ROUX

Remedial Action Work Plan

Harrison Place Site
BCP Site No. C932177
Lockport, NY

November 2023

Prepared for:

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Certification

I, Lori E. Riker, certify that I am currently a NYS-registered Professional Engineer and that this November 2023 Remedial Action Work Plan (RAWP) for the Harrison Place Site (C932177) was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

11/30/2023

Date

Stamp:

LORI E. RIKER
077625-1

1. Introduction

Roux Environmental Engineering and Geology, D.P.C. (Roux)[1] has prepared this Remedial Action Work Plan (RAWP) on behalf of Kearney Realty & Development Group, Inc. (Kearney Realty) to present the proposed scope of work and implementation procedures for completion of remedial activities at the Harrison Place Site, Brownfield Cleanup Program (BCP) Site No. C932177, in the City of Lockport, Niagara County, New York (see Figure 1).

Roux will oversee all remedial activities and subcontract the necessary remedial contractors on behalf of Kearney Realty. The work will be completed in accordance with the approved Brownfield Cleanup Agreement (BCA), 6NYCRR Part 375, New York State Department of Environmental Conservation (NYSDEC) DER-10 guidelines (Ref. 1), and the NYSDEC-approved RAWP.

1.1 Background and History

The Site is located at 210 Walnut Street, City of Lockport, New York on a 5-building complex bound by Walnut Street, Washburn Street, South Street, and Locust Street to the north, east, south, and west, respectively. The BCP Site is restricted to Building No. 3 in the southeast corner of the former Harrison complex (see Figure 2).

Based on findings by Brydges Engineering in Environment and Energy, DPC (BE3) the former Harrison complex is currently referred to as Commerce Square and was used by the Harrison Radiator Division of General Motors Corporation from approximately 1914 to 1987. The facility was used to manufacture copper and brass automobile parts. Building No. 1 contained offices, meeting rooms, a cafeteria, and other support areas. Building No. 1A, which had offices and security, is a small separate section on the western end of Building No. 3. Buildings Nos. 2 and 3 are three-story former manufacturing buildings that are interconnected. Building No. 4 is a three-story structure that was reportedly used for research and development, testing, and office space. Building No. 3 was the main production and assembly building for Harrison Radiator. It is a three-story structure with an open, full height center atrium that runs the full length of the building and contains an overhead crane. The Site has a history of subsurface petroleum storage particularly located west of Building No. 2 in the alley with at least three tanks located west of Building No. 3. Closure documentation identified that a total of 13 underground storage tanks (USTs) were located on the larger property in and around Building No. 3.

1.2 Summary of Environmental Conditions

Comprehensive environmental audits performed in 1977, 1981, and 1985 identified minor environmental issues with the Site. Environmental audit and closure evaluations performed in 1987 and 1988 indicated the following:

- A facility closure was completed by Harrison Radiator that included removal of all equipment, piping, ductwork, solids, chemicals, and asbestos.
- Pits and sumps were cleaned.

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[1] Benchmark Civil/Environmental Engineering & Geology, PLLC in association with TurnKey Environmental Restoration, LLC (Benchmark-TurnKey) became Roux on July 24, 2023.

- Facility wastewater was discharged to the combined sanitary/stormwater sewer system within the City of Lockport municipal system.
- Some of the USTs associated with the property were closed-in-place by filling them with concrete.

A spill was reported to NYSDEC by the City of Lockport Sewer & Water Division when petroleum odors were noted by a worker repairing a fire hydrant on the property. The spill report indicates the 500-gallon and 700-gallon USTs in front of Building No. 4 were removed in 2004. During UST closure activities, approximately 145 tons of petroleum impacted soil was removed and approximately 12,350 gallons of water was disposed. The spill was closed by the NYSDEC in 2005. In November 2009, the Phase II Environmental Site Assessment (ESA), prepared to assess subsurface conditions, suggested petroleum-impacted soils were present on the property. In September 2010, an ESA was conducted to provide a more comprehensive characterization of the various media on the Site. The assessment identified volatile organic compound (VOC)-impacted soil and bedrock groundwater. In December 2019, a subsurface investigation was completed within Building No. 3 where metals, polycyclic aromatic hydrocarbons (PAHs), and VOCs were identified in soils underlying the building. Five sub-slab vapor samples were collected and analyzed for VOCs and identified chlorinated solvents at each sample location. BE3 completed the Remedial Investigation (RI) between April 6, 2021 and April 26, 2022 in accordance with the March 2021 RI Work Plan (Ref. 2) and March 2022 Addendum (Ref. 3).

In November 2022, Benchmark-TurnKey was retained by Kearny Realty & Development Group, Inc. (Kearney Realty) to address the October 31, 2022, comment letter from the NYSDEC in consultation with the New York State Department of Health (NYSDOH) and revise the draft September 2022 Remedial Investigation/Alternatives Analysis (RI/AA) Report submitted by BE3 (Ref. 4). Benchmark-TurnKey submitted the revised RI/AA Report (Ref. 5) to NYSDEC on February 22, 2023. The RI/AA Report was provided to the public for review March 1 to April 15, 2023; no comments were received. Based on NYSDOH comments, Benchmark-TurnKey submitted a revised RI/AA Report on June 8, 2023. The NYSDEC/NYSDOH approved the RI/AA Report and issued the Decision Document on August 4, 2023.

Based on the data and analyses obtained during the Phase II and RI (by others), the following sections describe the environmental conditions at the Site.

1.2.1 Geology

In general, soils across the Site consist of sands with silts with varying amounts of gravel. The fill material ranged in thickness from approximately 2 to 12 feet across the Site. Below the fill are native sand, gravel, and silty clay deposits. Below the native material at a depth of approximately 27 feet is gray Lockport dolostone followed by Rochester shale directly beneath the dolostone. Based on the RI bedrock wells, the Lockport dolostone ranges in thickness from 27 to 60 feet below ground surface (fbgs). The thickness of the Rochester shale is not known because the two wells were only installed 15 feet into the formation or approximately 75 fbgs.

1.2.2 Hydrogeology

As described in the RI/AA Report (Ref. 5), groundwater was observed to flow through the non-native fill, native material on-site, and bedrock at about 8 fbgs. The groundwater elevations provided in the RI/AA Report suggest groundwater flow direction is to the northwest toward the Erie Canal. Water level measurements for the two wells installed in the Rochester formation (SBR-1 and SBR-3) were measured one day after development and because of the significant depth of these wells, it is suspected that equilibrium in water levels did not exist and caused the approximately 15-foot discrepancy. To further assess the situation, water level measurements were taken again on September 2, 2022; however, these were not provided to Kearney Realty by BE3. The SBR-1 well water level measured at an elevation of 609.7 feet (approximately 15 feet higher than the original measurement), which corresponds with other water level measurements in both the overburden and Lockport formation wells. BE3 had issues measuring the water level in bedrock well SBR-3.

On November 22, 2022, Benchmark-TurnKey collected a round of water level readings in overburden and bedrock wells; however, these groundwater elevations were not used to prepare isopotential maps since bedrock well BMW2 was covered by a roll-off, the riser of overburden well SOB-4 was likely adjusted due to ongoing construction work, overburden well MW-1 had a bailer submerged, and overburden well SOB-1 was under air pressure. Additional rounds of water levels will be obtained during implementation of this RAWP.

A hydraulic conductivity assessment was completed on May 4, 2021 by BE3. The hydraulic conductivity (K value) for overburden well BMW1 was 0.005275 centimeters per second (cm/sec) and bedrock wells BMW2 and BMW3 were 0.004195 cm/sec and 0.06947 cm/sec, respectively.

There is no known Site drainage other than overflow drains in the first-floor bathrooms that lead to the combined sewer. According to building drawings, sprinkler system piping runs beneath the concrete building. During the installation of monitoring well BMW1, a cast iron pipe running east-west was identified within the concrete slab beneath the building is assumed to be an abandoned process line.

1.2.3 Contamination by Media

The following sections provide a summary of the detailed results presented in the June 2023 RI/AA Report.

1.2.3.1 Subsurface Soil/Fill

Soil samples collected by BE3 during the RI show various metals (arsenic, barium, cadmium, copper, and lead) exceeding restricted residential SCOs (RRSCOs) at two locations and trichloroethene (TCE) exceeding the RRSCO at six locations. The TCE exceedances were at depth (>14 fbgs) except for boring BH-15 collected in the upper two feet; however, the result was 22 mg/kg compared to the RRSCO of 21 mg/kg.

Protection of groundwater SCOs (PGW SCOs) were exceeded for cis-1,2-dichloroethene (cis-1,2-DCE), TCE, and tetrachloroethene (PCE) at several locations primarily at depth (>10 fbgs) except for boring BH-15 (as indicated above) and SBS-1 (SOB-2) collected from 3-4 fbgs (0.74 mg/kg cis-1,2-DCE compared to PGW SCO of 0.25 mg/kg).

The soil sample collected from off-site boring SOB-3 at a depth of 21-22 fbgs had a PID reading of 1,300 ppm along with a TCE concentration above the RRSCO; therefore, TCE-impacted soils exist downgradient (north) of the BCP site boundary.

1.2.3.2 Groundwater

Groundwater samples collected by BE3 during the RI show metal concentrations above groundwater quality standards/guidance values (GWQS/GVs) are limited to iron, sodium, magnesium, and manganese. VOCs detected at values above GWQS/GVs in overburden groundwater include cis-1,2-dichloroethene (1,2-DCE) and TCE at wells MW1, MW2, and MW3, with the highest concentration (620,000 µg/L) detected in well MW2 indicating a likely on-site source. VOCs (cis-1,2-DCE, TCE, and PCE) were also detected in overburden groundwater in on-site wells SOB-1, SOB-5, and BMW1 but at concentrations one to four orders of magnitude lower than MW2. TCE was detected at a concentration of 230,000 µg/L in off-site downgradient overburden well SOB-3 indicating impacted groundwater is migrating off-site.

