generally still able to maintain the appearance of psychological contact with his surroundings.
85-81	29.9-27.2	Victim becomes irrational, loses contact with his environment, and drifts into a stupor. Muscular rigidity continues. Pulse and respirations are slow and the worker may develop cardiac arrhythmias.
80-78	27.1-25.5	Victim becomes unconscious. He does not respond to the spoken word. Most reflexes cease to function. Heartbeat becomes erratic
Below 78	Below 25.5	Cardiac and respiratory centers of the brain fail. Ventricular fibrillation occurs; probably edema and hemorrhage in the lungs; death.

6. Treatment of hypothermia: Keep worker dry. Remove any wet clothing and replace with dry clothes, or wrap person in dry blankets. Keep person at rest. Do not allow him/her to move around. Transport the victim to a medical facility as soon as possible.

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COOLING POWER OF WIND ON EXPOSED FLESH EXPRESSED AS AN EQUIVALENT TEMPERATURE (UNDER CALM CONDITIONS)

Estimated wind Speed (in mph)	Actual Temperature Reading (^{0}F)P											
	50	40	30	20	10	0	10	20	30	40	50	60
	Equivalent Chill Temperature (^{0}F)											
Calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	15	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-146
(Wind speeds greater than 40 mph have little additional effect.)	LITTLE DANGER in < hr with dry skin. Maximum danger of false sense of security.				INCREASING DANGER Danger from freezing of exposed flesh within one minute			GREAT DANGER Flesh may freeze within 30 seconds.				
	Trench foot and imersion foot may occur at any point on this chart											

Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.

(1) Reproduced from American Conference of Governmental Industrial Hygienists, Threshold Limit Values and Biological Exposure Indices for 1985-1986, p.01.

APPENDIX E
CHEMICAL HAZARDS

SAFETY DATA SHEET: PERCHLOROETHYLENE

IN CASE OF TRANSPORTATION EMERGENCY CONTACT:
CHEMTREC:(800) 424-9300

ALL OTHER INQUIRIES:
(770) 904-7042 // www.ciscochem.com
266 Rue Cezzan Lavonia, GA 30553

1. IDENTIFICATION
SUBSTANCE: TETRACHLOROETHYLENE

TRADE NAMES/SYNONYMS:
PERCHLOROETHYLENE; 1,1,2,2-TETRACHLOROETHYLENE; ETHYLENE TETRACHLORIDE; PERC; TETRACHLORETHYLENE; PERCHLORETHYLENE; TETRACHLOROETHENE

CHEMICAL FAMILY: halogenated, aliphatic

2. HAZARDS IDENTIFICATION
NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=0 REACTIVITY=0

EMERGENCY OVERVIEW:
COLOR: colorless
PHYSICAL FORM: volatile liquid
ODOR: faint odor, sweet odor
MAJOR HEALTH HAZARDS: respiratory tract irritation, skin irritation, eye irritation, central nervous system depression, cancer hazard (in humans)

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EXPOSURE: irritation, nausea, vomiting, chest pain, difficulty breathing, irregular heartbeat, headache, drowsiness, dizziness, disorientation, mood swings, loss of coordination, blurred vision, lung congestion, kidney damage, liver damage
LONG TERM EXPOSURE: irritation, nausea, stomach pain, loss of appetite, headache, drowsiness, dizziness, disorientation, sleep disturbances, pain in extremities, loss of coordination, blurred vision, hormonal disorders, internal bleeding, heart damage, liver damage, birth defects, brain damage, tumors, cancer
SKIN CONTACT:
SHORT TERM EXPOSURE: irritation (possibly severe)
LONG TERM EXPOSURE: irritation
EYE CONTACT:
SHORT TERM EXPOSURE: irritation
LONG TERM EXPOSURE: irritation
INGESTION:
SHORT TERM EXPOSURE: same as effects reported in short term inhalation
LONG TERM EXPOSURE: same as effects reported in long term inhalation

3. COMPOSITION
COMPONENT: TETRACHLOROETHYLENE
CAS NUMBER: 127-18-4
PERCENTAGE: 100.0

Hazardous: YES

4. FIRST AID MEASURES

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion:
Aspiration hazard. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Contact:
Wash skin with soap or mild detergent and water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Call a physician.

Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Note to Physician:
Do not administer adrenaline or epinephrine to a victim of chlorinated solvent poisoning.

5. FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS: Negligible fire hazard.

EXTINGUISHING MEDIA: carbon dioxide, regular dry chemical
Large fires: Use regular foam or flood with fine water spray.

FIRE FIGHTING: Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. For tank, rail car or tank truck, evacuation radius: 800 meters (1/2 mile).

FLASH POINT: No data available.

Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode

6. ACCIDENTAL RELEASE MEASURES

SOIL RELEASE:
Dig holding area such as lagoon, pond or pit for containment. Dike for later disposal. Absorb with sand or other non-combustible material.

WATER RELEASE:
Absorb with activated carbon. Remove trapped material with suction hoses. Subject to California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65). Keep out of water supplies and sewers.

OCCUPATIONAL RELEASE:
Avoid heat, flames, sparks and other sources of ignition. Stop leak if possible without personal risk. Small liquid spills: Absorb with sand or other non-combustible material. Large spills: Dike for later disposal. Remove sources of ignition. Keep unnecessary people away, isolate hazard area and deny entry. Notify Local Emergency Planning Committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304). If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at (800)424-8802 (USA) or (202)426-2675 (USA).

7. HANDLING AND STORAGE

Store in a cool, dry, ventilated area away from sources of heat or ignition. Isolate from flammable materials. Protect from direct sunlight. Wear special protective equipment (Sec. 8) for maintenance break-in or where exposures may exceed established exposure levels. Wash hands, face, forearms and neck when exiting restricted areas. Shower, dispose of outer clothing, change to clean garments at the end of the day. Avoid cross-contamination of street clothes. Wash hands before eating and do not eat, drink, or

smoke in workplace. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. EXPOSURE CONTROLS AND PERSONAL PROECTION

Airborne Exposure Limits:
-OSHA Permissible Exposure Limit (PEL): 100 ppm (TWA), 200 ppm (ceiling),
300 ppm/5min/3-hour (max)
-ACGIH Threshold Limit Value (TLV):
25 ppm (TWA), 100 ppm (STEL); listed as A3, animal carcinogen

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, Industrial Ventilation, A Manual of Recommended Practices, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or full face shield where dusting or splashing of solutions is possible. Maintain eye wash fountain and quick-drench facilities in work area.

CLOTHING: Wear appropriate chemical resistant clothing. GLOVES: Wear appropriate chemical resistant gloves.

RESPIRATOR: The following respirators and maximum use concentrations are drawn from NIOSH and/or OSHA.

At any detectable concentration -
Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.
Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive- pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure- demand or other positive-pressure mode.

Escape -
Any air-purifying full-facepiece respirator (gas mask) with a chin-style, front-mounted or back-mounted organic vapor canister.
Any appropriate escape-type, self-contained breathing apparatus.

For Unknown Concentrations or Immediately Dangerous to Life or Health -
Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive- pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure- demand or other positive-pressure mode.
Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: liquid
APPEARANCE: clear
COLOR: colorless
PHYSICAL FORM: volatile liquid
ODOR: faint odor, sweet odor
MOLECULAR WEIGHT: 165.83
MOLECULAR FORMULA: Cl2-C-C-Cl2
BOILING POINT: 250 F (121 C)
FREEZING POINT: -2 F (-19 C)
VAPOR PRESSURE: 14 mmHg @ 20 C

VAPOR DENSITY (air=1): 5.83
SPECIFIC GRAVITY (water=1): 1.6227
WATER SOLUBILITY: 0.015%
PH: Not available
VOLATILITY: Not available
ODOR THRESHOLD: 50 ppm
EVAPORATION RATE: 2.8 (butyl acetate=1)
COEFFICIENT OF WATER/OIL DISTRIBUTION: Not available
SOLVENT SOLUBILITY:
Soluble: alcohol, ether, benzene, chloroform, oils

10. STABILITY AND REACTIVITY

Stability:
Stable under ordinary conditions of use and storage. Slowly decomposed by light. Deteriorates rapidly in warm, moist climates.

