ENHANCED ANAEROBIC BIOREMEDIATION (EAB) INJECTION PILOT TEST WORK PLAN

PRIDE SOLVENTS & CHEMICAL CO.
WEST BABYLON, NEW YORK 11704

NYSDEC Site No. 152025
Work Assignment No. D009812-17

Submitted to:

NEW YORK STATE OF OPPORTUNITY. Department of Environmental Conservation

Division of Environmental Remediation
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1.0 INTRODUCTION

In accordance with the New York State Department of Environmental Conservation (NYSDEC) Division of Environmental Remediation (DER) Work Assignment (WA) No. D009812-17 approval letter dated July 23, 2021, TRC has prepared this Enhanced Anaerobic Bioremediation (EAB) Injection Pilot Test Work Plan for the Pride Solvents & Chemical Co. Site (NYSDEC Site No. 152025).

Except where specifically indicated otherwise, the NYSDEC's selected call-out contractor (Contractor) shall be responsible for performing or subcontracting all of the work described herein. TRC will review submittals and oversee all work to confirm completion consistent with the intent of the project documents. Pre-, mid-, and post-injection submittal and reporting requirements are described in the sections below. Note that the Contractor, in order to complete the work, may be required to supply additional information and submittals that are not listed in this Work Plan.

The pilot test will be conducted to test injection means and methods and obtain design data for the EAB remedy for impacts to deep groundwater. Deep groundwater at the Site is identified as Operable Unit 2 (OU-2) in the March 2013 Record of Decision (ROD), which requires the establishment of a horizontal EAB permeable reactive barrier (PRB) to treat OU-2 groundwater impacts. The EAB remedy was further evaluated in the February 2018 Pre-Design Investigation (PDI) Report prepared by CDM, which defines the extent of OU-2. The pilot test will be conducted in a part of the parking lot south of 78 Lamar Street, within a the downgradient portion of the OU-2 treatment zone.

2.0 SITE SETTING AND BACKGROUND

2.1 Site Location and Setting

The Site is located at 78 and 88 Lamar Street in West Babylon, Suffolk County, New York. A Site location map is provided as *Figure 1*. The site is located within the West Babylon Industrial Area. To the north, south, east, and west of the Site are various commercial and manufacturing facilities. Approximately 500 feet west of the Site is the Babylon Town Landfill.

The Site is approximately 1.38 acres and is currently developed with two buildings. Paved parking, loading and unloading, and storage areas are present to the north of the 88 Lamar Street building, south of the 78 Lamar Street building, and between both buildings. The Site is mostly developed with buildings and asphalt or concrete ground surface coverings. In front of each building are small landscaped areas. A paved storage area is present behind (north of) 78-88 Lamar Street. Additionally, the northern portion of the property at 88 Lamar Street is unpaved. Damaged asphalt pavement extends to approximately halfway between the Site buildings and the north property line; beyond the pavement, the lot is sand and gravel.

There are several existing groundwater monitoring wells, installed during previous investigation work, present onsite and at offsite properties. Additionally, there is on the Site a network of air sparge/soil vapor extraction (AS/SVE) wells from prior pilot testing work. As described below, existing monitoring wells will be used in the pre- and post-injection sampling and monitoring programs (as appropriate). The locations of existing on-Site monitoring and AS/SVE wells can be found on *Figure 2*. Information regarding the off-Site wells can be found within the historic reports referenced below. An inventory of monitoring wells has been included as *Table 1*.

Chlorinated volatile organic compounds (CVOCs) have been detected at elevated concentrations in soil samples collected near the interface between Upper Glacial Aquifer and the clay unit beneath the Site and in deep groundwater samples collected from monitoring wells screened at across the interface. The CVOC concentrations in deep groundwater indicated the potential for dense non-aqueous phase liquid (DNAPL) to be present in the aquifer above the clay unit, and DNAPL was detected during the 2018 Pre-Design Investigation in monitoring well MW-101D, located north of the 78 Lamar Street building. The CVOC plume was initially documented in the 2010 Remedial Investigation (RI) Report and further defined during the 2018 Pre-Design Investigation. A shallow CVOC plume (OU-1) is also present on Site; however, note, OU-1 remediation is not addressed as part of this work plan. Additional information and Site history can be found in the prior reporting completed for the Site. A repository of prior reports for the Site is maintained by the NYSDEC and can be found here: https://www.dec.ny.gov/data/DecDocs/152025/.

2.2 Geology and Hydrogeology

The depth to groundwater at the Site is approximately 10 feet below ground surface (bgs), and the predominant direction of groundwater flow is to the south-southeast. The Upper Glacial Aquifer, the shallowest hydrogeologic unit in the area of the Site, extends to a depth of approximately 80 feet. Beneath the Upper Glacial Aquifer is a clay unit which acts as a confining layer. The Upper Glacial Aquifer is comprised of permeable glacial outwash deposit soils and has an estimated horizontal hydraulic conductivity of up to 270 feet per day and an estimated vertical anisotropy of 10:1 (favoring lateral flow over horizontal), according to the Pre-Design Investigation Report.

The clay unit, believed to be the regional Gardiners Clay, was typically encountered during prior investigations at and around the Site, except for an area beneath the northern portion of the Site. The clay layer thickness ranges from 10 to 20 feet. The clay surface elevation varies and has been described as being "wrinkled" or scoured, leaving potential depressions for DNAPL to collect. The average vertical hydraulic conductivity of the clay unit has been reported to be 0.001 feet/day, or approximately 5 orders of magnitude lower than the Upper Glacial Aquifer. The high organic content of the clay, along with matrix diffusion, can act as a contaminant sink, potentially allowing the clay that has been in contact with DNAPL to serve as a slow-release, long-term source of CVOCs over time, sustaining the groundwater contaminant plume.

The clay surface is an important factor in the proposed remedy for the Site. The horizontal permeable reactive barrier (PRB) will be installed across this clay surface to prevent further contaminant transport due to DNAPL migration or dissolution, and to mitigate back diffusion of CVOCs mass from the clay, which can act as a long-term source for groundwater contamination.

2.3 Selected Groundwater Remedy and Treatment Objective

The goal for the remedial program is to restore the Site to pre-disposal conditions to the extent feasible, and at a minimum the remedy shall eliminate or mitigate all significant threats to public health and the environment. The OU-2 remedial action objectives (RAOs) are limited to groundwater and include:

RAOs for Public Health Protection:

- Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.
- Prevent contact with, or inhalation of volatiles, from contaminated groundwater.

RAOs for Environmental Protection:

- Restore groundwater aquifer to pre-disposal/pre-release conditions, to the extent practicable.
- Remove the source of ground or surface water contamination.

The March 2013 Record of Decision (ROD) specifies for OU-2 the installation of a horizontal PRB using enhanced anaerobic bioremediation (EAB). A PRB is an in-situ method for remediating contaminated groundwater that combines a passive chemical or biological treatment zone with subsurface fluid flow management. The treatment amendments typically may either degrade or retain the contaminants as impacted groundwater migrates through the PRB.

The EAB will be implemented via the injection of electron donors/carbon source, viscosity enhancing agents, nutrients, pH buffering agents and microbial cultures, collectively referred to as the amendments. The amendments will be injected to establish a sufficiently thick reactive zone (horizontal PRB) that will cover the most highly impacted section of the clay layer. The PRB will reduce the CVOC mass flux migration of contamination from the clay into the groundwater. The anticipated chemical gradients induced between the PRB and the clay will enhance back diffusion rates of CVOCs out of the clay, promoting degradation to less toxic byproducts in the PRB.

2.4 Bench and Pilot Scale Testing Objective

The proposed laboratory bench scale and field pilot scale testing program is intended to provide the data needed for design of the full-scale EAB for OU-2. The bench scale and pilot test results will be used to prepare the full-scale design, which will likely consist of several rows of injection wells oriented perpendicular to the direction of groundwater flow. The spacing of the wells, injection volumes and amendment loading rates, and the required frequency of re-applications will be determined based on the data from these tests.

The bench scale testing will consist of the following:

- Acid neutralization testing to select the pH buffer and dosages to maintain circum-neutral pH levels.
- Fluid viscosity enhancements tests to assess shear-thinning additives to increase amendment viscosity and prevent rapid “washout” from the treatment zone.
- Sorption tests to estimate amendment sorption potential onto soil near injection wells.
- Degradation tests to estimate amendment and contaminant half-lives and degradation rates.

Ursus Remediation Testing & Technologies, LLC (Ursus), of Mt. Horeb, Wisconsin, will conduct the bench scale treatability testing. Soil and groundwater samples, collected from the proposed injection well locations, will be delivered to the laboratory for the bench scale testing. Potable water shall be collected from the source proposed for the EAB pilot test in the requisite submittal described in Section 8.0 of this work plan.

The pilot test was recommended in the February 2018 Pre-Design Investigation Report prepared by CDM Smith. The pilot test will be conducted at the Site using a series of two (2) injection wells, eight (8) piezometers, and four (4) existing monitoring wells. The injections are anticipated to take up to 10 days to complete in the field, and follow-up soil and groundwater sampling will be completed after the pilot test to assess effectiveness and longevity, providing information needed for the full-scale design.

The specific design parameters the pilot test will determine include:

- Achievable Radius of Influence (ROI)/Area of Influence (AOI)
  - Determined by observations and sampling at the proposed piezometer locations.
  - The high permeability and groundwater flow rate is expected to result in an AOI that is not circular and is elongated in the direction of groundwater flow.
  - The lateral ROI (perpendicular to groundwater flow) will be used to define the spacing between injection points, while downgradient ROI will be used to define the number of rows of injection points that will be needed in the full-scale design.

- Achievable Flowrates and Injection Pressures
  - Determined by observing injection flow rates and pressure during pilot test amendment injection.
  - Daylighting of the injection fluid is not expected to be a major concern during the pilot test or full-scale injection program due to the depth of the treatment zone.

- Treatment Effectiveness
  - Ability to establish and maintain conditions appropriate for EAB including circum-neutral pH, negative oxidation/reduction potential (ORP), low to non-measurable dissolved oxygen (DO) and elevated dissolved organic carbon.
  - Ability to retain amendment in the injection zone at adequate dosages for extended periods of time to establish an effective horizontal PRB. The test results will be used along with the bench scale test results to assess required amendment re-application frequencies and dosages.
  - Ability to prevent the dissolution of DNAPL or desorption/back diffusion of PCE from the clay layer to prevent the clay from acting as a continuing source of dissolved PCE contamination downgradient.
  - Growth and persistence of the bacteria species required to sustain reductive dichlorination will be monitored.

3.0 BENCH SCALE TREATABILITY TESTING PREPARATION

Soil samples will be collected during injection well installation and groundwater will be collected from the injection wells following well development. The samples will be delivered to Ursus for bench scale treatability testing. The proposed injection wells will be installed in the locations shown on *Figure 3*. Quantities and relative depths of soil samples are identified below along with the injection well construction details. Groundwater sampling methods for the treatability testing are also described below. The bench scale treatability testing program described in Section 4 of this work plan will be completed by Ursus under subcontract to TRC as part of TRC's Work Assignment D009812-17 with the NYSDEC; however, the collection of all samples required for the bench scale treatability testing and shipment of samples to Ursus will be the responsibility of the Contractor. All other sampling and analysis unrelated to the bench scale treatability testing program described in this Work Plan will be the responsibility of the Contractor.

3.1 Injection Well Installation and Repairs to Existing Well Network

A utility locating survey and public One Call utility mark-out shall be completed be prior to invasive work at the Site. The soil vapor extraction and air sparging (SVE/AS) wells and subsurface piping at the Site, and within the pilot test treatment area must be protected during the pilot test. The SVE/AS components are depicted on *Figure 2.* Additionally, the deficiencies noted in the existing well network listed on *Table 1* shall be repaired during the injection well installation work. Access to offsite properties shall be coordinated with the NYSDEC prior to repair of the offsite wells.

Two injection wells shall be installed at the locations shown on *Figure 3.* Sonic rotary drilling methods shall be used to install the wells. A steel outer casing shall be advanced to the top of clay, and shall penetrate a minimum of 1 foot into the clay unit. Care must be taken to avoid penetrating deeper through the clay unit and creating a preferential pathway for potential contaminant migration through the clay unit and into the deeper aquifer. Continuous soil cores (maximum 5 feet in length) shall be collected, inspected and screened with a photoionization detector (PID), and logged during the drilling. The bottom of each injection well shall be set 1 foot into the clay layer. Completion depth will be determined for each well based on a review of the soil cores.

Each injection well shall be 2 inches in diameter and constructed with a 5-foot long injection screen. The bottom of the screen shall be installed 1 foot into the clay unit, and 4 feet of the well screen shall extend into the Upper Glacial Aquifer. The screen shall be stainless steel continuous wire-wrapped 0.01 inch (10-slot) screen. The filter pack shall be #0 sand, or otherwise approved well sorted sand filter pack material. The well riser material shall be 2-inch diameter Schedule 40 PVC. A minimum 6-inch diameter borehole shall be required to maintain a minimum 2-inch wide annular space around the well screen and riser to allow for proper filter pack and grout installation.

The filter pack shall extend a minimum of 2 feet above the well screen. A 2-foot thick hydrated bentonite seal shall be installed above the filter pack. A cement/bentonite grout, consisting of 95 pounds of cement per 5 pounds of bentonite shall be installed from the top of the bentonite seal to the bottom of the concrete manhole pad. Each well riser shall be finished with a 2-inch diameter female national pipe thread (NPT) adaptor.

A watertight flush-mounted steel manhole frame and lid shall be set over each well. The manhole shall be a minimum 10 inches in diameter and shall be set in a 2 foot by 2 foot concrete pad, one foot thick. The manhole must be rated to withstand vehicular traffic up to 25 tons since the pilot test will be completed in an active parking lot.

Construction details for the proposed injection wells are summarized below:

Pilot Test Injection Well ID No.	Anticipated Total Depth (below ground surface)[1]	Anticipated Top of Screen (below ground surface)[1]	Anticipated Bottom of Screen (below ground surface)[1]	Screen Material
PT-IW-101	81' (1 foot into clay)	76'	81'	2-Inch Diameter Wire-Wrapped Stainless Steel
PT-IW-102	81' (1 foot into clay)	76'	81'	2-Inch Diameter Wire-Wrapped Stainless Steel

[1]To be adjusted based on conditions observed in the field.

Example injection well construction details are shown on *Figure 4*. Field construction details for each injection well shall be recorded during installation and submitted to the NYSDEC.

3.1.1 Soil Sample Collection

Soil samples for the bench scale testing will be collected at the interface between Upper Glacial Aquifer and the clay unit. Collection of 12 pounds of Upper Glacial Aquifer soil from each of the two injection well boreholes (24 pounds in total) and 7.5 pounds of clay soil from each injection well borehole (15 pounds in total) is required. Additional soil should be collected at each borehole in the event that recovery is insufficient at either location.

The soil samples shall be placed in laboratory supplied one-liter jars (to be obtained by the contractor) with minimal headspace. The sand/gravel material from the Upper Glacial Aquifer should be containerized

separate from the clay. Ten one-liter glass jars of the Upper Glacial Aquifer (five jars per well) and six one-liter glass jars of the clay (3 jars per well) will be required for the treatability testing. A table summarizing the required bench scale testing sample volumes is provided below:

Geologic Zone	Total Soil Weight	Soil Volume
Upper Glacial Aquifer	24 Pounds	10 Liters (5 1-Liter Jars per Injection Well)
Clay Unit	15 Pounds	6 Liters (3 1-Liter Jars per Injection Well)

The jars should be properly labeled, wrapped in bubble wrap, placed in a cooler with ice and shipped to the Ursus laboratory for overnight delivery under standard chain of custody procedures. Please note that the laboratory may only accept deliveries on Tuesday through Friday and shipment on a Friday for weekend or Monday delivery is not permitted. The laboratory address and point of contact are as follows:

Andrew Wenzel
(608) 437-7413
1204 Springdale Street
Mount Horeb, WI 53572

3.1.2 Well Development and Groundwater Sample Collection

The newly installed injection wells shall be developed by pumping the wells. A submersible pump shall be placed near the bottom of the well screen and shall be used to aggressively pump the wells, without running the well dry. The maximum sustainable flow rate that the well can yield will be recorded and reported. Surging of the well shall be conducted after pumping if well development via pumping has been unsuccessful.

The well development shall continue until the effluent water turbidity is at 50 nephelometric turbidity units (NTUs). A minimum of 55 gallons of water shall be pumped from each well, regardless of how quickly the turbidity goals are achieved. Water quality indicator parameters (pH, dissolved oxygen (DO), oxidation/reduction potential (ORP), specific conductivity, total dissolved solids (TDS), temperature and turbidity) shall be recorded, using a properly calibrated instrument, during development of each well.

Groundwater samples for the bench scale treatability test will be collected after well development is complete. A submersible pump shall be installed in each well and pumped at a maximum flow rate of 0.5 liters per minute to collect the groundwater samples. Approximately 18 liters of water should be collected

from each injection well, for a total of 36 liters of water. A table summarizing the required groundwater sample volumes for bench scale laboratory testing is provided below:

Pilot Test Injection Well ID No.	Groundwater Volume
PT-IW-101	18 Liters
PT-IW-102	18 Liters

The jars shall be properly labeled, wrapped in bubble wrap, placed in a cooler with ice and shipped to the Ursus laboratory for overnight delivery under standard chain of custody procedures. Please note that the laboratory may only accept deliveries on Tuesday through Friday and shipment on a Friday for weekend or Monday delivery is not permitted. The laboratory address and point of contact are as provided above. Water quality indicator parameters, including dissolved DO, ORP, specific conductivity, TDS, temperature, turbidity and pH shall be measured and recorded, using properly calibrated instruments, while the bench scale testing samples are collected.

3.1.3 Injection Supply Water Sample Collection

Five liters of potable water shall be collected from the approved source proposed in Section 8.0 of this work plan. Potable water samples shall be containerized in five (5) 1-liter jars using the collection method specified in the water source submittal. Sample containers shall be properly labeled, wrapped in bubble wrap, placed in a cooler with ice and shipped to the Ursus laboratory for overnight delivery under standard chain of custody procedures. Please note that the laboratory may only accept deliveries on Tuesday through Friday and shipment on a Friday for weekend or Monday delivery is not permitted. The laboratory address and point of contact are as provided above. Water quality indicator parameters, including pH, DO, ORP, specific conductivity, TDS, temperature and turbidity shall be recorded while the bench scale testing samples are collected.

3.1.4 DNAPL Removal

If DNAPL, either as a separate phase liquid or emulsified within groundwater, is observed during well installation, development, gauging, or other activities associated with well installation, DNAPL shall be removed from that well via pumping to the greatest extent practical on a bi-weekly (e.g., one event every two weeks) basis. DNAPL removal events shall continue at this frequency prior to injection activities until direction is given by the NYSDEC to cease removal. The NYSDEC shall be notified immediately if DNAPL is observed.

Within 48 hours of each removal event, a log for each purged well documenting the DNAPL removal and containing (at a minimum): time and date, well identification number, total volume purged, total separate phase DNAPL recovered, total emulsified DNAPL recovered, and notes/observations shall be submitted to the NYSDEC. The means and methods for pumping and containerizing DNAPL shall be determined based on field observations.

Purged DNAPL and groundwater shall be containerized and disposed of in accordance with Section 3.1.5 of this work plan.

3.1.5 IDW Management

IDW generated during well installation and sampling work shall be containerized in properly labeled 55-gallon drums and disposed of offsite following the completion of well installation and sampling. Sampling of IDW shall be completed, as necessary, to characterize the waste for disposal in accordance with the requirements of selected disposal facilities. Label, store, transport and dispose of IDW in accordance with all applicable state, local, and federal rules and regulations.

IDW shall be temporarily staged on-Site prior to disposal in a location that will not impact the operations of the Site Owner or their tenants. The temporary staging location for IDW drums shall be coordinated with the Owner prior to mobilization for the well installation work.

3.2 Post-Installation Groundwater Sampling

3.2.1 Groundwater Quality

A minimum of 2 weeks following the injection well installation and development, the two new injection wells shall be sampled. All groundwater sampling completed as part of this work plan shall be in accordance with United States Environmental Protection Agency (USEPA) low-flow sampling procedures. Prior to sampling, each well shall be gauged to confirm groundwater depth, the total depth of each well and for the presence of NAPL. During purging, groundwater quality indicator parameters (pH, DO, ORP, specific conductivity, TDS, temperature and turbidity) shall be monitored using a properly calibrated instrument and the purged groundwater inspected for DNAPL, odor, discoloration, or other evidence of impacts. Samples shall be collected once field parameters have stabilized for three (3) consecutive readings. A copy of the purge logs, which includes the monitoring of the field parameters noted above, shall be included in the groundwater sampling results submittal described in Section 8.0 of this work plan.

The sampling pumps shall be placed at the mid-point of the new screen sections, near the Upper Glacial Aquifer and clay surface interface. Samples shall be analyzed for TCL VOCs and the following geochemical indicator parameters: total organic carbon (TOC), total and dissolved iron and manganese,

alkalinity, sulfate and sulfide. Samples shall be collected in laboratory provided jars, properly labeled and placed in a cooler with ice to maintain a temperature of 4 °C. The samples shall be transported under standard chain of custody procedures to a New York State Department of Health certified laboratory for analysis with a 10-day turnaround time (TAT). A Category B data deliverable package and electronic data deliverables (EDD) in EQuIS format shall be provided by the analytical laboratory.

3.2.2 Microbial Sampling

After completion of the groundwater sampling described above, a microbial sampling event will be conducted. Microbial sampling shall be completed using Bio-Trap® samplers from Microbial Insights of Knoxville, Tennessee. A Bio-Trap® shall be placed in each well at the mid-point of the well screen following instructions from Microbial Insights, and shall remain in the well for 60 days. The Bio-Traps® shall then be removed from the wells, packaged and sent to Microbial Insights in accordance with Microbial Insights' instructions. The samples will be analyzed for a variety of bacteria (i.e., *dehalococcoides*, *dehalobacter*) capable of degrading chlorinated solvents using the Microbial Insights QuantArray Chlor analysis.

The results of this testing will provide information on the need for bioaugmentation during the pilot test. Commercially available microbial cultures will be injected during the pilot test if low levels of dechlorinating bacteria are present in the sample. Microbial analysis will be performed on a 10-day turn-around time.

4.0 BENCH SCALE TESTING

The samples collected during the injection well installation shall be sent by the Contractor to Ursus for bench scale treatability testing (to be performed by Ursus under subcontract to TRC). The bench scale testing will provide data for several design parameters prior to the pilot test injection. The bench scale testing program will help identify the appropriate EAB amendments and dosages including anticipated amendment performance and half-life (longevity), pH buffer, and viscosity enhancements. The bench scale testing program includes the following tests:

1. Acid neutralization tests to select the pH buffer and dosages.
2. Fluid viscosity enhancement tests to assess shear-thinning additives to address the permeability contrast and enhance the distribution of injection fluid at the sand-clay interface.
3. Sorption tests to estimate amendment sorption potential and retardation rates onto soil.
4. Degradation tests to estimate amendment and contaminant half-lives and degradation rates.

4.1 Acid Neutralization Test

The soil and groundwater are slightly acidic and are unfavorable to bioremediation. A circum-neutral pH is needed for effective reductive dichlorination, and injection of pH adjustment agent with the amendment will be needed. Both the Upper Glacial Aquifer sand and the underlying clay will be tested.

The test will evaluate both the amount of base required to bring the soil/groundwater to neutral values and the most appropriate reagent for doing so. The tests will consist of adding different amounts of candidate alkaline agents to a soil/groundwater slurry and measuring the pH after different time intervals.

4.2 Viscosity Enhancement

The viscosity of the injection amendments will be altered in an attempt to limit amendment "wash out" from the highly transmissive zone at the interface between the Upper Glacial Aquifer and the clay unit. The SRS-Zvi substrate from Terra Systems, Inc. of Claymont, DE (or approved equal) will be used as the EAB amendment. The SRS-Zvi combines emulsified vegetable oil (EVO) (45% by weight), zero valent iron (ZVI) (10% by weight) and sodium lactate (4% by weight) to create and sustain geochemical conditions amenable to EAB. The recommended viscosity for the amendment mixture is between 40 and 60 centipoise. The viscosity may be affected both by the xanthan gum being used for thickening and by the water quality, which in turn may be affected by the base used to neutralize the soil. Testing will evaluate the amount of xanthan gum needed to achieve the target viscosity in the amendment mixture using Site water and the designated amount of base needed to neutralize the soil.

4.3 Amendment Adsorption

When the amendment is first added, much of the organics fraction of the amendment will be adsorbed onto soil surfaces, potentially limiting the distribution of the amendment downgradient. To estimate the amount of the amendment organics that are absorbed on the soil, an amendment sorption test will be run. The test will consist of adding different amounts of amendment to vials of soil, adding the target amount of PCE contaminated Site groundwater and measuring the amount in solution and on the soil after a relatively short time period (1 hour). TOC will be used as a surrogate to estimate amendment degradation and soil adsorption, because TOC will indicate if the amendment is still present in the sample. As part of the test, PCE contaminated Site groundwater will be used and the loss of PCE into the organics on the soil will also be measured.

4.4 Amendment Longevity

The ability of the amendment to persist in the environment at concentrations suitable to sustain the bioremediation program will be assessed during the amendment longevity test. This test will be conducted for 3 to 6 months, based on the TOC and PCE concentrations observed during the testing. The test will be conducted using the more permeable sand and the clay, either separately or in combination, based on the results of the prior tests described above.

TRC will coordinate with Ursus to direct the bench scale treatability testing program.

4.5 Bench Test Data Evaluation

After completion of each bench scale treatability test, Ursus will provide the results to TRC for review and consideration. The results of each of the tests will be used to determine the amendment quantities to be injected during the pilot test. The final amendment loading rates and mixtures will be provided to the Contractor a minimum of 30 days prior to the start of injections. While the quantities of amendments, presented in Table 3 and discussed in Section 5.3, may be altered, the total injection volume is likely to remain unchanged.

The results of the bench scale treatability testing program will be summarized in progress reports. A final report will be prepared by Ursus at the end of the testing and will contain the methods, findings, and conclusions of the program and recommendations.

5.0 PILOT TEST PREPARATION

The pilot test will involve the injection of the EAB amendment (i.e., SRS-Zvi [or approved equal], pH buffer, microbial culture, etc.) and water mixture into the two injection wells described above. A network of 8 piezometers will be installed to monitor the amendment distribution within the pilot testing area and to monitor amendment longevity, geochemical conditions and the ability of the pilot test to reduce CVOC concentrations in the treatment area. The injection will focus on the interface between the Upper Glacial Aquifer and the clay unit to establish the horizontal PRB and prevent matrix back diffusion into the overall water column. The injection of the amendment at this interface will also target any DNAPL identified in the treatment zone.

The injection amendment volumes described below are subject to change based on the results of the bench scale testing. There will be a period of approximately 3 to 6 months between the injection well installation and the pilot test to allow for the bench scale testing program to be completed and the results complied.

As described above, two injection wells will be used for the pilot test. A nominal pilot test treatment area of 1,200 square feet has been used as the basis for the amendment loading calculations; corresponding to an approximately 20-foot wide by 30-foot long (in the direction of groundwater flow) coverage area for each injection well. The pilot test treatment area covers approximately 9% of the roughly 14,000 square foot OU-2 treatment zone defined in the 2018 Pre-Design Investigation Report. The pilot test will target the 5-foot interval above the Upper Glacial Aquifer and clay unit interface.

5.1 Piezometer Installation

A series of 8 piezometers will be installed after the bench scale testing is completed. The timing of the piezometer installation is proposed to allow for well spacing adjustment based on the results of the bench scale testing, which may show that amendment distribution may be more limited than expected, which would require relocating piezometers closer to the injection wells. The piezometers shall be installed using similar drilling methods as the injection wells, with minor changes identified in this section. The proposed piezometer locations are shown on *Figure 3* and proposed well construction is shown on *Figure 4*. The actual drilling locations may vary based on field conditions and utility mark-outs; however, the relative distances from the injection wells will be important to allow for detailed assessment of the injection ROI and amendment longevity.