VOC exceedances of GWQS/GVs in bedrock (Lockport Dolostone) groundwater include cis-1,2-DCE and TCE in on-site well BMW3; TCE in on-site well BMW2; and cis-1,2-DCE and TCE in off-site well SBR-2. VOC exceedances of GWQS/GVs in bedrock (Rochester Shale) groundwater include benzene, toluene, cis-1,2-DCE, and TCE in on-site well SBR-3 and cis-1,2-DCE, TCE, and PCE in off-site well SBR-1. The TCE concentration in the Rochester Shale bedrock is two orders of magnitude higher in off-site downgradient well SBR-1 compared to on-site well SBR-3. Whereas the TCE concentration in the Lockport Dolostone bedrock on-site (well BMW3) is one order of magnitude higher than off-site (well SBR-2).

1.2.3.3 Soil Vapor and Indoor/Outdoor Air

BE3 completed the installation of six sub-slab (SS) vapor samples, eight indoor air samples (IA), and one outdoor air (OA) sample, all of which were deployed on May 25, 2021 and collected on May 26, 2021. The soil vapor and indoor air samples were compared to the Soil Vapor/Indoor Air Matrices from the NYSDOH October 2006 Guidance for Evaluating Soil Vapor Intrusion in the State of New York and amended May 2017 updates. The NYSDOH has developed three matrices to use as tools in decision making when soil vapor may be an issue. According to the matrices, the following SS/IA pairs require further action:

- Identify Source(s) and Resample or Mitigate
    - SS1/IA1 through SS5/IA5: cis-1,2-DCE
- Monitor
    - SS1/IA1 and SS2/IA2: PCE
- Mitigate
    - SS3/IA3 and SS5/IA5: PCE
    - SS1/IA1 though SS6/IA6: TCE

Because elevated VOC concentrations extend off-site in both the overburden and bedrock groundwater north of the BCP site boundary, it can be assumed that soil vapor will also have elevated VOC concentrations off-site.

1.2.3.4 Contamination Summary/Areas of Concern

Based on the 2021-2022 RI and previous investigations, the constituents of primary concern (COPCs) in Site soils, groundwater, and soil vapor/indoor air are chlorinated VOCs (cVOCs). The groundwater results indicate there is an overburden groundwater contamination source between wells MW2 and BMW2. The sample recovered at well MW2 defines a highly localized source of TCE where a concentration of 620,000 µg/L was detected compared to its GWQS/GV of 5 µg/L. The western edge of the building has much lower TCE concentrations than the central locations. Groundwater concentrations are generally below 1,000 µg/L, which suggests no concentrated solid contaminant mass exists outside of the source area.

1.3 Remedial Action Objectives

The remedial actions for the Harrison Place Site must satisfy Remedial Action Objectives (RAOs). RAOs are site-specific statements that convey the goals for minimizing substantial risks to public health and the environment. RAOs have been defined for the Site as follows:

Soil/Fill:

RAOs for Public Health Protection

- Prevent inhalation of or exposure to contaminants volatilizing from soil.
- Prevent ingestion/direct contact with contaminated soil.

RAOs for Environmental Protection

- Prevent migration of contaminants that would result in groundwater contamination.

Groundwater:

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 groundwater contamination.

Soil Vapor:

RAOs for Public Health Protection

- Mitigate impacts to public health resulting from existing, or the potential for, soil vapor intrusion into buildings at the Site.

1.4 Project Organization and Responsibilities

The remedial actions will be completed by remedial construction specialty contractors under contract to Roux on behalf of Kearney Realty. Roux, as the certifying professional engineer, will monitor the activities to verify that the work is performed in accordance with the BCA, the NYSDEC-approved RAWP, 6NYCRR Part 375, and NYSDEC DER-10 guidance.

2. Pre-Remediation/Preparation Tasks

The following tasks will be completed in preparation of remedial action activities:

2.1 Pre-Construction Activities

2.1.1 Utility Clearance

Prior to intrusive activities, a private utility locating company (such as On the Mark Utility Locating Services, Inc.) will be hired by Kearney Realty to locate private utilities beneath the floor and within the alleyway north of the building. Dig Safely New York (Call 811) will be contacted by the subcontracted drilling company a minimum of three business days in advance of the work and informed of the intent to perform intrusive work at the Site.

2.1.2 Permits/Notifications

Prior to injection activities, an Underground Injection Control (UIC) application will be submitted to the United States Environmental Protection Agency (USEPA) Region 2 Drinking Water & Groundwater Protection Section. The application will describe the planned beneficial use remediation wells, amendment product details, quantity of each amendment to be applied, and locations of planned injections. The USEPA will issue an authorize by rule once approved. Appendix A includes the UIC application to be submitted.

Injection activities will require the use of potable water. Access to water is anticipated within the building; however, if access to water proves to be an issue, a fire hydrant permit will be obtained from the City of Lockport for access to water for solution mixing during injection activities.

Roux will apply to the City of Lockport Public Works Department for a temporary wastewater discharge permit for industrial users. This will allow discharge of pretreated purged groundwater and trench/basement sump water to the municipal sanitary sewer system.

2.1.3 Site Access

Access to the Site during remedial activities will be restricted to the interior of Building No. 3 and the alleyway north of the Site provided access is provided in writing by the property owner. Construction cones and caution tape will be used around remedial action areas.

2.2 Health and Safety Plan Development

The Health and Safety Plan (HASP) in Appendix B has been prepared and will be enforced by Roux in accordance with the requirements of 29CFR 1910.120. The HASP covers on-site remedial activities. Roux will be responsible for site control and for the health and safety of its authorized site workers. All contractors, subcontractors, and other parties involved in on-site remedial activities will be required to develop a HASP as or more stringent as Roux's HASP.

2.2.1 Dust Monitoring and Controls

A Community Air Monitoring Plan (CAMP), which is included within the HASP in Appendix B, will be implemented during intrusive activities. Although unlikely, if community air monitoring indicates the need for dust suppression, the contractor will halt work and adjust drilling/injection activities to minimize dust formation. A water spray application may be used to mitigate airborne dust formation and migration. Potable water will either be obtained from a source inside the building, or a public hydrant provided by an off-site water service.

2.3 Waste Characterization

Waste characterization samples will be collected in accordance with the selected landfill analytical disposal requirements. Pre-characterization of the soil/fill will allow for direct loading and off-site transportation at the time of the impacted soil/fill excavation. Based on the results of the waste characterization sampling, impacted fill will be managed according to all federal, state, and local waste disposal regulations. It is anticipated that waste characterizations samples will be collected prior to injection activities within the proposed 30-foot by 30-foot excavation area, as described in Sections 3.1 and 3.2.

2.4 Imported Backfill Characterization

Any imported soil/fill material used for backfill will be subject to characterization requirements in accordance with DER-10 Table 5.4(e)10, or as otherwise approved by NYSDEC prior to import to the Site.

3. Remedial Action Activities

The NYSDEC will be notified at least 5 business days in advance of any planned remedial activities. Remedial work will be performed in accordance with this RAWP and documented by an experienced Roux professional. As summarized below and shown on Figure 3, the remedial program will generally include:

- Completing remedial injection activities to address cVOC impacted groundwater/ saturated soil and bedrock contamination on-site and mitigate off-site migration. Amendments will be applied to address elevated cVOC concentrations.
- Excavating cVOC-impacted unsaturated overburden soil/fill in the presumed source area around boring BH-16/well MW-2.
- Removing/treating/discharging basement sump and trench water.
- Installing on-site and off-site groundwater monitoring wells.
- Installing an SSDS throughout the building.
- Implementing a cover system consisting of building concrete floor slab, pavement, or two feet of clean cover meeting restricted residential soil cleanup objectives, and demarcation layer in areas of exposed remaining contamination, allowing for restricted residential use.

3.1 Remedial Injection Activities

3.1.1 USEPA Approvals

Prior to injection activities, Roux will provide NYSDEC with proof of approval by the USEPA Region 2 Drinking Water & Groundwater Protection Section to complete the beneficial use injections.

3.1.2 Injection Activities

A Site-specific remedial program was developed with design support provided by Regenesis®. Roux/Regenesis determined the in-situ groundwater/saturated soil/fill and bedrock remedial technologies to be implemented are a combination of in-situ chemical reduction (ISCR), enhanced anaerobic degradation, in-situ chemical oxidation (ISCO), bioaugmentation, and in-situ sorption and biodegradation. Appendix C includes the technical data sheets and safety data sheets (SDSs) for the following products supplied by Regenesis:

- ISCR: Sulfidated, colloidal zero-valent iron (S-MicroZVI®) promotes the destruction of contaminants through a direct chemical reaction and stimulates anaerobic biological degradation by rapidly creating a reducing environment that is favorable for reductive dechlorination.
- Enhanced Anaerobic Degradation: 3-D Microemulsion (3DME®) coats pore surfaces and results in a staged release of electron donors to enhance degradation.
- ISCO: PersulfOx® is a sodium persulfate-based technology that employs a patented catalyst to enhance the oxidative destruction of both hydrocarbons and chlorinated contaminants in groundwater and soil.