Hazardous Decomposition Products:
Carbon dioxide and carbon monoxide may form when heated to decomposition. Hydrogen chloride gas and phosgene gas may be formed upon heating. Decomposes with moisture to yield trichloroacetic acid and hydrochloric acid.

Hazardous Polymerization:
Will not occur.

Incompatibilities:
Strong acids, strong oxidizers, strong alkalis, especially NaOH, KOH; finely divided metals, especially zinc, barium, lithium. Slowly corrodes aluminum, iron and zinc.

Conditions to Avoid:
Moisture, light, heat and incompatibles.

11. TOXICOLOGICAL INFORMATION

TETRACHLOROETHYLENE:
IRRITATION DATA: 810 mg/24 hour(s) skin-rabbit severe; 500 mg/24 hour(s) skin-rabbit mild; 162 mg eyes-rabbit mild; 500 mg/24 hour(s) eyes-rabbit mild

TOXICITY DATA: 4100 ppm/6 hour(s) inhalation-rat LC50; >10000 mg/kg skin-rabbit LD50 (Dow); 2629 mg/kg oral-rat LD50

CARCINOGEN STATUS: NTP: Anticipated Human Carcinogen; IARC: Human Limited Evidence, Animal Sufficient Evidence, Group 2A; ACGIH: A3 -Confirmed Animal Carcinogen; EC: Category 2

LOCAL EFFECTS:
Irritant: inhalation, skin, eye

ACUTE TOXICITY LEVEL:
Moderately Toxic: ingestion
Slightly Toxic: inhalation

TARGET ORGANS: central nervous system

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: eye disorders, heart or cardiovascular disorders, kidney disorders, liver disorders, nervous system disorders, skin disorders and allergies

TUMORIGENIC DATA: Available.

MUTAGENIC DATA: Available.

REPRODUCTIVE EFFECTS DATA: Available.

ADDITIONAL DATA: May be excreted in breast milk. Alcohol may enhance the toxic effects. Stimulants such as epinephrine may induce ventricular fibrillation.

12. ECOLOGICAL INFORMATION

ECOTOXICITY DATA:

FISH TOXICITY: 8430 ug/L 96 hour(s) LC50 (Mortality) Flagfish (Jordanella floridae)

INVERTEBRATE TOXICITY: 7500 ug/L 48 hour(s) EC50 (Immobilization) Water flea (Daphnia magna)

ALGAL TOXICITY: 509000 ug/L 96 hour(s) EC50 (Photosynthesis) Diatom (Skeletonema costatum)

FATE AND TRANSPORT:

BIOCONCENTRATION: 49 ug/L 1-21 hour(s) BCF (Residue) Bluegill (Lepomis macrochirus) 3.43 ug/L

Environmental Fate:
When released into the soil, this material is expected to quickly evaporate. When released into the soil, this material may leach into groundwater. When released into the soil, this material may biodegrade to a moderate extent. When released to water, this material is expected to quickly evaporate. When released into water, this material is not expected to biodegrade. This material is not expected to significantly bioaccumulate. When released into the air, this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals.

Environmental Toxicity:
The LC50/96-hour values for fish are between 1 and 10 mg/l. The LC50/96-hour values for fish are between 10 and 100 mg/l. This material is expected to be toxic to aquatic life.

13. DISPOSAL CONSIDERATIONS

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. TRANSPORT INFORMATION

Domestic (Land, D.O.T.)

Proper Shipping Name: TETRACHLOROETHYLENE Hazard Class: 6.1
UN/NA: UN1897
Packing Group: III
Information reported for product/size: 20L
International (Water, I.M.O.)

Proper Shipping Name: TETRACHLOROETHYLENE Hazard Class: 6.1
UN/NA: UN1897
Packing Group: III
Information reported for product/size: 20L

Proper shipping paperwork:

UN 1897, Tetrachoroethylene, 6.1, PG III

Marine Pollutant

15. REGULATORY INFORMATION

U.S. REGULATIONS:
CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4): TETRACHLOROETHYLENE (PERCHLOROETHYLENE): 100 LBS RQ

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES

(40 CFR 355 Subpart B): Not regulated.

SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES
(40 CFR 355 Subpart C): Not regulated.

SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370 Subparts B and C):
ACUTE: Yes
CHRONIC: Yes
FIRE: No
REACTIVE: No
SUDDEN RELEASE: No

SARA TITLE III SECTION 313 (40 CFR 372.65): TETRACHLOROETHYLENE (PERCHLOROETHYLENE)

OSHA PROCESS SAFETY (29 CFR 1910.119): Not regulated.
STATE REGULATIONS:
California Proposition 65:
Known to the state of California to cause the following: TETRACHLOROETHYLENE (PERCHLOROETHYLENE) Cancer (Apr 01, 1988)

CANADIAN REGULATIONS: WHMIS CLASSIFICATION: D2

NATIONAL INVENTORY STATUS:
U.S. INVENTORY (TSCA): Listed on inventory.

TSCA 12(b) EXPORT NOTIFICATION: Not listed. CANADA INVENTORY (DSL/NDSL): Not determined.

16. OTHER INFORMATION

NFPA Ratings: Health: 2 Flammability: 0 Reactivity: 0

Label Hazard Warning:
WARNING! HARMFUL IF SWALLOWED, INHALED OR ABSORBED THROUGH SKIN. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM, LIVER AND KIDNEYS. SUSPECT CANCER HAZARD. MAY CAUSE CANCER. Risk of cancer depends
on level and duration of exposure.

Label Precautions:
Do not get in eyes, on skin, or on clothing.
Do not breathe vapor or mist.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.

Label First Aid:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. In all cases call a physician.

Product Use:
Laboratory Reagent.

CISCO provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product.
Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. CISCO MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS.

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Date Created: 5/18/2015
Date Updated: 6/11/2015

SAFETY DATA SHEET

Trichloroethylene

Airgas
an Air Liquide company

Section 1. Identification

GHS product identifier : Trichloroethylene

Chemical name : trichloroethylene

Other means of identification : trichloroethene; Ethene, 1,1,2-trichloro-; Ethene, trichloro-; Trichlorethylene; Ethylene, trichloro-

Product use : Synthetic/Analytical chemistry.

Synonym : trichloroethene; Ethene, 1,1,2-trichloro-; Ethene, trichloro-; Trichlorethylene; Ethylene, trichloro-

SDS # : 001206

Supplier's details : Airgas USA, LLC and its affiliates
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

24-hour telephone : 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : SKIN CORROSION/IRRITATION - Category 2
SERIOUS EYE DAMAGE/ EYE IRRITATION - Category 2A
GERM CELL MUTAGENICITY - Category 2
CARCINOGENICITY - Category 1
AQUATIC HAZARD (LONG-TERM) - Category 3

GHS label elements

Hazard pictograms :

Signal word : Danger

Hazard statements : Causes serious eye irritation.
Causes skin irritation.
May cause cancer.
Suspected of causing genetic defects.
Harmful to aquatic life with long lasting effects.

Precautionary statements

General : Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand.

Prevention : Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Wear protective gloves. Wear eye or face protection. Wear protective clothing. Avoid release to the environment. Wash hands thoroughly after handling.

Response : IF exposed or concerned: Get medical attention. IF ON SKIN: Wash with plenty of soap and water. Take off contaminated clothing and wash it before reuse. If skin irritation occurs: Get medical attention. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical attention.

Storage : Store locked up.

Disposal : Dispose of contents and container in accordance with all local, regional, national and international regulations.

Section 2. Hazards identification

Hazards not otherwise classified : None known.

Section 3. Composition/information on ingredients

Substance/mixture : Substance

Chemical name : trichloroethylene

Other means of identification : trichloroethene; Ethene, 1,1,2-trichloro-; Ethene, trichloro-; Trichlorethylene; Ethylene, trichloro-

CAS number/other identifiers

CAS number : 79-01-6

Product code : 001206

Ingredient name	%	CAS number
trichloroethylene	100	79-01-6

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband. In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Wash contaminated clothing thoroughly with water before removing it, or wear gloves. Continue to rinse for at least 10 minutes. Get medical attention. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : Wash out mouth with water. Remove dentures if any. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Stop if the exposed person feels sick as vomiting may be dangerous. Do not induce vomiting unless directed to do so by medical personnel. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Get medical attention. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : Causes serious eye irritation.