Soil samples for TOC analysis shall be collected from each piezometer to serve as a baseline for post-injection soil sample comparison. The results of analysis of the soil samples for TOC will be used to compare against post-injection soil sample results to assess the amendment injection ROI. The soil samples will be collected from the Upper Glacial Aquifer material from each borehole at depths which match the

piezometer screen depth intervals and analyzed for total TOC. Care shall be taken to not mix the clay material into the soil samples, which could bias the TOC results high.

A summary of the proposed location for each piezometer is provided below:

Well	Associated Injection Well	Distance from Injection Well (ft)	
		Down Gradient	Lateral/Side Gradient
PT-PZ-201	PT-IW-101	10	15
PT-PZ-202	PT-IW-101	5	0
PT-PZ-203	PT-IW-101	15	0
PT-PZ-204	PT-IW-101	10	5
PT-PZ-205	PT-IW-102	5	5
PT-PZ-206	PT-IW-102	10	0
PT-PZ-207	PT-IW-102	20	0
PT-PZ-208	PT-IW-102	10	10

5.1.1 Drilling

Sonic Rotary drilling methods shall be used to install the piezometers. A steel outer casing shall be advanced to the top of clay, and penetrate a minimum of 1 foot into the clay unit. Care must be taken to avoid penetrating the clay unit and creating a preferential pathway for potential contaminant migration through the clay unit and into the deeper aquifer. Continuous soil cores (maximum 5 foot length) shall be collected, inspected and screened with a PID, and logged during the drilling. The bottom of each piezometer shall be set 2 feet into the clay layer, which will be determined at each well based inspection of the soil cores.

The piezometers shall be 2 inches in diameter and shall be constructed with 10-foot long screens. The bottom of each 10-foot long screen shall be set 2 feet into the clay unit, and 8 feet of each well screen shall be installed across the Upper Glacial Aquifer. The screens shall be Schedule 40 PVC, 0.01 inch (10-slot) milled slot. The filter pack shall be constructed with a #00 sand, or otherwise appropriate well sorted sand filter pack material. The well riser material shall be 2-inch diameter Schedule 40 PVC. A minimum 6-inch diameter borehole shall be required to maintain a 2-inch wide annular space around each well screen and riser to allow for proper filter pack and grout installation.

The filter pack shall extend a minimum of 1 foot above the well screen. A 2-foot thick hydrated bentonite seal shall be installed above each filter pack. A cement/bentonite grout, consisting of 95 pounds of cement

per 5 pounds of bentonite shall be installed from the top of the bentonite seal to the bottom of the concrete manhole pad.

A watertight flush mounted steel manhole frame and cover shall be set over each piezometer. The manholes shall be a minimum 10 inches in diameter and shall be set in 2 foot by 2 foot concrete pads. The manholes must be rated to withstand vehicular traffic up to 25 tons since the pilot test shall be completed in an active parking lot.

Field construction details for each piezometers shall be recorded during installation and submitted to the NYSDEC.

5.1.2 Piezometer Development

The newly installed piezometers shall be developed by pumping the wells. A submersible pump shall be placed near the bottom of each screen and shall be used to aggressively pump the piezometers, without running the piezometers dry. The maximum sustainable flow rate that each piezometer can yield shall be recorded and reported. Surging of the well shall be conducted after the pumping if development has been unsuccessful.

The piezometer development shall continue until the effluent water turbidity is at 50 nephelometric turbidity units (NTUs).. A minimum of 55 gallons of water shall be pumped from each piezometer, regardless of how quickly the turbidity goals are achieved. Water quality indicator parameters (pH, DO, ORP, specific conductivity, TDS, temperature and turbidity) shall be recorded, using a properly calibrated instrument, during development of each well.

5.1.3 DNAPL Removal

DNAPL, if identified during piezometer installation, shall be removed in accordance with the requirements noted in Section 3.1.4 of this work plan.

5.1.4 IDW Management

IDW generated during piezometer installation shall be managed in accordance with the requirements of Section 3.1.5 of this work plan.

5.1.5 Survey

The location and elevation of the top of the casing (cap off) and ground surface adjacent to each of the newly installed injection wells, piezometers, and existing on-Site monitoring wells listed in *Table 2* shall

be surveyed by a land surveyor licensed to practice in the State of New York. Results of the survey shall be submitted to the NYSDEC in the format of a signed and sealed to-scale drawing showing well locations and in tabular format, horizontal coordinates and elevations. Included on the survey map shall be property boundaries, adjacent streets and major physical features (i.e., buildings, drainage features [such as sewer manholes and catch basins], aboveground utilities, limits of ground surface coverings [pavement and landscaping] and fence lines). The survey drawing should also be provided in electronic format in AutoCAD.

5.2 Baseline Groundwater Sampling

A baseline groundwater sampling event will be conducted approximately 1 month prior to the planned injection start date. The baseline groundwater sampling will include the collection of groundwater samples from the newly installed piezometers and the newly installed injection wells using low flow sampling techniques. Groundwater samples will also be collected from monitoring wells ERM-MW-01D, ERM-MW-05D, ERM-MW-06D and MW-102D. Samples will be collected from the mid-point of the screen level for each of the newly installed wells and wells ERM-MW-01D, ERM-MW-05D, ERM-MW-06D and MW-102D. Prior to sampling, each well shall be gauged to confirm groundwater depth, the total depth of each well and for the presence of NAPL. During purging, field parameters (pH, DO, ORP, specific conductivity, TDS, temperature and turbidity) shall be monitored, using a properly calibrated instrument, and the purged groundwater inspected for separate phase product, odor, discoloration, or other evidence of impacts. Samples shall be collected once field parameters have stabilized for three (3) consecutive readings. A copy of the purge logs, which includes the measurements recorded during monitoring of the field parameters, shall be included in the groundwater sampling results submittal described in Section 8.0 of this work plan.

Microbial samples shall be collected using low-flow sampling techniques, using bottles provided by Microbial Insights for sample collection and shipment. The Biotrap® samplers will not be used in the baseline sampling.

Samples for chemical analysis shall be delivered to a NYSDOH-approved laboratory. Samples for microbial analysis shall be delivered to Microbial Insights for QuantArray Chlor analysis. A Category B data deliverable package and electronic data deliverables (EDD) in EQuIS format shall be provided by the analytical laboratories in a 10-day TAT. The microbial sampling data shall be provided in tables and a narrative report with figures representing the population of the various microbial species included in the analysis. An EDD shall be provided with the microbial data in EQuIS format.

A summary of the analytical parameters for each well and each sampling event are provided in *Table 2.*

5.3 Injection Amendments and Volumes

The pilot test will use emulsified vegetable oil (EVO) as the carbon source. Because the full-scale injection will be conducted in areas where DNAPL may be present, zero valent iron (ZVI) will also be included in the EVO mixture. EVO is a complex carbon source that will remain active in the subsurface for an extended period of time, potentially 3 years or longer. The longevity of EVO is ideal for PRBs, allowing for reduced operation and maintenance (O&M) costs that may be experienced with other more soluble doners, which will require frequent reapplication to maintain the desired geochemical conditions and bio-active treatment zone. The emulsified oil droplets will collide with soil particles as they move through the aquifer, with the oil droplets sorbing to the soil surfaces based on carbon-carbon affinity and surface charge differences between the soil surface and the emulsifier in the EVO. ITRC (2011)[1] and the US Navy (NAVFAC, 2015)[2] recommend the use of EVO in PRBs to intercept and cut off plume migration because this EVO can form a stationary bioactive zone to intercept migrating contamination (NAVFAC Design Considerations for Enhanced Reductive Dechlorination, March 2015). When ZVI is injected into the aquifer it quickly promotes strong reducing conditions that can enhance the EAB process. Additionally, ZVI is capable of directly degrading PCE through abiotic processes without the generation of intermediate byproducts.

The SRS-Zvi amendment from Terra Systems of Claymont, Delaware (or approved equal) shall be used for this Site. The combination of EVO and ZVI in the SRS-Zvi amendment results in an injection fluid that is denser than water and which will sink and remain near the sand/clay interface. The amendment has a high viscosity, which may need to be enhanced in the field after dilution with a sheer thinning fluid. The emulsions in the EVO adhere to soil surfaces preventing or limiting "washout". The SRS-Zvi includes sodium lactate as an additional carbon source that quickly breaks down to establish the anaerobic conditions needed for bioremediation. The amendment is also blended with nutrients and Vitamin B12, which has been established to enhance reductive dichlorination.

Injection will target a 50% pore volume displacement over the approximately 5-foot interval above the clay in the 1,200 square foot nominal treatment area (the pore volume is estimated at approximately 13,500 gallons based on an estimated porosity of 30%). Therefore, approximately 6,725 gallons of amendments and water will be injected to provide coverage during the pilot test. The safety data sheets for the proposed amendments, subject to change, are provided in *Appendix A*.

The proposed EVO loading rate for the pilot test was developed using the Substrate Estimating Tool for Enhanced Anaerobic Bioremediation of Chlorinated Solvents developed by the Environmental Security

[1] Permeable Reactive Barrier: Technology Update; Interstate Technology & Regulatory Council (ITRC), June 2011.
[2] Design Considerations for Enhanced Reductive Dechlorination; NAVFAC, March 2015.

Technology Certification Program (ESTCP, 2010). The calculations consider both the contaminant stoichiometric demand as well as the soil oil retention capacity. Approximately 7,350 pounds of the SRS-Zvi amendment, or 825 gallons (three 275-gallon totes), shall be injected along with 5,900 gallons of water. Each well would receive approximately 412 gallons of SRS-Zvi (one and a half 275-gallon totes).

Xanthan gum shall be added to the amendments as a sheer thinning fluid (STF) to increase the viscosity of the injection fluid when it is not exposed to significant sheering pressure. A resting, or kinematic, viscosity between 40 and 60 centipoise has been recommended as an optimal range to prevent amendment wash-out from the treatment zone. The target xanthan gum loading rate will be dependent on the results of the bench scale treatability testing. Based on average rates of 0.1% to 0.5% by solution weight, TRC estimates that approximately 200 to 250 pounds of xanthan gum may be needed for the pilot test.

Sodium bicarbonate shall be added to the injection amendment mixture to increase and buffer the groundwater pH. The groundwater pH in deep monitoring wells in or near the pilot test treatment zone was observed to be low during the Pre-Design Investigation, with an average pH value of 5.68 standard units (su) when considering monitoring wells ERM-MW-5D, ERM-MW-7D, MW-101D, and MW-102D. A pH in the range of 6.5 to 8 su is needed for effective EAB. The sodium bicarbonate loading rate will be determined during the bench scale treatability testing. Based initially on a target dosage of one-third the solubility limit for sodium bicarbonate, TRC estimates the sodium bicarbonate loading rate will be less than 1,500 pounds of bicarbonate per injection well.

A commercially available bioaugmentation culture shall be injected into each injection well after the carbon source and pH adjustment amendment injections have been completed. A batch of 500 gallons of anaerobic chase water shall be prepared and injected after the addition of the bioaugmentation culture. The SDC-9© or KB-1© cultures both contain high concentrations of the *dehalococcodies* (Dhc) bacteria, which is capable of complete sequential dichlorination of PCE to ethylene. One liter of either of these cultures will contain over $1x10^{11}$ active bacterial cells. A total of 5 liters of one of these cultures per well will be sufficient to provide an average bacterial population of $1x10^{7}$ cells/L in the treatment zone, which should be sufficient to support EAB.

An oxygen scavenger shall be added to the injection fluid to remove excess oxygen that may hinder the generation of the required reducing conditions, which would be harmful to the bioaugmentation culture. Sodium bisulfate is proposed as the oxygen scavenger. TRC anticipates that approximately 10 pounds of sodium bisulfate, or 5 pounds per well shall be required for the injections.

Two tracers are also proposed for the pilot test injection program. Bromide will be used as a chemical tracer, and a color dye will be included in the injection batches to allow for easy visual identification of injection amendment in the piezometers and downgradient monitoring wells. The color dye will be

biodegradable and will conform to National Sanitation Foundation (NSF) Standard 60 for use in and around potable water sources.

A summary of the estimated injection amendment quantities is provided in *Table 3*.

5.4 Pilot Test Equipment

A summary of the required pilot test equipment and materials is provided below. The Contractor shall be responsible for delivering all equipment and material to the Site needed to conduct the pilot test and related sampling/monitoring work.

5.4.1 Water Source

The injection water shall be obtained from a potable source. A fire hydrant or utility connection in the building can be used, pending permits or owner acceptance. The required water can be pumped into a tank at the beginning of the project, or drawn from the potable source on an as-needed basis during the pilot test.

5.4.2 Mixing Tanks

Mixing tanks shall be sized to handle the proposed injection program. Multiple batches can be prepared for each injection well. Sufficient mixing and holding volumes should be provided to prevent excessive downtime for batch mixing. Care should be taken to keep the injection solution agitated to prevent the STF (xanthan gum) from settling. High sheer pumps or mixers should be supplied to keep the injection fluid adequately mixed.

5.4.3 Secondary Containment and Hose Protection

All injection fluids and materials, other than potable water, shall be stored within containers with secondary containment for spill control. The secondary containment should be sufficient in size to contain 100% of the volume of the largest vessel. Hose bridges shall be used to convey fluids from the secondary containment to prevent hose sidewalls from buckling.

Hoses running to the injection wells shall be protected with hose ramps as needed. The hose ramps shall be capable of protecting the hoses from heavy vehicles, such as the large box trucks that typically operate in the parking lot area.

5.4.4 Injection Pumps and Instrumentation

The injection pump shall be capable of delivering injection flow rates of up to 5 gallons per minute at pressure up to 50 psi. Adjustments to the pumping pressure and flow rate will be required during the pilot test. Flow meters with direct read instantaneous flow rate (in gallons per minute) and total cumulative volume (in gallons) shall be supplied to accurately measure flow rates and volumes injected at each well. A pressure gauge shall also be installed at each well head to log and monitor injection pressures during the pilot test.

The injection pump shall be rated for viscous injection fluids, as the injection material will have a viscosity ranging from 40 to 60 centipoise. Care should be taken to avoid exceeding the fracturing pressure of the soil during injection.

5.5 Environmental Protection Agency (EPA) Underground Injection Control (UIC) Permitting Requirements

An Underground Injection Control (UIC) permit will be required from Region 2 of the US Environmental Protection Agency (EPA). The UIC permit will allow for the remediation amendment injection. A completed draft application form is included as *Appendix B*, along with a memorandum discussing the proposed pilot test injection strategy, injection well locations, amendment volumes and injection duration.

6.0 PILOT SCALE INJECTION

The pilot test will be conducted in an active parking area. The Contractor shall prepare and submit a health and safety plan (HASP) that will include traffic management and the use of high visibility vests for all field crew. The injection material and equipment described above shall be stored in a safe area with sufficient signage and fencing to control access to the work area. The field team will take care to prevent unsafe conditions during every pilot test activity.

6.1 Injection Mobilization

All of the equipment, instrumentation, materials and supplies required for the injection program described above as well as required incidentals and labor will be mobilized to the Site to conduct the injections. Additional equipment and material may be required based on the Contractor's proposed means and methods for injections. The Contractor will discuss the proposed equipment locations with the NYSDEC and the building tenant/operator prior to mobilization to determine the optimal location for equipment and materials storage.

The Contractor will inspect the area and identify all stormwater drains and inlets, or any culverts or other utility areas which may receive injection fluid if daylighting occurs during the pilot test. These locations should be photographed and identified on a site plan. If directed by TRC, drains and inlets shall be temporarily covered prior to injection. Inspections of potential receptors should be conducted daily, and injections should be halted if injection fluid is observed migrating towards stormwater drains or other utilities.

6.2 Injection Program

The pilot test will be completed by injecting into one injection well at a time. Injection into both wells simultaneously should not be conducted without approval from TRC. Groundwater quality indicator parameter readings (pH, DO, ORP, specific conductivity, TDS, temperature and turbidity) from the piezometers and deep monitoring well network will be useful in the final design and the Contractor shall record the data described below. Field data shall be scanned/photographed at the end of each day and submitted to TRC for review during and after the pilot test. Calibration logs for all field equipment shall be maintained throughout the pilot test.

A bound field book will also be used to log daily activities and field observations. This field book shall be used to log daily activities and progress throughout the pilot test. The field book will also be used to record start and stop times for injections and site work, any visitors to the site, a description of injection progress, field measurements, and any other notes of significance during the day.

The injections will be conducted in batches during normal working hours, with the quantity of water and amendments for each batch recorded in a lot. The mixing tanks will be connected to an injection pump using flexible hoses rated for the intended use and compatible with the injection materials. Cam and grove fittings, supplied with safety locks, are recommended for each connection. The injection pump will be connected to the injection well using pressure rated hoses and fittings. The injection pump can be electric or pneumatic, and direct drive or a diaphragm pump. Electrical power may not be available at the Site and the Contractor shall be responsible for power supply. The fitting at the well head shall be constructed with a 90° elbow to prevent kinking of the hose. Hose ramps should be placed over the injection hoses to prevent tripping hazards during injections and damage from vehicles. TRC recommends using 2 mixing tanks to reduce down time between injection batches. Work shall be conducted Monday through Friday, from 8:00 AM to 5:00 PM, unless alternate hours are approved by NYSDEC.

6.3 Injection Oversight and Monitoring

The following data shall be recorded and maintained during the pilot test:

- For each injection well: flow rates, total volume injected and pressure will be recorded on an hourly basis.
- Records of each batch of injection amendments will be recorded. The records will include the volume of amendment, pH buffer, water, xanthan gum and additional additives and nutrients or other amendments added to the water. A quantitative estimate of the final viscosity of the prepared injection amendment will be made using a zahn funnel, and will be noted in the batch log.
- Depth to groundwater measurements will be collected twice daily from all piezometers, deep monitoring wells and the non-operating injection well twice daily during injections.
- Groundwater quality parameters (pH, DO, ORP, specific conductivity, TDS, temperature and turbidity) will be recorded at all piezometers, deep monitoring wells and the non-operating injection well at a minimum of twice daily, spaced a minimum of 3 hours apart, during injections. These measurements will be taken using a properly calibrated multi-parameter water quality meter, such as a Horiba or YSI Sonde.
- Observations of the colored dye will be recorded in each monitoring well and piezometer during each round of groundwater quality parameter readings.
- Field test kits for bromide will be used at each piezometer and downgradient monitoring well at a minimum frequency of once daily.
- General system operational inspections will be conducted regularly, and any deficiencies will be corrected immediately.

- Periodic inspections of nearby utility manholes, stormwater catch basins or other potential receptors will be conducted through the day to inspect for daylighting. If daylighting is observed, the Contractor shall notify TRC and injection will be stopped immediately.

6.4 Bioaugmentation

A bioaugmentation event will be conducted immediately after the conclusion of EAB amendment injections in both wells. The bioaugmentation event will involve the addition of 10 liters of a commercially available microbial culture designed for the degradation of chlorinated solvents. The microbial culture will be added directly to the well using nitrogen or other inert gas to transmit the culture into the well. Care will be taken to avoid exposing the microbial culture to oxygen. The manufacturer's instructions will be followed during the injection. After each well has been dosed with approximately 5 liters of culture, a batch of anaerobic chase water will be injected into the well to disperse the microbes into the treatment zone.

The anaerobic water will be prepared using an oxygen scavenger (sodium bisulfate) to remove dissolved oxygen from the water prior to injection. Dissolved oxygen readings should be taken before injecting the water into the wells.

7.0 POST INJECTION SAMPLING

7.1 Post Injection Groundwater Monitoring

Post injection groundwater samples will be collected from the injection wells, piezometers and monitoring wells sampled during the baseline sampling event. Monitoring events will be conducted at 3 and 6 months after the completion of injections, with an option for an additional event 9 months post-injection if the results of prior events dictate additional monitoring will is required. Refer to *Table 2* for groundwater monitoring/sampling schedule and parameters.

Samples will be collected via USEPA low-flow sampling techniques from the mid-point of the screen level for each of the injection wells, piezometers, and wells ERM-MW-01D, ERM-MW-05D, ERM-MW-06D and MW-102D. Prior to sampling, each well shall be gauged to confirm groundwater depth, the total depth of each well and for the presence of NAPL. During purging, field parameters (pH, DO, ORP, specific conductivity, TDS, temperature and turbidity) shall be monitored, using a properly calibrated instrument, and the purged groundwater inspected for separate phase product, odor, discoloration, or other evidence of impacts. Samples shall be collected once field parameters have stabilized for three (3) consecutive readings. The purge logs, which include the field parameter measurements noted above, shall be included in the groundwater sampling results submittal described in Section 8.0 of this work plan. Samples shall be collected in laboratory provided bottle ware. The microbial samples shall be collected via low-flow methods in bottles provided by Microbial Insights.

Samples for chemical analysis shall be delivered to a NYSDOH-approved laboratory. Samples for microbial analysis shall be delivered to Microbial Insights for QuantArray Chlor analysis. A Category B data deliverable package and electronic data deliverables (EDD) in EQuIS format shall be provided by the analytical laboratories within a 10-day TAT. The microbial sampling data shall be provided in tables and a narrative report with figures representing the population of the various microbial species included in the analysis. An EDD shall be provided with the microbial data in EQuIS format.

The post-injection monitoring will provide information on the longevity of the injection amendments in the subsurface and their ability to act as a horizontal PRB to prevent further dissolution of DNAPL, or back diffusion of PCE from the clay.

7.1.1 DNAPL Removal

DNAPL, if identified during post injection groundwater monitoring, shall be removed in accordance with the requirements noted in Section 3.1.4 of this work plan.

7.1.2 IDW Management

IDW generated during post injection groundwater monitoring shall be managed in accordance with the requirements of Section 3.1.5 of this work plan.

7.2 Post Injection Soil Sampling Requirements

Post injection soil samples shall be collected at 5 locations approximately 2 weeks after the completion of injections. Drilling shall be completed to the Upper Glacial Aquifer and clay interface using a Geoprobe direct push drill rig or other approved method. Avoid penetrating the clay unit and creating a preferential pathway for potential contaminant migration through the clay unit and into the deeper aquifer. Continuous soil cores (maximum 5-foot length) will be collected, inspected and screened with a PID, and logged during the drilling. Care shall be taken to not mix the clay material into the soil samples submitted for TOC analysis, which could bias the TOC results high. A sample shall be collected from 2 feet above the clay layer in each boring and analyzed for TOC. The selected samples shall be shipped under standard chain of custody procedures to a NYSDOH-certified laboratory for analysis. The soil samples will be used to assess relative change in total organic carbon and estimate/confirm the anticipated ROI of the pilot test. The proposed soil sample locations are provided on *Figure 3*.

8.0 CONTRACTOR SUBMITTALS

The Contractor shall provide, at a minimum, the following submittals to TRC and NYSDEC in accordance with the submission schedule in the below table. The table below is intended to be a summary, additional submittals may be required.

Submittal Description	Schedule
Pre-Injection Well Installation Mobilization	
Proposed schedule for injection well installation and development and bench scale treatability testing sample collection and equipment to be used for injection well installation and sample collection.	Within 14 days of receipt of notice to proceed from NYSDEC
Contractor HASP for all activities covered under this work plan.	21 days prior to mobilization
Names of proposed subcontractors to be used to complete the work, including but not limited to: • NYSDOH-certified laboratory for soil and groundwater sampling (with the exception of microbial sampling) • Utility locating surveyor • NYS licenses land surveyor	21 days prior to mobilization
Proposed waste hauler and disposal facility permits for anticipated waste streams and proposed IDW staging location(s).	21 days prior to mobilization
Proposed source(s) of potable water, potable water sampling collection methods, results of analysis of sample of proposed potable water source, and required permit applications if fire hydrants are to be used.	30 days prior to mobilization
Daily field summary and photographic log template. Logs shall include, at a minimum: project information, site conditions, date, onsite personnel, equipment present, description of work performed, and photographic log.	21 days prior to mobilization
Post-Injection Well Installation	
Shipment documentation for the bench scale testing samples.	1 day after shipment
Injection well boring, construction and development logs. • Boring logs shall include boring/well identification, descriptions of soil encountered, PID screening results, visual/olfactory observations, boring depth and diameter, observed groundwater depth, material recovery for each sampling interval, analytical sample collection depth and identification, etc. • Well construction logs shall include materials of construction, manhole details, wellhead details, well and borehole diameters, screened interval depth, total well depth, etc. • Well development logs shall include all data recorded during well development.	7 days after well installation
Analytical results from the baseline groundwater sampling event and soil sample analytical results for TOC.	7 days after receipt of data

Submittal Description	Schedule
DNAPL removal logs (if encountered).	5 days after DNAPL removal event
Daily field summaries and photographic logs.	Previous weeks' logs shall be submitted by end of day the following Monday.
Pre-Pilot Test Injection	
Proposed schedule for pilot test injection preparation work and injection program specified in Sections 5.0 and 6.0.	Within 30 days of receipt of final amendment loading from TRC
Proposed source of injection amendments along with safety data sheets (SDS) and material quality assays provided by vendors.	30 days prior to mobilization
Manufacturers' data sheets on proposed injection equipment and instrumentation, including but not limited to: proposed hoses, hose protection equipment, pumps, mixing tanks, secondary containment, flow meters/totalizers, pressure gauges, and water quality parameter meters.	30 days prior to mobilization
Daily field summary and photographic logs.	Previous weeks' logs shall be submitted by end of day the following Monday.
Piezometer boring, construction and development logs. • Boring logs shall include boring/piezometer identification, descriptions of soil encountered, PID screening results, visual/olfactory observations, boring depth and diameter, observed groundwater depth, material recovery for each sampling interval, analytical sample collection depth and identification, etc. • Piezometer construction logs shall include materials of construction, manhole details, wellhead details, well and borehole diameters, screened interval depth, total well depth, etc. • Piezometer development logs shall include all data recorded during well development.	7 days after piezometer installation
DNAPL removal logs (if encountered).	5 days after DNAPL removal event
Blank copies of batch mixing, injection volume/pressure, geochemical reading and groundwater elevations log sheets that will be used during the injections.	14 days prior to mobilization
Survey map of locations and elevations of all wells and piezometers and additional features as described above. Locations and photographs of drainage features that are near the injection area and are potentially in the path of injection fluid in the event of daylighting shall be included with the survey.	21 days after completion of piezometer installation
Mid- and Post-Pilot Test Injection	
Field notes, injection and batch mixing log sheets, groundwater level measurements and groundwater quality parameter readings.	Daily beginning at start of injection

Submittal Description	Schedule
Daily field summary and photographic logs.	Previous weeks' logs shall be submitted by end of day the following Monday.
Concise narrative describing the pilot test activities and injection methods.	14 days post injection completion
Groundwater sampling logs and analytical data from baseline, 3- and 6-month post-injection groundwater sampling events, including groundwater surface elevation contour maps.	7 days after receipt of analytical data
Soil boring logs and analytical results of post-injection soil samples.	7 days after receipt of analytical data

TRC and the NYSDEC will review submittals and notify the Contractor of any deficiencies or discrepancies which will require correction prior to the work.