- Bioaugmentation: Bio-Dechlor Inoculum (BDI PLUS®) contains species of Dehalococcoides sp. (DHC), the bacteria responsible for complete dechlorination of chlorinated VOCs to non-toxic end products.

- In-Situ Sorption and Biodegradation: PlumeStop® consists of very fine particles of activated carbon that behave as a colloidal biomatrix, binding to the aquifer matrix, rapidly removing contaminants from groundwater, and expediting permanent contaminant biodegradation. PlumeStop is used to remediate cVOCs and prevent off-site migration.

The overall goal of the remediation project is to reduce the above contaminants concentrations in on-site groundwater to acceptable levels, determined in consultation with the NYSDEC.

- Area A: Presumed Source Area (Overburden): Prior to source material removal, the area surrounding BH-16/MW-2 will be injected with amendments (11 injection points) to address the impacted saturated overburden. Application of PersulfOx within an approximate 900 square foot area applied from approximately 9 to 26 fbgs to reduce the mass of chlorinated VOC contamination beneath the presumed source area. If a second injection is deemed necessary, Roux will analyze the groundwater chemistry and determine the amendment(s) that would be most effective and efficient at further reducing groundwater concentrations. The data and recommended approach would be provided to NYSDEC and NYSDOH for review.

- Area B: Central Area (Overburden): Application of PersulfOx within an approximate 9,000 square foot area (90 injection points) applied from approximately 9 to 26 fbgs to address chlorinated VOC contamination in the smear/saturated zone. If a second injection is deemed necessary, Roux will analyze the groundwater chemistry and determine the amendment(s) that would be most effective and efficient at further reducing groundwater concentrations. The data and recommended approach would be provided to NYSDEC and NYSDOH for review.

- Area C: Lockport Dolostone and Rochester Shale (Bedrock): Application of 3DME, S-MicroZVI, and BDI PLUS within an approximate 3,200 square foot area applied at two locations from approximately 26 to 56 fbgs to address chlorinated VOC contamination in the Lockport Dolostone bedrock formation in the vicinity of monitoring wells BMW-3. Application of 3DME, S-MicroZVI, and BDI PLUS within an approximate 3,200 square foot area applied at two locations from approximately 65 to 75 fbgs to address chlorinated VOC contamination in the Rochester Shale bedrock formation in the vicinity of monitoring well SBR-3.

- Area D: Downgradient Property Boundary (Overburden): Application of PlumeStop and S-MicroZVI along an approximate 180 feet applied from approximately 9 to 26 fbgs via 30 injection points. This barrier will treat chlorinated VOC-impacted groundwater before it migrates off-site.

- Area E: Lockport Dolostone and Rochester Shale (Bedrock): Application of 3DME, S-MicroZVI, and BDI PLUS within an approximate 2,100 square foot area applied at two locations from approximately 26 to 56 fbgs to address chlorinated VOC contamination in the Lockport Dolostone bedrock formation upgradient of off-site bedrock wells SBR-1 and SBR-2. Application of 3DME, S-MicroZVI, and BDI PLUS within an approximate 2,100 square foot area applied at two locations from approximately 65 to 75 fbgs to address chlorinated VOC contamination in the Rochester Shale bedrock formation upgradient of off-site bedrock wells SBR-1 and SBR-2.

Table 1 summarizes the estimated volume of amendments planned for each injection area. Overburden and bedrock injections are planned downgradient of the basement sump (i.e., groundwater flows away from the basement sump), which is in the southwest corner of the building at approximately 14 fbgs. The basement sump will be inspected every hour by dropping a bailer into the sump during injections in the southwest portion of Area B. In the event pumping of the basement water, as described in Section 3.5.1, reverses the direction of groundwater flow causing amendment daylighting in the sump, pumping will be stopped until nearby injections are complete.

In the event daylighting of product occurs or if a point becomes compromised, the injection team will first attempt to seal up around the injection rods with either granular bentonite or bentonite chips. If unsuccessful, the injection rod will be retracted, the injection point will be filled with bentonite chips, and the surface will be sealed with quick asphalt if needed to minimize amendment lost at the surface. Absorbent material (e.g., Speedy Dry or spill pads) may be used to clean up amendment that daylights to the surface. Absorbent material will be containerized and disposed as municipal waste.

Following injection activities, injection points will be sealed with bentonite and the concrete floor and asphalt alleyway will be repaired in-kind.

3.2 Remedial Excavation of Soil/Fill

Following injection activities in the presumed source area around boring BH-16/well MW-2, monitoring well MW-2 will be decommissioned in accordance with NYSDC Policy CP-43 (Ref. 6) and impacted unsaturated overburden soil/fill will be excavated and disposed off-site at an approved commercial landfill. An approximate 30-foot by 30-foot opening will be cut in the concrete floor and the unsaturated soil/fill will be excavated. Based on the boring log for BH-16, the upper approximately 12 feet beneath the concrete floor appears to be unsaturated. Excavation will stop once the soil becomes saturated such that the excavation would require dewatering, or the soil/fill is too wet to transport off-site. Therefore, the extent of in-place impact is estimated to cover 900 square-feet by 12 feet deep, for a corresponding in-place volume of 400 cubic yards (CY). Accounting for contingency and excavation inefficiencies, the volume is estimated at 600 CY. At 1.7 ton/CY, an estimated 1,000 ton of impacted soil will be disposed off-site. The excavation will be enlarged if visual and olfactory impacts are apparent and/or sidewall PID readings exceed 100 ppm to the extent it is safe and feasible considering the columns supporting the building. The extents and depth of the excavation will be manually measured and located on the Site survey drawing using the concrete columns, walls, and doors as reference.

3.2.1 Management and Disposal of Excavated Material

As discussed in Section 2.3, waste characterization samples will be collected in accordance with the selected landfill analytical disposal requirements. Pre-characterization of the soil/fill will allow for direct loading and off-site transportation at the time of the impacted soil/fill excavation. An appropriate disposal application will be prepared for disposal facility review and approval. Waste facility approvals will be received prior to excavation activities to allow for direct loading. All disposal activities will be in accordance with applicable local, state, and federal waste disposal regulations.

3.2.2 Confirmatory Sampling

Post-excavation confirmatory soil samples will be collected from the sidewalls and bottom of the excavation at the frequency outlined in DER-10 (one sidewall sample per 30 linear feet and one bottom sample per 900 square feet). Samples will be analyzed for Target Compound List (TCL) VOCs via EPA Method 8260 to document VOC concentrations that remain. Confirmatory sidewall soil samples that exceed PGW SCOs for contaminants of concern will be excavated if safe and feasible or subject to in-situ chemical oxidation treatment. Remedial injections in this area will begin at 9 fbgs in the event excavation cannot proceed to 12 fbgs due to structural concerns or need for dewatering.

3.2.3 Excavation Backfill

Upon completion of the excavation, a demarcation layer of geotextile fabric will be placed at the bottom and on the sides of the excavation prior to backfilling. The excavated area will be backfilled with clean approved material that adheres to imported soil requirements per DER-10 and a new concrete pad will be poured to match the existing floor.

3.2.4 Equipment Decontamination

Following excavation work, all equipment will be cleaned free of soil clods, mud, or clinging debris prior to removal from the Site. Equipment will be power washed, as needed, on an impermeable pad in a location convenient to the remedial contractor. Wash water will be collected and characterized for disposal.

3.3 Active Subslab Depressurization System

An active subslab depressurization (ASD) system will be designed and installed throughout the building to mitigate potential vapor intrusion into the building. An ASD system creates a low-pressure zone beneath a building slab using a powered fan connected via piping to create negative pressure beneath the building foundation. The low-pressure field prevents soil gas from entering the building. In general, the essential components of an ASD will include:

- Installation of suction pits and/or subsurface piping beneath the slab to adequately provide negative pressure beneath the entire basement footprint.
- Installation of a vent stack from the suction pits and/or subsurface piping that will extend above the roof line for discharge.
- Installation of continuous operation fan(s) equipped with a pressure gauge to assure the system is under negative pressure.
- Sealing major slab and foundation penetrations, including joints, cracks and utility and pipe penetrations.

A formal ASD System Work Plan will be submitted prior to the installation of the ASD system, which will occur prior to building occupancy. The Work Plan will include the results of planned pre-installation communication testing, which will be used to determine the radius of influence below the slab; number of required suction points and/or subsurface piping locations; and number and types of fans to adequately provide negative pressure under the building slab. The ASD system will be designed in general accordance with the EPA design document entitled “Radon Prevention in the Design and Construction of Schools and Other Large Buildings” Third Printing with Addendum, June 1994 and the NYSDOH “Guidance for Evaluating Soil Vapor Intrusion in the State of New York” dated October 2006.

Upon startup of the ASD system, a sample of the effluent air will be collected and analyzed for VOCs via EPA Method TO-15 to determine if treatment is required.

3.4 Groundwater Monitoring Well Installation and Sampling

3.4.1 Monitoring Well Installation/Replacement

A monitoring well cluster will be installed directly outside the northwest corner of the building as shown on Figure 3 to evaluate/monitor the effectiveness of the injections and in-situ barrier. One well will be installed to monitor each of the overburden (MW-6), Lockport (BMW-4), and Rochester (BMW-5) formations. Bedrock wells will be advanced a minimum of 3 feet into component rock before casing to ensure no further contaminant migration. Monitoring wells that are damaged or destroyed during excavation activities (e.g., MW-2) will be replaced in kind. Monitoring wells MW-1 and MW-3 will be reinstalled to be consistent with the construction of the other overburden wells on-site.

3.4.2 Water Level Measurements

Water levels in all on-site and adjacent off-site monitoring wells will be collected over several months to determine if there are seasonal fluctuations and if flow direction is influenced by the Erie Canal.