Inhalation : No known significant effects or critical hazards.

Skin contact : Causes skin irritation.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Ingestion : No known significant effects or critical hazards.

Section 4. First aid measures

Over-exposure signs/symptoms

Eye contact : Adverse symptoms may include the following:, pain or irritation, watering, redness

Inhalation : No specific data.

Skin contact : Adverse symptoms may include the following:, irritation, redness

Ingestion : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.

Specific treatments : No specific treatment.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media : None known.

Specific hazards arising from the chemical : In a fire or if heated, a pressure increase will occur and the container may burst. This material is harmful to aquatic life with long lasting effects. Fire water contaminated with this material must be contained and prevented from being discharged to any waterway, sewer or drain.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide
halogenated compounds
carbonyl halides

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Avoid breathing vapor or mist. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Section 6. Accidental release measures

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air). Water polluting material. May be harmful to the environment if released in large quantities.

Methods and materials for containment and cleaning up

Small spill : Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble. Alternatively, or if water-insoluble, absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.

Large spill : Stop leak if without risk. Move containers from spill area. Approach release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see Section 13). Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilled product. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Avoid exposure - obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Do not get in eyes or on skin or clothing. Do not ingest. Avoid breathing vapor or mist. Avoid release to the environment. If during normal use the material presents a respiratory hazard, use only with adequate ventilation or wear appropriate respirator. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Empty containers retain product residue and can be hazardous. Do not reuse container.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Store locked up. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

trichloroethylene

ACGIH TLV (United States, 3/2016).
STEL: 25 ppm 15 minutes.
TWA: 10 ppm 8 hours.
OSHA PEL 1989 (United States, 3/1989).
STEL: 1080 mg/m³ 15 minutes.
STEL: 200 ppm 15 minutes.
TWA: 270 mg/m³ 8 hours.
TWA: 50 ppm 8 hours.
OSHA PEL Z2 (United States, 2/2013).
AMP: 300 ppm 5 minutes.
CEIL: 200 ppm
TWA: 100 ppm 8 hours.

Section 8. Exposure controls/personal protection

Appropriate engineering controls : If user operations generate dust, fumes, gas, vapor or mist, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: chemical splash goggles.

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state : Liquid. [Watery liquid.]

Color : Colorless.

Molecular weight : 131.38 g/mole

Molecular formula : C2-H-Cl3

Boiling/condensation point : 86.7°C (188.1°F)

Melting/freezing point : -84.8°C (-120.6°F)

Critical temperature : Not available.

Odor : Characteristic.

Odor threshold : Not available.

pH : Not available.

Flash point : Not available.

Burning time : Not applicable.

Burning rate : Not applicable.

Evaporation rate : 6.39 (butyl acetate = 1)

Flammability (solid, gas) : Not available.

Section 9. Physical and chemical properties

Lower and upper explosive (flammable) limits : Lower: 8%
Upper: 10.5%

Vapor pressure : 9.9 kPa (74.256033302 mm Hg) [room temperature]

Vapor density : 4.5 (Air = 1)

Specific Volume (ft ^{3}/lb) : 0.6849

Gas Density (lb/ft ^{3}) : 1.46

Relative density : 1.5

Solubility : Not available.

Solubility in water : 1.1 g/l

Partition coefficient: n-octanol/water : 2.53

Auto-ignition temperature : 410°C (770°F)

Decomposition temperature : Not available.

SADT : Not available.

Viscosity : Dynamic (room temperature): 0.58 mPa·s (0.58 cP)

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : No specific data.

Incompatible materials : No specific data.

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
trichloroethylene	LC50 Inhalation Vapor LD50 Dermal LD50 Oral	Rat Rabbit Rat	140700 mg/m³ >20 g/kg 4920 mg/kg	1 hours - -

IDLH : 1000 ppm

Irritation/Corrosion

Product/ingredient name	Result	Species	Score	Exposure	Observation
trichloroethylene	Eyes - Moderate irritant Skin - Severe irritant	Rabbit Rabbit	- -	24 hours 20 milligrams 24 hours 2 milligrams	- -

Sensitization

Not available.

Section 11. Toxicological information

Mutagenicity

Not available.

Carcinogenicity

Not available.

Classification

Product/ingredient name	OSHA	IARC	NTP
trichloroethylene	-	1	Reasonably anticipated to be a human carcinogen.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : Causes serious eye irritation.

Inhalation : No known significant effects or critical hazards.

Skin contact : Causes skin irritation.

Ingestion : No known significant effects or critical hazards.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : Adverse symptoms may include the following:, pain or irritation, watering, redness

Inhalation : No specific data.

Skin contact : Adverse symptoms may include the following:, irritation, redness

Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.

Carcinogenicity : May cause cancer. Risk of cancer depends on duration and level of exposure.

Mutagenicity : Suspected of causing genetic defects.

Section 11. Toxicological information

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Product/ingredient name	Result	Species	Exposure
trichloroethylene	Acute EC50 95000 µg/l Marine water	Algae - Skeletonema costatum	96 hours
	Acute EC50 36.5 mg/l Fresh water	Algae - Chlamydomonas reinhardtii - Exponential growth phase	72 hours
	Acute LC50 20 mg/l Marine water	Crustaceans - Elminius modestus	48 hours
	Acute LC50 18 mg/l Fresh water	Daphnia - Daphnia magna	48 hours
	Acute LC50 3100 µg/l Fresh water	Fish - Jordanella floridae - Juvenile (Fledgling, Hatchling, Weanling)	96 hours
	Chronic EC10 12.3 mg/l Fresh water	Algae - Chlamydomonas reinhardtii - Exponential growth phase	72 hours
	Chronic NOEC 10 mg/l Fresh water	Daphnia - Daphnia magna	21 days

Persistence and degradability

Not available.

Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
trichloroethylene	2.53	17	low

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Section 13. Disposal considerations

United States - RCRA Toxic hazardous waste "U" List

Ingredient	CAS #	Status	Reference number
Trichloroethylene; Ethene, trichloro-	79-01-6	Listed	U228

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1710	UN1710	UN1710	UN1710	UN1710
UN proper shipping name	TRICHLOROETHYLENE	TRICHLOROETHYLENE	TRICHLOROETHYLENE	TRICHLOROETHYLENE	TRICHLOROETHYLENE
Transport hazard class(es)	6.1 	6.1 	6.1 	6.1 	6.1 
Packing group	III	III	III	III	III
Environment	No.	No.	No.	No.	No.
Additional information	**Reportable quantity** 100 lbs / 45.4 kg [8. 2147 gal / 31.096 L] Package sizes shipped in quantities less than the product reportable quantity are not subject to the RQ (reportable quantity) transportation requirements. **Limited quantity** Yes. **Packaging instruction** **Passenger aircraft** Quantity limitation: 60 L **Cargo aircraft** Quantity limitation: 220 L **Special provisions** IB3, N36, T4, TP1, T1	Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.26-2.36 (Class 6). **Explosive Limit and Limited Quantity Index** 5	-	-	**Passenger and Cargo Aircraft**Quantity limitation: 60 L **Cargo Aircraft Only** Quantity limitation: 220 L **Limited Quantities - Passenger Aircraft** Quantity limitation: 2 L

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 5(a)2 final significant new use rules**: trichloroethylene

TSCA 8(a) CDR Exempt/Partial exemption: Not determined

TSCA 12(b) one-time export: trichloroethylene

United States inventory (TSCA 8b): This material is listed or exempted.

Clean Water Act (CWA) 307: trichloroethylene

Clean Water Act (CWA) 311: trichloroethylene

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Immediate (acute) health hazard
Delayed (chronic) health hazard

Composition/information on ingredients

Name	%	Fire hazard	Sudden release of pressure	Reactive	Immediate (acute) health hazard	Delayed (chronic) health hazard
trichloroethylene	100	No.	No.	No.	Yes.	Yes.