Tables

Table 1
NYSDEC
Pride Solvents & Chemical Co. Enhanced Anaerobic Bioremediation Injection Pilot Test Work Plan
Monitoring Well Inventory

Well ID	Property Address	Northing	Easting	Dia. (in.)	Present?	Surface Condition/ Location Description	Date Inspected	Headspace (ppm)	Depth to Water (feet below top of riser)	Depth to Product (feet below top of riser)	Total Depth (TD) From Historic Reporting (feet below top of riser)	Measured TD (feet below top of riser)	Deficiencies
Historic H2M/Tyree Wells													
MW-01	78/88 Lamar	208456.5	1156343.5	2	Yes	Located in a parking lot with commercial vehicles (e.g., vans, box trucks).	9/15/2021	0.0	10.58	N/A	20.36	19.97	None noted.
MW-02	78/88 Lamar	208500.0	1156453.1	2	Yes	Located near the entrance of a parking lot for commerical vehicles.	4/20/2021				20.30		Inaccessible. Manhole cover is damaged and must be replaced.
MW-03	78/88 Lamar	208701.5	1156234.0	4	Could not confirm	Located in the Winter Brothers parking lot.	4/20/2021				50.40		Inaccessible - likely located under a dumpster in the Winter Brothers parking lot.
MW-04	78/88 Lamar	208631.4	1156410.8	2	Yes	Located in the grassy area in front of the building on a concrete pad.	9/15/2021	0.0	9.89	N/A	20.38	20.01	Steel well cap is present and unable to be locked. Current cap to be replaced with a gasketed plug that a lock may be installed in.
MW-05	78/88 Lamar	208699.7	1156227.3	2	Could not confirm	Located in the Winter Brothers parking lot.	4/20/2021				20.28		Inaccessible - likely located under a dumpster in the Winter Brothers parking lot.
MW-06	78/88 Lamar	208465.1	1156296.0	4	Yes	Located near the SVE/AS shed. Concrete is broken around the well.	9/15/2021	4.0	11.14	N/A	21.47	21.41	Missing bolts in manhole must be replaced. Well plug is worn/damaged and must be replaced.
MW-07	78/88 Lamar	208471.0	1156379.3	4	Yes	Located in a parking lot with commercial vehicles (e.g., vans, box trucks).	9/15/2021	0.0	11.25	N/A	21.54	22.87	None noted.
MW-08	78/88 Lamar	208485.6	1156415.5	4	Yes	Located in a parking lot with commercial vehicles (e.g., vans, box trucks).	9/15/2021	0.0	10.15	N/A	21.50	21.15	Missing bolts in manhole must be replaced.
MW-09	78/88 Lamar	208546.6	1156315.9	4	Yes	Located in an alley between buildings.	9/15/2021	0.0	10.71	N/A	20.39	21.75	Missing bolts in manhole must be replaced. Well plug is worn/damaged and must be replaced.
MW-10	78/88 Lamar	208657.9	1156252.5	4	Yes	Located in Winters Brothers parking lot. Parking lot is mostly broken concrete with loose stone/gravel.	4/20/2021	8.7	10.61	N/A	20.97	20.65	Missing bolts in manhole must be replaced. Well plug is worn/damaged and must be replaced.
MW-11	78/88 Lamar	208676.9	1156291.9	4	Yes	Located in Winters Brothers parking lot. Parking lot is mostly broken concrete with loose stone/gravel.	9/15/2021	10.6	10.51	N/A	20.96	21.14	Missing bolts in manhole must be replaced. Well plug is worn/damaged and must be replaced.

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Well ID	Property Address	Northing	Easting	Dia. (in.)	Present?	Surface Condition/ Location Description	Date Inspected	Headspace (ppm)	Depth to Water (feet below top of riser)	Depth to Product (feet below top of riser)	Total Depth (TD) From Historic Reporting (feet below top of riser)	Measured TD (feet below top of riser)	Deficiencies
2004 RI Wells													
ERM-MW-1D	78/88 Lamar	208482.5	1156430.2	2	Yes	Located in a parking lot with commercial vehicles (e.g., vans, box trucks).	9/7/2021	0.5	10.69	N/A	82.20	81.24	Well plug is worn/damaged and must be replaced.
ERM-MW-1S	78/88 Lamar	208483.8	1156433.8	2	Yes	Located in a parking lot with commercial vehicles (e.g., vans, box trucks).	9/15/2021	0.4	10.11	N/A	19.65	19.61	Missing bolts in manhole must be replaced.
ERM-MW-2D	55 Kean	Unknown		2			4/20/2021				86.31		These wells no longer exist per the CDM RI
ERM-MW-2S	55 Kean			2			4/20/2021				19.59		
ERM-MW-3D	31 Lamar	207477.0	1156954.2	2	Yes	Located in grassy area with visible concrete pad.	4/20/2021	0.0	10.29	N/A	85.70	85.70	Well plug is worn/damaged and must be replaced.
ERM-MW-3S	31 Lamar	207481.3	1156953.0	2	Yes	Located in grassy area with visible concrete pad.	4/20/2021	0.0	10.18	N/A	19.10	19.29	None noted.
ERM-MW-4D	31 Lamar	207279.5	1157100.0	2	Yes	Located in grassy area with visible concrete pad.	4/20/2021	0.0	10.31	N/A	91.06	90.61	None noted.
ERM-MW-4S	31 Lamar	207280.9	1157103.0	2	Yes	Located in grassy area with visible concrete pad.	4/20/2021	0.0	10.04	N/A	20.00	20.00	None noted.
ERM-MW-5D	78/88 Lamar	208440.1	1156311.3	2	Yes	Located in a parking lot with commercial vehicles (e.g., vans, box trucks).	9/7/2021	0.0	11.91	N/A	85.45	86.65	Well plug is worn/damaged and must be replaced.
ERM-MW-6D	78/88 Lamar	208464.2	1156364.7	2	Yes	Located in a parking lot with commercial vehicles (e.g., vans, box trucks).	9/7/2021	0.0	11.09	N/A	86.00	85.67	Missing bolts in manhole must be replaced. Well plug is worn/damaged and must be replaced.
ERM-MW-7D	78/88 Lamar	208579.8	1156325.8	2	Yes	Located in a parking lot with commercial vehicles (e.g., vans, box trucks).	9/7/2021	2.1	11.01	N/A	85.40	86.54	Missing bolts in manhole must be replaced. Well plug is worn/damaged and must be replaced.

Table 1
NYSDEC
Pride Solvents & Chemical Co. Enhanced Anaerobic Bioremediation Injection Pilot Test Work Plan
Monitoring Well Inventory

Well ID	Property Address	Northing	Easting	Dia. (in.)	Present?	Surface Condition/ Location Description	Date Inspected	Headspace (ppm)	Depth to Water (feet below top of riser)	Depth to Product (feet below top of riser)	Total Depth (TD) From Historic Reporting (feet below top of riser)	Measured TD (feet below top of riser)	Deficiencies
2010 RI Wells													
MW-7SM	78/88 Lamar	208585.6	1156317.8	2	Yes	Located in a parking lot with commercial vehicles (e.g., vans, box trucks).	9/7/2021	2.6	10.58	N/A	128.00	127.65	Missing bolts in manhole must be replaced.
MW-12D	91 Kean	208783.0	1156148.3	2	Could not confirm	Located on another property (waste management site).	4/20/2021				97.00		Unable to access property during the Site visit.
MW-12SM	91 Kean	208789.6	1156145.7	2	Could not confirm	Located on another property (waste management site).	4/20/2021				122.00		Unable to access property during the Site visit.
MW-13D	58 Lamar	208257.6	1156392.1	2	Yes	Located in parking area/storage area. Tenant indicated that they do not store materials over/around the well.	4/20/2021	3.2	10.61	N/A	83.50	83.50	None noted.
MW-14D	63 Lamar	208348.7	1156612.0	2	Yes	Located in grassy area with visible concrete pad.	4/20/2021	4.9	8.92	N/A	82.00	80.59	Stripped bolts in manhole must be replaced.
MW-14SM	63 Lamar	208354.7	1156609.2	2	Yes	Located in grassy area with visible concrete pad.	4/20/2021	0.0	11.69	N/A	120.00	120.51	Stripped bolts in manhole must be replaced.
MW-15D	34 Lamar	207727.2	1156755.5	2	Could not confirm	Located in active consturction site property.	4/20/2021				84.50		Well is not accessible - located at an active construction site.
MW-16D	31 Lamar	207935.0	1156984.1	2	Yes	Located in a well paved parking lot for commerical/industrial tenants.	4/20/2021	0.0	10.29	N/A	86.00	84.29	None noted.
MW-17D	Edison Ave and Mahand St (wooded area)	207319.8	1157459.1	2	Could not confirm	Located on a grassy area next to Edison Avenue.	4/20/2021				90.00		Could not confirm if the well was buried or located beyond the fence line.

Table 1
NYSDEC
Pride Solvents & Chemical Co. Enhanced Anaerobic Bioremediation Injection Pilot Test Work Plan
Monitoring Well Inventory

Well ID	Property Address	Northing	Easting	Dia. (in.)	Present?	Surface Condition/ Location Description	Date Inspected	Headspace (ppm)	Depth to Water (feet below top of riser)	Depth to Product (feet below top of riser)	Total Depth (TD) From Historic Reporting (feet below top of riser)	Measured TD (feet below top of riser)	Deficiencies
2018 PDI Wells													
MW-100D	78/88 Lamar	208531.6	1156274.2	2	Yes	Located in an alley between buildings. Labeled with spray paint.	9/7/2021	6.6	11.61	N/A	91.40	90.40	None noted.
MW-101D	78/88 Lamar	208560.0	1156344.6	2	Yes	Located in the parking lot. Vehicles are sometimes parked in this location.	9/7/2021	1581	10.68	N/A	83.22	84.01	None noted.
MW-102D	78/88 Lamar	208449.8	1156398.3	4	Yes	Located in a parking lot with commercial vehicles (e.g., vans, box trucks).	9/7/2021	0	10.52	N/A	85.35	83.27	Damaged bolts in manhole must be replaced.
MW-103D	63 Lamar	208498.7	1156519.2	4	Yes	Located in roadway.	4/20/2021	0.5	8.19	N/A	80.91	80.80	Missing bolts in manhole must be replaced.
MW-104D	55 Kean	208103.4	1156541.7	4	Could not confirm	Located in a school bus parking lot. Parking lot is mostly broken concrete with very loose stone/gravel.	4/20/2021				89.01		Inaccessible - located in a bus parking lot and appears to be buried.
MW-105D	63 Lamar	208236.8	1156664.4	4	Yes	Located in school bus parking lot, near personal vehicle parking (near entrance gate).	4/20/2021	48.5	9.18	N/A	84.21	86.11	None noted.
MW-106D	31 Lamar	207854.4	1156874.8	4	Yes	Located in a well paved parking lot for commerical/industrial tenants.	4/20/2021	21.6	9.91	N/A	87.88	90.34	None noted.

Note:
- Shaded box indicates the well is installed off-Site.

Table 2
NYSDEC
Pride Solvents & Chemical Co. Enhanced Anaerobic Bioremediation Injection Pilot Test Work Plan
Groundwater Monitoring and Sampling Program

Well Designation	Estimated Screen Interval (ft)[1]	Monitoring/Sampling Schedule and Parameters			
		Baseline	3 Months After Injection	6 Months After Injection	9 Months After Injection (if required)
Monitoring Wells					
PT-IW-101	76-81	TCL VOCs, TOC, Bromide, GCIP , Microbial, GWQP	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GCIP , Microbial, GWQP	TCL VOCs, TOC, Bromide, GWQP
PT-IW-102	76-81	TCL VOCs, TOC, Bromide, GCIP , Microbial, GWQP	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GCIP , Microbial, GWQP	TCL VOCs, TOC, Bromide, GWQP
PT-PZ-201	76-81	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP
PT-PZ-202	76-81	TCL VOCs, TOC, Bromide, GCIP , Microbial, GWQP	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GCIP , Microbial, GWQP	TCL VOCs, TOC, Bromide, GWQP
PT-PZ-203	76-81	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP
PT-PZ-204	76-81	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP
PT-PZ-203	76-81	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP
PT-PZ-205	76-81	TCL VOCs, TOC, Bromide, GCIP , Microbial, GWQP	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GCIP , Microbial, GWQP	TCL VOCs, TOC, Bromide, GWQP
PT-PZ-206	76-81	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP
PT-PZ-207	76-81	TCL VOCs, TOC, Bromide, GCIP , Microbial, GWQP	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GCIP , Microbial, GWQP	TCL VOCs, TOC, Bromide, GWQP
PT-PZ-208	76-81	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP
ERM-MW-01D	71.4 - 81.4	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP
ERM-MW-05D	75.1 - 85.1	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP
ERM-MW-06D	76 - 86	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP
MW-102D	81 - 86	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP	TCL VOCs, TOC, Bromide, GWQP

Notes:

[1] All proposed groundwater samples listed above will be collected from the middle of saturated screen.

Microbial = QPCR QuantArray Chlor from Microbial Insights.

GCIP = Geochemical Indicator Parameters: Chloride, Total and Dissolved Fe, Total and Dissolved Mn, Alkalinity, Sulfate, Sodium, Nitrate, Phosphate, Dissolved Gases (Methane, Ethane, Ethene) .

GWQP = Groundwater Quality Parameters: pH, Temperature, Dissolved Oxygen, Specific Conductivity, Oxidation-Reduction Potential, Total Dissolved Solids, & Turbidity (with field instruments).

Refer to work plan for required turnaround time and laboratory data deliverable packages.

Table 3
NYSDEC
Pride Solvents & Chemical Co. Enhanced Anaerobic Bioremediation Injection Pilot Test Work Plan
Initial Assessment of Required Injection Amendment Quantities

Injection Amendment	Purpose	Notes	Total Volume/Weight	Volume/Weight Per Injection Point
SRS-Zvi	Carbon Source	Emulsified vegetable oil formulated zero valent iron included to promote rapid destruction of chlorinated solvents	825 gallons (7,367 pounds)	412.5 gallons
Sodium Bicarbonate	pH Adjustment	Used to increase pH to near neutral levels and provide a buffer to prevent future pH changes	3,000 pounds	1,500 pounds
Xanthan Gum	Sheer Thinning Fluid	Used to increase the resting viscosity of the injection fluid to prevent "wash out" along the Upper Glacial Aquifer and clay interface	250 pounds	125 pounds
Water	Dilution	Potable water	5,900 gallons	2950 gallons
KB-1	Bioaugmentation Culture	Microbial culture added to enhance reductive dechlorination	10 Liters	5 Liters
Bromide	Chemical Tracer	To be mixed with injection fluid and analyzed	100 pounds	50 pounds
Color Dye	Visual Tracer	Use a biodegradable, non-toxic dye compliant with NSF Standard 60	~ 1 pint (based on manufacturer's recommendation)	~ 1/2 pint (based on manufacturer's recommendation)
Sodium Bisulfate	Oxygen Scavenger	Added to remove oxygen from injection water, critical for bioaugmentation injection	10 pounds	5 pounds

Figures

SCALE: 1:2400

1 0.5 0 KILOMETERS 1 2

1000 500 0 METERS 1000 2000

1 0.5 0 MILES 1

1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000 FEET

QUADRANGLE LOCATION

MAP INCLUDES INFORMATION FROM THE FOLLOWING MAP SHEET(S):
TP, AMITYVILLE, NY, 7.5 MINUTE DATED 2019,
E, BAY SHORE WEST, NY, 7.5 MINUTE DATED 2019,
NE, GREENLAWN, NY, 7.5 MINUTE DATED 2019,
N, HUNTINGTON, NY, 7.5 MINUTE DATED 2019.

MAP OBTAINED THROUGH USE OF TOPOVIEW WITH THE INTERFACE CREATED BY THE NATIONAL GEOLOGIC MAP DATABASE PROJECT (NGMDB), IN SUPPORT OF THE TOPOGRAPHIC MAPPING PROGRAM, MANAGED BY THE USGS NATIONAL GEOSPATIAL PROGRAM (NGP).

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PROJECT:
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
PRIDE SOLVENTS & CHEMICAL CO. - SITE NO. 152025
78 & 88 LAMAR STREET
WEST BABYLON, NEW YORK 11704

TITLE:

SITE LOCATION MAP

DRAWN BY:	H. DELGADO
CHECKED BY:	P. CASTELLANO
APPROVED BY:	D. GLASS
DATE:	MARCH 2022
PROJ. NO.:	435639.0000.0000
FILE:	Fig 1 - Site Location Map (PSCC).dwg

FIGURE 1

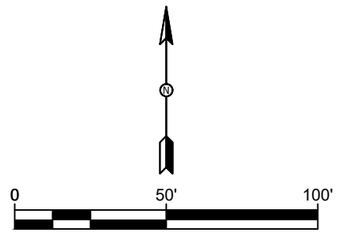
8.5x11 --- ATTACHED XREF'S: --- ATTACHED IMAGES: EPSG2263; NY, Amityville, 20190925, TM; NY, Bay Shore, West, 20190919, TM; NY, Greenlawn, 20190919, TM; NY, Huntington, 20190925, TM;
DRAWING NAME: \\cliftonpark-vfp\cliftonpark\ECR\Projects\NYSDEC\D009812\Work Assignments\D009812-17 Pride Solvents and Chemical Co\OU2\Workplan\Figures\TRC Working Drawings\ Fig 1 - Site Location Map (PSCC).dwg --- PLOT DATE: March 09, 2022 - 11:17PM --- LAYOUT: 8.5x11P

LEGEND (SYMBOLS NOT TO SCALE):

	SITE BOUNDARY
MW-###	MONITORING WELL LOCATION AND IDENTIFICATION NUMBER (2018 PRE-DESIGN INVESTIGATION)
MW-##	MONITORING WELL LOCATION AND IDENTIFICATION NUMBER (2010REMEDIAL INVESTIGATION)
ERM-MW-##	ERM MONITORING WELL LOCATION AND IDENTIFICATION NUMBER (2010 REMEDIAL INVESTIGATION)
MW-##	CDM MONITORING WELL LOCATION AND IDENTIFICATION NUMBER (2010 REMEDIAL INVESTIGATION)
VMP-##	VAPOR MONITORING POINT LOCATION AND IDENTIFICATION NUMBER
AS-##	AIR SPARGE POINT LOCATION AND IDENTIFICATION NUMBER
SVE-##	SOIL VAPOR EXTRACTION POINT LOCATION AND IDENTIFICATION NUMBER

NOTES:

1. LOCATIONS AND DIMENSIONS OF PHYSICAL FEATURES, BOUNDARIES, AND SAMPLE LOCATIONS ARE APPROXIMATE.
2. AERIAL IMAGE BACKGROUND SOURCED FROM NEARMAP DATED OCTOBER 20, 2021.



SCALE: 1" = 50'
SHEET SIZE: 11" BY 17"

PROJECT:
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
PRIDE SOLVENTS & CHEMICAL CO. - SITE NO. 152025
78 & 88 LAMAR STREET
WEST BABYLON, NEW YORK 11704

TITLE:
MONITORING AND AS/SVE WELL LOCATIONS

DRAWN BY:	H. DELGADO	PROJ NO.:	435693.0000.0000
CHECKED BY:	P. CASTELLANO		**FIGURE 2**
APPROVED BY:	D. GLASS		
DATE:	MARCH 2022		

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FILE NO.: Fig 2 - Monitoring and AS-SVE Well Locs (PSCC).dwg

LEGEND (SYMBOLS NOT TO SCALE):

- SITE BOUNDARY
- APPROXIMATE EXTENT OF OU-2 (DEEP GROUNDWATER) TREATMENT AREA - 14,000 FT^2 (2018 PRE-DESIGN INVESTIGATION)
- PILOT TEST TREATMENT ZONE - 1,200 FT^2
- CONCEPTUAL INJECTION POINT AREA OF INFLUENCE
- PT-IW-1## — PROPOSED INJECTION WELL LOCATION AND IDENTIFICATION NUMBER
- PT-PZ-2## — PROPOSED PIEZOMETER LOCATION AND IDENTIFICATION NUMBER
- PT-SS-3## — PROPOSED POST-INJECTION SOIL SAMPLE LOCATON AND IDENTIFICATION NUMBER
- MW-### — EXISTING MONITORING WELL LOCATION AND IDENTIFICATION NUMBER (2016 PRE-DESIGN INVESTIGATION)
- ERM-MW-## — ERM MONITORING WELL LOCATION AND IDENTIFICATION NUMBER (2010 REMEDIAL INVESTIGATION)
- APPROXIMATE DIRECTION OF GROUNDWATER FLOW
- AIR SPARGE AND SOIL VAPOR EXTRACTION PIPING
- AS-## — AIR SPARGE WELL LOCATION (2016)
- SVE-## — SOIL VAPOR EXTRACTION WELL LOCATION (2016)

N

0 20' 40'

SCALE: 1" = 20'
SHEET SIZE: 11" BY 17"

NOTES:

1. LOCATIONS AND DIMENSIONS OF PHYSICAL FEATURES, BOUNDARIES, AND WELL LOCATIONS ARE APPROXIMATE. ACTUAL WELL LOCATIONS WILL BE ADJUSTED BASED ON FIELD DATA AND UTILITY MARKOUT.
2. AERIAL IMAGE BACKGROUND SOURCED FROM NEARMAP DATED OCTOBER 20, 2021.
3. ONLY DEEP MONITORING WELLS ARE SHOWN ON THIS FIGURE FOR CLARITY.
4. AS-BUILT PIPE AND AIR SPARGE LOCATIONS SOURCED FROM SURVEY DRAWING BY F.C. WATSON LAND SURVEYOR PC, DATED AUGUST 16, 2016. LOCATIONS AND ARRANGEMENT SHOWN ARE APPROXIMATE.

PROJECT:
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TITLE:
PILOT TEST INJECTION WELL AND PIEZOMETER LAYOUT

DRAWN BY:	H. DELGADO	PROJ NO.:	435693.0000.0000
CHECKED BY:	H. NICHOLS		
APPROVED BY:	D. GLASS		**FIGURE 3**
DATE:	MARCH 2022		

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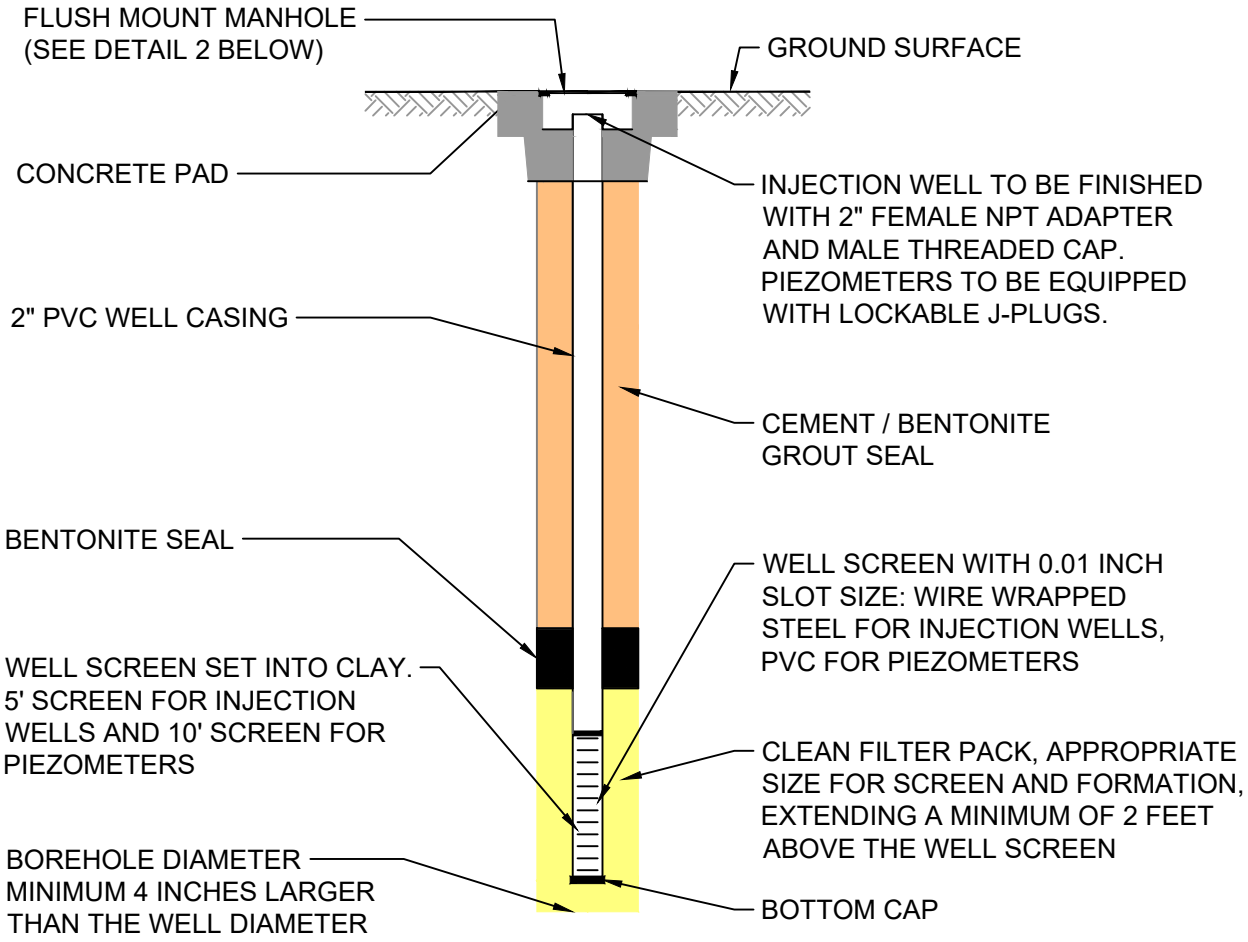
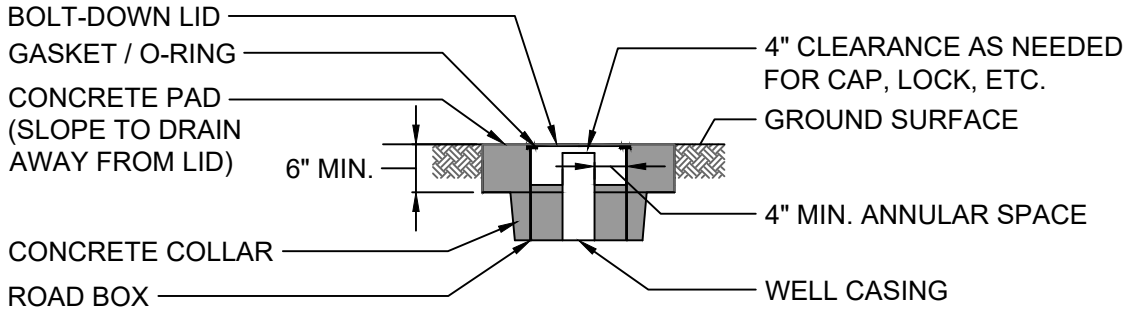
FILE NO.: Fig 3 - Pilot Test Inj. Well and PZ Layout.dwg



DETAIL 1 - INJECTION WELL AND PIEZOMETER CONSTRUCTION DETAILS

NOT TO SCALE



DETAIL 2 - FLUSH MOUNT MANHOLE DETAILS

NOT TO SCALE

NOTE:
REFER TO WORK PLAN TEXT FOR DETAILS OF WELL CONSTRUCTION.

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PROJECT:
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
PRIDE SOLVENTS & CHEMICAL CO. - SITE NO. 152025
78 & 88 LAMAR STREET
WEST BABYLON, NEW YORK 11704

TITLE:
INJECTION WELL AND PIEZOMETER CONSTRUCTION DETAILS

DRAWN BY:	H. DELGADO
CHECKED BY:	H. NICHOLS
APPROVED BY:	D. GLASS
DATE:	MARCH 2022
PROJ. NO.:	435639.0000.0000
FILE:	Fig 4 - Well Details.dwg

FIGURE 4

Appendix A
Safety Data Sheets for Amendments

SRS®-Z_{VI} (2 µm)
Combined Emulsified Vegetable Oil Substrate and 2 µm Zero Valent Iron
SAFETY DATA SHEET

January 1st, 2020

1. Product Identification

Synonyms: Combined Emulsified Vegetable Oil Substrate and 2 µm Zero Valent Iron [SRS®-Z_{VI} (2 µm)]; Emulsified Vegetable Oil (EVO) and Zero Valent Iron (ZVI)

Recommended Use: Treatment of groundwater contaminated with DNAPL level concentrations of chlorinated solvents and other anaerobically degradable compounds.