3.4.3 Sampling

Prior to the injection program, Roux will collect groundwater samples from the existing wells and newly installed well cluster for analysis of TCL VOCs by EPA Method 8260C. Approximately three months after the injection program, Roux will collect groundwater samples from the following locations:

- On-site Overburden Wells: MW-1, MW-2, MW-3, SOB-1, SOB-5
- Off-site Overburden Well: SOB-3, SOB-4, MW-6
- On-site Bedrock Wells: SBR-3, BMW-3
- Off-site Bedrock Wells: SBR-1, SBR-2, BMW-4, BMW-5

Sampling will be performed three months following injection activities to evaluate the effectiveness of the in-situ groundwater treatment. Sampling of well SOB-1 may be discontinued depending on observed concentrations considering current concentrations are relatively low and the well is located outside of the injection grid; however, well SOB-1 will be monitored until otherwise approved by NYSDEC.

3.4.4 Frequency

Post-remedial groundwater monitoring will be conducted quarterly for one year at which time the frequency of sampling will be reassessed; however, we anticipate quarterly groundwater sampling for a maximum of two years followed by two years of semi-annual sampling and annual sampling thereafter. Groundwater monitoring will continue as outlined in the Site Management Plan (SMP).

3.4.5 Analysis

The monitoring wells will be sampled for TCL VOCs via EPA Method 8260C. Select wells may be analyzed for other parameters and the results used to determine the need for and timing of an additional round of injections as well as the appropriate injection amendments.

3.5 Water Management

3.5.1 Building Sump/Trench Water

Standing water from the basement sump and building utility trenches will be managed throughout remediation using standard remediation protocol including collection, on-site pretreatment, sampling/characterization, and discharge to the municipal sewer system via an industrial discharge permit or off-site disposal at an approved receiving facility per regulations. The industrial discharge permit application will be shared with NYSDEC so they can assess if the discharge of remediation waters is acceptable under the permit conditions and if all contaminants of concern will be monitored under the permit. Prior to any discharge to the municipal sewer system, the approved industrial discharge permit will be provided to NYSDEC. NYSDEC will be copied on any monitoring reports (if any) related to this permit.

Following remediation, management of basement water will be reassessed based on the quantity and quality. If necessary, a permanent industrial discharge permit application will be submitted, and a new sump pump installed. Post-remedial provisions for managing basement water will be included in the SMP.

3.5.2 Groundwater

Groundwater purged during monitoring well development and sampling will be stored in clean 55-gallon drums (or a frac tank) and pretreated prior to discharge.

3.5.3 On-Site Pretreatment

If the collected water is turbid, it will be pumped through a bag or cartridge filter. The water will then be pumped through a granular activated carbon (GAC) unit. Pretreated water will be sampled and discharged if the results meet the City of Lockport discharge standards. If results fail to meet the discharge standards, the water may be further treated on-site or transported off-site for disposal.

Spent GAC will be characterized and regenerated off-site or disposed at a permitted disposal facility in accordance with applicable federal and state regulations. Settled solids in the drum/tank and spent filter bags will be disposed off-site. The drum/tank will be decontaminated via pressure washing. Water from pressure washing will be run through the GAC unit and added to the pretreated groundwater. Roux will coordinate with the municipal sanitary sewer authority to obtain any necessary temporary discharge permits.

3.5.4 Off-site Disposal

If water is instead containerized and transported off-site for disposal, no pre-treatment will be required. The drums/tank containing water generated during remedial activities will be picked up by an authorized hauler and transported off-site to an approved disposal facility.

3.6 Cover System

The Site is currently improved with a building and concrete floor slab as the existing cover system. A new concrete floor will be installed following soil/fill excavation activities in the presumed former source area. Any other disturbances to the cover system during remedial activities will be mitigated with a new or repaired concrete floor.

The existing concrete floor will be inspected and repaired as necessary to ensure it properly functions as a part of the Site-wide cover system, specifically within the injection area. Certification of the concrete cover will be included with the Final Engineering Report (FER). The final cover system will allow for restricted-residential use.

3.7 Building Materials Abatement

Kearney Realty will subcontract abatement of asbestos-containing material (ACM), lead-based paint, polychlorinated biphenyls (PCBs), and mold based on the results of a hazardous materials inspection and survey of Building No. 3 conducted between May 28 and June 1, 2021. Waste disposal records generated during those activities will be included in the FER.

4. Remedial Activities Support Documents

4.1 Health and Safety Protocols

Appendix B includes the HASP prepared by Roux for use by our employees in accordance with 40CFR 300.150 of the NCP and 29CFR 1910.120. The HASP includes the following site-specific information:

- A hazard assessment.
- Training requirements.
- Definition of exclusion, contaminant reduction, and other work zones.
- Monitoring procedures for Site operations.
- Safety procedures.
- Contingency plan for potential emergencies
- Personal protective clothing and equipment requirements for various field operations.
- Community air monitoring
- Disposal and decontamination procedures.

A member of the field team will be designated to serve as the Site Safety and Health Officer (SSHO). The SSHO will report directly to the Project Manager and the Corporate Health and Safety Coordinator. The HASP will be subject to revision as necessary, based on new information that is discovered during the remedial activities.

4.1.1 Community Air Monitoring

Real-time community air monitoring will be performed during remedial activities at the Site as outlined in the HASP. Particulate and VOC monitoring will be performed along the upwind and downwind perimeter of the work area during all ground intrusive activities (including injections) in accordance with the CAMP. The CAMP is consistent with the requirements for community air monitoring at remediation sites as established by the NYSDOH and NYSDEC. Accordingly, it follows procedures and practices outlined under DER-10 Appendix 1A (NYSDOH's Generic Community Air Monitoring Plan) and Appendix 1B (Fugitive Dust and Particulate Monitoring). Both the NYSDEC and NYSDOH project managers will be notified of any CAMP exceedances that require corrective actions or shut down of work within one business day.

4.2 Citizen Participation Activities and Fact Sheets

NYSDEC will coordinate and lead community relations throughout the course of the project with support from Roux as requested. The RI/AA Report received no public comments during the review period.

The NYSDEC, with input from Roux and Kearney Realty & Development Group, Inc., will issue project-related fact sheets to keep the public informed of BCP activities.

5. Preliminary Schedule

Roux will provide NYSDEC with 7 days' notice of field activities and provide email updates on the remedial progress. The preliminary remedial schedule is as follows:

- **November 2023:** NYSDEC/NYSDOH approval of RAWP.
- **November/December 2023:** Apply for necessary permits, perform private utility survey.
- **January 2023:**
    - Mobilize equipment
    - Install off-site groundwater well cluster
    - Collect pre-remedial round of groundwater samples
    - Remove concrete floor in Area B and collect waste characterization samples
    - Begin pumping basement sump and trench water; pretreat and discharge water to municipal sanitary sewer
    - Complete remedial injections in building
    - Decommission well MW-2
- **February-April 2024:**
    - Excavate and dispose unsaturated soil/fill
    - Backfill excavation with clean imported material
    - Reinstall wells MW-1, MW-2, and MW-3
    - Submit ASD System Work Plan
- **May 2024:**
    - Perform remedial injections to install downgradient barrier wall
    - Perform 1st post-injection groundwater sampling event.
    - Install ASD system
- **June 1, 2024:** Submit draft Environmental Easement package.
- **August 2024:** Perform 2nd post-injection groundwater sampling event; reinject within Areas A and B if required.
- **August 1, 2024:** Submit draft SMP.
- **November 2024:** Perform 3rd post-injection groundwater sampling event.
- **October 1, 2024:** Submit final SMP and draft FER.
- **October 15, 2024:** Record Environmental Easement.
- **November 15, 2024:** Submit final FER.
- **December 2024:** Receive Certificate of Completion (COC).
- **February 2025**: Begin post-COC quarterly groundwater sampling.

6. Remedial Activities Reporting

6.1 Construction Monitoring

Roux will be on-site full-time during all remedial activities to monitor and document injection locations; document remediation activities; conduct community air monitoring; and perform groundwater monitoring. Standard reporting procedures will include preparation of a daily report and, when appropriate, problem identification and corrective measures reports. Appendix D contains sample project documentation forms. Daily reports will be available on-site and submitted to the NYSDEC as part of the FER. The NYSDEC will be promptly notified of problems requiring modifications to this RAWP prior to proceeding or completion of the construction item. Photo documentation of the remedial activities will be prepared by a field representative throughout the duration of the project as necessary to convey typical work activities, changed conditions, and/or special circumstances. If determined to be necessary, periodic on-site construction progress meetings will be held to which NYSDEC will receive an invitation.

6.2 Final Engineering Report

The FER will be prepared at the conclusion of the remedial activities and include the following information and documentation, consistent with the NYSDEC DER-10 Technical Guidance for Site Remediation:

- Background and Site description.
- Summary of the Site remedy that satisfied the RAOs for the Site.
- Certification by a Professional Engineer to satisfy the requirements outlined in 6NYCRR Part 375-1.6(c)(4).
- Description of engineering and institutional controls at the Site.
- Site map showing the areas remediated.
- Documentation of materials disposed off-site.
- Documentation of imported materials.
- Copies of daily inspection reports and, if applicable, problem identification and corrective measure reports.
- Analytical data packages and data usability summary reports (DUSRs).
- CAMP data and reports.
- Photo documentation of remedial activities.
- Text describing the remedial activities performed; a description of any deviations from the Work Plan and associated corrective measures taken; and other pertinent information necessary to document that the site activities were carried out in accordance with this Work Plan.