SARA 313

	Product name	CAS number	%
Form R - Reporting requirements	trichloroethylene	79-01-6	100
Supplier notification	trichloroethylene	79-01-6	100

SARA 313 notifications must not be detached from the SDS and any copying and redistribution of the SDS shall include copying and redistribution of the notice attached to copies of the SDS subsequently redistributed.

State regulations

Massachusetts : This material is listed.

New York : This material is listed.

New Jersey : This material is listed.

Pennsylvania : This material is listed.

California Prop. 65

WARNING: This product contains a chemical known to the State of California to cause cancer and birth defects or other reproductive harm.

Section 15. Regulatory information

Ingredient name	Cancer	Reproductive	No significant risk level	Maximum acceptable dosage level
trichloroethylene	Yes.	Yes.	14 µg/day (ingestion) 50 µg/day (inhalation)	No.

International regulations

International lists

National inventory

Australia : This material is listed or exempted.

Canada : This material is listed or exempted.

China : This material is listed or exempted.

Europe : This material is listed or exempted.

Japan : This material is listed or exempted.

Malaysia : This material is listed or exempted.

New Zealand : This material is listed or exempted.

Philippines : This material is listed or exempted.

Republic of Korea : This material is listed or exempted.

Taiwan : This material is listed or exempted.

Canada

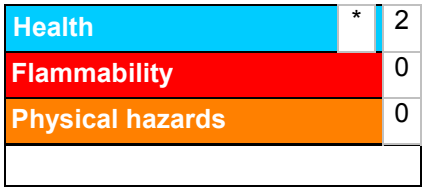
WHMIS (Canada) : Class D-1B: Material causing immediate and serious toxic effects (Toxic).
Class D-2A: Material causing other toxic effects (Very toxic).
Class D-2B: Material causing other toxic effects (Toxic).

CEPA Toxic substances: This material is listed.
Canadian ARET: This material is not listed.
Canadian NPRI: This material is listed.
Alberta Designated Substances: This material is not listed.
Ontario Designated Substances: This material is not listed.
Quebec Designated Substances: This material is not listed.

Section 16. Other information

Canada Label requirements : Class D-1B: Material causing immediate and serious toxic effects (Toxic).
Class D-2A: Material causing other toxic effects (Very toxic).
Class D-2B: Material causing other toxic effects (Toxic).

Hazardous Material Information System (U.S.A.)



Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks Although HMIS® ratings are not required on SDSs under 29 CFR 1910. 1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

National Fire Protection Association (U.S.A.)

Section 16. Other information

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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Procedure used to derive the classification

Classification	Justification
Skin Irrit. 2, H315	Expert judgment
Eye Irrit. 2A, H319	Expert judgment
Muta. 2, H341	Expert judgment
Carc. 1, H350	Expert judgment
Aquatic Chronic 3, H412	Expert judgment

History

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Date of previous issue : No previous validation

Version : 0.01

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL 73/78 = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United Nations

References : Not available.

Indicates information that has changed from previously issued version.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

REGENESIS
Technology-Based Solutions for the Environment

SAFETY DATA SHEET

1. Identification

Product identifier **3-D Microemulsion®**

Other means of identification None.

Recommended use Remediation of soils and groundwater.

Recommended restrictions None known.

Manufacturer/Importer/Supplier/Distributor information

Company Name Regenesis

Address 1011 Calle Sombra
San Clemente, CA 92673

Telephone 949-366-8000

E-mail CustomerService@regenesis.com

Emergency phone number CHEMTREC® at 1-800-424-9300 (International)

2. Hazard(s) identification

Physical hazards Not classified.

Health hazards

Skin corrosion/irritation	Category 2
Serious eye damage/eye irritation	Category 1

OSHA defined hazards Not classified.

Label elements

Signal word Danger

Hazard statement Causes skin irritation. Causes serious eye damage.

Precautionary statement

Prevention Wash thoroughly after handling. Wear protective gloves. Wear eye/face protection.

Response If on skin: Wash with plenty of water. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a poison center/doctor. If skin irritation occurs: Get medical advice/attention. Take off contaminated clothing and wash before reuse.

Storage Store away from incompatible materials.

Disposal Dispose of waste and residues in accordance with local authority requirements.

Hazard(s) not otherwise classified (HNOC) None known.

3. Composition/information on ingredients

Mixtures

Chemical name	CAS number	%
HRC-PED	823190-10-9	48-53
Fatty Acids (neutralized)	61790-12-3 or 112-80-1	30-35
Glycerol Tripolylactate	201167-72-8	<10

Composition comments All concentrations are in percent by weight unless otherwise indicated.

4. First-aid measures

Inhalation	Move to fresh air. Call a physician if symptoms develop or persist.
Skin contact	Remove contaminated clothing. Wash with plenty of soap and water. If skin irritation occurs: Get medical advice/attention. Wash contaminated clothing before reuse.
Eye contact	Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention immediately.
Ingestion	Rinse mouth. Never give anything by mouth to a victim who is unconscious or is having convulsions. Do not induce vomiting without advice from poison control center. Get medical attention if symptoms occur.
Most important symptoms/effects, acute and delayed	Severe eye irritation. Symptoms may include stinging, tearing, redness, swelling, and blurred vision. Permanent eye damage including blindness could result. Skin irritation. May cause redness and pain.
Indication of immediate medical attention and special treatment needed	Provide general supportive measures and treat symptomatically. Keep victim under observation. Symptoms may be delayed.
General information	Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

5. Fire-fighting measures

Suitable extinguishing media	Water spray. Carbon dioxide (CO2). Dry chemical powder. Foam.
Unsuitable extinguishing media	Do not use water jet as an extinguisher, as this will spread the fire.
Specific hazards arising from the chemical	During fire, gases hazardous to health may be formed. Combustion products may include: carbon oxides, phosphorus compounds and metal oxides.
Special protective equipment and precautions for firefighters	Self-contained breathing apparatus and full protective clothing must be worn in case of fire.
Fire fighting equipment/instructions	Move containers from fire area if you can do so without risk. Water spray should be used to cool containers.
Specific methods	Use standard firefighting procedures and consider the hazards of other involved materials.
General fire hazards	No unusual fire or explosion hazards noted.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures	Keep unnecessary personnel away. Keep people away from and upwind of spill/leak. Surfaces may become slippery after spillage. Wear appropriate protective equipment and clothing during clean-up. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Ensure adequate ventilation. Local authorities should be advised if significant spillages cannot be contained. For personal protection, see section 8 of the SDS.
Methods and materials for containment and cleaning up	Spilled product may create a slipping hazard. The product is immiscible with water and will spread on the water surface. Large Spills: Stop the flow of material, if this is without risk. Use water spray to reduce vapors or divert vapor cloud drift. Dike the spilled material, where this is possible. Cover with plastic sheet to prevent spreading. Absorb in vermiculite, dry sand or earth and place into containers. Following product recovery, flush area with water. Flush area clean with lots of water. Be aware of potential for surfaces to become slippery. Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination. Never return spills to original containers for re-use. For waste disposal, see section 13 of the SDS.
Environmental precautions	Avoid discharge into drains, water courses or onto the ground.

7. Handling and storage

Precautions for safe handling	Do not get this material in contact with eyes. Avoid contact with eyes, skin, and clothing. Provide adequate ventilation. Wear appropriate personal protective equipment. Observe good industrial hygiene practices.
Conditions for safe storage, including any incompatibilities	Store in original tightly closed container. Store in a cool, dry, well-ventilated place. Store away from incompatible materials (see Section 10 of the SDS). Recommended storage containers: plastic lined steel, plastic, glass, aluminum, stainless steel, or reinforced fiberglass.

8. Exposure controls/personal protection

Occupational exposure limits	No exposure limits noted for ingredient(s).
Biological limit values	No biological exposure limits noted for the ingredient(s).
Appropriate engineering controls	Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. Eye wash facilities and emergency shower must be available when handling this product.