Supplier:
Terra Systems, Inc.
130 Hickman Road, Suite 1
Claymont, Delaware 19703
Telephone (302) 798-9553
Fax (302) 798-9554
www.terrasystems.net

2. Hazards Identification

Emergency Overview

Caution: May cause eye irritation.
Health Rating: 1 - Slight
Flammability Rating: 1 - Slight
Reactivity Rating: 1 - Slight
Contact Rating: 1 - Slight
Protective Equipment: Goggles; Proper Gloves
Storage Color Code: Green (General Storage)

Potential Health Effects

Inhalation: Not expected to be a health hazard. May irritate lungs and mucous membranes and cause irritation, dizziness, and nausea. Remove to fresh air.

Ingestion: Not expected to be a health hazard via ingestion. Large doses may produce abdominal spasms, diarrhea.

Skin Contact: No adverse effects expected. May cause irritation or sensitization in sensitive individuals.

Eye Contact: May cause irritation, watering, and possible reddening.

Chronic Exposure: No information found.

Aggravation of Pre-existing Conditions: No information found.

3. Composition/Information on Ingredients

Ingredient	Synonyms	CAS #	Percent	Hazardous
Soybean oil	Soya oil	8001-22-7	45%	No
Iron suspension	ZVI	7439-89-6	10%	No
60% Sodium Lactate	2-hydroxpropionic acid sodium salt	72-17-3	4%	No
Emulsifiers and proprietary nutrient package containing nitrogen, phosphorus and vitamin B_{12}		Mixture	6%	No

The emulsifiers are a trade secret and consists of ingredients of unknown acute toxicity.

4. First Aid Measures

Inhalation: Not expected to require first aid measures. Remove to fresh air. Get medical attention for any breathing difficulty.

Ingestion: If large amounts were swallowed, give water to drink and get medical advice.

Skin Contact: Not expected to require first aid measures. Wash exposed area with soap and water. Get medical advice if irritation develops.

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

5. Fire Fighting Measures

Fire: The zero valent iron powder, when dry, may self-combust and has the potential to catch paper towels, rags, etc. on fire. Avoid airborne dispersion of fine powder in an enclosed area to reduce potential dust ignition. Keep SRS®-EZVI wet and avoid contact with combustible materials.

Explosion: May generate hydrogen gas vapors that can cause explosion when exposed to a spark or flame. Closed containers may explode if exposed to extreme heat.

Fire Extinguishing Media: Dry chemical, sand, foam, graphite, or carbon dioxide. Water spray may be ineffective on fire but can protect fire-fighters and cool closed containers. Use fog nozzles if water is used.

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

6. Accidental Release Measures

Clean-up personnel may require protective clothing. Absorb in sand, paper towels, “Oil Dry”, or other inert material. Scoop up and containerize for disposal. Flush trace residues to sewer with soap and water. Containerized waste may be sent to an approved waste disposal facility.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Containers of this material are not hazardous when empty since they do not contain vapors or harmful substances; observe all warnings and precautions listed for the product. Do not store above 49 C (120 F). Keep container tightly closed and upright when not in use to prevent leakage.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:	None established.
Ventilation System:	Not expected to require any special ventilation.
Personal Respirators (NIOSH Approved):	Not expected to require personal respirator usage.
Skin Protection:	Wear protective gloves and clean body-covering clothing.
Eye Protection:	Use chemical safety goggles and/or a full-face shield where splashing is possible. Provide readily accessible eye wash stations and safety showers.
Slips, Trips, and Falls:	Material is slippery when spilled. Clean up with sand, paper towels, “Oil Dry”, or other inert material.

9. Physical and Chemical Properties

Appearance:	Gray viscous liquid.
Odor:	Vegetable oil.
Solubility:	Not soluble in water.
Specific Gravity (water=1):	1.07 (8.93 pounds per gallon)
pH:	6-8
% Volatiles by volume @ 21C (70F):	Negligible.
Boiling Point:	≥ 100C (≥ 212F)
Melting Point:	No information found.
Flash Point (F):	No information found.
Autoignition Temperature:	No information found.
Decomposition Temperature:	No information found.
Vapor Density (Air=1):	No information found.
Vapor Pressure (mm Hg):	< 1.0 @ 20C (68F).
Evaporation Rate (BuAc=1):	No information found.
Viscosity @23 C (73 F):	440-1,942 centipoises
Partition Coefficient (octanol/water):	No information found.

10. Stability and Reactivity

Stability: Stable under ordinary conditions of use and storage. May generate hydrogen gas.

Reactivity: Not reactive under ordinary conditions.

Hazardous Decomposition Products: Carbon dioxide and carbon monoxide may form when heated to decomposition.

Hazardous Polymerization: Will not occur.

Incompatibilities: Strong oxidizers, acids.

Conditions to Avoid: Incompatibles. Isolate from heat and open flame.

11. Toxicological Information

Soybean Oil: No information found on toxicology. It is not a carcinogen listed by IARC, NTP, NIOSH, OSHA, or ACGIH.

Emulsifier/Nutrient Mixture: No information found on toxicology. It is not a carcinogen listed by IARC, NTP, NIOSH, OSHA, or ACGIH.

Sodium Lactate: Oral rat LD50: 2000 mg/kg. Irritation for sodium lactate: standard Draize 100 mg - mild. This compound is not listed as a carcinogen by IARC, NRP, NIOSH, OSHA, or ACGIM.

Zero Valent Iron: No information found on toxicology. It is not a carcinogen listed by IARC, NTP, NIOSH, OSHA, or ACGIH.

Glycerol: Practically non-toxic.

SRS-EZVI: The toxicity of the mixture has not been measured.

12. Ecological Information

Environmental Fate: No information found.

Environmental Toxicity: No information found.

Degradability: SRS is completely biodegradable under both aerobic and anaerobic conditions.

Soil Mobility: SRS will move with groundwater until the adsorbed onto the soil. Degradation products may be mobile. The ZVI portion will not be mobile.

Bioaccumulation Potential: No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal 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

Not regulated.

15. Regulatory Information

OSHA STATUS: This product is not hazardous under the criteria of the Federal OSHA hazard Communication Standard 29 CFR 1910.1200. However, thermal processing and decomposition fumes from this product may be hazardous as noted in Section 10.

TSCA STATUS: No component of this product is listed on the TSCA inventory.

CERCLA (Comprehensive Response Compensation, and Liability Act): Not reportable.

SARA TITLE III (Superfund Amendments and Reauthorization Act)
Section 312 Extremely Hazardous Substances: None
Section 311/312 Hazard Categories: Non-hazardous Under Section 311/312
Section 313 Toxic Chemicals: None

RCRA STATUS: If discarded in its purchased form, this product would not be a hazardous waste either by listing or by characteristic. However, under RCRA, it is the responsibility of the product user to determine at the time of disposal, whether a material containing the product or derived from the product should be classified as a hazardous waste. (40 CFR 261.20-24)

CALIFORNIA PROPOSITION 65: The following statement is made in order to comply with the California safe Drinking Water and Toxic Enforcement Act of 1986. The product contains no chemicals known to the State of California to cause cancer.

16. Other Information

NFPA Ratings:	Health: **1** Flammability: **1** Reactivity: **1**
Date Revised:	January 1, 2018
Revision Information:	SDS Section(s) changed since last revision of document include: Added glycerol as component.
Disclaimer:	Terra Systems, Inc. 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. TERRA SYSTEMS, INC. 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. ACCORDINGLY, TERRA SYSTEMS, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.

Prepared by: Terra Systems, Inc.
Phone Number: (302) 798-9553 (U.S.A.)

SDS

Safety Data Sheet

1. IDENTIFICATION

Product Identifier: **Sodium Bisulfate**

Product Code(s): S1159

Synonyms: Sodium Hydrogen Sulfate; Sodium Acid Sulfate; Sodium Pyrosulfate; Sulfuric Acid, Monosodium Salt.

Recommended Use: For manufacturing, industrial, and laboratory use only. Use as a catalyst or as a laboratory solute.

Uses Advised Against: Not for food, drug, or household use.

Supplier: Rocky Mountain Reagents, Inc.
4621 Technology Drive, Golden, CO 80403
Phone: (303) 762-0800 Fax: (303) 762-1240

Emergency Phone Number: For health emergency, call poison control: (800) 222-1222.

2. HAZARDS IDENTIFICATION

Hazard Classifications: Eye Damage/Irritation: Category 1

Signal Word: DANGER

Hazard Statements: Causes serious eye damage.

Pictograms:

Precautionary Statements:

Prevention: Wear eye protection and face protection.

Response: 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 or doctor.

Storage: Not applicable.

Disposal: Not applicable.

Hazards Not Otherwise Classified: Not applicable.

Toxicity Statement: Not applicable.

3. COMPOSITION AND INFORMATION ON INGREDIENTS

Component	Common Name / Synonyms	CAS#	Chemical Formula	% by Weight
Sodium Bisulfate	Sodium Hydrogen Sulfate	7681-38-1	$NaHSO_4$	≥ 91.5

Trade Secret Statement: Not applicable.

4. FIRST AID MEASURES

First Aid Procedures:

Inhalation: Move to fresh air. If breathing is difficult, give oxygen. If not breathing, give artificial respiration. Call a physician if symptoms occur.

Ingestion: Do not induce vomiting unless directed to do so by medical personnel. If vomiting occurs, keep head low so that vomit does not enter lungs. Never give anything by mouth to an unconscious person. Call a physician or poison control center if symptoms occur.

Skin Contact: Wash skin with soap and plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. Call a physician if symptoms occur.

Eye Contact: Check for and remove contact lenses, if present and easy to do. Immediately flush eyes with gentle but large stream of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Call a physician immediately.

General Advice: Poison information centers in each state can provide additional assistance for scheduled poisons. Ensure that those providing first aid and medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Symptoms and Effects: Irritation, coughing, wheezing, burns, redness, itchiness, nausea, vomiting, diarrhea. Harmful if exposed to the eyes. May be harmful if swallowed, inhaled, or exposed to the skin. Prolonged or repeated exposure may cause respiratory sensitization and tooth decay.

Immediate Medical Care/ Special Treatment: Get medical attention if you feel unwell or are concerned. Treat symptomatically.

5. FIREFIGHTING MEASURES

Suitable Extinguishing Media: Water spray, dry powder, alcohol resistant foam, carbon dioxide.

Unsuitable Extinguishing Media: Do not use a solid (straight) water stream, as it may scatter and spread fire.

Hazardous Combustion Products: Sodium oxides, sulfur oxides.

Specific Hazards: Excessive thermal conditions may cause decomposition and yield hazardous combustion products listed above.

Special Protective Equipment/ Precautions for Firefighters: As in any fire, wear MSHA/NIOSH-approved (or equivalent), self-contained, positive-pressure or pressure-demand breathing apparatus and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions and Protective Equipment: Ventilate area of leak or spill. Isolate hazard area and keep unnecessary and unprotected personnel away from the area of the leak or spill. Wear appropriate personal protective equipment (see Section 8). Avoid contact with eyes, skin, and clothing.

Emergency Procedures: In case of chemical emergency, or if unsure how to address an accidental release, consult a professional (see Section 1).

Methods for Containment: Prevent entry into waterways, sewer, basements, or confined areas. Avoid generation of product as dust. Product should not be released to the environment. Contain and recover waste when possible.

Methods for Cleanup: Sweep or collect spill with an inert material (e.g. vermiculite, dry sand, earth, cloth, or fleece) and place in a non-combustible container for reclamation or disposal. Do not flush to sewer. Clean contaminated surface thoroughly. Residues from spills can be diluted with water. Never return spills in original containers for reuse. Clean up in accordance with all applicable regulations.

7. HANDLING AND STORAGE

Handling: Wear personal protective equipment (see Section 8). Provide sufficient air exchange and/or exhaust in work rooms. Avoid contact with skin, eyes, and clothing. Avoid generation of dust. Do not breathe product dust. Limit exposure to moisture. Do not ingest. When using, do not eat, drink, or smoke. Keep away from incompatible materials (see Section 10). Handle in accordance with good industrial hygiene and safety practice. Wash thoroughly after handling. Containers of this material may be hazardous when empty, as they retain product residues. Observe all warnings and precautions listed for this product.

Storage: Store in a cool, dry, ventilated area. Store in a segregated and approved area away from heat and incompatible materials (see Section 10). Store in original container. Keep containers tightly closed and upright. Keep away from food, drink, and animal foodstuffs. Keep out of the reach of children. Comply with all national, state, and local codes pertaining to the storage, handling, dispensing, and disposal of this product.

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

Exposure Limits: No information found.

Engineering Controls: Ensure adequate ventilation. 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.

Personal Protective Measures:

Eye/Face Protection: Wear safety glasses with side shields or goggles. Maintain approved eye wash station and accessible rinse facilities in work area.

Skin Protection: Wear appropriate chemical resistant clothing (with long sleeves) and appropriate chemical resistant gloves.

Respiratory Protection:	An air-purifying, NIOSH-approved respirator with an organic vapor cartridge or canister may be permissible under certain circumstances where airborne concentrations are expected to exceed exposure limits. Use a positive-pressure, air-supplied respirator if there is any potential for an uncontrolled release, if exposure levels are unknown, or if any other circumstances exist where air-purifying respirators may not provide adequate protection.
Specific Requirements for Personal Protective Equipment:	Ensure that glove material is compatible with this product. This information is available from glove manufacturers.

9. PHYSICAL AND CHEMICAL PROPERTIES

Unless otherwise indicated, all properties are given at 25 °C and standard pressure.

Appearance:	White, powdered solid.
Odor:	Odorless.
Odor Threshold:	No information found.
Formula Weight:	120.06
pH:	No information found.
Melting/Freezing Point:	315 °C
Boiling Point/Range:	No information found.
Decomposition Temperature:	No information found.
Flash Point:	Not applicable.
Auto-ignition Temperature:	Not applicable.
Flammability:	Not flammable.
Flammability/Explosive Limits:	Not applicable.
Solubility:	285 g/L aqueous.
Vapor Pressure:	No information found.
Vapor Density:	No information found.
Specific Gravity:	2.7 (Water = 1)
Evaporation Rate:	No information found.
Viscosity:	No information found.
Partition Coefficient (n-octanol/water):	No information found.

10. STABILITY AND REACTIVITY

Reactivity Data:	No information found.
Chemical Stability:	Stable under normal conditions. Hygroscopic.
Conditions to Avoid:	Excessive heat, moisture, incompatible materials.
Incompatible Materials:	Strong oxidizers, strong bases.
Hazardous Decomposition Products:	Sodium oxides, sulfur oxides.

Possibility of Hazardous Reactions:	May react vigorously or violently with the incompatible materials listed above. Excessive thermal conditions may yield hazardous decomposition products listed above.
Hazardous Polymerization:	Will not occur.

11. TOXICOLOGICAL INFORMATION

Routes of Exposure:	Inhalation, ingestion, skin contact, eye contact.
Acute Effects:	Harmful if exposed to the eyes. May be harmful if swallowed, inhaled, or exposed to the skin.
Chronic Effects:	Prolonged or repeated exposure may cause respiratory sensitization and tooth decay.
Toxicological Data:	LD_{50} Oral, Rat: 2800 mg/kg Causes serious eye irritation based on animal data.
Symptoms of Exposure:	Irritation, coughing, wheezing, burns, redness, itchiness, nausea, vomiting, diarrhea.
Carcinogenic Effects:	This product is not considered to be a carcinogen by IARC, ACGIH, NTP, or OSHA.

12. ECOLOGICAL INFORMATION

Ecotoxicological Data:	No information found.
Persistence and Degradability:	No information found.
Environmental Effects:	Not expected to be hazardous to the environment. However, the possibility of an environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

13. DISPOSAL INFORMATION

Disposal Instructions:	Dispose of this material and its container to an approved waste collection point. Minimize exposure to product waste (see Section 8). Do not dispose unused waste down drains or into sewers. All wastes must be handled in accordance with local, state, and federal regulations.
Contaminated Packaging:	Because containers retain product residue, follow label warnings even after container is emptied. Offer rinsed packaging material to local recycling facilities.
Waste Codes:	No information found.

14. TRANSPORT INFORMATION

DOT:	Not regulated.
Environmental Hazard Regulations:	Not regulated as a marine pollutant.
Other Transport Precautions:	No information found.

15. REGULATORY INFORMATION

U.S. Federal Regulations:

OSHA: This product is considered a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

TSCA Inventory: All components of this product are on the U.S. TSCA Inventory.

U.S. EPCRA (SARA Title III):

Section 302: No information found.

Sections 311/312:

Hazard Category	List (Yes/No)
Section 311 – Hazardous Chemical	Yes
Immediate Hazard	Yes
Delayed Hazard	No
Fire Hazard	No
Pressure Hazard	No
Reactivity Hazard	No

Section 313: No information found.

CERCLA Reportable Quantities: No information found.

International Inventories:

Country 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)	Yes
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
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes

*A "Yes" indicates that the listed component(s) of this product comply with the inventory requirements administered by the governing country(s).

16. OTHER INFORMATION

Disclaimer: Rocky Mountain Reagents, Inc. provides the information in this Safety Data Sheet in the belief that it is reliable but assumes no responsibility for its completeness or accuracy. The physical properties reported in this SDS are obtained from literature and do not constitute product specifications. Rocky Mountain Reagents, Inc. makes and gives no representations or warranties with respect to the information contained herein or the product to which it refers, whether express, implied, or statutory, including without limitation, warranties of accuracy, completeness, merchantability, non-infringement, performance, safety, suitability, stability, and fitness for a particular purpose. No warranty against infringement of any patent, copyright or trademark is made or implied. This SDS is intended only as a guide to the appropriate handling of the material by a properly trained person. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. Accordingly, Rocky Mountain Reagents, Inc. assumes no liability whatsoever for the use of or reliance upon this information including results obtained, incidental or consequential damages, or lost profits.

Issue Date: May 19, 2016

Reason for Revision: Update of Section 9 over 08/06/2015 version.

SAFETY DATA SHEET

Sodium Bicarbonate

Section: 1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	Sodium Bicarbonate
Other means of identification	:	None
Recommended use	:	No Data available
Restrictions on use	:	None known
Company	:	Drillchem Drilling Solutions, LLC PO Box 132107 Spring, TX 77393 USA Office: (281) 713-8941
Emergency telephone number	:	(800) 424-9300 (24 Hours) CHEMTREC
Issuing date	:	09/12/2018

Section: 2. HAZARDS IDENTIFICATION

GHS Classification

Flammable liquids	:	Not classified
Skin irritation	:	Category 3
Eye irritation	:	Category 2B
Carcinogenicity	:	Not classified
Reproductive toxicity	:	Not classified
Specific target organ toxicity - single exposure	:	Not classified
Aspiration hazard	:	Not classified
Acute Oral Toxicity	:	Category 5

GHS Label element

Hazard pictograms :

Signal Word	:	Warning
Hazard Statements	:	May be harmful if swallowed. Causes skin mild irritation. Causes eye irritation.
Precautionary Statements	:	**Prevention:** Observe good industrial hygiene practices. **Response:** IF SWALLOWED: USA Immediately call the National POISON CENTER at 800-222-1222. OUT SIDE USA Immediately call poison center or doctor. DO NOT induce vomiting. IF ON SKIN, Take off immediately all contaminated clothing. Rinse skin with water/shower. IF INHALED, Remove to fresh air and keep comfortable for breathing. If not breathing give artificial respiration. DO NOT use mouth to mouth resuscitation without proper protection. IF IN EYES rinse cautiously with water for at least 15 minutes.

IF ON CLOTHING, Take off contaminated clothing.
Stop leaks if safe to do so. See section 6 for proper clean up.

Storage: Store in a well-ventilated place, Keep container tightly closed when not in use.

Disposal: Dispose of content and/ container in accordance with local, regional, national and/or international regulations.

Other hazards : Irritation to the respiratory system.

Section : 3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Names	CAS #.	Concentration%	Other Identifiers
Sodium Bicarbonate	144-55-8	99 - 100%	Baking Soda

Section: 4. FIRST AID MEASURES

In case of eye contact : Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.

In case of skin contact : Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid immediately. Wash clothing before reuse.

If swallowed : Do NOT induce vomiting. Get medical aid immediately.

If inhaled : Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult and **IF TRAINED**, give oxygen. Get medical aid. Do NOT use mouth-to-mouth resuscitation without protection.

Protection of first-aiders : No data available.

Notes to physician : The severity of outcome following ingestion may be more related to the time between ingestion and treatment, rather than the amount ingested. Therefore, there is a need for rapid treatment of any ingestion exposure.

Most important symptoms and effects, both acute and delayed : No data available.

Section: 5. FIREFIGHTING MEASURES

Suitable extinguishing media : Carbon dioxide, dry chemical powder or appropriate foam. Use water to keep non- leaking, fire-exposed containers cool.

Unsuitable extinguishing media : No data available.

Specific hazards during firefighting	:	When heated to decomposition Sodium Bicarbonate emits acrid smoke, fumes, and carbon dioxide and sodium oxides.
Special protective equipment for firefighters	:	As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. Use water spray to keep fire-exposed containers cool. Substance is noncombustible. Contact with metals may evolve flammable hydrogen gas.

Section: 6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures	:	Evacuate the area immediately. Isolate the hazard area. Keep out unnecessary and unprotected personnel. Increase ventilation to area or move container to a well-ventilated and secure area. Do not touch damaged containers or spilled product unless wearing appropriate protective equipment. Before entry, especially into confined areas, check atmosphere with an appropriate monitor.
Environmental precautions	:	No data available.
Methods and materials for containment and cleaning up	:	Contain the discharged material. If sweeping of a contaminated area is necessary use a dust suppressant agent. Report spills to local health, safety and environmental authorities, as required.

Section: 7. HANDLING AND STORAGE

Advice on safe handling	:	Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use with adequate ventilation. Do not breathe dust minimize dust generation and accumulation. Do not get in eyes, on skin, or on clothing.
Conditions for safe storage	:	Store in a cool, dry, well-ventilated area, out of direct sunlight. Keep quantities stored as small as possible. Storage area should be clearly identified, clear of obstruction and accessible only to trained and authorized personnel.
Suitable material	:	No data available
Unsuitable material	:	No data available

Section: 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

Chemical Names	ACGIH- TLV	OSHA - PEL
Sodium Bicarbonate	5 mg/m3 TWA Respirable fraction	5 mg/m3 TWA Respirable fraction

ACGIH® = American Conference of Governmental Industrial Hygienists. TLV® = Threshold Limit Value. OSHA = US Occupational Safety and Health Administration. PEL = Permissible Exposure Limits.

NOTE: TWA Means "TWA is the employee's average airborne exposure in any 8-hour work shift of a 40-hour work week which shall not be exceeded."

Engineering measures	:	Provide general or local exhaust ventilation systems to maintain airborne concentrations below TLV/PELs Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Personal protective equipment

Eye protection	:	Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US).
Hand protection	:	Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique to avoid skin contact with this product. Dispose of contaminated gloves after use. Select gloves tested to the **ANSI/ISEA 105-2011** Full contact: Nitrile rubber Splash contact: Nitrile rubber
Skin protection	:	Chemical splash protecting against chemicals, the type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.
Respiratory protection	:	Respiratory protection respirator Use a type N100 as a backup to engineering controls.
Hygiene measures	:	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.

Section: 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	Solid Granules
Colour	:	White
Odor	:	None
Flash point	:	no data available
pH	:	9
Odour Threshold	:	no data available
Melting point/freezing point	:	no data available
Initial boiling point and boiling range	:	3038°F 1670 °C
Evaporation rate	:	no data available
Flammability (solid, gas)	:	no data available
Upper explosion limit	:	no data available
Lower explosion limit	:	no data available
Vapour pressure	:	no data available
Relative vapour density	:	no data available
Relative density	:	1.3
Density	:	no data available

Water solubility	:	Soluble
Solubility in other solvents	:	no data available
Partition coefficient: n-octanol/water	:	no data available
Auto-ignition temperature	:	no data available
Thermal decomposition temperature	:	no data available
Viscosity, dynamic	:	no data available
Viscosity, kinematic	:	no data available
Molecular weight	:	no data available
Specific gravity	:	no data available

Section: 10. STABILITY AND REACTIVITY

Chemical stability	:	The product is stable and non-reactive under normal conditions of use, storage and transport.
Possibility of hazardous reactions	:	Violent polymerization occurs when mixed with Methyl Vinyl Ether.
Conditions to avoid	:	Exposure to moisture may affect product quality.
Incompatible materials	:	Strong acids, Borane/boron oxides, Zinc, Calcium oxide, Methyl vinyl ether, Calcium chloride is attacked by bromine trifluoride.
Hazardous decomposition products	:	When heated to decomposition, calcium chloride emits toxic fumes of hydrogen chloride.

Section: 11. TOXICOLOGICAL INFORMATION

Chemical Name	LD50 oral rat	LC50 Dermal Rat
Sodium Bicarbonate	1000 mg/kg	2630mg/kg

Information on likely routes of exposure	:	Ingestion, Eye contact, Skin contact

Potential Health Effects

Repeated or prolonged contact with dust may produce chronic eye irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation.

Eyes	:	Causes severe eye irritation.
Skin	:	Causes skin irritation.

Ingestion	:	Harmful if swallowed.
Inhalation	:	Irritation to the respiratory system.

Toxicity

Product

Acute oral toxicity	:	Category 5
Acute inhalation toxicity	:	No data available
Acute dermal toxicity	:	No data available
Skin corrosion/irritation	:	No data available
Serious eye damage/eye irritation	:	No data available
Respiratory or skin sensitization	:	No data available
Carcinogenicity	:	No

Chemical Name	IARC	ACGIH	NTP	OSHA
Sodium Bicarbonate	Not Listing	Not Listing	Not listed	Not Listed

Reproductive effects	:	Not a reproductive hazard
Germ cell mutagenicity	:	Not a mutagen
Teratogenicity	:	Not harmful the unborn child
STOT - single exposure	:	Not classified
STOT - repeated exposure	:	Not classified
Aspiration toxicity	:	Not an aspiration hazard.
Signs and Symptoms	:	Dust may produce irritation of eyes, mouth and respiratory tract. Inhalation of the dust may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering

Section: 12. ECOLOGICAL INFORMATION

Ecotoxicity

Sodium Bicarbonate	LC50 759 mg/l	Fish	96 hours
Sodium Bicarbonate	EC50 590mg/l	Daphnia	48 hours

Toxicity Not toxic to aquatic organisms, contain runoff

Persistence and degradability no data available

Mobility: no data available

Bioaccumulation: no data available

PBT and vPvB assessment: No Data available

Section: 13. DISPOSAL CONSIDERATIONS

Disposal methods	:	Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Dispose in accordance with all applicable 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	:	**DO NOT REUSE EMPTY CONTAINER!** Container with residues should be considered to be hazardous wastes.

Section: 14. TRANSPORT INFORMATION

The shipper/consignor/sender is responsible to ensure that the packaging, labeling, and markings are in compliance with the selected mode of transport.

Land transport (DOT):

Not regulated as dangerous goods.

Air transport (IATA)

Not regulated as dangerous goods

Sea transport (IMDG/IMO)

Not regulated as dangerous goods

Section: 15. REGULATORY INFORMATION

This product is not known to be a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

TSCA: All components of this product are on the TSCA Inventory or are exempt from TSCA Inventory requirements under 40 CFR 720.30

EPCRA - Emergency Planning and Community Right-to-Know Act: Not listed.

CERCLA Reportable Quantity: Not listed.

SARA 304 Extremely Hazardous Substances Reportable Quantity: Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910. 1001-1050): All ingredients are listed in 1910.1200

US. Toxic Substances Control Act (TSCA) Section 12(b) Export Notification (40 CFR 707, Subpart D):
Not regulated.