The post-injection groundwater sampling data will be reviewed by a qualified, independent data validation expert. Specifically, a DUSR will be prepared, with appropriate data qualifiers added to the results. The DUSR format will follow the NYSDEC's September 1997 DUSR guidelines and DER-10 guidance. The DUSR and any necessary qualifications to the data will be appended to the FER

6.3 Site Management Plan

For any BCP site not cleaned up to NYSDEC Part 375 unrestricted soil cleanup objectives (USCOs), preparation of an SMP that describes site-specific Institutional Controls and/or Engineering Controls (IC/EC) is a required component of the final remedy. Therefore, as part of the final remedy, an SMP will be prepared. Consistent with NYSDEC BCP requirements, the SMP will include the following components:

6.3.1 Institutional and Engineering Control Plan

The IC/EC Plan will identify all use restrictions and engineering controls for the Site and details the steps and media-specific requirements necessary to ensure the following institutional and/or engineering controls remain in place and effective:

Institutional Controls:

Imposition of an institutional control in the form of an environmental easement for the controlled property that will:

- Require the remedial party or site owner to complete and submit to the Department a periodic certification of institutional and engineering controls in accordance with 6NYCRR Part 375-1.8 (h)(3);
- Allow the use and development of the controlled property for restricted residential use as defined by 6NYCRR Part 375-1.8(g), although land use is subject to local zoning laws;
- Restrict the use of groundwater as a source of potable or process water, without necessary water quality treatment as determined by the NYSDOH or Niagara County DOH; and
- Require compliance with the Department-approved Site Management Plan.

Engineering Controls:

A site cover currently exists and will be maintained to allow for restricted residential use of the site. Any site redevelopment will maintain the existing site cover. The site cover may include paved surface parking areas, a concrete slab, sidewalks, or soil where the upper two feet of exposed surface soil meets the applicable SCOs for restricted residential use. Any fill material brought to the site will meet the requirements for the identified site use as set forth in 6NYCRR Part 375-6.7(d).

In-situ chemical oxidation (ISCO) will be implemented to treat chlorinated solvent contamination in the overburden soil and groundwater. The chemical oxidant will be injected into the subsurface to destroy the contaminants in the following areas:

- Area A – A 900-square foot area located beneath the presumed source area in the north central portion of the site. Oxidizing amendments will be applied via injection wells screened from approximately 12 to 26 feet below ground surface. If additional injections are deemed necessary, the groundwater chemistry will be analyzed to determine the amendment(s) that would be most effective and efficient at further reducing groundwater concentrations; and
- Area B – A 9,000-square foot area located in the central portion of the site. Oxidizing amendments will be applied via injection wells screened from approximately 9 to 26 fbgs. If additional injections are deemed necessary, the groundwater chemistry will be analyzed to determine the amendment(s) that would be most effective and efficient at further reducing groundwater concentrations.

In-situ chemical reduction (ISCR) will be implemented to treat chlorinated solvent contamination in the Lockport Dolostone and Rochester Shale bedrock groundwater. The chemical reducing amendment(s) will be injected into the subsurface to destroy the contaminants in the following areas:

- Area C – A 3,200-square foot area located in the western portion of the site. Treatment of Area C includes the Lockport Dolostone bedrock zone, amendments will be applied via injection wells screened from approximately 26 to 56 fbgs;
- Area D – A 3,200-square foot area located in the western portion of the site. Treatment of Area D includes the Rochester Shale bedrock zone, amendments will be applied via injection wells screened from approximately 65 to 75 fbgs;
- Area F – A 2,100-square foot area located in the northern portion of the site. Treatment of Area F includes the Lockport Dolostone bedrock zone, amendments will be applied via injection wells screened from approximately 26 to 56 fbgs; and
- Area G – A 2,100-square foot area located in the northern portion of the site. Treatment of Area F includes the Rochester Shale bedrock zone, amendments will be applied via injection wells screened from approximately 65 to 75 fbgs.

In-situ enhanced biodegradation will be employed to treat chlorinated solvent contamination in the Lockport Dolostone and Rochester shale bedrock groundwater in the source areas located under Building 3. These injections will occur after the completion of the injection events of remedial elements 5 and 6. The biological breakdown of contaminants through anaerobic reductive dechlorination will be enhanced by injecting bacterial cultures into the subsurface to promote microbe growth. Amendments will be introduced into the subsurface via injection wells in Areas A, B, C, D, F, and G. Separate amendments to serve as an ongoing energy source for the bacteria will be injected to sustain biological activity.

Activated carbon and ZVI will be injected into the overburden to create a barrier wall to prevent the migration of chlorinated solvent contamination in overburden groundwater. In the area of the captured contamination, conditions will be maintained that will allow anaerobic degradation of chlorinated solvents to occur. The activated carbon/ZVI barrier will be added to the subsurface along the downgradient boundary of the site via injection wells screened from approximately 9 to 26 fbgs. The barrier will span approximately 180 feet along the northern site boundary.

Any on-site buildings will be required to have a sub-slab depressurization system, or other acceptable measures, to mitigate the migration of vapors into the building from soil and/ or groundwater.

This IC/EC Plan includes, but may not be limited to:

- An Excavation Plan that details the provisions for management of future excavations in areas of remaining contamination;
- Descriptions of the provisions of the environmental easement including any land use or groundwater use restrictions;
- Provisions for the management and inspection of the identified engineering controls;
- Maintaining site access controls and Department notification; and
- The steps necessary for the periodic reviews and certification of the institutional and/or engineering controls.

6.3.2 Monitoring Plan

The Monitoring Plan will assess the performance and effectiveness of the remedy. The Plan includes, but may not be limited to:

- Monitoring of groundwater to assess the performance and effectiveness of the remedy;
- A schedule of monitoring and frequency of submittals to the Department; and
- Monitoring for vapor intrusion for any buildings on the site, as may be required by the Institutional and Engineering Control Plan discussed above.

6.3.3 Operation and Maintenance (O&M) Plan

The O&M Plan will ensure continued operation, maintenance, inspection, and reporting of any mechanical or physical components of the active vapor mitigation system(s). The O&M Plan includes, but is not limited to:

- Procedures for operating and maintaining the system(s); and
- Compliance inspection of the system(s) to ensure proper O&M as well as providing the data for any necessary reporting.

6.4 Corrective Measures Plan

If any component of the remedy is found to have failed, or if the periodic certification cannot be provided due to the failure of an IC/EC, a Corrective Measures Plan will be submitted to the NYSDEC for approval. This Plan will explain the failure and provide the details and schedule for performing work necessary to correct the failure. Unless an emergency condition exists, no work will be performed pursuant to the Corrective Measures Plan until it is approved by the NYSDEC.

7. References

New York State Department of Environmental Conservation. DER-10; *Technical Guidance for Site Investigation and Remediation.* May 2010.

BE3 Corp. *Remedial Investigation Work Plan, Harrison Place, Northwest Corner – Intersection of South & Washburn Street, Lockport, New York, NYSDEC Site No. C932177*. March 2021.

BE3 Corp. *Remedial Investigation Work Plan Addendum, Harrison Place, Northwest Corner – Intersection of South & Washburn Street, Lockport, New York, NYSDEC Site No. C932177*. March 2022.

BE3 Corp. *Draft Remedial Investigation/Alternatives Analysis Report, 210 Walnut Street, Lockport, New York, NYSDEC Site No. C932177.* September 2022.

Benchmark Civil/Environmental Engineering & Geology, PLLC in association with TurnKey Environmental Restoration, LLC. *Remedial Investigation/Alternatives Analysis Report, Harrison Place Site, BCP Site No. 932177, Lockport, New York. February 2023;* revised June 2023.

New York State Department of Environmental Conservation. CP-43: *Groundwater Monitoring Well Decommissioning Policy*. November 3, 2009.