Individual protection measures, such as personal protective equipment

Eye/face protection	Wear approved, tight fitting indirect vented or non-vented safety goggles where splashing is probable. Face shield is recommended.
Skin protection	
Hand protection	Wear appropriate chemical resistant gloves. Rubber or vinyl-coated gloves are recommended.
Other	Wear appropriate chemical resistant clothing.
Respiratory protection	If engineering controls do not maintain airborne concentrations below recommended exposure limits (where applicable) or to an acceptable level (in countries where exposure limits have not been established), an approved respirator must be worn.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
General hygiene considerations	Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

Appearance	
Physical state	Liquid.
Form	Semi-solid.
Color	Amber.
Odor	Odorless.
Odor threshold	Not available.
pH	Not available.
Melting point/freezing point	Not available.
Initial boiling point and boiling range	Not available.
Flash point	> 200.0 °F (> 93.3 °C) Closed Cup
Evaporation rate	Not available.
Flammability (solid, gas)	Not available.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	Not available.
Flammability limit - upper (%)	Not available.
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Relative density	0.9 - 1.1
Solubility(ies)	
Solubility (water)	Insoluble.
Solubility (other)	Slightly soluble in acetone.
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	Not available.

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Undergoes hydrolysis in water to form lactic acid, glycerol and fatty acids.
Possibility of hazardous reactions	No dangerous reaction known under conditions of normal use.
Conditions to avoid	Avoid temperatures exceeding the flash point. Contact with incompatible materials.
Incompatible materials	Strong oxidizing agents. Bases. Acids.
Hazardous decomposition products	Thermal decomposition or combustion may produce: carbon oxides, phosphorus compounds, metal oxides.

11. Toxicological information

Information on likely routes of exposure

Inhalation	May cause irritation to the respiratory system.
Skin contact	Causes skin irritation.
Eye contact	Causes serious eye damage.
Ingestion	Ingestion may cause irritation and malaise.
Symptoms related to the physical, chemical and toxicological characteristics	Severe eye irritation. Symptoms may include stinging, tearing, redness, swelling, and blurred vision. Permanent eye damage including blindness could result. Skin irritation. May cause redness and pain.

Information on toxicological effects

Acute toxicity	Not available.
Skin corrosion/irritation	Causes skin irritation.
Serious eye damage/eye irritation	Causes serious eye damage.

Respiratory or skin sensitization

Respiratory sensitization	Not a respiratory sensitizer.
Skin sensitization	This product is not expected to cause skin sensitization.
Germ cell mutagenicity	No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.
Carcinogenicity	This product is not considered to be a carcinogen by IARC, ACGIH, NTP, or OSHA.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

Reproductive toxicity	This product is not expected to cause reproductive or developmental effects.
Specific target organ toxicity - single exposure	Not classified.
Specific target organ toxicity - repeated exposure	Not classified.
Aspiration hazard	Not an aspiration hazard.

12. Ecological information

Ecotoxicity	The product is not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.
Persistence and degradability	Material is readily degradable and undergoes hydrolysis in several hours.
Bioaccumulative potential	No data available.
Mobility in soil	The product is immiscible in water.
Other adverse effects	None known.

13. Disposal considerations

Disposal instructions	Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Dispose of contents/container in accordance with local/regional/national/international regulations.
Local disposal regulations	Dispose in accordance with all applicable regulations.
Hazardous waste code	The waste code should be assigned in discussion between the user, the producer and the waste disposal company.

Waste from residues / unused products	Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).
Contaminated packaging	Empty containers should be taken to an approved waste handling site for recycling or disposal. Since emptied containers may retain product residue, follow label warnings even after container is emptied.

14. Transport information

DOT

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code	Not established.

15. Regulatory information

US federal regulations

This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.
One or more components are not listed on TSCA.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories	Immediate Hazard - Yes Delayed Hazard - No Fire Hazard - No Pressure Hazard - No Reactivity Hazard - No

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical	Yes

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Not regulated.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA)	Not regulated.

US state regulations

US. Massachusetts RTK - Substance List

Not regulated.

US. New Jersey Worker and Community Right-to-Know Act

Not listed.

US. Pennsylvania Worker and Community Right-to-Know Law

Fatty Acids (neutralized) (CAS 61790-12-3 or 112-80-1)

US. Rhode Island RTK

Not regulated.

US. California Proposition 65

California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65): This material is not known to contain any chemicals currently listed as carcinogens or reproductive toxins.

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	No
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

Issue date 22-April-2015

Revision date -

Version # 01

Further information HMIS® is a registered trade and service mark of the American Coatings Association (ACA).

HMIS® ratings Health: 3
Flammability: 1
Physical hazard: 0

NFPA ratings

Disclaimer Regenesis cannot anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use. The information in the sheet was written based on the best knowledge and experience currently available.

REGENESIS
Technology-Based Solutions for the Environment

SAFETY DATA SHEET

1. Identification

Product identifier	**Bio-Dechlor INOCULUM® Plus**
Other means of identification	DHC microbial consortium (SDC-9).
Recommended use	Soil and Groundwater Remediation.
Recommended restrictions	None known.

Manufacturer/Importer/Supplier/Distributor information

Company Name	Regenesis
Address	1011 Calle Sombra San Clemente, CA 92673
Telephone	949-366-8000
E-mail	CustomerService@regenesis.com
Emergency phone number	CHEMTREC® at 1-800-424-9300 (International)

2. Hazard(s) identification

Physical hazards	Not classified.
Health hazards	Not classified.
OSHA defined hazards	Not classified.

Label elements

Hazard symbol	None.
Signal word	None.
Hazard statement	The mixture does not meet the criteria for classification.
Precautionary statement	
Prevention	Observe good industrial hygiene practices.
Response	Wash hands after handling.
Storage	Store away from incompatible materials.
Disposal	Dispose of waste and residues in accordance with local authority requirements.
Hazard(s) not otherwise classified (HNOC)	None known.

3. Composition/information on ingredients

Mixtures

The manufacturer lists no ingredients as hazardous according to OSHA 29 CFR 1910.1200.

Chemical name	CAS number	%
DHC microbial consortium comprised of microorganisms of the genus Dehalococcoides	Not Applicable	100

Composition comments All concentrations are in percent by weight unless otherwise indicated.

4. First-aid measures

Inhalation	Move to fresh air. Call a physician if symptoms develop or persist.
Skin contact	Wash off with soap and water. Get medical attention if irritation develops and persists.
Eye contact	Rinse with water. Get medical attention if irritation develops and persists.
Ingestion	Rinse mouth. Get medical attention if symptoms occur.
Most important symptoms/effects, acute and delayed	Direct contact with eyes may cause temporary irritation.
Indication of immediate medical attention and special treatment needed	Treat symptomatically.

General information	If you feel unwell, seek medical advice (show the label where possible). Show this safety data sheet to the doctor in attendance.

5. Fire-fighting measures

Suitable extinguishing media	Carbon dioxide (CO2). Water. Foam.
Unsuitable extinguishing media	None known.
Specific hazards arising from the chemical	During fire, gases hazardous to health may be formed.
Special protective equipment and precautions for firefighters	Self-contained breathing apparatus and full protective clothing must be worn in case of fire.
Fire fighting equipment/instructions	Move containers from fire area if you can do so without risk.
Specific methods	Use standard firefighting procedures and consider the hazards of other involved materials. Use water spray to keep fire-exposed containers cool.
General fire hazards	No unusual fire or explosion hazards noted. The product itself does not burn.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures	Keep unnecessary personnel away. Avoid contact with spilled material. For personal protection, see section 8 of the SDS.
Methods and materials for containment and cleaning up	This product is miscible in water. Disinfect the spill area with 5% bleach solution after clean-up. Large Spills: Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Cover with plastic sheet to prevent spreading. Absorb in vermiculite, dry sand or earth and place into containers. Following product recovery, flush area with water. Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination. Never return spills to original containers for re-use. For waste disposal, see section 13 of the SDS.
Environmental precautions	Avoid discharge into drains, water courses or onto the ground.