SARA Community Right-to-Know Program: None

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List: Not listed.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130): Not listed.

Safe Drinking Water Act: Not regulated.

US STATE REGULATION:

US. California Controlled Substances. CA Department of Justice (California Health and Safety Code Section 11100): Not listed

US. Massachusetts RTK - Substance List: All components of this product are on the Massachusetts Inventory or are exempt from Inventory requirements.

US. New Jersey Worker and Community Right-to-Know Act: All components of this product are on the New Jersey inventory or are exempt from Inventory requirements.

US. Pennsylvania Worker and Community Right-to-Know Law: All components of this product are on the Pennsylvania Inventory or are exempt from Inventory requirements..

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 CHEMICAL CONTROL LAWS:

United States TSCA Inventory: On TSCA Inventory

Canadian Domestic Substances List (DSL): On DSL Inventory

Section: 16. OTHER INFORMATION

Revision Date : 09/12/2018

Version Number : 1.0

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the txt.

130 Research Lane, Ste 2
Guelph ON N1G 5G3
(519) 822-2265

KB-1® Material Safety Data Sheet

Section 1: Material Identification

Trade Name: KB-1®
Chemical Family: bacterial mixture
Chemical name: No IUC name for mixture is known to exist
Manufacturer/Supplier: SiREM
130 Research Lane, Suite 2,
Guelph, Ontario,
Canada N1G 5G3

For Information call: 519-822-2265 / 1-866-251-1747 x236
Emergency Number: 519-822-2265
Description: Microbial inoculum (non-pathogenic, non-hazardous)
Trade Name: KB-1®
Product Use: Bioremediation of contaminated groundwater.
Date Prepared: 2 February 2005

Section 2: Composition, Information on Ingredients

KB-1® is a microbial culture grown in an aqueous dilute mineral salt solution media containing no hazardous ingredients.

The microbial composition of KB-1® (as determined by phylogenetic analysis) is listed in Table 1. Identification of organisms was obtained by matching 16S rRNA gene sequence of organisms in KB-1® to other known organisms. The characteristics of related organisms can be used to identify potential or likely characteristics of organisms in KB-1®.

Table 1. Genus' Identified in KB-1® Microbial Inoculum

Genus
Dehalococcoides sp.
Geobacter sp.
Methanomethlovorans sp.

Section 3: Hazards Identification:

A review of the available data does not indicate any known health effects related to normal use of this product.

Section 4: First Aid Measures:

Avoid direct contact with skin and eyes. In any case of any exposure which elicits a response, a physician should be consulted immediately.

Eye Contact: Flush eyes with water for at least 15 minutes, occasionally lift upper and lower eyelids, if undue irritation or redness occurs seek medical attention.

Skin Contact: Remove contaminated clothing and wash skin thoroughly with water and antibacterial soap. Seek medical attention if irritation develops or open wounds are present.

Ingestion: Do not induce vomiting, drink several cups of water, seek medical attention.

Inhalation: Remove to fresh air. If not breathing give artificial respiration. In case of labored breathing give oxygen. Call a physician.

Section 5 - Fire Fighting Measures:

Non-flammable
Flash Point: not applicable
Upper flammable limit: not applicable
Lower flammable limit: not applicable

Section 6 – Accidental Release Procedures

Spilled KB-1® should be soaked up with sorbant and saturated with a 10% bleach solution (prepared by making a one in ten dilution of diluted standard bleach [normally sold at a strength of 5.25% sodium hypochlorite] to disinfect affected surfaces. Sorbant should be double bagged and disposed of as indicated in section 12. After removal of sorbant, area should be washed with 10% bleach solution to disinfect. If liquid from the culture vessel is present on the fittings, non-designated tubing or exterior of the stainless steel pressure vessel liquid should be wiped off and the area washed with 10% bleach solution.

Section 7 - Handling and Storage

KB-1® is shipped in stainless steel pressure vessels and connected to injection lines and inert gas is used to pressurize the vessel to displace the contents. KB-1® should be handled with care to avoid any spillage. Vessels are shipped with 1 pound per square inch (psi) pressure; valves should not be opened until connections to appropriate lines for subsurface injection are in place.

Storage Requirements: Avoid exposing stainless steel pressure vessels to undue temperature extremes (i.e., temperatures less than 0°C or greater than 30°C may result in harm to the microbial cultures and damage to the vessels). All valves should be in the closed position when the vessel is not pressurized or not in use to prevent the escape of gases and to maintain anaerobic conditions in the vessel. Avoid exposure of the culture to air as the presence of oxygen will kill dechlorinating microorganisms.

Section 8 - Exposure Controls/Personal Protection

Personal protective equipment:

Skin: Protective gloves (latex, vinyl or nitrile) should be worn.
Eye Protection: Wear appropriate protective eyeglasses or goggles when opening pressure vessels, valves, or when pressurizing vessels to inject contents into the subsurface.
Respiratory: No respiratory protection is required.
Engineering Controls: Good general room ventilation is expected to be adequate.

Section 9: Physical and Chemical Properties:

Physical State: liquid
Odour: skunky odour
Appearance: dark grey, slightly turbid liquid under anaerobic conditions, pink if exposed to air (oxygen).
Specific gravity: not determined
Vapor pressure: not applicable
Vapor density: not applicable
Evaporation rate: not determined
Boiling point: ~100° C
Freezing point/melting point: ~ 0°C

pH: 6.5-7.5
Solubility: fully soluble in water

Section 10 – Stability and Reactivity Data

Stable and non-reactive.
Maintain under anaerobic conditions to preserve product integrity.
Materials to avoid: none known

Section 11 - Toxicological Information

Potential for Pathogenicity:

KB-1® has tested negative (i.e., the organisms are not present) for a variety of pathogenic organisms listed in Table 2. While there is no evidence that virulent pathogenic organisms are present in KB-1®, there is potential that certain organisms in KB-1® may have the potential to act as opportunistic (mild) pathogens, particularly in individuals with open wounds and/or compromised immune systems. For this reason standard hygienic procedures such as hand washing after use should be observed.

Table 2, Results of Human Pathogen Screening of KB-1® Dechlorinator

Organism	**Disease(s) Caused**	***Test result***
Salmonella sp.	Typhoid fever, gastroenteritis	Not Detected
Listeria monocytogenes	Listerioses	Not Detected
Vibrio sp.,	Cholera, gastroenteritis	Not Detected
Campylobacter sp.,	Bacterial diarrhea	Not Detected
Clostridia sp.,	Food poisoning, Botulism, tetanus, gas gangrene	Not Detected
Bacillus anthracis	Anthrax	Not Detected
Pseudomonas aeruginosa	Wound infection	Not Detected
Yersinia sp.,	Bubonic Plague, intestinal infection	Not Detected
Yeast and Mold	Candidiasis, Yeast infection etc.	Not Detected
Fecal coliforms	Indicator organisms for many human pathogens diarrhea, urinary tract infections	Not Detected
Enterococci	Various opportunistic infections	Not Detected

Section 12. Disposal Considerations

Material must be disinfected or sterilized prior to disposal. Consult local regulations prior to disposal.

Section 13 – Transport Information

Non-hazardous, non-pathogenic microbial inoculum – Biosafety Risk Group 1.

Chemicals, Not Otherwise Indexed (NOI), Non-hazardous

Not subject to TDG or DOT guidelines.

Disclaimer:

The information provided on this MSDS sheet is based on current data and represents our opinion based on the current standard of practice as to the proper use and handling of this product under normal, reasonably foreseeable conditions.

Last revised: 2 August 2011

130 Research Lane, Ste 2
Guelph ON N1G 5G3
(519) 822-2265

KB-1® Plus Material Safety Data Sheet

Section 1: Material Identification

Trade Name: KB-1® Plus
Chemical Family: bacterial mixture
Chemical name: No IUC name for mixture is known to exist

Manufacturer/Supplier: SiREM
130 Research Lane, Suite 2,
Guelph, Ontario,
Canada N1G 5G3

For Information call: 519-822-2265 / 1-866-251-1747 x236
Emergency Number: 519-822-2265

Description: Microbial inoculum (non-pathogenic, non-hazardous)
Trade Name: KB-1® Plus
Product Use: Bioremediation of contaminated groundwater.
Date Prepared: 23 October 2008

Section 2: Composition, Information on Ingredients

KB-1® Plus is a microbial culture grown in a dilute aqueous mineral salt solution media containing no hazardous ingredients.

The microbial composition of KB-1® Plus is listed in Table 1.

Table 1. Major Microbial Groups Identified in KB-1® Plus Microbial Inoculum

Dehalococcoides sp.
Geobacter sp.
Methanomethylovorans sp.
Dehalobacter sp.
Dehalogenimonas sp.

Section 3: Hazards Identification:

A review of the available data does not indicate any known health effects related to normal use of this product.

Section 4: First Aid Measures:

Avoid direct contact with skin and eyes. In any case of any exposure which elicits a response, a physician should be consulted immediately.

Eye Contact: Flush eyes with water for at least 15 minutes, occasionally lift upper and lower eyelids, if undue irritation or redness occurs seek medical attention.

Skin Contact: Remove contaminated clothing and wash skin thoroughly with water and antibacterial soap. Seek medical attention if irritation develops or open wounds are present.

Ingestion: Do not induce vomiting, drink several cups of water, seek medical attention.

Inhalation: Remove to fresh air. If not breathing give artificial respiration. In case of labored breathing give oxygen. Call a physician.

Section 5 - Fire Fighting Measures:

Non-flammable
Flash Point: not applicable
Upper flammable limit: not applicable
Lower flammable limit: not applicable

Section 6 – Accidental Release Procedures

Spilled KB-1® Plus should be soaked up with sorbant and saturated with a 10% bleach solution (prepared by making a one in ten dilution of diluted standard bleach [normally sold at a strength of 5.25% sodium hypochlorite] to disinfect affected surfaces. Sorbant should be double bagged and disposed of as indicated in section 12. After removal of sorbant, area should be washed with 10% bleach solution to disinfect. If liquid from the culture vessel is present on the fittings, non-designated tubing or exterior of the stainless steel pressure vessel liquid should be wiped off and the area washed with 10% bleach solution.

Section 7 - Handling and Storage

KB-1® Plus is shipped in stainless steel pressure vessels in a protective over pack. KB-1® Plus should be handled with care to avoid any spillage. Vessels are shipped with 1 pound per square inch (psi) pressure; valves should not be opened until connections to appropriate lines for subsurface injection are in place.

Storage Requirements: Avoid exposing stainless steel pressure vessels to undue temperature extremes (i.e., temperatures less than 0°C or greater than 30°C may result in harm to the microbial cultures and damage to the vessels). All valves should be in the closed position when the vessel is not pressurized or not in use to prevent the escape of gases and to maintain anaerobic conditions in the vessel. Avoid exposure of the culture to air as the presence of oxygen will kill dechlorinating microorganisms.

Section 8 - Exposure Controls/Personal Protection

Personal protective equipment:

Skin: Protective gloves (latex, vinyl or nitrile) should be worn.
Eye Protection: Wear appropriate protective eyeglasses or goggles when opening pressure vessels, valves, or when pressurizing vessels to inject contents into the subsurface.
Respiratory: No respiratory protection is required.
Engineering Controls: Good general room ventilation is expected to be adequate.

Section 9: Physical and Chemical Properties:

Physical State: liquid
Odour: skunky odour
Appearance: dark grey, slightly turbid liquid under anaerobic conditions, pink if exposed to air (oxygen).
Specific gravity: 1
Vapor pressure: not applicable
Vapor density: not applicable
Evaporation rate: not determined
Boiling point: ~100° C
Freezing point/melting point: ~ 0°C

pH: 6.5-7.5
Solubility: fully soluble in water

Section 10 – Stability and Reactivity Data

Stable and non-reactive.
Maintain under anaerobic conditions to preserve product integrity.
Materials to avoid: none known

Section 11 - Toxicological Information

Potential for Pathogenicity:

KB-1® Plus has tested negative (i.e., the organisms are not present) for a variety of pathogenic organisms listed in Table 2. While there is no evidence that virulent pathogenic organisms are present in KB-1® Plus, there is potential that certain organisms in KB-1® Plus may have the potential to act as opportunistic (mild) pathogens, particularly in individuals with open wounds and/or compromised immune systems. For this reason standard hygienic procedures such as hand washing after use should be observed.

Table 2, Results of Human Pathogen Screening of KB-1® Plus

Organism	**Disease(s) Caused**	***Test result***
Salmonella sp.	Typhoid fever, gastroenteritis	Not Detected
Listeria monocytogenes	Listerioses	Not Detected
Vibrio sp.,	Cholera, gastroenteritis	Not Detected
Campylobacter sp.,	Bacterial diarrhea	Not Detected
Clostridia sp.,	Food poisoning, Botulism, tetanus, gas gangrene	Not Detected
Bacillus anthracis	Anthrax	Not Detected
Pseudomonas aeruginosa	Wound infection	Not Detected
Yersinia sp.,	Bubonic Plague, intestinal infection	Not Detected
Yeast and Mold	Candidiasis, Yeast infection etc.	Not Detected
Fecal coliforms	Indicator organisms for many human pathogens diarrhea, urinary tract infections	Not Detected
Enterococci	Various opportunistic infections	Not Detected

Section 12. Disposal Considerations

Material must be disinfected or sterilized prior to disposal. Consult local regulations prior to disposal.

Section 13 – Transport Information

Non-hazardous, non-pathogenic microbial inoculum

Chemicals, Not Otherwise Indexed (NOI), Non-hazardous

Not subject to TDG or DOT guidelines.

Disclaimer:

The information provided on this MSDS sheet is based on current data and represents our opinion based on the current standard of practice as to the proper use and handling of this product under normal, reasonably foreseeable conditions.

Last revised: 12 June 2012

SiREM
Leading Science · Lasting Solutions

130 Research Lane, Ste 2
Guelph ON N1G 5G3
(519) 822-2265

Chemical Components in KB-1® Growth Media

KB-1® consists of a microbial culture grown in a mineral salts media containing the ingredients listed in Table 1.

Table 1: Chemical Ingredients of KB-1® growth media

Chemical Name	Formula	CAS#	Concentration grams/Liter
Potassium Phosphate Dibasic	KH_2PO_4	7758-11-4	0.27
Potassium Phosphate Monobasic	K_2HPO_4	7778-77-0	0.34
Ammonium Chloride	NH_4Cl	12125-02-9	0.535
Calcium Chloride	$CaCl_2$	10035-04-8	0.07
Magnesium Sulfate	$MgSO_4$	10034-99-8	0.125
Ferrous Chloride	$FeCl_2$	13478	0.02
Sodium bicarbonate	$NaHCO_3$	144-55-8	2.0
Ferrous Ammonium Sulfate	$(NH_4)_2Fe(SO_4)_2$	7783-85-9	0.4
Sodium sulfide	Na_2S	1313-84-4	0.12
Resazurin	$C_{12}H_6NNaO_4$	62758-13-8	0.001
Boric Acid	H_3BO_3	10043-35-3	0.0006
Zinc Chloride	$ZnCl$	7646-85-7	0.0002
Sodium Molybdate	Na_2MoO_4	10102-40-6	0.0002
Nickel II Chloride	$NiCl_2$	7791-20-0	0.0015
Manganese Chloride	$MnCl_2$	13446-34-9	0.002
Copper II Chloride	$CuCl_2$	10125-13-0	0.0002
Cobalt Chloride	$CoCl_2$	7791-13-1	0.003
Disodium Selenite	Na_2SeO_3	10102-18-8	0.00004
Aluminum Trisulfate	$Al_2(SO_4)_3$	10043-01-3	0.0002
Vitamins	Various	Various	0.01 maximum

Section 1. Product and Company Identification

Product Name Xanthan Gum
CAS Number 11138-66-2

Parchem - fine & specialty chemicals
415 Huguenot Street
New Rochelle, NY 10801
(914) 654-6800 **(914) 654-6899**
parchem.com **info@parchem.com**

EMERGENCY RESPONSE NUMBER
CHEMTEL
Toll Free US & Canada: 1 (800) 255-3924
All other Origins: 1 (813) 248-0585
Collect Calls Accepted

Section 2. Hazards Identification

Classification of the substance or mixture
Classification: Substances is not classified as a hazardous substance or mixture
OSHA Hazards: No know OSHA hazards. Not a dangerous substance according to GHS

GHS Label Elements
Pictograms: N/A
Signal word: N/A

Hazard and precautionary statements
None

Primary Route of Entry: Inhalation, eye, and skin contact
Symptoms and effects of acute overexposure: Inhalation of the dust and eye contact may cause irritation. May be irritating to the skin of a sensitive person.
Chronic Overexposure: Same as above.
Medical Conditions Generally Aggravated By This Material: None

HMIS (USA)
Health Hazard: 0
Fire Hazard: 0
Reactivity: 0

National Fire Protection Association (USA)
Health: 0
Flammability: 0
Reactivity: 0

Protective Equipment: Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Safety glasses.

Section 3. Composition / Information on Ingredients

Common Name Xanthan Gum
CAS Number 11138-66-2

COMPONENT	CAS NUMBER	CONCENTRATION
Xanthan Gum	11138-66-2	≥ 99.0%
Glyoxal	107-22-2	≤ 1%

Section 4. First Aid Measures

Eye Contact: Flush eyes with large volume of water.
Skin Contact: Wash with warm water and mild soap.
Inhalation: Remove from exposure.
Note: If irritation persists, consult physician.

Section 5. Firefighting Measures

Flash Point: Not determined
Extinguishing Media: Water, Carbon Dioxide, Foam.
Special Firefighting Procedures: Firefighters should wear full protective clothing, including self-contained breathing equipment.
Unusual Fire and Explosion Hazards: A potential dust explosion hazard exists if the dust concentration in the air is high.

Section 6. Accidental Release Measures

Steps to Be Taken If Material Is Released or Spilled: Dry Powder - Sweep up or vacuum promptly and put into a disposable container. Wet material becomes slippery. Wash with water solution or apply absorbent material, sweep up and wash area

Section 7. Handling and Storage

Precautions For Handling And Storage: Store in dry place. Keep container closed to avoid moisture pick-up. Do not store at temperatures above 30°C/86°F. Practice reasonable care and cleanliness.

Section 8. Exposure Controls / Personal Protection

Engineering: Use local exhaust ventilation to maintain minimal exposure to nuisance dust.
Personal Protective Equipment: Use approved respirator if dust becomes a nuisance.
Engineering: Use local exhaust ventilation to maintain minimal exposure to nuisance dust.
Personal Protective Equipment: Use approved respirator if dust becomes a nuisance

Section 9. Physical and Chemical Properties

Appearance: Off-white to beige, powder
Odor: No distinguishable odor.
Odor Threshold: No applicable information is available
pH: 4 – 7
Melting point/Freezing Point: No applicable information is available
Initial Boiling Point and Boiling Point Range: No applicable information is available
Flash Point: No applicable information is available
Evaporation Rate: No applicable information is available
Flammability: No applicable information is available
Upper/Lower Flammability or Explosive Limits: No applicable information is available
Vapor Pressure: No applicable information is available
Relative Density: No applicable information is available
Solubility: Cold
Partition Coefficient: No applicable information is available
Auto-Ignition Temperature: > 200°C
Decomposition Temperature: No applicable information is available
Viscosity: 1200 - 1800 cPs
Reactivity: Stable
Chemical Stability: Stable
Possibility of Hazardous Reactions: Will not occur.
Conditions to Avoid: Water, product will become slippery
Incompatible Materials: Strong oxidizers.
Hazardous Decomposition Products: Carbon Dioxide, Carbon Monoxide.

Section 10. Stability and Reactivity

Stability: Stable
Materials To Avoid: Strong oxidizers.
Conditions to Avoid: Water, product will become slippery
Hazardous Decomposition Products: Carbon Dioxide, Carbon Monoxide.
Hazardous Polymerization: Will not occur.

Section 11. Toxicological Information

Acute toxicity
Acute oral toxicity – Xanthan Gum
LD50 Oral: 45.000 mg/kg species: rat
LD50 Oral: 20.000 mg/kg Species: mouse

Glyoxal
LD50 Oral: 2.000 - 5.000 mg/kg Species: rat
LD50 Oral: 2.960 mg/kg Species: rat

LD50 Oral: 1.280 mg/kg Species: mouse

Acute inhalation toxicity – Xanthan Gum
21 mg/l Exposure time: 1 h
Species: rat
An LC50/inhalation/4h/rat could not be determined because no mortality of rats was observed at the maximum achievable concentration.

Glyoxal
LD50: 2,4 l mg/l
Exposure time: 4 h
Species: rat
Acute dermal toxicity – xanthan gum: no skin irritation

Glyoxal
LD50 Dermal: 12, 70 mg/kg
Species: rabbit
LD50 Dermal: 6.600 mg/kg
Species: guinea pig

Skin corrosion/irritation
Skin irritation – xanthan gum
Species: rat
Result: no skin irritation
Exposure time: 360 h no skin irritation
Species: rabbit
Result: no skin irritation
Exposure time: 120 h no skin irritation

Glyoxal
Species: rabbit
Result: mild skin irritation
Classification: irritating to skin.
Serious eye damage/eye irritation: eye irritation

Xanthan gum
Species: rat
Result: no eye irritation
Exposure time: 120 h no eye irritation

Glyoxal
Species: rabbit
Result: mild eye irritation

Respiratory or skin sensitization
Sensitization xanthan gum
Species: guinea pig
Result: did not cause sensitization on
Laboratory animals: no known sensitizing effect.

Glyoxal
Classification: may cause sensitization by skin contact.

Germ cell mutagenicity remarks
Xanthan gum: animal testing did not show any mutagenic effects.

Carcinogenicity
Xanthan gum: not classifiable as a human carcinogen. Did not show carcinogenic, teratogenic or mutagenic effects in animal experiments.

Reproductive toxicity
Xanthan gum
Species: rat
Dose: 0.5 g/kg/d
Xanthan gum
Species: rat
Application route: oral
Exposure time: 24 h
No adverse effect has been observed in chronic toxicity tests.

Glyoxal
Species: rat
Application route: oral
Exposure time: 28 d NOAEL: 40 mg/kg

Aspiration hazard
Aspiration toxicity xanthan gum: no aspiration toxicity classification

Acute effects
Glyoxal: causes skin irritation, causes serious eye irritation, harmful if inhaled.
Sensitization
Glyoxal: may cause an allergic skin reaction.
Repeated dose toxicity xanthan gum: no adverse effect has been observed in chronic toxicity tests.
Glyoxal: repeated or prolonged exposure may cause irritation of eyes and skin, chronic exposure damages the brain and the cen-tral nervous system. Further information glyoxal possible risk of irreversible effects.

Section 12. Ecological Information

Toxicity
Toxicity to fish Xanthan Gum: 420 mg/l
Exposure time: 96 h
Species: Oncorhynchus mykiss (rainbow trout)
Glyoxal
LC50: 460 - 680 mg/l
Exposure time: 96 h
Species: Leuciscus idus (Golden orfe)
Method: DIN 38412

Toxicity to daphnia and other aquatic invertebrates: No data is available on the product itself. Toxicity to daphnia and other aquatic invertebrates.
Glyoxal
EC50: 404 mg/l
Exposure time: 48 h
Species: Daphnia

Toxicity to algae: no data available
Toxicity to algae – glyoxal
Ecso: > 100 mg/l
Exposure time: 72 h
Species: pseudokirchneriella subcapit a ta (green algae) method: oecd test guideline 201

Toxicity to bacteria: no data available
Toxicity to bacteria – glyoxal
Ecso: 102 mg/l
Exposure time: 16 h
Species: bacteria

Persistence and degradability:
Xanthan gum: 93 %
Method: oecd test guideline 302 readily biodegradable.
Glyoxal: 90 - 100 % readily biodegradable.

Bioaccumulative potential:
Xanthan Gum: The product is miscible in water and readily biodegradable in both water and soil. Accumulation is not expected.
Glyoxal: Bioaccumulation is unlikely.

Mobility in soil: Distribution among environmental compartments

Xanthan Gum: no data available
Results of PBT and vPvB assessment
Xanthan Gum: This substance is not considered to be persistent, bioaccumulating nor toxic (PBT).

Other adverse effects: Biochemical Oxygen Demand (BOD)
Xanthan Gum: 200 mg/g
Glyoxal: 175 mg/g

Chemical Oxygen Demand (COD)
Glyoxal: 350 mg/g

Additional ecological information Xanthan Gum: The product does not need to be labelled in accordance with EC directives or respective national laws. This product has no known eco-toxicological effects.

Section 13. Disposal Considerations

Waste Treatment Methods: Dispose of product and contaminated packaging in accordance with all local, state, and federal environmental control regulations.

Section 14. Transport Information

Land Transport: Goods not dangerous in these regulations
Inland Navigation: Transport goods not dangerous in these regulations
Sea Shipping Transport: Goods not dangerous in these regulations
Air Transport: Goods not dangerous in these regulations

Section 15. Regulatory Information

OSHA Hazards: No known OSHA hazards

SARA 302 Components
SARA 302: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
SARA 313: This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards: No SARA Hazards

Massachusetts Right to Know Components
No components are subject to the Massachusetts Right to Know Act.
Pennsylvania Right to Know Components
Xanthan Gum (CAS-No. 11138-66-2)

Glyoxal (CAS-No. 107-22-2)

New Jersey Right to Know Components

Xanthan Gum (CAS-No. 11138-66-2)
Glyoxal (CAS-No. 107-22-2)

California Prop. 65 Components: This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm

Section 16. Other Information

Disclaimer: The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product.

REVISION DATE: 5/31/2017

Appendix B
USEPA UIC Permit Application Package

TRC
1430 Broadway, 10th Floor
New York, NY 10018
T 212.221.7822
TRCcompanies.com

Memorandum

To:	Norma Ortega Environmental Protection Agency
From:	Howard Nichols, PE Project Engineer
Subject:	Pride Solvents & Chemical Co. Site NYSDEC Site No. 152025 78 & 88 Lamar Street, West Babylon, NY UIC Permit Application
Date:	March 18, 2022
CC:	Samantha Salotto, PE (NYSDEC) Phillip Castellano, PE (TRC)
Project No.:	435693.0000.0000

This package has been prepared to request Environmental Protection Agency (EPA) approval for an underground injection control (UIC) permit for the Pride Solvents & Chemical Co. Site (Site) located in West Babylon, New York. The Site is in the New York State Superfund Program and the UIC application is being submitted in support of a planned Enhanced Anaerobic Bioremediation (EAB) Injection Pilot Test for chlorinated solvents in deep soil and groundwater beneath the Site (Operable Unit 2 [OU-2]). The proposed remediation pilot test has been approved by the New York State Department of Environmental Conservation (NYSDEC), and the Department Project Manager, Ms. Samantha Salotto, PE, is copied on this memorandum.

The UIC application form is provided as Attachment 1 to this application. A brief description of the proposed remediation is provided below, along with information about the proposed amendments.

Site Background

The Site is located at 78 and 88 Lamar Street in West Babylon, Suffolk County, New York. A Site location map is provided as *Figure 1*. The site is located within the West Babylon Industrial Area. To the north, south, east, and west of the Site are various commercial and manufacturing facilities. Approximately 500 feet west of the Site is the Babylon Town Landfill.

The Site is approximately 1.38 acres and is currently developed with two buildings. Paved parking, loading and unloading, and storage areas are present to the north of the 88 Lamar Street building, south of the 78 Lamar Street building, and between both buildings. The Site is mostly developed with buildings and asphalt or concrete ground surface coverings. In front (south) of each building are small landscaped areas. A paved storage area is present behind (north of) 78-88 Lamar Street. Additionally, the northern portion of the property at 88 Lamar Street is unpaved. Damaged asphalt pavement

extends to approximately halfway between the Site buildings and the north property line; beyond the pavement the lot is sand and gravel.