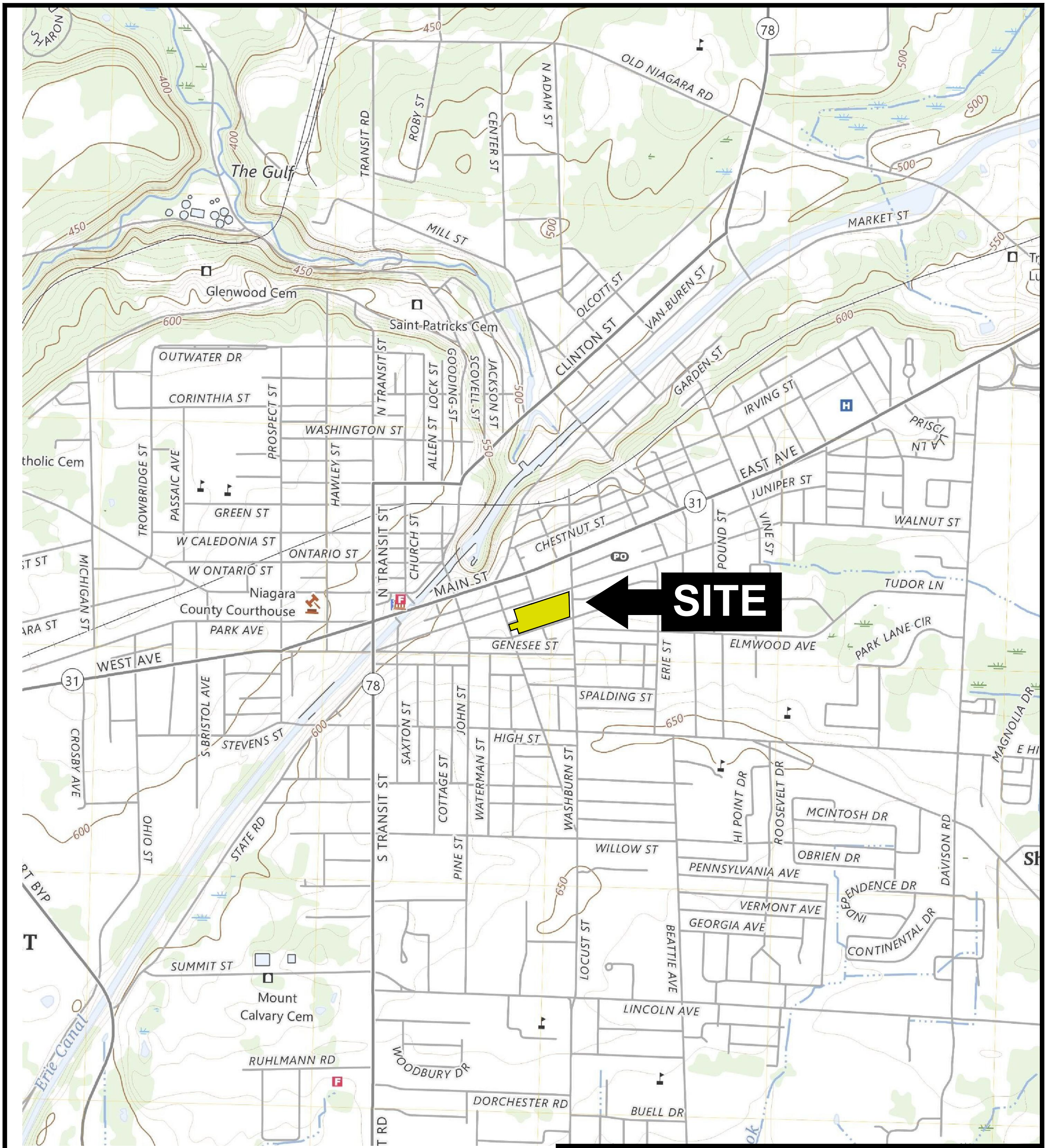
TABLES

Table 1
Summary of Amendment Volumes by Injection Area

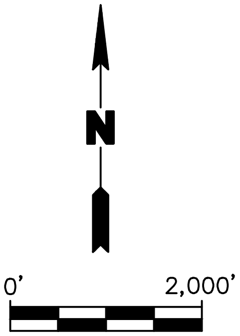
Remedial Action Work Plan
Harrison Place Site C932177

Injection Area		Length	Width	Coverage Area	Depth Interval	Thickness	No. Injection Points	No. Days	PersulfOx (lb)	Water (gal)	PlumeStop (lb)	Water (gal)	3DME (lb)	Water (gal)	S-MicroZVI (lb)	BDI Plus (L)	Water (gal)
A	MW-2 Vicinity (Presumed Source Area)	30	30	900	9 to 26	17	11	2	4,684	3,180	--	--	--	--	--	--	--
B	Central Area	180	50	9,000	9 to 26	17	90	7	35,374	24,021	--	--	--	--	--	--	--
C	Bedrock - Rochester (SBR-3 Vicinity)	80	40	3,200	65 to 75	10	2	2	--	--	--	--	1,200	2,732	1,000	10	100
	Bedrock - Lockport (BMW-3 Vicinity)	80	40	3,200	26 to 56	30	2	3	--	--	--	--	3,200	7,286	2,500	28	280
D	Downgradient Barrier	180	--	--	9 to 26	17	30	9	--	--	12,400	28,342	--	--	3,100	--	--
E	Bedrock - Rochester (Upgradient SBR-1/-2)	70	30	2,100	65 to 75	10	2	2	--	--	--	--	800	1,821	1,000	6	60
	Bedrock - Lockport (Upgradient SBR-1/-2)	70	30	2,100	26 to 56	30	2	3	--	--	--	--	2,400	5,464	2,000	18	180
						Totals	**139**	**28**	**40,058**	**27,201**	**12,400**	**28,342**	**7,600**	**17,303**	**9,600**	**62**	**620**

FIGURES



QUADRANGLE LOCATION



SOURCE:
USGS, 2023, LOCKPORT, NY
7.5 MINUTE TOPOGRAPHIC QUADRANGLE

Title:

SITE LOCATION & VICINITY MAP
REMEDIAL ACTION WORK PLAN
HARRISON PLACE SITE

BCP SITE NO. C932177
LOCKPORT, NEW YORK

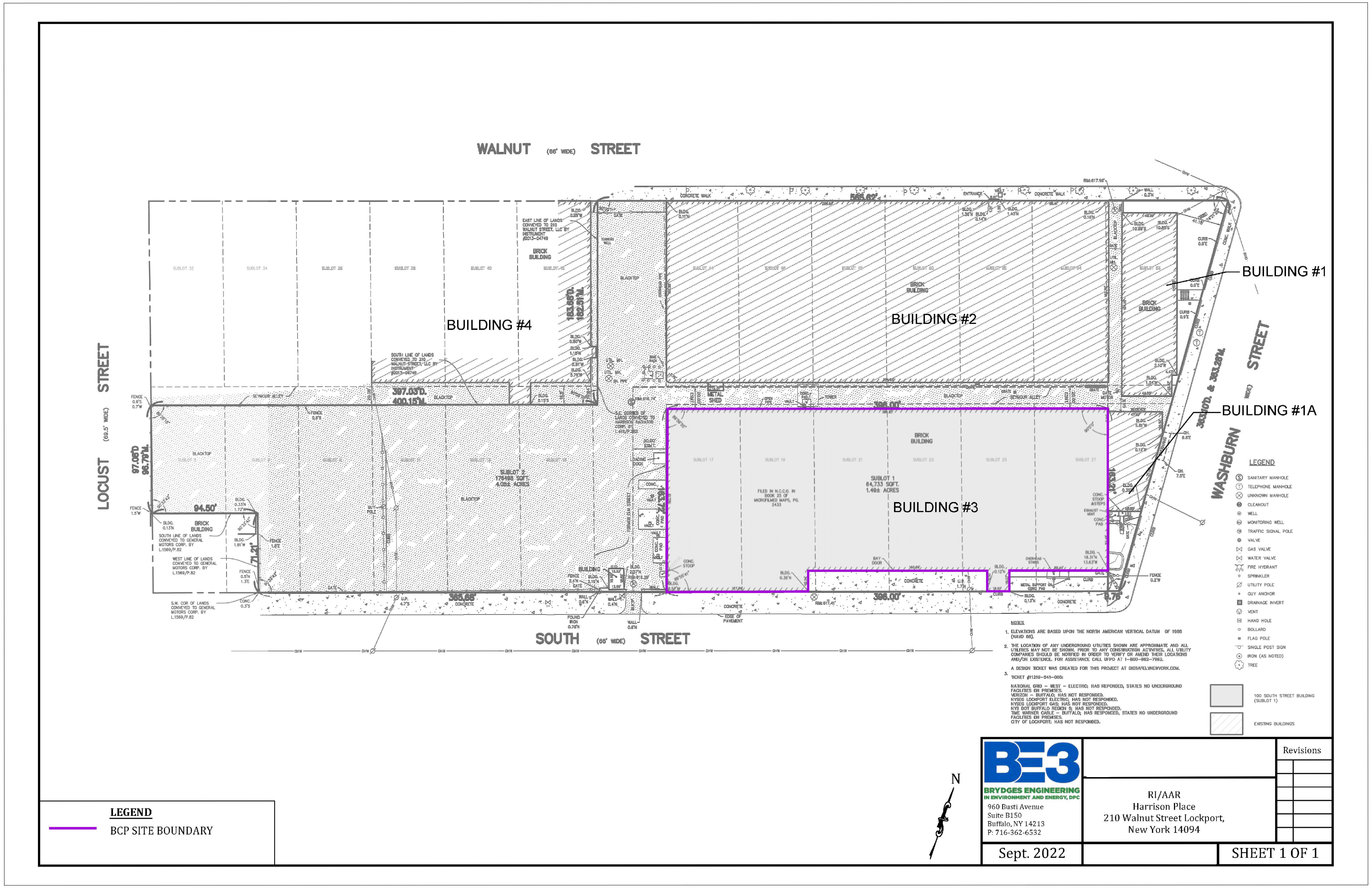
Prepared for:

KEARNEY REALITY & DEVELOPMENT GROUP, INC.

ROUX

Compiled by: CNK	Date: NOVEMBER 2023	FIGURE
Prepared by: CNK	Scale: AS SHOWN	1
Project Mgr: LER	Project: 0684-022-001	
File: FIGURE 1; SITE VICINITY AND LOCATION MAP.DWG		

F:\CAD\BENCHMARK\KEARNEY REALTY AND DEVELOPMENT GROUP\RAWP\FIGURE 1; SITE VICINITY AND LOCATION MAP.DWG



NOTES

1. ELEVATIONS ARE BASED UPON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

2. THE LOCATION OF ANY UNDERGROUND UTILITIES SHOWN ARE APPROXIMATE AND ALL UTILITIES MAY NOT BE SHOWN. PRIOR TO ANY CONSTRUCTION ACTIVITIES, ALL UTILITY COMPANIES SHOULD BE NOTIFIED IN ORDER TO VERIFY OR AMEND THEIR LOCATIONS AND/OR EXISTENCE. FOR ASSISTANCE CALL UFPO AT 1-800-962-7962.