7. Handling and storage

Precautions for safe handling	Avoid prolonged exposure. Observe good industrial hygiene practices. Wear appropriate personal protective equipment (See Section 8).
Conditions for safe storage, including any incompatibilities	Store in original tightly closed container. Recommended storage containers: plastic lined steel, plastic, glass, aluminum, stainless steel, or reinforced fiberglass. Store away from incompatible materials (see Section 10 of the SDS). Store in a cool, dry area at 4 - 5°C (39 - 41°F).

8. Exposure controls/personal protection

Occupational exposure limits	No exposure limits noted for ingredient(s).
Biological limit values	No biological exposure limits noted for the ingredient(s).
Appropriate engineering controls	General ventilation normally adequate. Provide eyewash station.

Individual protection measures, such as personal protective equipment

Eye/face protection	Tightly fitting safety goggles.
Skin protection	
Hand protection	The following glove materials are recommended: vinyl or rubber.
Other	Wear suitable protective clothing.
Respiratory protection	Not normally needed. In case of insufficient ventilation, wear suitable respiratory equipment. If engineering controls do not maintain airborne concentrations below recommended exposure limits (where applicable) or to an acceptable level (in countries where exposure limits have not been established), an approved respirator must be worn.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
General hygiene considerations	Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

Appearance	
Physical state	Liquid.
Form	Liquid.
Color	Murky yellow.
Odor	Musty.
Odor threshold	Not available.
pH	Not available.
Melting point/freezing point	Not available.
Initial boiling point and boiling range	212 °F (100 °C)
Flash point	Not flammable.
Evaporation rate	Not available.
Flammability (solid, gas)	Not applicable.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	Not available.
Flammability limit - upper (%)	Not available.
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Relative density	0.9 - 1.1
Solubility(ies)	
Solubility (water)	Soluble.
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	Not available.

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Material is stable under normal conditions.
Possibility of hazardous reactions	No dangerous reaction known under conditions of normal use.
Conditions to avoid	Contact with incompatible materials. Keep from freezing.
Incompatible materials	Strong oxidizing agents. Bases. Acids.
Hazardous decomposition products	No hazardous decomposition products are known.

11. Toxicological information

Information on likely routes of exposure

Inhalation	Prolonged inhalation may be harmful.
Skin contact	Prolonged or repeated skin contact may result in minor irritation.
Eye contact	Direct contact with eyes may cause temporary irritation.
Ingestion	Ingestion may cause irritation and stomach discomfort.
Symptoms related to the physical, chemical and toxicological characteristics	Direct contact with eyes may cause temporary irritation.

Information on toxicological effects

Acute toxicity	Not expected to be acutely toxic.
Skin corrosion/irritation	Prolonged skin contact may cause temporary irritation.
Serious eye damage/eye irritation	Direct contact with eyes may cause temporary irritation.
Respiratory or skin sensitization	
Respiratory sensitization	Not a respiratory sensitizer.
Skin sensitization	This product is not expected to cause skin sensitization.
Germ cell mutagenicity	No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.
Carcinogenicity	This product is not considered to be a carcinogen by IARC, ACGIH, NTP, or OSHA.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

Reproductive toxicity	This product is not expected to cause reproductive or developmental effects.
Specific target organ toxicity - single exposure	Not classified.
Specific target organ toxicity - repeated exposure	Not classified.
Aspiration hazard	Not an aspiration hazard.
Chronic effects	Prolonged inhalation may be harmful.
Further information	May be harmful by inhalation, ingestion, or skin absorption via bacterial action.

12. Ecological information

Ecotoxicity	The product is not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.
Persistence and degradability	This material will degrade in the environment. Material is readily degradable and undergoes hydrolysis in several hours.
Bioaccumulative potential	No data available.
Mobility in soil	Expected to be highly mobile in soil.
Other adverse effects	None known.

13. Disposal considerations

Disposal instructions	Collect and reclaim or dispose in sealed containers at licensed waste disposal site.
Local disposal regulations	Dispose in accordance with all applicable regulations.
Hazardous waste code	The waste code should be assigned in discussion between the user, the producer and the waste disposal company.
Waste from residues / unused products	Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).
Contaminated packaging	Empty containers should be taken to an approved waste handling site for recycling or disposal. Since emptied containers may retain product residue, follow label warnings even after container is emptied.

14. Transport information

DOT

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code	Not available.

15. Regulatory information

US federal regulations

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories

Immediate Hazard - No
Delayed Hazard - No
Fire Hazard - No
Pressure Hazard - No
Reactivity Hazard - No

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical No

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Not regulated.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA) Not regulated.

US state regulations

US. Massachusetts RTK - Substance List

Not regulated.

US. New Jersey Worker and Community Right-to-Know Act

Not listed.

US. Pennsylvania Worker and Community Right-to-Know Law

Not listed.

US. Rhode Island RTK

Not regulated.

US. California Proposition 65

Not Listed.

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	No
Canada	Domestic Substances List (DSL)	No
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	No
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	No
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	No
Korea	Existing Chemicals List (ECL)	No
New Zealand	New Zealand Inventory	No
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	No

Country(s) or region	Inventory name	On inventory (yes/no)*
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	No

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

Issue date 12-February-2015

Revision date -

Version # 01

Further information HMIS® is a registered trade and service mark of the American Coatings Association (ACA).

HMIS® ratings
Health: 0
Flammability: 0
Physical hazard: 0

NFPA ratings

Disclaimer Regenesis cannot anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use. The information in the sheet was written based on the best knowledge and experience currently available.

REGENESIS
Technology-Based Solutions for the Environment

SAFETY DATA SHEET

1. Identification

Product identifier	**Chemical Reducing Solution (CRS®)**
Other means of identification	None.
Recommended use	Soil and Groundwater Remediation.
Recommended restrictions	None known.

Manufacturer/Importer/Supplier/Distributor information

Company Name	Regenesis
Address	1011 Calle Sombra San Clemente, CA 92673
Telephone	949-366-8000
E-mail	CustomerService@regenesis.com
Emergency phone number	CHEMTREC® at 1-800-424-9300 (International)

2. Hazard(s) identification

Physical hazards	Not classified.
Health hazards	Not classified.
OSHA defined hazards	Not classified.

Label elements

Hazard symbol	None.
Signal word	None.
Hazard statement	The mixture does not meet the criteria for classification.
Precautionary statement	
Prevention	Observe good industrial hygiene practices.
Response	Wash hands after handling.
Storage	Store away from incompatible materials.
Disposal	Dispose of waste and residues in accordance with local authority requirements.
Hazard(s) not otherwise classified (HNOC)	None known.

3. Composition/information on ingredients

Mixtures

The manufacturer lists no ingredients as hazardous according to OSHA 29 CFR 1910.1200.

Chemical name	CAS number	%
Water	7732-18-5	85-92
Ferrous Gluconate	299-29-6	8-15

Composition comments All concentrations are in percent by weight unless otherwise indicated.

4. First-aid measures

Inhalation	Move to fresh air. Call a physician if symptoms develop or persist.
Skin contact	Remove contaminated clothing and shoes. Wash off with soap and water. Get medical attention if irritation develops and persists.
Eye contact	Rinse with water. Get medical attention if irritation develops and persists.
Ingestion	Rinse mouth. Never give anything by mouth to a victim who is unconscious or is having convulsions. Do not induce vomiting without advice from poison control center. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs. Get medical attention if symptoms occur.

Most important symptoms/effects, acute and delayed	Direct contact with eyes may cause temporary irritation.
Indication of immediate medical attention and special treatment needed	Treat symptomatically.
General information	If you feel unwell, seek medical advice (show the label where possible). Show this safety data sheet to the doctor in attendance.