There are several existing groundwater monitoring wells, installed during previous investigation work, present on-Site and on off-Site properties. Additionally, there is on the Site a network of air sparge/soil vapor extraction (AS/SVE) wells from prior pilot testing work. As described below, existing monitoring wells will be used in the pre- and post-injection sampling and monitoring programs (as appropriate). The locations of existing on-Site monitoring and AS/SVE wells can be found on *Figure 2*.

Chlorinated volatile organic compound (CVOC) contamination has been detected at elevated concentrations in on-Site soil near the interface between Upper Glacial Aquifer and the clay unit and in deep groundwater samples collected from monitoring wells screened at across the interface. The CVOC concentrations in deep groundwater indicate the potential for dense non-aqueous phase liquid (DNAPL) to be present in the aquifer above the clay unit, and DNAPL was detected during the 2018 Pre-Design Investigation in monitoring well MW-101D, located north of the 78 Lamar Street building. The CVOC plume associated with the contamination noted above was initially documented in the 2010 Remedial Investigation (RI) Report and further defined during the 2018 Pre-Design Investigation. Additional information and Site history can be found in the prior reporting completed for the Site. A repository of prior reports for this Site is maintained by the NYSDEC and can be found here https://www.dec.ny.gov/data/DecDocs/152025/.

Geology and Hydrogeology

The depth to groundwater at the Site is approximately 10 feet below ground surface (bgs), and the predominant direction of groundwater flow is to the south-southeast. The Upper Glacial Aquifer, the shallowest hydrogeologic unit in the area of the Site, extends to a depth of approximately 80 feet. Beneath the Upper Glacial Aquifer is a clay unit which acts as a confining layer. The Upper Glacial Aquifer is comprised of permeable glacial outwash deposit soils and has an estimated horizontal hydraulic conductivity of up to 270 feet per day and an estimated vertical anisotropy of 10:1 (favoring lateral flow over horizontal), according to the Pre-Design Investigation Report.

The clay unit, believed to be the regional Gardiners Clay, was typically encountered during prior investigations at and around the Site, except for the area beneath the northern portion of the Site. The clay layer thickness ranges from 10 to 20 feet. The clay surface elevation varies and has been described as being “wrinkled” or scoured, leaving potential depressions for DNAPL to collect. The average vertical hydraulic conductivity of the clay unit has been reported to be 0.001 feet/day, or approximately 5 orders of magnitude lower than the Upper Glacial Aquifer. The high organic content of the clay, along with matric diffusion, can act as a contaminant sink, potentially allowing the clay that has been in contact with DNAPL to serve as a slow-release, long-term source of CVOCs over time, sustaining the groundwater plume.

The clay surface is an important factor in the proposed remedy for the Site. The horizontal permeable reactive barrier (PRB) will be installed across this clay surface to prevent further contaminant transport due to DNAPL migration or dissolution, and to mitigate back diffusion of CVOCs mass from the clay, which can act as a long-term source for groundwater contamination.

Treatment Objective

The goal for the remedial program is to restore the Site to pre-disposal conditions to the extent feasible, and at a minimum the remedy shall eliminate or mitigate all significant threats to public health and the environment. The OU-2 remedial action objectives (RAOs) are limited to groundwater and include:

RAOs for Public Health Protection:

- Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.
- Prevent contact with, or inhalation of volatiles, from contaminated groundwater.

RAOs for Environmental Protection:

- Restore groundwater aquifer to pre-disposal/pre-release conditions, to the extent practicable.
- Remove the source of ground or surface water contamination.

The March 2013 Record of Decision (ROD) specifies for OU-2 the installation of a horizontal PRB using enhanced anaerobic bioremediation (EAB). A PRB is an in-situ method for remediating contaminated groundwater that combines a passive chemical or biological treatment zone with subsurface fluid flow management. The treatment amendments typically may either degrade or retain the contaminants as impacted groundwater migrates through the PRB.

The EAB will be implemented via the injection of electron donors/carbon source, zero valent iron, viscosity enhancing agents, nutrients, pH buffering agents and microbial cultures, collectively referred to as the amendments. The amendments will be injected to establish a sufficiently thick reactive zone (horizontal PRB) that will cover the most highly impacted section of the clay layer. The PRB will reduce the CVOC mass flux migration of contamination from the clay into the groundwater. The anticipated chemical gradients induced between the PRB and the clay will enhance back diffusion rates of COVCs out of the clay, allowing for degradation to less toxic byproducts in the PRB.

Proposed Injection Wells

Two injection wells will be installed at the locations shown on *Figure 3.* Sonic rotary drilling methods will be used to install the wells. A steel outer casing will be advanced to the top of clay, and will penetrate a minimum of 1 foot into the clay unit. Care will be taken to avoid penetrating deeper through the clay unit and creating a preferential pathway for potential contaminant migration through the clay unit and into the deeper aquifer. Continuous soil cores (maximum 5 feet in length) will be collected, inspected and screened with a photoionization detector (PID), and logged during the drilling. The bottom of each injection well will be set 1 foot into the clay layer. Completion depth will be determined for each well based on a review of the soil cores. An example well construction detail has been included as *Figure 4.*

Each injection well will be 2 inches in diameter and constructed with a 5-foot long injection screen. The bottom of the screen will be installed 1 foot into the clay unit, and 4 feet of the well screen will extend

into the Upper Glacial Aquifer. The screen will be stainless steel continuous wire-wrapped 0.01 inch (10-slot) screen. The filter pack will be #0 sand, or otherwise approved well sorted sand filter pack material. The well riser material will be 2-inch diameter Schedule 40 PVC. A minimum 6-inch diameter borehole will be required to maintain a minimum 2-inch wide annular space around the well screen and riser to allow for proper filter pack and grout installation.

The filter pack will extend a minimum of 2 feet above the well screen. A 2-foot thick hydrated bentonite seal will be installed above the filter pack. A cement/bentonite grout, consisting of 95 pounds of cement per 5 pounds of bentonite will be installed from the top of the bentonite seal to the bottom of the concrete manhole pad. Each well riser will be finished with a 2-inch diameter female national pipe thread (NPT) adaptor. A watertight flush-mounted steel manhole frame and lid will be set over each well. The manhole will be set in a 2 foot by 2 foot concrete pad, one foot thick.

Construction details for the proposed injection wells are summarized below:

Pilot Test Injection Well ID No.	Anticipated Total Depth (below ground surface)[1]	Anticipated Top of Screen (below ground surface)[1]	Anticipated Bottom of Screen (below ground surface)[1]	Screen Material
PT-IW-101	81' (1 foot into clay)	76'	81'	2-Inch Diameter Wire-Wrapped Stainless Steel
PT-IW-102	81' (1 foot into clay)	76'	81'	2-Inch Diameter Wire-Wrapped Stainless Steel

[1]To be adjusted based on conditions observed in the field.

Injection Amendments and Volumes

The pilot test will use emulsified vegetable oil (EVO) as the carbon source. Because the full scale injection will be conducted in areas where DNAPL is present, zero valent iron (ZVI) will also be included in the EVO mixture. EVO is a complex carbon source that will remain active in the subsurface for an extended time, potentially 3 years or longer. The longevity of EVO is ideal for PRBs, allowing for reduced operation and maintenance (O&M) costs that may be experienced with other more soluble doners, which will require frequent reapplication to maintain the desired geochemical conditions and bio-active treatment zone. The emulsified oil droplets will collide with soil particles as they move through the aquifer, with the oil droplets sorbing to the soil surfaces based on carbon-carbon affinity and surface charge differences between the soil surface and the emulsifier in the EVO. ITRC (2011)[1] and The US Navy (NAVFAC, 2015)[2] recommended the use of EVO in PRBs to intercept and cut off plume migration because EVO can form a stationary bioactive zone to intercept migrating contamination (NAVFAC Design Considerations for Enhanced Reductive

[1] Permeable Reactive Barrier: Technology Update; Interstate Technology & Regulatory Council (ITRC), June 2011.
[2] Design Considerations for Enhanced Reductive Dechlorination; NAVFAC, March 2015.

Dechlorination, March 2015). When ZVI is injected into the aquifer it quickly promotes strong reducing conditions that can enhance the EAB process. Additionally, ZVI is capable of directly degrading PCE through abiotic processes without the generation of intermediate byproducts.

The SRS-Zvi amendment from Terra Systems of Claymont, Delaware shall be used for this Site. The combination of EVO and ZVI present in the SRS-Zvi amendment results in an injection amendment that is denser than water which will sink and remain near the sand/clay interface. The amendment has a high viscosity, which may need to be enhanced in the field after dilution with a sheer thinning fluid. The emulsions in the EVO adhere to soil surfaces preventing or limiting "washout". The SRS-Zvi includes sodium lactate as an additional carbon source that quickly breaks down to establish the anaerobic conditions needed for bioremediation. The amendment is also blended with nutrients and Vitamin B12, which has been established to enhance reductive dichlorination.

Injection will target a 50% pore volume displacement over the 5-foot interval immediately above the clay in the 1,200 square foot nominal treatment area (the pore volume is estimated at approximately 13,500 gallons based on an estimated porosity of 30%). Approximately 6,725 gallons of amendments and water will be injected to provide coverage during the pilot test. The safety data sheets for the proposed amendments, subject to change, are attached this memorandum.

The proposed EVO loading rate for the pilot test was developed using the Substrate Estimating Tool for Enhanced Anaerobic Bioremediation of Chlorinated Solvents developed by the Environmental Security Technology Certification Program (ESTCP, 2010). The calculations consider both the contaminant stoichiometric demand as well as the soil oil retention capacity. Approximately 7,350 pounds of the SRS-Zvi amendment, or 825 gallons (three 275 gallon totes), will be injected along with 5,900 gallons of water. Each well would receive approximately 412 gallons of SRS-Zvi (approximately one and a half 275 gallon totes).

Xanthan gum will be added to the amendments as a sheer thinning fluid (STF) to increase the viscosity of the injection fluid when it is not exposed to significant sheering pressure. A resting, or kinematic, viscosity between 40 and 60 centipoise has been recommended as an optimal range to prevent amendment wash-out from the treatment zone. The target xanthan gum loading rate will be dependent on the results of bench scale treatability testing (to be performed prior to injection). Based on average rates of 0.1% to 0.5% by solution weight, TRC estimates that approximately 200 to 250 pounds of xanthan gum may be needed for the pilot test.

Sodium bicarbonate will be added to the injection amendment mixture to increase and buffer the groundwater pH. The groundwater pH of deep monitoring wells in or near the pilot test treatment zone was observed to be low during the Pre-Design Investigation, with an average pH value of 5.68 standard units (su) when considering monitoring wells ERM-MW-5D, ERM-MW-7D, MW-101D, and MW-102D. A pH in the range of 6.5 to 8 su is needed for effective EAB. The sodium bicarbonate loading rate will be determined during bench scale treatability testing. Assuming a target dosage of one-third the solubility limit for sodium bicarbonate, TRC estimates the sodium bicarbonate loading rate will be less than 1,500 pounds of bicarbonate per injection well.

A commercially available bioaugmentation culture will be injected into each injection well after the carbon source and pH adjustment amendment injections have been completed. A batch of 500 gallons of anaerobic chase water will be prepared and injected after the addition of the bioaugmentation culture. The SDC-9© or KB-1© cultures both contain high concentrations of the *dehalococcodies* (Dhc) bacteria, which is capable of complete sequential dichlorination of PCE to ethylene. One liter of either of these cultures will contain over $1x10^{11}$ active bacterial cells. A total of 5 liters of one of these cultures per well will be sufficient to provide an average bacterial population of $1x10^{7}$ cells/L in the treatment zone, which should be sufficient to support EAB.

An oxygen scavenger will be added to the injection fluid to remove excess oxygen that may hinder the generation of the required reducing conditions, which would be harmful to the bioaugmentation culture. Sodium bisulfate is proposed as the oxygen scavenger. TRC anticipates that approximately 10 pounds of sodium bisulfate, or 5 pounds per well will be required for the injections.

Two tracers are also proposed for the pilot test injection program. Bromide will be used as a chemical tracer, and a color dye will be included in the injection batches to allow for easy visual identification of injection amendment in the piezometers and downgradient monitoring wells. The color dye will be biodegradable and will conform to National Sanitation Foundation (NSF) Standard 60 for use in and around potable water sources.

A summary of the estimated injection amendment quantities is provided in *Table 1*.

Enclosures:

Figure 1	Site Location Map
Figure 2	Monitoring and AS/SVE Well Locations
Figure 3	Pilot Test Injection Well and Piezometer Layout
Figure 4	Injection Well and Piezometer Construction Details
Table 1	Injection Amendment Quantities
Attachment 1	UIC Application Form
Attachment 2	SDS Forms

FIGURES

SCALE: 1:2400

1 0.5 0 KILOMETERS 1 2

1000 500 0 METERS 1000 2000

1 0.5 0 MILES 1

1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000 FEET

QUADRANGLE LOCATION

MAP INCLUDES INFORMATION FROM THE FOLLOWING MAP SHEET(S):
TP, AMITYVILLE, NY, 7.5 MINUTE DATED 2019,
E, BAY SHORE WEST, NY, 7.5 MINUTE DATED 2019,
NE, GREENLAWN, NY, 7.5 MINUTE DATED 2019,
N, HUNTINGTON, NY, 7.5 MINUTE DATED 2019.

MAP OBTAINED THROUGH USE OF TOPOVIEW WITH THE INTERFACE CREATED BY THE NATIONAL GEOLOGIC MAP DATABASE PROJECT (NGMDB), IN SUPPORT OF THE TOPOGRAPHIC MAPPING PROGRAM, MANAGED BY THE USGS NATIONAL GEOSPATIAL PROGRAM (NGP).

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New York, NY 10018
Phone: 212.221.7822
www.TRCcompanies.com

PROJECT:
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
PRIDE SOLVENTS & CHEMICAL CO. - SITE NO. 152025
78 & 88 LAMAR STREET
WEST BABYLON, NEW YORK 11704

TITLE:

SITE LOCATION MAP

DRAWN BY:	H. DELGADO
CHECKED BY:	P. CASTELLANO
APPROVED BY:	D. GLASS
DATE:	MARCH 2022
PROJ. NO.:	435639.0000.0000
FILE:	Fig 1 - Site Location Map (PSCC).dwg

FIGURE 1

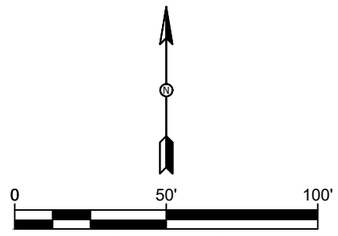
8.5x11 --- ATTACHED XREF'S: --- ATTACHED IMAGES: EPSG2263; NY, Amityville, 20190925, TM; NY, Bay Shore, West, 20190919, TM; NY, Greenlawn, 20190919, TM; NY, Huntington, 20190925, TM;
DRAWING NAME: \\cliftonpark-vfp\cliftonpark\ECR\Projects\NYSDEC\D009812\Work Assignments\D009812-17 Pride Solvents and Chemical Co\OU2\Workplan\Figures\TRC Working Drawings\ Fig 1 - Site Location Map (PSCC).dwg --- PLOT DATE: March 09, 2022 - 11:17PM --- LAYOUT: 8.5x11P

LEGEND (SYMBOLS NOT TO SCALE):

	SITE BOUNDARY
MW-###	MONITORING WELL LOCATION AND IDENTIFICATION NUMBER (2018 PRE-DESIGN INVESTIGATION)
MW-##	MONITORING WELL LOCATION AND IDENTIFICATION NUMBER (2010REMEDIAL INVESTIGATION)
ERM-MW-##	ERM MONITORING WELL LOCATION AND IDENTIFICATION NUMBER (2010 REMEDIAL INVESTIGATION)
MW-##	CDM MONITORING WELL LOCATION AND IDENTIFICATION NUMBER (2010 REMEDIAL INVESTIGATION)
VMP-##	VAPOR MONITORING POINT LOCATION AND IDENTIFICATION NUMBER
AS-##	AIR SPARGE POINT LOCATION AND IDENTIFICATION NUMBER
SVE-##	SOIL VAPOR EXTRACTION POINT LOCATION AND IDENTIFICATION NUMBER

NOTES:

1. LOCATIONS AND DIMENSIONS OF PHYSICAL FEATURES, BOUNDARIES, AND SAMPLE LOCATIONS ARE APPROXIMATE.
2. AERIAL IMAGE BACKGROUND SOURCED FROM NEARMAP DATED OCTOBER 20, 2021.



SCALE: 1" = 50'
SHEET SIZE: 11" BY 17"

PROJECT:
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
PRIDE SOLVENTS & CHEMICAL CO. - SITE NO. 152025
78 & 88 LAMAR STREET
WEST BABYLON, NEW YORK 11704

TITLE:
MONITORING AND AS/SVE WELL LOCATIONS

DRAWN BY:	H. DELGADO	PROJ NO.:	435693.0000.0000
CHECKED BY:	P. CASTELLANO		**FIGURE 2**
APPROVED BY:	D. GLASS		
DATE:	MARCH 2022		

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FILE NO.: Fig 2 - Monitoring and AS-SVE Well Locs (PSCC).dwg

LEGEND (SYMBOLS NOT TO SCALE):

- SITE BOUNDARY
- APPROXIMATE EXTENT OF OU-2 (DEEP GROUNDWATER) TREATMENT AREA - 14,000 FT^2 (2018 PRE-DESIGN INVESTIGATION)
- PILOT TEST TREATMENT ZONE - 1,200 FT^2
- CONCEPTUAL INJECTION POINT AREA OF INFLUENCE
- PT-IW-1## — PROPOSED INJECTION WELL LOCATION AND IDENTIFICATION NUMBER
- PT-PZ-2## — PROPOSED PIEZOMETER LOCATION AND IDENTIFICATION NUMBER
- PT-SS-3## — PROPOSED POST-INJECTION SOIL SAMPLE LOCATON AND IDENTIFICATION NUMBER
- MW-### — EXISTING MONITORING WELL LOCATION AND IDENTIFICATION NUMBER (2016 PRE-DESIGN INVESTIGATION)
- ERM-MW-## — ERM MONITORING WELL LOCATION AND IDENTIFICATION NUMBER (2010 REMEDIAL INVESTIGATION)
- APPROXIMATE DIRECTION OF GROUNDWATER FLOW
- AIR SPARGE AND SOIL VAPOR EXTRACTION PIPING
- AS-## — AIR SPARGE WELL LOCATION (2016)
- SVE-## — SOIL VAPOR EXTRACTION WELL LOCATION (2016)

N

0 20' 40'

SCALE: 1" = 20'
SHEET SIZE: 11" BY 17"

NOTES:

1. LOCATIONS AND DIMENSIONS OF PHYSICAL FEATURES, BOUNDARIES, AND WELL LOCATIONS ARE APPROXIMATE. ACTUAL WELL LOCATIONS WILL BE ADJUSTED BASED ON FIELD DATA AND UTILITY MARKOUT.
2. AERIAL IMAGE BACKGROUND SOURCED FROM NEARMAP DATED OCTOBER 20, 2021.
3. ONLY DEEP MONITORING WELLS ARE SHOWN ON THIS FIGURE FOR CLARITY.
4. AS-BUILT PIPE AND AIR SPARGE LOCATIONS SOURCED FROM SURVEY DRAWING BY F.C. WATSON LAND SURVEYOR PC, DATED AUGUST 16, 2016. LOCATIONS AND ARRANGEMENT SHOWN ARE APPROXIMATE.

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78 & 88 LAMAR STREET
WEST BABYLON, NEW YORK 11704

TITLE:
PILOT TEST INJECTION WELL AND PIEZOMETER LAYOUT

DRAWN BY:	H. DELGADO	PROJ NO.:	435693.0000.0000
CHECKED BY:	H. NICHOLS		
APPROVED BY:	D. GLASS		**FIGURE 3**
DATE:	MARCH 2022		

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Phone: 212.221.7822
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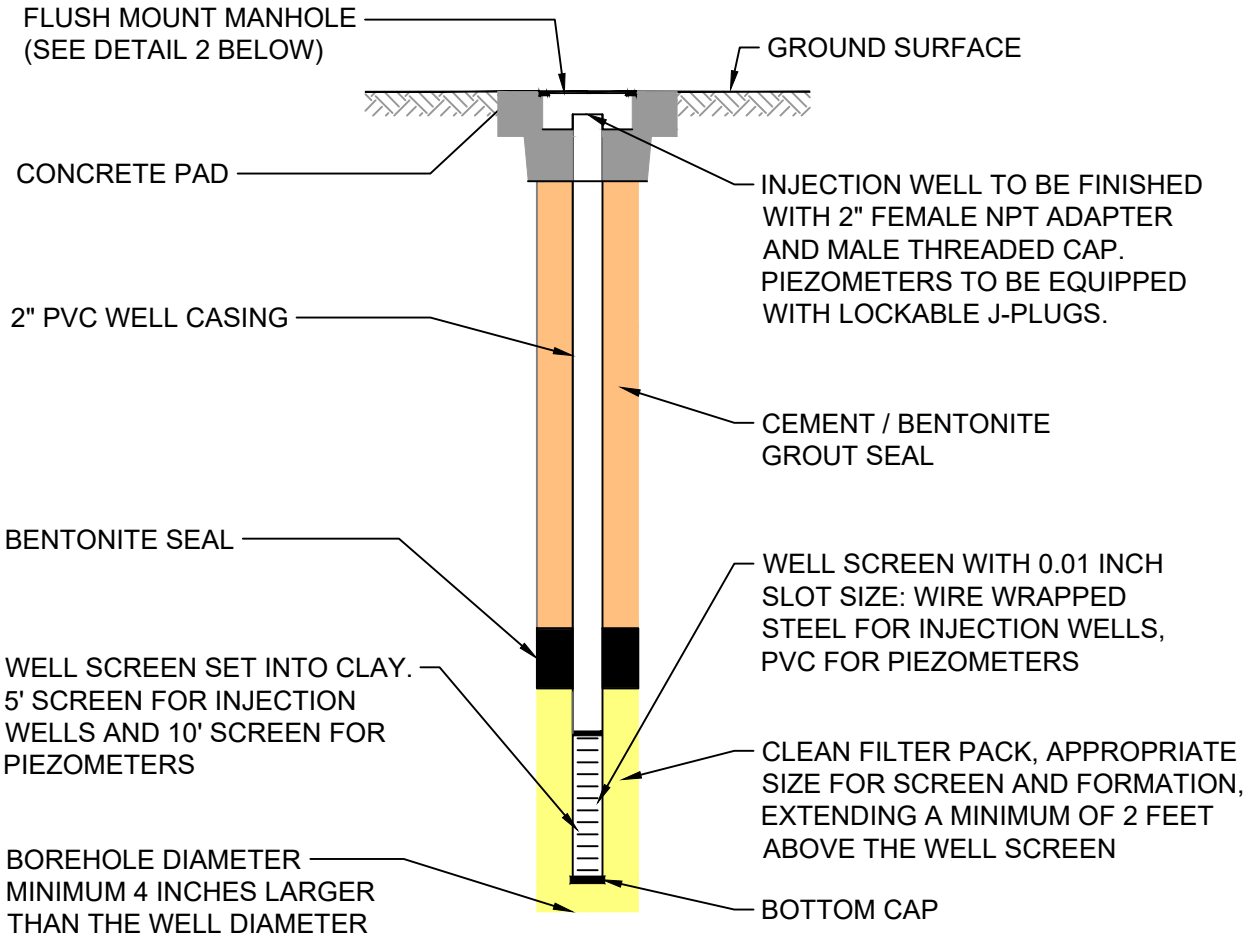
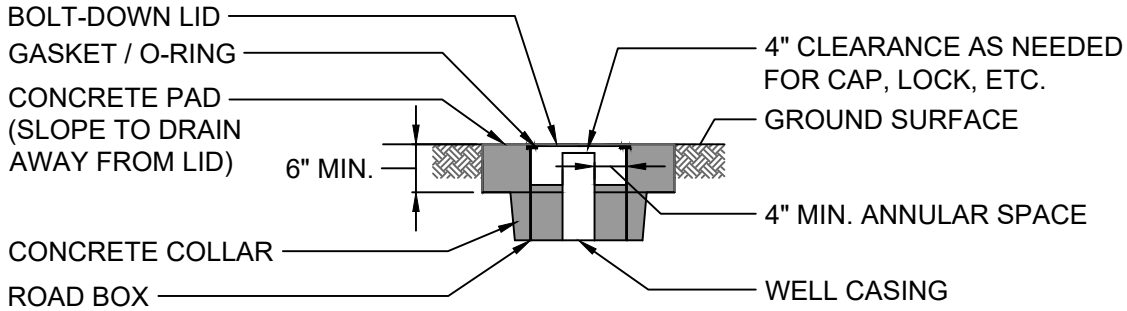
FILE NO.: Fig 3 - Pilot Test Inj. Well and PZ Layout.dwg



DETAIL 1 - INJECTION WELL AND PIEZOMETER CONSTRUCTION DETAILS

NOT TO SCALE



DETAIL 2 - FLUSH MOUNT MANHOLE DETAILS

NOT TO SCALE

NOTE:
REFER TO WORK PLAN TEXT FOR DETAILS OF WELL CONSTRUCTION.

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PRIDE SOLVENTS & CHEMICAL CO. - SITE NO. 152025
78 & 88 LAMAR STREET
WEST BABYLON, NEW YORK 11704

TITLE:
INJECTION WELL AND PIEZOMETER CONSTRUCTION DETAILS

DRAWN BY:	H. DELGADO
CHECKED BY:	H. NICHOLS
APPROVED BY:	D. GLASS
DATE:	MARCH 2022
PROJ. NO.:	435639.0000.0000
FILE:	Fig 4 - Well Details.dwg

FIGURE 4

TABLES

Table 1
NYSDEC
Pride Solvents & Chemical Co. Enhanced Anaerobic Bioremediation Injection PIlot Test Work Plan
Initial Assessment of Required Injection Amendment Quantities

Injection Amendment	Purpose	Notes	Total Volume/Weight	Volume/Weight Per Injection Point
SRS-Zvi	Carbon Source	Emulsified vegetable oil formulated zero valent iron included to promote rapid destruction of chlorinated solvents	825 gallons (7,367 pounds)	412.5 gallons
Sodium Bicarbonate	pH Adjustment	Used to increase pH to near neutral levels and provide a buffer to prevent future pH changes	3,000 pounds	1,500 pounds
Xanthan Gum	Sheer Thinning Fluid	Used to increase the resting viscosity of the injection fluid to prevent "wash out" along the Upper Glacial Aquifer and clay interface	250 pounds	125 pounds
Water	Dilution	Potable water	5,900 gallons	2950 gallons
KB-1	Bioaugmentation Culture	Microbial culture added to enhance reductive dechlorination	10 Liters	5 Liters
Bromide	Chemical Tracer	To be mixed with injection fluid and analyzed	100 pounds	50 pounds
Color Dye	Visual Tracer	Use a biodegradable, non-toxic dye compliant with NSF Standard 60	~ 1 pint (based on manufacturer's recommendation)	~ 1/2 pint (based on manufacturer's recommendation)
Sodium Bisulfate	Oxygen Scavenger	Added to remove oxygen from injection water, critical for bioaugmentation injection	10 pounds	5 pounds

ATTACHMENT 1

UIC Well Inventory Form

Type or print all information. See reverse for instructions. OMB No. 2040-0042 Approval Expires 12/31/2018

INVENTORY OF INJECTION WELLS

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

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

1. DATE PREPARED *(Year, Month, Day)*: 22-03-18

2. FACILITY ID NUMBER:

PAPERWORK REDUCTION ACT NOTICE

The public reporting burden for this collection of information is estimated at about 0.5 hour per response including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or any other aspect of this collection of information, includingsuggestions for reducing this burden, Director, Collection Strategies Division (2822), U.S. Environmental Protection Agency, 1200 Pennsylvania Avenue, NW, Washington, DC 20460, and to the Office of Management and Budget, Paperwork Reduction Project, Washington, DC20503.