3. A DESIGN TICKET WAS CREATED FOR THIS PROJECT AT DIGSAFELYNEWYORK.COM.

TICKET #11219-541-005:

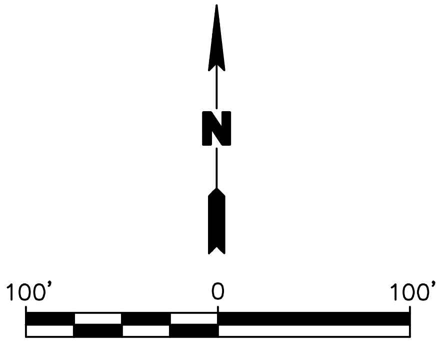
NATIONAL GRID – WEST – ELECTRIC; HAS REPONDED, STATES NO UNDERGROUND FACILITIES ON PREMISES.
VERIZON – BUFFALO; HAS NOT RESPONDED.
NYSEG LOCKPORT ELECTRIC; HAS NOT RESPONDED.
NYSEG LOCKPORT GAS; HAS NOT RESPONDED.
NYS DOT BUFFALO REGION 5; HAS NOT RESPONDED.
TIME WARNER CABLE – BUFFALO; HAS RESPONDED, STATES NO UNDERGROUND FACILITIES ON PREMISES.
CITY OF LOCKPORT; HAS NOT RESPONDED.

BRYDGES ENGINEERING IN ENVIRONMENT AND ENERGY, DPC
960 Busti Avenue
Suite B150
Buffalo, NY 14213
P: 716-362-6532

RI/AAR
Harrison Place
210 Walnut Street Lockport,
New York 14094

Sept. 2022

SHEET 1 OF 1



Title:

SITE SURVEY
REMEDIAL ACTION WORK PLAN
HARRISON PLACE SITE

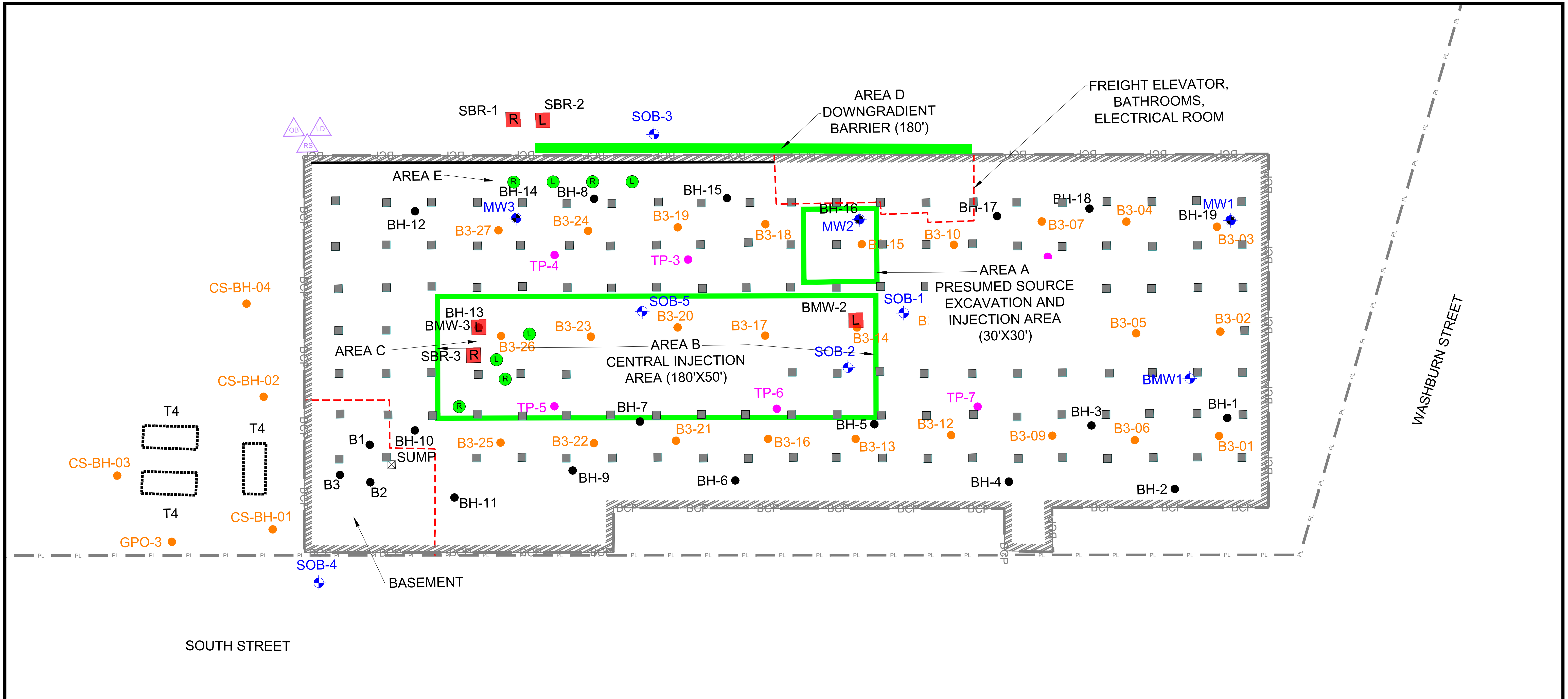
BCP SITE NO. C932177
LOCKPORT, NEW YORK

Prepared for:

KEARNEY REALITY & DEVELOPMENT GROUP, INC.

ROUX	Compiled by: CNK	Date: NOVEMBER 2023	FIGURE
	Prepared by: CNK	Scale: AS SHOWN	2
	Project Mgr: LER	Project: 0684-022-001	
	File: FIGURE 2; SITE SURVEY.DWG		

F:\CAD\BENCHMARK\KEARNEY REALTY AND DEVELOPMENT GROUP\RAWP\FIGURE 2; SITE SURVEY.DWG



LEGEND:

- PL — PROPERTY BOUNDARY
- BCP — BCP SITE BOUNDARY
- EXTERIOR BUILDING WALL
- INTERIOR BUILDING WALL OR FEATURE
- FORMER UST LOCATION (PANAMERICAN, JAN 2010 ESA)
- SUMP ⊠ BASEMENT SUMP
- ■ BUILDING COLUMN
- S0B-1 MW-1 BMW-1 ⊕ OVERBURDEN WELLS
- SBR-1 🟥R ROCHESTER SHALE BEDROCK WELLS
- BMW-3 🟥L LOCKPORT DOLOSTONE BEDROCK WELLS

- BH-1 ● SOIL BORING (BE3, OCT 2022 BCP RI)
- B3-01 ● SOIL BORING BUILDING #3 (NYSDEC, DEC 2010 ESA)
- CS-BH-04 ● SOIL BORING EXTERIOR (PANAMERICAN ENVIRONMENTAL, JAN 2010 ESA)
- TP-1 ● "TEST POINT" SOIL BORING (JADE ENVIRONMENTAL, DEC 2019 SUBSURFACE INV.)

TRACK 4 REMEDIAL PLAN:

- L PROPOSED LOCKPORT DOLOSTONE BEDROCK INJECTION
- R PROPOSED ROCHESTER SHALE BEDROCK INJECTION
- OB LD RS PROPOSED WELL CLUSTER (OVERBURDEN, LOCKPORT AND ROCHESTER WELLS)
- 🟩 PROPOSED GRID INJECTIONS

N

40' 0 40'

NOTES:
1. THE BCP SITE WILL BE SUBJECT TO AN ENVIRONMENTAL EASEMENT.
2. AN ACTIVE SUBSLAB DEPRESSURIZATION SYSTEM WILL BE INSTALLED THROUGHOUT THE BUILDING.

Title:
PLANNED REMEDIAL ACTION TO ACHIEVE RRSCOs
REMEDIAL ACTION WORK PLAN
HARRISON PLACE SITE

BCP SITE NO. C932177
LOCKPORT, NEW YORK

Prepared for:
KEARNEY REALITY & DEVELOPMENT GROUP, INC.

ROUX

Compiled by: CNK	Date: NOVEMBER 2023	FIGURE
Prepared by: CNK	Scale: AS SHOWN	3
Project Mgr: LER	Project: 0684-022-001	
File: FIGURE 3; REMEDIAL ACTION (INJECTION LOCATIONS) (TRACK 4).DWG		

F:\CAD\BENCHMARK\KEARNEY REALTY AND DEVELOPMENT GROUP\RAWP\FIGURE 3; REMEDIAL ACTION (INJECTION LOCATIONS) (TRACK 4).DWG

APPENDIX

A. Permit Application

B. Health and Safety Plan (including CAMP)

C. Injection Amendment Product SDS & Technical Data Sheets

D. Project Documentation Forms

APPENDIX A

Permit Application

Type or print all information. See reverse for instructions.