5. Fire-fighting measures

Suitable extinguishing media	Small fires: Dry chemical powder. Larger fires: Water spray, fog or foam.
Unsuitable extinguishing media	None known.
Specific hazards arising from the chemical	During fire, gases hazardous to health may be formed. Combustion products may include: carbon monoxide, carbon dixoide, iron oxides.
Special protective equipment and precautions for firefighters	Use protective equipment appropriate for surrounding materials.
Fire fighting equipment/instructions	Move containers from fire area if you can do so without risk.
Specific methods	Use standard firefighting procedures and consider the hazards of other involved materials. Use water spray to keep fire-exposed containers cool.
General fire hazards	No unusual fire or explosion hazards noted. The product itself does not burn.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures	Keep unnecessary personnel away. Avoid contact with spilled material. For personal protection, see section 8 of the SDS.
Methods and materials for containment and cleaning up	This product is miscible in water. Large Spills: Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Cover with plastic sheet to prevent spreading. Absorb in vermiculite, dry sand or earth and place into containers. Following product recovery, flush area with water. Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination. Never return spills to original containers for re-use. For waste disposal, see section 13 of the SDS.
Environmental precautions	Avoid discharge into drains, water courses or onto the ground.

7. Handling and storage

Precautions for safe handling	Avoid contact with eyes, skin, and clothing. Avoid prolonged exposure. Avoid breathing spray mist. Use with adequate ventilation. Observe good industrial hygiene practices. Wear appropriate personal protective equipment (See Section 8).
Conditions for safe storage, including any incompatibilities	Store in original tightly closed container. Store in a cool, dry, well-ventilated place. Store away from incompatible materials (see Section 10 of the SDS). Keep away from extreme heat and strong oxidizing agents.

8. Exposure controls/personal protection

Occupational exposure limits	No exposure limits noted for ingredient(s).
Biological limit values	No biological exposure limits noted for the ingredient(s).
Appropriate engineering controls	Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. Provide eyewash station and safety shower.

Individual protection measures, such as personal protective equipment

Eye/face protection	Use safety glasses. Where contact with eyes is likely, use chemical goggles. Use a face shield as needed.
Skin protection	
Hand protection	Wear appropriate chemical resistant gloves.
Other	Wear suitable protective clothing. Wear appropriate chemical resistant gloves.

Respiratory protection	In case of insufficient ventilation, wear suitable respiratory equipment. If engineering controls do not maintain airborne concentrations below recommended exposure limits (where applicable) or to an acceptable level (in countries where exposure limits have not been established), an approved respirator must be worn. Wear respiratory protection during operations where spraying or misting occurs. If respirators are used, a program should be instituted to assure compliance with OSHA 29 CFR 1910.134.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
General hygiene considerations	Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

Appearance	
Physical state	Liquid.
Form	Liquid.
Color	Dark green to black.
Odor	Odorless.
Odor threshold	Not available.
pH	6 - 8
Melting point/freezing point	Not available.
Initial boiling point and boiling range	Not available.
Flash point	Not flammable.
Evaporation rate	Not available.
Flammability (solid, gas)	Not applicable.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	Not available.
Flammability limit - upper (%)	Not available.
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Relative density	1 - 1.2
Solubility(ies)	
Solubility (water)	Miscible
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	Not available.

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	A component of this product can oxidize in air: iron (II) to iron (III).
Possibility of hazardous reactions	No dangerous reaction known under conditions of normal use.
Conditions to avoid	Contact with incompatible materials. Keep from freezing.
Incompatible materials	Oxidizing agents.
Hazardous decomposition products	Thermal decomposition can produce oxides of carbon and iron.

11. Toxicological information

Information on likely routes of exposure

Inhalation	Prolonged inhalation may be harmful.
Skin contact	Prolonged or repeated skin contact may result in minor irritation.
Eye contact	Direct contact with eyes may cause temporary irritation.
Ingestion	Expected to be a low ingestion hazard.
Symptoms related to the physical, chemical and toxicological characteristics	Direct contact with eyes may cause temporary irritation.

Information on toxicological effects

Acute toxicity	Not expected to be acutely toxic.
Skin corrosion/irritation	Prolonged skin contact may cause temporary irritation.
Serious eye damage/eye irritation	Direct contact with eyes may cause temporary irritation.
Respiratory or skin sensitization	
Respiratory sensitization	Not a respiratory sensitizer.
Skin sensitization	This product is not expected to cause skin sensitization.
Germ cell mutagenicity	No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.
Carcinogenicity	This product is not considered to be a carcinogen by IARC, ACGIH, NTP, or OSHA.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

Reproductive toxicity	This product is not expected to cause reproductive or developmental effects.
Specific target organ toxicity - single exposure	Not classified.
Specific target organ toxicity - repeated exposure	Not classified.
Aspiration hazard	Not an aspiration hazard.
Chronic effects	Prolonged inhalation may be harmful.
Further information	Ferrous Gluconate Dihydrate (6047-12-7) is Generally Recognized as Safe (GRAS) (21 CFR §184.1308).

12. Ecological information

Ecotoxicity	The product is not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.
Persistence and degradability	No data is available on the degradability of this product.
Bioaccumulative potential	No data available.
Mobility in soil	Expected to be highly mobile in soil.
Other adverse effects	None known.

13. Disposal considerations

Disposal instructions	Collect and reclaim or dispose in sealed containers at licensed waste disposal site.
Local disposal regulations	Dispose in accordance with all applicable regulations.
Hazardous waste code	The waste code should be assigned in discussion between the user, the producer and the waste disposal company.
Waste from residues / unused products	Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).
Contaminated packaging	Empty containers should be taken to an approved waste handling site for recycling or disposal. Since emptied containers may retain product residue, follow label warnings even after container is emptied.

14. Transport information

DOT

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not available.

15. Regulatory information

US federal regulations

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories

Immediate Hazard - No
Delayed Hazard - No
Fire Hazard - No
Pressure Hazard - No
Reactivity Hazard - No

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical No

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Not regulated.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA) Not regulated.

US state regulations

US. Massachusetts RTK - Substance List

Not regulated.

US. New Jersey Worker and Community Right-to-Know Act

Not listed.

US. Pennsylvania Worker and Community Right-to-Know Law

Not listed.

US. Rhode Island RTK

Not regulated.

US. California Proposition 65

Not Listed.

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No

Country(s) or region	Inventory name	On inventory (yes/no)*
China	Inventory of Existing Chemical Substances in China (IECSC)	No
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	Yes
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	No
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

Issue date 26-February-2015

Revision date -

Version # 01

Further information HMIS® is a registered trade and service mark of the American Coatings Association (ACA).

HMIS® ratings Health: 1
Flammability: 0
Physical hazard: 0

NFPA ratings

Disclaimer Regenesis cannot anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use. The information in the sheet was written based on the best knowledge and experience currently available.

APPENDIX F
CONFINED SPACE ENTRY CHECKLIST/PERMIT

PWGC
CLIENT DRIVEN SOLUTIONS

CONFINED SPACE ENTRY PERMIT

Confined Space □	Hazardous Area □	Non Permit Required □

Notes:
No work will be performed unless the space meets non permit requirements
Permit valid 8 hours only. All copies of permit will remain at this job site until job is completed.
A single entry permit can be filled out prior to start of daily work.
SAFETY STANDBY PERSON IS REQUIRED FOR ALL CONFINED SPACE WORK

Site Location and Description:_____
Purpose of Entry:_____
Supervisor(s) in charge of Crew:_____

Requirements	**Date**	**Time**	**Requirements**	**Date**	**Time**
Lock Out/De-energize/try-out			**Full Body Harness w/"D" Ring**		
Line(s) Broken-capped-blanked			**Emergency Escape Retrieval**		
Purged-Flush and Vent			**Lifelines**		
Ventilation			Fire Extinguishers		
Secure Area (Post and Flag)			Lighting (Explosive Proof)		
Breathing Apparatus			Protective Clothing		
Resuscitator-Inhalator			Respirator(s) (Air Purifying)		
Standby Safety Personnel			Burning and Welding Permit		

BOLD DENOTES MINIMUM REQUIREMENTS TO BE COMPLETED & REVIEWED PRIOR TO ENTRY
Items that do not apply enter N/A in the blank

Monitoring Tests	Permissible Entry Levels	Results (record every 30 minutes beginning ½ hour prior to entry)							
Oxygen	19.5 to 23.5%								
LEL	Below 10%								
Hydrogen sulfide (H_2S)	10ppm† 15ppm‡								

†Short term exposure limit (STEL)
‡8 hour Time weighted average (TWA)