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

- ☐ Deletion
- ☑ First Time Entry
- ☐ Entry Change
- ☐ Replacement

4. FACILITY NAME AND LOCATION

A. NAME *(last, first, and middle initial)*: Pride Solvents & Chemical Co.

B. STREET ADDRESS/ROUTE NUMBER: 78 Laar Street

C. LATITUDE

DEG	MIN	SEC
40	44	14.244

D. LONGITUDE

DEG	MIN	SEC
-73	22	43.968

E. TOWNSHIP/RANGE

TOWNSHIP	RANGE	SECT	1/4 SECT

F. CITY/TOWN: West Babylon

G. STATE: NY

H. ZIP CODE: 11704

I. NUMERIC COUNTY CODE: 103

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

5. LEGAL CONTACT:

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

B. NAME *(last, first, and middle initial)*: Samantha Salotto

C. PHONE *(area code and number)*: (518) 402-9903

D. ORGANIZATION: NY State DEC

E. STREET/P.O. BOX: 625 Broadway

F. CITY/TOWN: Albany

G. STATE: NY

H. ZIP CODE: 12233

I. OWNERSHIP *(mark "x")*

- ☐ PRIVATE
- ☐ PUBLIC
- ☒ SPECIFY OTHER
- ☐ STATE
- ☐ FEDERAL

State Superfund Project

6. WELL INFORMATION:

A. CLASS AND TYPE		B. NUMBER OF WELLS		C. TOTAL NUMBER OF WELLS	D. WELL OPERATION STATUS				
		COMM	NON-COMM		UC	AC	TA	PA	AN
V	B		2	2	2				
				0					
				0					
				0					
				0					
				0					
				0					

COMMENTS *(Optional)*:

Emulsified vegetable oil and zero valent iron will be injected in a water solution to enhance the degredation of chlorinated solvent contamination in the aquifer. Additional minor amendments including sodium bicarbonate (pH buffer), sodium bisulfate (oxygen scavenger), KB1 microbial culture, bromide and colored dye (tracers) and xanthan gum (sheer thinning fluid).

KEY:

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

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

ATTACHMENT 2

Injection Amendment SDS

SRS®-Z_{VI} (2 µm)
Combined Emulsified Vegetable Oil Substrate and 2 µm Zero Valent Iron
SAFETY DATA SHEET

January 1st, 2020

1. Product Identification

Synonyms: Combined Emulsified Vegetable Oil Substrate and 2 µm Zero Valent Iron [SRS®-Z_{VI} (2 µm)]; Emulsified Vegetable Oil (EVO) and Zero Valent Iron (ZVI)

Recommended Use: Treatment of groundwater contaminated with DNAPL level concentrations of chlorinated solvents and other anaerobically degradable compounds.

Supplier:
Terra Systems, Inc.
130 Hickman Road, Suite 1
Claymont, Delaware 19703
Telephone (302) 798-9553
Fax (302) 798-9554
www.terrasystems.net

2. Hazards Identification

Emergency Overview

Caution: May cause eye irritation.
Health Rating: 1 - Slight
Flammability Rating: 1 - Slight
Reactivity Rating: 1 - Slight
Contact Rating: 1 - Slight
Protective Equipment: Goggles; Proper Gloves
Storage Color Code: Green (General Storage)

Potential Health Effects

Inhalation: Not expected to be a health hazard. May irritate lungs and mucous membranes and cause irritation, dizziness, and nausea. Remove to fresh air.

Ingestion: Not expected to be a health hazard via ingestion. Large doses may produce abdominal spasms, diarrhea.

Skin Contact: No adverse effects expected. May cause irritation or sensitization in sensitive individuals.

Eye Contact: May cause irritation, watering, and possible reddening.

Chronic Exposure: No information found.

Aggravation of Pre-existing Conditions: No information found.

3. Composition/Information on Ingredients

Ingredient	Synonyms	CAS #	Percent	Hazardous
Soybean oil	Soya oil	8001-22-7	45%	No
Iron suspension	ZVI	7439-89-6	10%	No
60% Sodium Lactate	2-hydroxpropionic acid sodium salt	72-17-3	4%	No
Emulsifiers and proprietary nutrient package containing nitrogen, phosphorus and vitamin B_{12}		Mixture	6%	No

The emulsifiers are a trade secret and consists of ingredients of unknown acute toxicity.

4. First Aid Measures

Inhalation: Not expected to require first aid measures. Remove to fresh air. Get medical attention for any breathing difficulty.

Ingestion: If large amounts were swallowed, give water to drink and get medical advice.

Skin Contact: Not expected to require first aid measures. Wash exposed area with soap and water. Get medical advice if irritation develops.

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

5. Fire Fighting Measures

Fire: The zero valent iron powder, when dry, may self-combust and has the potential to catch paper towels, rags, etc. on fire. Avoid airborne dispersion of fine powder in an enclosed area to reduce potential dust ignition. Keep SRS®-EZVI wet and avoid contact with combustible materials.

Explosion: May generate hydrogen gas vapors that can cause explosion when exposed to a spark or flame. Closed containers may explode if exposed to extreme heat.

Fire Extinguishing Media: Dry chemical, sand, foam, graphite, or carbon dioxide. Water spray may be ineffective on fire but can protect fire-fighters and cool closed containers. Use fog nozzles if water is used.

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

6. Accidental Release Measures

Clean-up personnel may require protective clothing. Absorb in sand, paper towels, “Oil Dry”, or other inert material. Scoop up and containerize for disposal. Flush trace residues to sewer with soap and water. Containerized waste may be sent to an approved waste disposal facility.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Containers of this material are not hazardous when empty since they do not contain vapors or harmful substances; observe all warnings and precautions listed for the product. Do not store above 49 C (120 F). Keep container tightly closed and upright when not in use to prevent leakage.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:	None established.
Ventilation System:	Not expected to require any special ventilation.
Personal Respirators (NIOSH Approved):	Not expected to require personal respirator usage.
Skin Protection:	Wear protective gloves and clean body-covering clothing.
Eye Protection:	Use chemical safety goggles and/or a full-face shield where splashing is possible. Provide readily accessible eye wash stations and safety showers.
Slips, Trips, and Falls:	Material is slippery when spilled. Clean up with sand, paper towels, “Oil Dry”, or other inert material.

9. Physical and Chemical Properties

Appearance:	Gray viscous liquid.
Odor:	Vegetable oil.
Solubility:	Not soluble in water.
Specific Gravity (water=1):	1.07 (8.93 pounds per gallon)
pH:	6-8
% Volatiles by volume @ 21C (70F):	Negligible.
Boiling Point:	≥ 100C (≥ 212F)
Melting Point:	No information found.
Flash Point (F):	No information found.
Autoignition Temperature:	No information found.
Decomposition Temperature:	No information found.
Vapor Density (Air=1):	No information found.
Vapor Pressure (mm Hg):	< 1.0 @ 20C (68F).
Evaporation Rate (BuAc=1):	No information found.
Viscosity @23 C (73 F):	440-1,942 centipoises
Partition Coefficient (octanol/water):	No information found.

10. Stability and Reactivity

Stability: Stable under ordinary conditions of use and storage. May generate hydrogen gas.

Reactivity: Not reactive under ordinary conditions.

Hazardous Decomposition Products: Carbon dioxide and carbon monoxide may form when heated to decomposition.

Hazardous Polymerization: Will not occur.

Incompatibilities: Strong oxidizers, acids.

Conditions to Avoid: Incompatibles. Isolate from heat and open flame.

11. Toxicological Information

Soybean Oil: No information found on toxicology. It is not a carcinogen listed by IARC, NTP, NIOSH, OSHA, or ACGIH.

Emulsifier/Nutrient Mixture: No information found on toxicology. It is not a carcinogen listed by IARC, NTP, NIOSH, OSHA, or ACGIH.

Sodium Lactate: Oral rat LD50: 2000 mg/kg. Irritation for sodium lactate: standard Draize 100 mg - mild. This compound is not listed as a carcinogen by IARC, NRP, NIOSH, OSHA, or ACGIM.

Zero Valent Iron: No information found on toxicology. It is not a carcinogen listed by IARC, NTP, NIOSH, OSHA, or ACGIH.

Glycerol: Practically non-toxic.

SRS-EZVI: The toxicity of the mixture has not been measured.

12. Ecological Information

Environmental Fate: No information found.

Environmental Toxicity: No information found.

Degradability: SRS is completely biodegradable under both aerobic and anaerobic conditions.

Soil Mobility: SRS will move with groundwater until the adsorbed onto the soil. Degradation products may be mobile. The ZVI portion will not be mobile.

Bioaccumulation Potential: No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal 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

Not regulated.

15. Regulatory Information

OSHA STATUS: This product is not hazardous under the criteria of the Federal OSHA hazard Communication Standard 29 CFR 1910.1200. However, thermal processing and decomposition fumes from this product may be hazardous as noted in Section 10.

TSCA STATUS: No component of this product is listed on the TSCA inventory.

CERCLA (Comprehensive Response Compensation, and Liability Act): Not reportable.

SARA TITLE III (Superfund Amendments and Reauthorization Act)
Section 312 Extremely Hazardous Substances: None
Section 311/312 Hazard Categories: Non-hazardous Under Section 311/312
Section 313 Toxic Chemicals: None

RCRA STATUS: If discarded in its purchased form, this product would not be a hazardous waste either by listing or by characteristic. However, under RCRA, it is the responsibility of the product user to determine at the time of disposal, whether a material containing the product or derived from the product should be classified as a hazardous waste. (40 CFR 261.20-24)

CALIFORNIA PROPOSITION 65: The following statement is made in order to comply with the California safe Drinking Water and Toxic Enforcement Act of 1986. The product contains no chemicals known to the State of California to cause cancer.

16. Other Information

NFPA Ratings:	Health: **1** Flammability: **1** Reactivity: **1**
Date Revised:	January 1, 2018
Revision Information:	SDS Section(s) changed since last revision of document include: Added glycerol as component.
Disclaimer:	Terra Systems, Inc. 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. TERRA SYSTEMS, INC. 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. ACCORDINGLY, TERRA SYSTEMS, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.

Prepared by: Terra Systems, Inc.
Phone Number: (302) 798-9553 (U.S.A.)

SDS

Safety Data Sheet

1. IDENTIFICATION

Product Identifier: **Sodium Bisulfate**

Product Code(s): S1159

Synonyms: Sodium Hydrogen Sulfate; Sodium Acid Sulfate; Sodium Pyrosulfate; Sulfuric Acid, Monosodium Salt.

Recommended Use: For manufacturing, industrial, and laboratory use only. Use as a catalyst or as a laboratory solute.

Uses Advised Against: Not for food, drug, or household use.

Supplier: Rocky Mountain Reagents, Inc.
4621 Technology Drive, Golden, CO 80403
Phone: (303) 762-0800 Fax: (303) 762-1240

Emergency Phone Number: For health emergency, call poison control: (800) 222-1222.

2. HAZARDS IDENTIFICATION

Hazard Classifications: Eye Damage/Irritation: Category 1

Signal Word: DANGER

Hazard Statements: Causes serious eye damage.

Pictograms:

Precautionary Statements:

Prevention: Wear eye protection and face protection.

Response: 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 or doctor.

Storage: Not applicable.

Disposal: Not applicable.

Hazards Not Otherwise Classified: Not applicable.

Toxicity Statement: Not applicable.

3. COMPOSITION AND INFORMATION ON INGREDIENTS

Component	Common Name / Synonyms	CAS#	Chemical Formula	% by Weight
Sodium Bisulfate	Sodium Hydrogen Sulfate	7681-38-1	$NaHSO_4$	≥ 91.5

Trade Secret Statement: Not applicable.

4. FIRST AID MEASURES

First Aid Procedures:

Inhalation: Move to fresh air. If breathing is difficult, give oxygen. If not breathing, give artificial respiration. Call a physician if symptoms occur.

Ingestion: Do not induce vomiting unless directed to do so by medical personnel. If vomiting occurs, keep head low so that vomit does not enter lungs. Never give anything by mouth to an unconscious person. Call a physician or poison control center if symptoms occur.

Skin Contact: Wash skin with soap and plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. Call a physician if symptoms occur.

Eye Contact: Check for and remove contact lenses, if present and easy to do. Immediately flush eyes with gentle but large stream of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Call a physician immediately.

General Advice: Poison information centers in each state can provide additional assistance for scheduled poisons. Ensure that those providing first aid and medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Symptoms and Effects: Irritation, coughing, wheezing, burns, redness, itchiness, nausea, vomiting, diarrhea. Harmful if exposed to the eyes. May be harmful if swallowed, inhaled, or exposed to the skin. Prolonged or repeated exposure may cause respiratory sensitization and tooth decay.

Immediate Medical Care/ Special Treatment: Get medical attention if you feel unwell or are concerned. Treat symptomatically.

5. FIREFIGHTING MEASURES

Suitable Extinguishing Media: Water spray, dry powder, alcohol resistant foam, carbon dioxide.

Unsuitable Extinguishing Media: Do not use a solid (straight) water stream, as it may scatter and spread fire.

Hazardous Combustion Products: Sodium oxides, sulfur oxides.

Specific Hazards: Excessive thermal conditions may cause decomposition and yield hazardous combustion products listed above.

Special Protective Equipment/ Precautions for Firefighters: As in any fire, wear MSHA/NIOSH-approved (or equivalent), self-contained, positive-pressure or pressure-demand breathing apparatus and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions and Protective Equipment: Ventilate area of leak or spill. Isolate hazard area and keep unnecessary and unprotected personnel away from the area of the leak or spill. Wear appropriate personal protective equipment (see Section 8). Avoid contact with eyes, skin, and clothing.

Emergency Procedures: In case of chemical emergency, or if unsure how to address an accidental release, consult a professional (see Section 1).

Methods for Containment: Prevent entry into waterways, sewer, basements, or confined areas. Avoid generation of product as dust. Product should not be released to the environment. Contain and recover waste when possible.

Methods for Cleanup: Sweep or collect spill with an inert material (e.g. vermiculite, dry sand, earth, cloth, or fleece) and place in a non-combustible container for reclamation or disposal. Do not flush to sewer. Clean contaminated surface thoroughly. Residues from spills can be diluted with water. Never return spills in original containers for reuse. Clean up in accordance with all applicable regulations.

7. HANDLING AND STORAGE

Handling: Wear personal protective equipment (see Section 8). Provide sufficient air exchange and/or exhaust in work rooms. Avoid contact with skin, eyes, and clothing. Avoid generation of dust. Do not breathe product dust. Limit exposure to moisture. Do not ingest. When using, do not eat, drink, or smoke. Keep away from incompatible materials (see Section 10). Handle in accordance with good industrial hygiene and safety practice. Wash thoroughly after handling. Containers of this material may be hazardous when empty, as they retain product residues. Observe all warnings and precautions listed for this product.

Storage: Store in a cool, dry, ventilated area. Store in a segregated and approved area away from heat and incompatible materials (see Section 10). Store in original container. Keep containers tightly closed and upright. Keep away from food, drink, and animal foodstuffs. Keep out of the reach of children. Comply with all national, state, and local codes pertaining to the storage, handling, dispensing, and disposal of this product.

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

Exposure Limits: No information found.

Engineering Controls: Ensure adequate ventilation. 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.

Personal Protective Measures:

Eye/Face Protection: Wear safety glasses with side shields or goggles. Maintain approved eye wash station and accessible rinse facilities in work area.

Skin Protection: Wear appropriate chemical resistant clothing (with long sleeves) and appropriate chemical resistant gloves.

Respiratory Protection:	An air-purifying, NIOSH-approved respirator with an organic vapor cartridge or canister may be permissible under certain circumstances where airborne concentrations are expected to exceed exposure limits. Use a positive-pressure, air-supplied respirator if there is any potential for an uncontrolled release, if exposure levels are unknown, or if any other circumstances exist where air-purifying respirators may not provide adequate protection.
Specific Requirements for Personal Protective Equipment:	Ensure that glove material is compatible with this product. This information is available from glove manufacturers.

9. PHYSICAL AND CHEMICAL PROPERTIES

Unless otherwise indicated, all properties are given at 25 °C and standard pressure.

Appearance:	White, powdered solid.
Odor:	Odorless.
Odor Threshold:	No information found.
Formula Weight:	120.06
pH:	No information found.
Melting/Freezing Point:	315 °C
Boiling Point/Range:	No information found.
Decomposition Temperature:	No information found.
Flash Point:	Not applicable.
Auto-ignition Temperature:	Not applicable.
Flammability:	Not flammable.
Flammability/Explosive Limits:	Not applicable.
Solubility:	285 g/L aqueous.
Vapor Pressure:	No information found.
Vapor Density:	No information found.
Specific Gravity:	2.7 (Water = 1)
Evaporation Rate:	No information found.
Viscosity:	No information found.
Partition Coefficient (n-octanol/water):	No information found.

10. STABILITY AND REACTIVITY

Reactivity Data:	No information found.
Chemical Stability:	Stable under normal conditions. Hygroscopic.
Conditions to Avoid:	Excessive heat, moisture, incompatible materials.
Incompatible Materials:	Strong oxidizers, strong bases.
Hazardous Decomposition Products:	Sodium oxides, sulfur oxides.

Possibility of Hazardous Reactions:	May react vigorously or violently with the incompatible materials listed above. Excessive thermal conditions may yield hazardous decomposition products listed above.
Hazardous Polymerization:	Will not occur.

11. TOXICOLOGICAL INFORMATION

Routes of Exposure:	Inhalation, ingestion, skin contact, eye contact.
Acute Effects:	Harmful if exposed to the eyes. May be harmful if swallowed, inhaled, or exposed to the skin.
Chronic Effects:	Prolonged or repeated exposure may cause respiratory sensitization and tooth decay.
Toxicological Data:	LD_{50} Oral, Rat: 2800 mg/kg Causes serious eye irritation based on animal data.
Symptoms of Exposure:	Irritation, coughing, wheezing, burns, redness, itchiness, nausea, vomiting, diarrhea.
Carcinogenic Effects:	This product is not considered to be a carcinogen by IARC, ACGIH, NTP, or OSHA.

12. ECOLOGICAL INFORMATION

Ecotoxicological Data:	No information found.
Persistence and Degradability:	No information found.
Environmental Effects:	Not expected to be hazardous to the environment. However, the possibility of an environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

13. DISPOSAL INFORMATION

Disposal Instructions:	Dispose of this material and its container to an approved waste collection point. Minimize exposure to product waste (see Section 8). Do not dispose unused waste down drains or into sewers. All wastes must be handled in accordance with local, state, and federal regulations.
Contaminated Packaging:	Because containers retain product residue, follow label warnings even after container is emptied. Offer rinsed packaging material to local recycling facilities.
Waste Codes:	No information found.

14. TRANSPORT INFORMATION

DOT:	Not regulated.
Environmental Hazard Regulations:	Not regulated as a marine pollutant.
Other Transport Precautions:	No information found.

15. REGULATORY INFORMATION

U.S. Federal Regulations:

OSHA: This product is considered a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

TSCA Inventory: All components of this product are on the U.S. TSCA Inventory.

U.S. EPCRA (SARA Title III):

Section 302: No information found.

Sections 311/312:

Hazard Category	List (Yes/No)
Section 311 – Hazardous Chemical	Yes
Immediate Hazard	Yes
Delayed Hazard	No
Fire Hazard	No
Pressure Hazard	No
Reactivity Hazard	No

Section 313: No information found.

CERCLA Reportable Quantities: No information found.

International Inventories:

Country 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)	Yes
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
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes

*A "Yes" indicates that the listed component(s) of this product comply with the inventory requirements administered by the governing country(s).

16. OTHER INFORMATION

Disclaimer: Rocky Mountain Reagents, Inc. provides the information in this Safety Data Sheet in the belief that it is reliable but assumes no responsibility for its completeness or accuracy. The physical properties reported in this SDS are obtained from literature and do not constitute product specifications. Rocky Mountain Reagents, Inc. makes and gives no representations or warranties with respect to the information contained herein or the product to which it refers, whether express, implied, or statutory, including without limitation, warranties of accuracy, completeness, merchantability, non-infringement, performance, safety, suitability, stability, and fitness for a particular purpose. No warranty against infringement of any patent, copyright or trademark is made or implied. This SDS is intended only as a guide to the appropriate handling of the material by a properly trained person. It shall be the user's responsibility to develop proper methods of handling and personal protection based on the actual conditions of use. Accordingly, Rocky Mountain Reagents, Inc. assumes no liability whatsoever for the use of or reliance upon this information including results obtained, incidental or consequential damages, or lost profits.

Issue Date: May 19, 2016

Reason for Revision: Update of Section 9 over 08/06/2015 version.

SAFETY DATA SHEET

Sodium Bicarbonate

Section: 1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	Sodium Bicarbonate
Other means of identification	:	None
Recommended use	:	No Data available
Restrictions on use	:	None known
Company	:	Drillchem Drilling Solutions, LLC PO Box 132107 Spring, TX 77393 USA Office: (281) 713-8941
Emergency telephone number	:	(800) 424-9300 (24 Hours) CHEMTREC
Issuing date	:	09/12/2018

Section: 2. HAZARDS IDENTIFICATION

GHS Classification

Flammable liquids	:	Not classified
Skin irritation	:	Category 3
Eye irritation	:	Category 2B
Carcinogenicity	:	Not classified
Reproductive toxicity	:	Not classified
Specific target organ toxicity - single exposure	:	Not classified
Aspiration hazard	:	Not classified
Acute Oral Toxicity	:	Category 5

GHS Label element

Hazard pictograms :

Signal Word	:	Warning
Hazard Statements	:	May be harmful if swallowed. Causes skin mild irritation. Causes eye irritation.
Precautionary Statements	:	**Prevention:** Observe good industrial hygiene practices. **Response:** IF SWALLOWED: USA Immediately call the National POISON CENTER at 800-222-1222. OUT SIDE USA Immediately call poison center or doctor. DO NOT induce vomiting. IF ON SKIN, Take off immediately all contaminated clothing. Rinse skin with water/shower. IF INHALED, Remove to fresh air and keep comfortable for breathing. If not breathing give artificial respiration. DO NOT use mouth to mouth resuscitation without proper protection. IF IN EYES rinse cautiously with water for at least 15 minutes.

IF ON CLOTHING, Take off contaminated clothing.
Stop leaks if safe to do so. See section 6 for proper clean up.

Storage: Store in a well-ventilated place, Keep container tightly closed when not in use.

Disposal: Dispose of content and/ container in accordance with local, regional, national and/or international regulations.

Other hazards : Irritation to the respiratory system.

Section : 3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Names	CAS #.	Concentration%	Other Identifiers
Sodium Bicarbonate	144-55-8	99 - 100%	Baking Soda

Section: 4. FIRST AID MEASURES

In case of eye contact : Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.

In case of skin contact : Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid immediately. Wash clothing before reuse.

If swallowed : Do NOT induce vomiting. Get medical aid immediately.

If inhaled : Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult and **IF TRAINED**, give oxygen. Get medical aid. Do NOT use mouth-to-mouth resuscitation without protection.

Protection of first-aiders : No data available.

Notes to physician : The severity of outcome following ingestion may be more related to the time between ingestion and treatment, rather than the amount ingested. Therefore, there is a need for rapid treatment of any ingestion exposure.

Most important symptoms and effects, both acute and delayed : No data available.

Section: 5. FIREFIGHTING MEASURES

Suitable extinguishing media : Carbon dioxide, dry chemical powder or appropriate foam. Use water to keep non- leaking, fire-exposed containers cool.

Unsuitable extinguishing media : No data available.

Specific hazards during firefighting	:	When heated to decomposition Sodium Bicarbonate emits acrid smoke, fumes, and carbon dioxide and sodium oxides.
Special protective equipment for firefighters	:	As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. Use water spray to keep fire-exposed containers cool. Substance is noncombustible. Contact with metals may evolve flammable hydrogen gas.

Section: 6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures	:	Evacuate the area immediately. Isolate the hazard area. Keep out unnecessary and unprotected personnel. Increase ventilation to area or move container to a well-ventilated and secure area. Do not touch damaged containers or spilled product unless wearing appropriate protective equipment. Before entry, especially into confined areas, check atmosphere with an appropriate monitor.
Environmental precautions	:	No data available.
Methods and materials for containment and cleaning up	:	Contain the discharged material. If sweeping of a contaminated area is necessary use a dust suppressant agent. Report spills to local health, safety and environmental authorities, as required.

Section: 7. HANDLING AND STORAGE

Advice on safe handling	:	Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use with adequate ventilation. Do not breathe dust minimize dust generation and accumulation. Do not get in eyes, on skin, or on clothing.
Conditions for safe storage	:	Store in a cool, dry, well-ventilated area, out of direct sunlight. Keep quantities stored as small as possible. Storage area should be clearly identified, clear of obstruction and accessible only to trained and authorized personnel.
Suitable material	:	No data available
Unsuitable material	:	No data available

Section: 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

Chemical Names	ACGIH- TLV	OSHA - PEL
Sodium Bicarbonate	5 mg/m3 TWA Respirable fraction	5 mg/m3 TWA Respirable fraction

ACGIH® = American Conference of Governmental Industrial Hygienists. TLV® = Threshold Limit Value. OSHA = US Occupational Safety and Health Administration. PEL = Permissible Exposure Limits.

NOTE: TWA Means "TWA is the employee's average airborne exposure in any 8-hour work shift of a 40-hour work week which shall not be exceeded."

Engineering measures	:	Provide general or local exhaust ventilation systems to maintain airborne concentrations below TLV/PELs Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Personal protective equipment

Eye protection	:	Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US).
Hand protection	:	Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique to avoid skin contact with this product. Dispose of contaminated gloves after use. Select gloves tested to the **ANSI/ISEA 105-2011** Full contact: Nitrile rubber Splash contact: Nitrile rubber
Skin protection	:	Chemical splash protecting against chemicals, the type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.
Respiratory protection	:	Respiratory protection respirator Use a type N100 as a backup to engineering controls.
Hygiene measures	:	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.

Section: 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	Solid Granules
Colour	:	White
Odor	:	None
Flash point	:	no data available
pH	:	9
Odour Threshold	:	no data available
Melting point/freezing point	:	no data available
Initial boiling point and boiling range	:	3038°F 1670 °C
Evaporation rate	:	no data available
Flammability (solid, gas)	:	no data available
Upper explosion limit	:	no data available
Lower explosion limit	:	no data available
Vapour pressure	:	no data available
Relative vapour density	:	no data available
Relative density	:	1.3
Density	:	no data available

Water solubility	:	Soluble
Solubility in other solvents	:	no data available
Partition coefficient: n-octanol/water	:	no data available
Auto-ignition temperature	:	no data available
Thermal decomposition temperature	:	no data available
Viscosity, dynamic	:	no data available
Viscosity, kinematic	:	no data available
Molecular weight	:	no data available
Specific gravity	:	no data available

Section: 10. STABILITY AND REACTIVITY

Chemical stability	:	The product is stable and non-reactive under normal conditions of use, storage and transport.
Possibility of hazardous reactions	:	Violent polymerization occurs when mixed with Methyl Vinyl Ether.
Conditions to avoid	:	Exposure to moisture may affect product quality.
Incompatible materials	:	Strong acids, Borane/boron oxides, Zinc, Calcium oxide, Methyl vinyl ether, Calcium chloride is attacked by bromine trifluoride.
Hazardous decomposition products	:	When heated to decomposition, calcium chloride emits toxic fumes of hydrogen chloride.

Section: 11. TOXICOLOGICAL INFORMATION

Chemical Name	LD50 oral rat	LC50 Dermal Rat
Sodium Bicarbonate	1000 mg/kg	2630mg/kg

Information on likely routes of exposure	:	Ingestion, Eye contact, Skin contact

Potential Health Effects

Repeated or prolonged contact with dust may produce chronic eye irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation.

Eyes	:	Causes severe eye irritation.
Skin	:	Causes skin irritation.