Monitoring Equipment

_____
Type Model # Serial #

_____
Type Model # Serial #

Safety standby person(s):_____
Supervisor authorizing entry:_____

APPENDIX G
EMERGENCY INFORMATION

EMERGENCY PHONE NUMBERS

General Emergencies - Police/Fire Department/Ambulance	911
Local Emergency Medical Center (St. Joseph's Hospital)	1-516-579-6000
National Response Center	1-800-424-8802
Poison Control	1-800-222-1222
NYSDEC Spills Division	1-800-457-7362
NYSDEC Hazardous Waste Division	1-631-444-0375
Suffolk County Department of Health	1-631-787-2200
PWGC Project Director, James Rhodes	1-631-589-6353
PWGC Project Manager/Health & Safety Manager, Ryan Morley	1-631-589-6353
PWGC Site Safety Officer, Kaitlyn Crosby (or assignee)	1-631-664-2016

PWGC
CLIENT DRIVEN SOLUTIONS

INCIDENT / NEAR MISS REPORT AND INVESTIGATION - PAGE 1 OF 2
TYPE OF INCIDENT - CHECK ALL THAT APPLY
☐ INJURY/ILLNESS ☐ VEHICLE DAMAGE ☐ PROPERTY DAMAGE ☐ FIRE ☐ SPILL/RELEASE ☐ PERMIT EXCEEDENCE ☐ NEAR MISS ☐ OTHER
GENERAL INFORMATION
PROJECT NAME: DATE OF REPORT: REPORT NO.:
DATE OF INCIDENT: TIME: DAY OF WEEK:
LOCATION OF INCIDENT:
WEATHER CONDITIONS: ADEQUATE LIGHTING AT SCENE? ☐ YES ☐ NO ☐ N/A
DESCRIBE WHAT HAPPENED (STEP BY STEP - USE ADDITIONAL PAGES IF NECESSARY)
AFFECTED EMPLOYEE INFORMATION
NAME: EMPLOYEE: ☐ YES ☐ NO
HOME ADDRESS:
SOCIAL SECURITY NO.: HOME PHONE NO.:
JOB CLASSIFICATION: YEARS IN JOB CLASSIFICATION:
HOURS WORKED ON SHIFT PRIOR TO INCIDENT: AGE:
DID INCIDENT RELATE TO ROUTINE TASK FOR JOB CLASSIFICATION? ☐ YES ☐ NO
INJURY/ILLNESS INFORMATION
NATURE OF INJURY OR ILLNESS:
OBJECT/EQUIPMENT/SUBSTANCE CAUSING HARM:
FIRST AID PROVIDED? ☐ YES ☐ NO
IF YES, WHERE WAS IT GIVEN: ☐ ON-SITE ☐ OFF-SITE
IF YES, WHO PROVIDED FIRST AID:
WILL THE INJURY/ILLNESS RESULT IN: ☐ RESTRICTED DUTY ☐ LOST TIME ☐ UNKNOWN

INCIDENT / NEAR MISS REPORT AND INVESTIGATION - PAGE 2 OF 2 REPORT NO.
MEDICAL TREATMENT INFORMATION
WAS MEDICAL TREATMENT PROVIDED? ☐ YES ☐ NO
IF YES, WAS MEDICAL TREATMENT PROVIDED: ☐ ON-SITE ☐ DR.'S OFFICE ☐ HOSPITAL
NAME OF PERSON(S) PROVIDING TREATMENT:
ADDRESS WHERE TREATMENT WAS PROVIDED:
TYPE OF TREATMENT:
VEHICLE AND PROPERTY DAMAGE INFORMATION
VEHICLE/PROPERTY DAMAGED:
DESCRIPTION OF DAMAGE:
SPILL AND AIR EMISSIONS INFORMATION:
SUBSTANCE SPILLED OR RELEASED: FROM WHERE: TO WHERE:
ESTIMATED QUANTITY/DURATION:
CERCLA HAZARDOUS SUBSTANCE? ☐ YES ☐ NO
REPORTABLE TO AGENCY? ☐ YES ☐ NO SPECIFY:
WRITTEN REPORT: ☐ YES ☐ NO TIME FRAME:
RESPONSE ACTION TAKEN:
PERMIT EXCEEDENCE
TYPE OF PERMIT: PERMIT #:
DATE OF EXCEEDENCE: DATE FIRST KNOWLEDGE OF EXCEEDENCE:
PERMITTED LEVEL OR CRITERIA:
EXCEEDENCE LEVEL OR CRITERIA:
REPORTABLE TO AGENCY? ☐ YES ☐ NO SPECIFY:
WRITTEN REPORT: ☐ YES ☐ NO TIME FRAME:
RESPONSE ACTION TAKEN:
NOTIFICATIONS
NAMES OF PERSONNEL NOTIFIED: DATE/TIME:
CLIENT NOTIFIED: DATE/TIME:
AGENCY NOTIFIED: DATE/TIME:
CONTACT NAME:
PERSONS PREPARING REPORT
EMPLOYEE'S NAME:(PRINT) SIGN:
SUPERVISOR'S NAME:(PRINT) SIGN:

INVESTIGATIVE REPORT			
DATE OF INCIDENT:	DATE OF REPORT:	REPORT NUMBER:	
INCIDENT COST: ESTIMATED: $_____		ACTUAL: $_____	
OSHA RECORDABLE(S): ☐ YES ☐ NO # RESTRICTED DAYS ____ # DAYS AWAY FROM WORK ____			
CAUSE ANALYSIS			
IMMEDIATE CAUSES - WHAT ACTIONS AND CONDITIONS CONTRIBUTED TO THIS EVENT?			
BASIC CAUSES - WHAT SPECIFIC PERSONAL OR JOB FACTORS CONTRIBUTED TO THIS EVENT?			
ACTION PLAN			
REMEDIAL ACTIONS - WHAT HAS AND OR SHOULD BE DONE TO CONTROL EACH OF THE CAUSES LISTED?			
ACTION	PERSON RESPONSIBLE	TARGET DATE	COMPLETION DATE
PERSONS PERFORMING INVESTIGATION			
INVESTIGATOR'S NAME: (PRINT)	SIGN:	DATE:	
INVESTIGATOR'S NAME: (PRINT)	SIGN:	DATE:	
INVESTIGATOR'S NAME: (PRINT)	SIGN:	DATE:	
MANAGEMENT REVIEW			
PROJECT MANAGER: (PRINT)	SIGN:	DATE:	
COMMENTS:			
H&S MANAGER: (PRINT)	SIGN:	DATE:	
COMMENTS:			

EXAMPLES OF IMMEDIATE CAUSES

Substandard Actions

Substandard Conditions

1. Operating equipment without authority
2. Failure to warn
3. Failure to secure
4. Operating at improper speed
5. Making safety devices inoperable
6. Removing safety devices
7. Using defective equipment
8. Failure to use PPE properly
9. Improper loading
10. Improper placement
11. Improper lifting
12. Improper position for task
13. Servicing equipment in operation
14. Under influence of alcohol/drugs
15. Horseplay

1. Guards or barriers
2. Protective equipment
3. Tools, equipment, or materials
4. Congestion
5. Warning system
6. Fire and explosion hazards
7. Poor housekeeping
8. Noise exposure
9. Exposure to hazardous materials
10. Extreme temperature exposure
11. Illumination
12. Ventilation
13. Visibility

EXAMPLES OF BASIC CAUSES

Personal Factors

1. Capability
2. Knowledge
3. Skill
4. Stress
5. Motivation
6. Work Standards
7. Wear and tear
8. Abuse or misuse

Job Factors

1. Supervision
2. Engineering
3. Purchasing
4. Maintenance
5. Tools/equipment

MANAGEMENT PROGRAMS FOR CONTROL OF INCIDENTS

1. Leadership and administration
2. Management training
3. Planned inspections
4. Task analysis and procedures
5. Task observation
6. Emergency preparedness
7. Organizational rules
8. Accident/incident analysis
9. Personal protective equipment
10. Health control
11. Program audits
12. Engineering controls
13. Personal communications
14. Group meetings
15. General promotion
16. Hiring and placement
17. Purchasing controls