Ingestion	:	Harmful if swallowed.
Inhalation	:	Irritation to the respiratory system.

Toxicity

Product

Acute oral toxicity	:	Category 5
Acute inhalation toxicity	:	No data available
Acute dermal toxicity	:	No data available
Skin corrosion/irritation	:	No data available
Serious eye damage/eye irritation	:	No data available
Respiratory or skin sensitization	:	No data available
Carcinogenicity	:	No

Chemical Name	IARC	ACGIH	NTP	OSHA
Sodium Bicarbonate	Not Listing	Not Listing	Not listed	Not Listed

Reproductive effects	:	Not a reproductive hazard
Germ cell mutagenicity	:	Not a mutagen
Teratogenicity	:	Not harmful the unborn child
STOT - single exposure	:	Not classified
STOT - repeated exposure	:	Not classified
Aspiration toxicity	:	Not an aspiration hazard.
Signs and Symptoms	:	Dust may produce irritation of eyes, mouth and respiratory tract. Inhalation of the dust may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering

Section: 12. ECOLOGICAL INFORMATION

Ecotoxicity

Sodium Bicarbonate	LC50 759 mg/l	Fish	96 hours
Sodium Bicarbonate	EC50 590mg/l	Daphnia	48 hours

Toxicity Not toxic to aquatic organisms, contain runoff

Persistence and degradability no data available

Mobility: no data available

Bioaccumulation: no data available

PBT and vPvB assessment: No Data available

Section: 13. DISPOSAL CONSIDERATIONS

Disposal methods	:	Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Dispose in accordance with all applicable 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	:	**DO NOT REUSE EMPTY CONTAINER!** Container with residues should be considered to be hazardous wastes.

Section: 14. TRANSPORT INFORMATION

The shipper/consignor/sender is responsible to ensure that the packaging, labeling, and markings are in compliance with the selected mode of transport.

Land transport (DOT):

Not regulated as dangerous goods.

Air transport (IATA)

Not regulated as dangerous goods

Sea transport (IMDG/IMO)

Not regulated as dangerous goods

Section: 15. REGULATORY INFORMATION

This product is not known to be a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

TSCA: All components of this product are on the TSCA Inventory or are exempt from TSCA Inventory requirements under 40 CFR 720.30

EPCRA - Emergency Planning and Community Right-to-Know Act: Not listed.

CERCLA Reportable Quantity: Not listed.

SARA 304 Extremely Hazardous Substances Reportable Quantity: Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910. 1001-1050): All ingredients are listed in 1910.1200

US. Toxic Substances Control Act (TSCA) Section 12(b) Export Notification (40 CFR 707, Subpart D):
Not regulated.

SARA Community Right-to-Know Program: None

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List: Not listed.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130): Not listed.

Safe Drinking Water Act: Not regulated.

US STATE REGULATION:

US. California Controlled Substances. CA Department of Justice (California Health and Safety Code Section 11100): Not listed

US. Massachusetts RTK - Substance List: All components of this product are on the Massachusetts Inventory or are exempt from Inventory requirements.

US. New Jersey Worker and Community Right-to-Know Act: All components of this product are on the New Jersey inventory or are exempt from Inventory requirements.

US. Pennsylvania Worker and Community Right-to-Know Law: All components of this product are on the Pennsylvania Inventory or are exempt from Inventory requirements..

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 CHEMICAL CONTROL LAWS:

United States TSCA Inventory: On TSCA Inventory

Canadian Domestic Substances List (DSL): On DSL Inventory

Section: 16. OTHER INFORMATION

Revision Date : 09/12/2018

Version Number : 1.0

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the txt.

130 Research Lane, Ste 2
Guelph ON N1G 5G3
(519) 822-2265

KB-1® Material Safety Data Sheet

Section 1: Material Identification

Trade Name: KB-1®
Chemical Family: bacterial mixture
Chemical name: No IUC name for mixture is known to exist
Manufacturer/Supplier: SiREM
130 Research Lane, Suite 2,
Guelph, Ontario,
Canada N1G 5G3

For Information call: 519-822-2265 / 1-866-251-1747 x236
Emergency Number: 519-822-2265
Description: Microbial inoculum (non-pathogenic, non-hazardous)
Trade Name: KB-1®
Product Use: Bioremediation of contaminated groundwater.
Date Prepared: 2 February 2005

Section 2: Composition, Information on Ingredients

KB-1® is a microbial culture grown in an aqueous dilute mineral salt solution media containing no hazardous ingredients.

The microbial composition of KB-1® (as determined by phylogenetic analysis) is listed in Table 1. Identification of organisms was obtained by matching 16S rRNA gene sequence of organisms in KB-1® to other known organisms. The characteristics of related organisms can be used to identify potential or likely characteristics of organisms in KB-1®.

Table 1. Genus' Identified in KB-1® Microbial Inoculum

Genus
Dehalococcoides sp.
Geobacter sp.
Methanomethlovorans sp.

Section 3: Hazards Identification:

A review of the available data does not indicate any known health effects related to normal use of this product.

Section 4: First Aid Measures:

Avoid direct contact with skin and eyes. In any case of any exposure which elicits a response, a physician should be consulted immediately.

Eye Contact: Flush eyes with water for at least 15 minutes, occasionally lift upper and lower eyelids, if undue irritation or redness occurs seek medical attention.

Skin Contact: Remove contaminated clothing and wash skin thoroughly with water and antibacterial soap. Seek medical attention if irritation develops or open wounds are present.

Ingestion: Do not induce vomiting, drink several cups of water, seek medical attention.

Inhalation: Remove to fresh air. If not breathing give artificial respiration. In case of labored breathing give oxygen. Call a physician.

Section 5 - Fire Fighting Measures:

Non-flammable
Flash Point: not applicable
Upper flammable limit: not applicable
Lower flammable limit: not applicable

Section 6 – Accidental Release Procedures

Spilled KB-1® should be soaked up with sorbant and saturated with a 10% bleach solution (prepared by making a one in ten dilution of diluted standard bleach [normally sold at a strength of 5.25% sodium hypochlorite] to disinfect affected surfaces. Sorbant should be double bagged and disposed of as indicated in section 12. After removal of sorbant, area should be washed with 10% bleach solution to disinfect. If liquid from the culture vessel is present on the fittings, non-designated tubing or exterior of the stainless steel pressure vessel liquid should be wiped off and the area washed with 10% bleach solution.

Section 7 - Handling and Storage

KB-1® is shipped in stainless steel pressure vessels and connected to injection lines and inert gas is used to pressurize the vessel to displace the contents. KB-1® should be handled with care to avoid any spillage. Vessels are shipped with 1 pound per square inch (psi) pressure; valves should not be opened until connections to appropriate lines for subsurface injection are in place.

Storage Requirements: Avoid exposing stainless steel pressure vessels to undue temperature extremes (i.e., temperatures less than 0°C or greater than 30°C may result in harm to the microbial cultures and damage to the vessels). All valves should be in the closed position when the vessel is not pressurized or not in use to prevent the escape of gases and to maintain anaerobic conditions in the vessel. Avoid exposure of the culture to air as the presence of oxygen will kill dechlorinating microorganisms.

Section 8 - Exposure Controls/Personal Protection

Personal protective equipment:

Skin: Protective gloves (latex, vinyl or nitrile) should be worn.
Eye Protection: Wear appropriate protective eyeglasses or goggles when opening pressure vessels, valves, or when pressurizing vessels to inject contents into the subsurface.
Respiratory: No respiratory protection is required.
Engineering Controls: Good general room ventilation is expected to be adequate.

Section 9: Physical and Chemical Properties:

Physical State: liquid
Odour: skunky odour
Appearance: dark grey, slightly turbid liquid under anaerobic conditions, pink if exposed to air (oxygen).
Specific gravity: not determined
Vapor pressure: not applicable
Vapor density: not applicable
Evaporation rate: not determined
Boiling point: ~100° C
Freezing point/melting point: ~ 0°C

pH: 6.5-7.5
Solubility: fully soluble in water

Section 10 – Stability and Reactivity Data

Stable and non-reactive.
Maintain under anaerobic conditions to preserve product integrity.
Materials to avoid: none known

Section 11 - Toxicological Information

Potential for Pathogenicity:

KB-1® has tested negative (i.e., the organisms are not present) for a variety of pathogenic organisms listed in Table 2. While there is no evidence that virulent pathogenic organisms are present in KB-1®, there is potential that certain organisms in KB-1® may have the potential to act as opportunistic (mild) pathogens, particularly in individuals with open wounds and/or compromised immune systems. For this reason standard hygienic procedures such as hand washing after use should be observed.

Table 2, Results of Human Pathogen Screening of KB-1® Dechlorinator

Organism	**Disease(s) Caused**	***Test result***
Salmonella sp.	Typhoid fever, gastroenteritis	Not Detected
Listeria monocytogenes	Listerioses	Not Detected
Vibrio sp.,	Cholera, gastroenteritis	Not Detected
Campylobacter sp.,	Bacterial diarrhea	Not Detected
Clostridia sp.,	Food poisoning, Botulism, tetanus, gas gangrene	Not Detected
Bacillus anthracis	Anthrax	Not Detected
Pseudomonas aeruginosa	Wound infection	Not Detected
Yersinia sp.,	Bubonic Plague, intestinal infection	Not Detected
Yeast and Mold	Candidiasis, Yeast infection etc.	Not Detected
Fecal coliforms	Indicator organisms for many human pathogens diarrhea, urinary tract infections	Not Detected
Enterococci	Various opportunistic infections	Not Detected

Section 12. Disposal Considerations

Material must be disinfected or sterilized prior to disposal. Consult local regulations prior to disposal.

Section 13 – Transport Information

Non-hazardous, non-pathogenic microbial inoculum – Biosafety Risk Group 1.

Chemicals, Not Otherwise Indexed (NOI), Non-hazardous

Not subject to TDG or DOT guidelines.

Disclaimer:

The information provided on this MSDS sheet is based on current data and represents our opinion based on the current standard of practice as to the proper use and handling of this product under normal, reasonably foreseeable conditions.

Last revised: 2 August 2011

130 Research Lane, Ste 2
Guelph ON N1G 5G3
(519) 822-2265

KB-1® Plus Material Safety Data Sheet

Section 1: Material Identification

Trade Name: KB-1® Plus
Chemical Family: bacterial mixture
Chemical name: No IUC name for mixture is known to exist

Manufacturer/Supplier: SiREM
130 Research Lane, Suite 2,
Guelph, Ontario,
Canada N1G 5G3

For Information call: 519-822-2265 / 1-866-251-1747 x236
Emergency Number: 519-822-2265

Description: Microbial inoculum (non-pathogenic, non-hazardous)
Trade Name: KB-1® Plus
Product Use: Bioremediation of contaminated groundwater.
Date Prepared: 23 October 2008

Section 2: Composition, Information on Ingredients

KB-1® Plus is a microbial culture grown in a dilute aqueous mineral salt solution media containing no hazardous ingredients.

The microbial composition of KB-1® Plus is listed in Table 1.

Table 1. Major Microbial Groups Identified in KB-1® Plus Microbial Inoculum

Dehalococcoides sp.
Geobacter sp.
Methanomethylovorans sp.
Dehalobacter sp.
Dehalogenimonas sp.

Section 3: Hazards Identification:

A review of the available data does not indicate any known health effects related to normal use of this product.

Section 4: First Aid Measures:

Avoid direct contact with skin and eyes. In any case of any exposure which elicits a response, a physician should be consulted immediately.

Eye Contact: Flush eyes with water for at least 15 minutes, occasionally lift upper and lower eyelids, if undue irritation or redness occurs seek medical attention.

Skin Contact: Remove contaminated clothing and wash skin thoroughly with water and antibacterial soap. Seek medical attention if irritation develops or open wounds are present.

Ingestion: Do not induce vomiting, drink several cups of water, seek medical attention.

Inhalation: Remove to fresh air. If not breathing give artificial respiration. In case of labored breathing give oxygen. Call a physician.

Section 5 - Fire Fighting Measures:

Non-flammable
Flash Point: not applicable
Upper flammable limit: not applicable
Lower flammable limit: not applicable

Section 6 – Accidental Release Procedures

Spilled KB-1® Plus should be soaked up with sorbant and saturated with a 10% bleach solution (prepared by making a one in ten dilution of diluted standard bleach [normally sold at a strength of 5.25% sodium hypochlorite] to disinfect affected surfaces. Sorbant should be double bagged and disposed of as indicated in section 12. After removal of sorbant, area should be washed with 10% bleach solution to disinfect. If liquid from the culture vessel is present on the fittings, non-designated tubing or exterior of the stainless steel pressure vessel liquid should be wiped off and the area washed with 10% bleach solution.

Section 7 - Handling and Storage

KB-1® Plus is shipped in stainless steel pressure vessels in a protective over pack. KB-1® Plus should be handled with care to avoid any spillage. Vessels are shipped with 1 pound per square inch (psi) pressure; valves should not be opened until connections to appropriate lines for subsurface injection are in place.

Storage Requirements: Avoid exposing stainless steel pressure vessels to undue temperature extremes (i.e., temperatures less than 0°C or greater than 30°C may result in harm to the microbial cultures and damage to the vessels). All valves should be in the closed position when the vessel is not pressurized or not in use to prevent the escape of gases and to maintain anaerobic conditions in the vessel. Avoid exposure of the culture to air as the presence of oxygen will kill dechlorinating microorganisms.

Section 8 - Exposure Controls/Personal Protection

Personal protective equipment:

Skin: Protective gloves (latex, vinyl or nitrile) should be worn.
Eye Protection: Wear appropriate protective eyeglasses or goggles when opening pressure vessels, valves, or when pressurizing vessels to inject contents into the subsurface.
Respiratory: No respiratory protection is required.
Engineering Controls: Good general room ventilation is expected to be adequate.

Section 9: Physical and Chemical Properties:

Physical State: liquid
Odour: skunky odour
Appearance: dark grey, slightly turbid liquid under anaerobic conditions, pink if exposed to air (oxygen).
Specific gravity: 1
Vapor pressure: not applicable
Vapor density: not applicable
Evaporation rate: not determined
Boiling point: ~100° C
Freezing point/melting point: ~ 0°C

pH: 6.5-7.5
Solubility: fully soluble in water

Section 10 – Stability and Reactivity Data

Stable and non-reactive.
Maintain under anaerobic conditions to preserve product integrity.
Materials to avoid: none known

Section 11 - Toxicological Information

Potential for Pathogenicity:

KB-1® Plus has tested negative (i.e., the organisms are not present) for a variety of pathogenic organisms listed in Table 2. While there is no evidence that virulent pathogenic organisms are present in KB-1® Plus, there is potential that certain organisms in KB-1® Plus may have the potential to act as opportunistic (mild) pathogens, particularly in individuals with open wounds and/or compromised immune systems. For this reason standard hygienic procedures such as hand washing after use should be observed.

Table 2, Results of Human Pathogen Screening of KB-1® Plus

Organism	**Disease(s) Caused**	***Test result***
Salmonella sp.	Typhoid fever, gastroenteritis	Not Detected
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Vibrio sp.,	Cholera, gastroenteritis	Not Detected
Campylobacter sp.,	Bacterial diarrhea	Not Detected
Clostridia sp.,	Food poisoning, Botulism, tetanus, gas gangrene	Not Detected
Bacillus anthracis	Anthrax	Not Detected
Pseudomonas aeruginosa	Wound infection	Not Detected
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Fecal coliforms	Indicator organisms for many human pathogens diarrhea, urinary tract infections	Not Detected
Enterococci	Various opportunistic infections	Not Detected

Section 12. Disposal Considerations

Material must be disinfected or sterilized prior to disposal. Consult local regulations prior to disposal.

Section 13 – Transport Information

Non-hazardous, non-pathogenic microbial inoculum

Chemicals, Not Otherwise Indexed (NOI), Non-hazardous

Not subject to TDG or DOT guidelines.

Disclaimer:

The information provided on this MSDS sheet is based on current data and represents our opinion based on the current standard of practice as to the proper use and handling of this product under normal, reasonably foreseeable conditions.

Last revised: 12 June 2012

SiREM
Leading Science · Lasting Solutions

130 Research Lane, Ste 2
Guelph ON N1G 5G3
(519) 822-2265

Chemical Components in KB-1® Growth Media

KB-1® consists of a microbial culture grown in a mineral salts media containing the ingredients listed in Table 1.

Table 1: Chemical Ingredients of KB-1® growth media

Chemical Name	Formula	CAS#	Concentration grams/Liter
Potassium Phosphate Dibasic	KH_2PO_4	7758-11-4	0.27
Potassium Phosphate Monobasic	K_2HPO_4	7778-77-0	0.34
Ammonium Chloride	NH_4Cl	12125-02-9	0.535
Calcium Chloride	$CaCl_2$	10035-04-8	0.07
Magnesium Sulfate	$MgSO_4$	10034-99-8	0.125
Ferrous Chloride	$FeCl_2$	13478	0.02
Sodium bicarbonate	$NaHCO_3$	144-55-8	2.0
Ferrous Ammonium Sulfate	$(NH_4)_2Fe(SO_4)_2$	7783-85-9	0.4
Sodium sulfide	Na_2S	1313-84-4	0.12
Resazurin	$C_{12}H_6NNaO_4$	62758-13-8	0.001
Boric Acid	H_3BO_3	10043-35-3	0.0006
Zinc Chloride	$ZnCl$	7646-85-7	0.0002
Sodium Molybdate	Na_2MoO_4	10102-40-6	0.0002
Nickel II Chloride	$NiCl_2$	7791-20-0	0.0015
Manganese Chloride	$MnCl_2$	13446-34-9	0.002
Copper II Chloride	$CuCl_2$	10125-13-0	0.0002
Cobalt Chloride	$CoCl_2$	7791-13-1	0.003
Disodium Selenite	Na_2SeO_3	10102-18-8	0.00004
Aluminum Trisulfate	$Al_2(SO_4)_3$	10043-01-3	0.0002
Vitamins	Various	Various	0.01 maximum

Section 1. Product and Company Identification

Product Name Xanthan Gum
CAS Number 11138-66-2

Parchem - fine & specialty chemicals
415 Huguenot Street
New Rochelle, NY 10801
(914) 654-6800 **(914) 654-6899**
parchem.com **info@parchem.com**

EMERGENCY RESPONSE NUMBER
CHEMTEL
Toll Free US & Canada: 1 (800) 255-3924
All other Origins: 1 (813) 248-0585
Collect Calls Accepted

Section 2. Hazards Identification

Classification of the substance or mixture
Classification: Substances is not classified as a hazardous substance or mixture
OSHA Hazards: No know OSHA hazards. Not a dangerous substance according to GHS

GHS Label Elements
Pictograms: N/A
Signal word: N/A

Hazard and precautionary statements
None

Primary Route of Entry: Inhalation, eye, and skin contact
Symptoms and effects of acute overexposure: Inhalation of the dust and eye contact may cause irritation. May be irritating to the skin of a sensitive person.
Chronic Overexposure: Same as above.
Medical Conditions Generally Aggravated By This Material: None

HMIS (USA)
Health Hazard: 0
Fire Hazard: 0
Reactivity: 0

National Fire Protection Association (USA)
Health: 0
Flammability: 0
Reactivity: 0

Protective Equipment: Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Safety glasses.

Section 3. Composition / Information on Ingredients

Common Name Xanthan Gum
CAS Number 11138-66-2

COMPONENT	CAS NUMBER	CONCENTRATION
Xanthan Gum	11138-66-2	≥ 99.0%
Glyoxal	107-22-2	≤ 1%

Section 4. First Aid Measures

Eye Contact: Flush eyes with large volume of water.
Skin Contact: Wash with warm water and mild soap.
Inhalation: Remove from exposure.
Note: If irritation persists, consult physician.

Section 5. Firefighting Measures

Flash Point: Not determined
Extinguishing Media: Water, Carbon Dioxide, Foam.
Special Firefighting Procedures: Firefighters should wear full protective clothing, including self-contained breathing equipment.
Unusual Fire and Explosion Hazards: A potential dust explosion hazard exists if the dust concentration in the air is high.

Section 6. Accidental Release Measures

Steps to Be Taken If Material Is Released or Spilled: Dry Powder - Sweep up or vacuum promptly and put into a disposable container. Wet material becomes slippery. Wash with water solution or apply absorbent material, sweep up and wash area

Section 7. Handling and Storage

Precautions For Handling And Storage: Store in dry place. Keep container closed to avoid moisture pick-up. Do not store at temperatures above 30°C/86°F. Practice reasonable care and cleanliness.

Section 8. Exposure Controls / Personal Protection

Engineering: Use local exhaust ventilation to maintain minimal exposure to nuisance dust.
Personal Protective Equipment: Use approved respirator if dust becomes a nuisance.
Engineering: Use local exhaust ventilation to maintain minimal exposure to nuisance dust.
Personal Protective Equipment: Use approved respirator if dust becomes a nuisance

Section 9. Physical and Chemical Properties

Appearance: Off-white to beige, powder
Odor: No distinguishable odor.
Odor Threshold: No applicable information is available
pH: 4 – 7
Melting point/Freezing Point: No applicable information is available
Initial Boiling Point and Boiling Point Range: No applicable information is available
Flash Point: No applicable information is available
Evaporation Rate: No applicable information is available
Flammability: No applicable information is available
Upper/Lower Flammability or Explosive Limits: No applicable information is available
Vapor Pressure: No applicable information is available
Relative Density: No applicable information is available
Solubility: Cold
Partition Coefficient: No applicable information is available
Auto-Ignition Temperature: > 200°C
Decomposition Temperature: No applicable information is available
Viscosity: 1200 - 1800 cPs
Reactivity: Stable
Chemical Stability: Stable
Possibility of Hazardous Reactions: Will not occur.
Conditions to Avoid: Water, product will become slippery
Incompatible Materials: Strong oxidizers.
Hazardous Decomposition Products: Carbon Dioxide, Carbon Monoxide.

Section 10. Stability and Reactivity

Stability: Stable
Materials To Avoid: Strong oxidizers.
Conditions to Avoid: Water, product will become slippery
Hazardous Decomposition Products: Carbon Dioxide, Carbon Monoxide.
Hazardous Polymerization: Will not occur.

Section 11. Toxicological Information

Acute toxicity
Acute oral toxicity – Xanthan Gum
LD50 Oral: 45.000 mg/kg species: rat
LD50 Oral: 20.000 mg/kg Species: mouse

Glyoxal
LD50 Oral: 2.000 - 5.000 mg/kg Species: rat
LD50 Oral: 2.960 mg/kg Species: rat

LD50 Oral: 1.280 mg/kg Species: mouse

Acute inhalation toxicity – Xanthan Gum
21 mg/l Exposure time: 1 h
Species: rat
An LC50/inhalation/4h/rat could not be determined because no mortality of rats was observed at the maximum achievable concentration.

Glyoxal
LD50: 2,4 l mg/l
Exposure time: 4 h
Species: rat
Acute dermal toxicity – xanthan gum: no skin irritation

Glyoxal
LD50 Dermal: 12, 70 mg/kg
Species: rabbit
LD50 Dermal: 6.600 mg/kg
Species: guinea pig

Skin corrosion/irritation
Skin irritation – xanthan gum
Species: rat
Result: no skin irritation
Exposure time: 360 h no skin irritation
Species: rabbit
Result: no skin irritation
Exposure time: 120 h no skin irritation

Glyoxal
Species: rabbit
Result: mild skin irritation
Classification: irritating to skin.
Serious eye damage/eye irritation: eye irritation

Xanthan gum
Species: rat
Result: no eye irritation
Exposure time: 120 h no eye irritation

Glyoxal
Species: rabbit
Result: mild eye irritation

Respiratory or skin sensitization
Sensitization xanthan gum
Species: guinea pig
Result: did not cause sensitization on
Laboratory animals: no known sensitizing effect.

Glyoxal
Classification: may cause sensitization by skin contact.

Germ cell mutagenicity remarks
Xanthan gum: animal testing did not show any mutagenic effects.

Carcinogenicity
Xanthan gum: not classifiable as a human carcinogen. Did not show carcinogenic, teratogenic or mutagenic effects in animal experiments.

Reproductive toxicity
Xanthan gum
Species: rat
Dose: 0.5 g/kg/d
Xanthan gum
Species: rat
Application route: oral
Exposure time: 24 h
No adverse effect has been observed in chronic toxicity tests.

Glyoxal
Species: rat
Application route: oral
Exposure time: 28 d NOAEL: 40 mg/kg

Aspiration hazard
Aspiration toxicity xanthan gum: no aspiration toxicity classification

Acute effects
Glyoxal: causes skin irritation, causes serious eye irritation, harmful if inhaled.
Sensitization
Glyoxal: may cause an allergic skin reaction.
Repeated dose toxicity xanthan gum: no adverse effect has been observed in chronic toxicity tests.
Glyoxal: repeated or prolonged exposure may cause irritation of eyes and skin, chronic exposure damages the brain and the cen-tral nervous system. Further information glyoxal possible risk of irreversible effects.

Section 12. Ecological Information

Toxicity
Toxicity to fish Xanthan Gum: 420 mg/l
Exposure time: 96 h
Species: Oncorhynchus mykiss (rainbow trout)
Glyoxal
LC50: 460 - 680 mg/l
Exposure time: 96 h
Species: Leuciscus idus (Golden orfe)
Method: DIN 38412

Toxicity to daphnia and other aquatic invertebrates: No data is available on the product itself. Toxicity to daphnia and other aquatic invertebrates.
Glyoxal
EC50: 404 mg/l
Exposure time: 48 h
Species: Daphnia

Toxicity to algae: no data available
Toxicity to algae – glyoxal
Ecso: > 100 mg/l
Exposure time: 72 h
Species: pseudokirchneriella subcapit a ta (green algae) method: oecd test guideline 201

Toxicity to bacteria: no data available
Toxicity to bacteria – glyoxal
Ecso: 102 mg/l
Exposure time: 16 h
Species: bacteria

Persistence and degradability:
Xanthan gum: 93 %
Method: oecd test guideline 302 readily biodegradable.
Glyoxal: 90 - 100 % readily biodegradable.

Bioaccumulative potential:
Xanthan Gum: The product is miscible in water and readily biodegradable in both water and soil. Accumulation is not expected.
Glyoxal: Bioaccumulation is unlikely.

Mobility in soil: Distribution among environmental compartments

Xanthan Gum: no data available
Results of PBT and vPvB assessment
Xanthan Gum: This substance is not considered to be persistent, bioaccumulating nor toxic (PBT).

Other adverse effects: Biochemical Oxygen Demand (BOD)
Xanthan Gum: 200 mg/g
Glyoxal: 175 mg/g

Chemical Oxygen Demand (COD)
Glyoxal: 350 mg/g

Additional ecological information Xanthan Gum: The product does not need to be labelled in accordance with EC directives or respective national laws. This product has no known eco-toxicological effects.

Section 13. Disposal Considerations

Waste Treatment Methods: Dispose of product and contaminated packaging in accordance with all local, state, and federal environmental control regulations.

Section 14. Transport Information

Land Transport: Goods not dangerous in these regulations
Inland Navigation: Transport goods not dangerous in these regulations
Sea Shipping Transport: Goods not dangerous in these regulations
Air Transport: Goods not dangerous in these regulations

Section 15. Regulatory Information

OSHA Hazards: No known OSHA hazards

SARA 302 Components
SARA 302: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
SARA 313: This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards: No SARA Hazards

Massachusetts Right to Know Components
No components are subject to the Massachusetts Right to Know Act.
Pennsylvania Right to Know Components
Xanthan Gum (CAS-No. 11138-66-2)

Glyoxal (CAS-No. 107-22-2)

New Jersey Right to Know Components

Xanthan Gum (CAS-No. 11138-66-2)
Glyoxal (CAS-No. 107-22-2)

California Prop. 65 Components: This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm

Section 16. Other Information

Disclaimer: The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product.

REVISION DATE: 5/31/2017