OMB No. 2040-0042 Approval Expires 4/30/2022

INVENTORY OF INJECTION WELLS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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

1. DATE PREPARED *(Year, Month, Day)*

23-11-28

2. FACILITY ID NUMBER (To be completed by the permitting authority)

3. FACILITY INFORMATION

NAME, ADDRESS, PHONE NUMBER AND/OR EMAIL

Harrison Place Site (BCP C932177)
210 Walnut Street
Lockport, NY 14094
845-306-7705
Contact - Ken Kearney email: KKearney@KearneyRealtyGroup.com

INDIAN COUNTRY ☐ Yes ☒ No

4. LEGAL CONTACT INFORMATION

NAME, ADDRESS, ORGANIZATION, PHONE NUMBER AND/OR EMAIL

Kearney Realty & Development Group
57 US Route 6, Suite 207
Baldwin Place, NY 10505
845-306-7705
Contact - Ken Kearney email: KKearney@KearneyRealtyGroup.com

TYPE ☒ Owner ☐ Operator

5. LOCATIONAL INFORMATION

Surface Location

1/4 of ____ 1/4 of ____ Section 109.14 Township 4 Range 20.1

____ ft. from (N/S) ____ Line of quarter section

____ ft. from (E/W) ____ Line of quarter section.

Latitude 43.169460

Longitude -78.687021

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		139	139	139				

KEY: AC = Active
UC = Under Construction
TA = Temporarily Abandoned
PA = Permanently Abandoned and Approved by State
AN = Permanently Abandoned and not Approved by State

COMMENTS *(Optional):*

Injection activities include the application of PersulfOx® at 101 injection points and PlumeStop® and S-MicroZVI® at 30 injection points to treat overburden groundwater and the application of 3DME®, S-MicroZVI®, and BDI PLUS® at 8 injection points to treat bedrock groundwater. Injection points are temporary and will be filled in at grade and abandoned following injection activities.

Name and Official Title *(Please type or print)*

Lori Riker, Principal Engineer with Roux Environmental Engineering and Geology, D.P.C.
(716) 856-0599
lriker@rouxinc.com

Date Submitted

11/28/2023

INSTRUCTIONS FOR FORM 7520-16

Use this form to provide inventory information about injection wells regulated under the Underground Injection Control Program.

DATE PREPARED: Enter date in order of year, month, and day.

FACILITY OR EPA ID NUMBER: This will be completed by EPA or the permitting authority.

NAME, ADDRESS, PHONE AND/OR EMAIL OF FACILITY: Enter the name and street address, city/town, state, and ZIP code of the facility. Also provide an email address (if available) and/or a phone number.

INDIAN COUNTRY: Check yes if the well is located in Indian country. Indian country (as defined in 18 U.S.C. 1151) includes: all land within the limits of any Indian reservation under the jurisdiction of the U.S. government; all dependent Indian communities within the borders of the U.S.; and all Indian allotments, the Indian titles to which have not been extinguished.

NAME, ADDRESS, PHONE, ORGANIZATION, AND/OR EMAIL OF LEGAL CONTACT: Enter the name and street address, city/town, state, and ZIP code and the name of the organization to which the legal contact for any questions regarding the information provided belongs. Also provide an email address (if available) and/or a phone number.

LEGAL CONTACT TYPE: Check the appropriate box to indicate the type of legal contact (i.e., owner or operator). For wells operated by lease, the operator is the legal contact.

WELL LOCATION: Fill in the complete township, range, and section to the nearest quarter-quarter section. A township is north or south of the baseline, and a range is east or west of the principal meridian (e.g., T12N, R34W). Also include the distance, in feet, from the nearest north or south line and nearest east or west line of the quarter-section. Also, enter the **latitude** and **longitude** of the well in decimal degrees, to five or six places if possible; be sure to include a negative sign for the longitude of a well in the Western Hemisphere and a negative sign for the latitude of a well in the Southern Hemisphere. For an area permit, give the latitude and longitude of the approximate center of the area.

WELL CLASS AND TYPE: Enter the class (as defined in 40 CFR 144.6) and type of injection well. Use the most pertinent code selected from the list on the next page. When selecting type X, please explain in the comment space.

NUMBER OF WELLS: Enter the total number of **commercial** and **non-commercial** wells of each class/type, as applicable. A commercial facility is a single or multiple well facility that is specifically engaged in the business of injecting waste fluids generated by third party producers that is originated off-site and transported to the facility by truck for a fee or compensation.

TOTAL NUMBER OF WELLS: Enter the total number of injection wells of each specified class and type.

WELL OPERATION STATUS: Enter the number of wells under each operation status (use the key on the front of the form).

PAPERWORK REDUCTION ACT NOTICE: The public reporting and recordkeeping burden for this collection of information is estimated to average 0.4 hours per response. Burden means the total time, effort, or financial resource expended by persons to generate, maintain, retain, or disclose or provide information to or for a Federal Agency. This includes the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purposes of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust the existing ways to comply with any previously applicable instructions and requirements; train personnel to be able to respond to the collection of information; search data sources; complete and review the collection of information; and, transmit or otherwise disclose the information. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. Send comments on the Agency’s need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including the use of automated collection techniques to Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822), 1200 Pennsylvania Ave., NW., Washington, D.C. 20460. Include the OMB control number in any correspondence. Do not send the completed forms to this address.

CLASS AND TYPE OF WELL

CLASS I: Wells that inject industrial and municipal waste, including hazardous waste, beneath the lowermost formation containing a USDW.

Type	
I	Non-Hazardous Industrial Disposal Well.
M	Non-Hazardous Municipal Disposal Well.
H	Hazardous Waste Disposal Well injecting below the lowermost USDW.
R	Radioactive Waste Disposal Well.
X	Other Class I Wells (not included in Type “I,” “M,” “H,” or “R”).

CLASS II: Wells used to dispose of fluids which are brought to the surface in connection with oil or natural gas production; to inject fluids for enhanced recovery of oil or natural gas; or to store hydrocarbons.

Type	
A	Annular Disposal Well.
D	Produced Fluid Disposal Well.
H	Hydrocarbon Storage Well (excluding natural gas).
R	Enhanced Recovery Well.
X	Other Class II Wells (not included in Type “A,” “D,” “H,” or “R”).

CLASS III: Wells that inject fluids for the extraction of minerals.

Type	
G	In Situ Gasification Well.
M	Solution Mining Well.
S	Sulfur Mining Well by Frasch Process.
T	Geothermal Well.
U	Uranium Mining Well (excluding solution mining of conventional mines).
X	Other Class III Wells (not included in Type “G,” “M,” “S,” “T,” “U,” or “X”).

CLASS IV: Wells that inject hazardous waste into/above USDWs.

Type	
H	Hazardous Facility Injection Well.
R	Remediation Well at RCRA or CERCLA site.

CLASS V: Wells not currently classified as Class I, II, III, IV, or VI.

Type	
A	Industrial Well.
B	Beneficial Use Well.
C	Fluid Return Well.
D	Sewage Treatment Effluent Well.
E	Cesspool (non-domestic).
F	Septic System.
G	Experimental Technology Well.
H	Drainage Well.
I	Mine Backfill Well.
J	Waste Discharge Well.

APPENDIX B

Health and Safety Plan (including CAMP)

Health and Safety Plan

Harrison Place Site
BCP Site No. C932177
Lockport, NY

November 2023

Prepared for:

Kearney Realty & Development Group, Inc.
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Acknowledgement

Plan Reviewed by (initial):

Corporate Health and Safety Director:	Brian Hobbs
Project Manager:	Lori E. Riker
Designated Site Safety and Health Officer:	Paul W. Werthman

Acknowledgement:

I acknowledge that I have reviewed the information contained in this site-specific Health and Safety Plan, and understand the hazards associated with performance of the field activities described herein. I agree to comply with the requirements of this plan.

NAME (PRINT)	SIGNATURE	DATE

1. Introduction

1.1 General

In accordance with OSHA requirements contained in 29CFR 1910.120, this Health and Safety Plan (HASP) describes the specific health and safety practices and procedures to be employed by Roux Environmental Engineering and Geology, D.P.C. (Roux) employees during remedial action activities at the Harrison Place Site (Site) located at 210 Walnut Street in Lockport, Niagara County, New York. This HASP presents procedures for Roux employees who will be involved with remedial action field activities; it does not cover the activities of other contractors, subcontractors, or other individuals on the Site. These firms will be required to develop and enforce their own HASPs as discussed in Section 2.0. Roux accepts no responsibility for the health and safety of contractor, subcontractor, or other personnel.

This HASP presents information on known Site health and safety hazards using available historical information, and identifies the equipment, materials and procedures that will be used to eliminate or control these hazards. Environmental monitoring will be performed during the field activities to provide real-time data for on-going assessment of potential hazards.

1.2 Background

The Site is in the City of Lockport, New York on a 5-building complex bound by Walnut Street, Washburn Street, South Street, and Locust Street to the north, east, south, and west, respectively (Figure 1). The BCP Site is restricted to Building No. 3 in the southeast corner of the former Harrison complex.

Based on findings by Brydges Engineering in Environment and Energy, DPC (BE3) the former Harrison complex is currently referred to as Commerce Square and was used by the Harrison Radiator Division of General Motors Corporation from approximately 1914 to 1987. The facility was used to manufacture copper and brass automobile parts. Building No. 1 contained offices, meeting rooms, a cafeteria, and other support areas. Building No. 1A, which had offices and security, is a small separate section on the western end of Building No. 3. Buildings Nos. 2 and 3 are three-story former manufacturing buildings that are interconnected. Building No. 4 is a three-story structure that was reportedly used for research and development, testing, and office space. Building No. 3 was the main production and assembly building for Harrison Radiator. It is a three-story structure with an open, full height center atrium that runs the full length of the building and contains an overhead crane. The Site has a history of subsurface petroleum storage particularly located west of Building No. 2 in the alley with at least three tanks located west of Building No. 3. Closure documentation identified that a total of 13 underground storage tanks (USTs) were located on the property which included the following:

- Two 10,000-gallon USTs west of Building No. 2.
- Four 5,500-gallon USTs east of Building No. 4.
- One 2,500-gallon UST west of Building No. 3.
- Three 20,000-gallon USTs adjacent to the storage yard, west of the boiler house in Building No. 3.
- One 500-gallon UST north of Building No. 2 beneath the sidewalk on Walnut Street.
- One 750-gallon UST north of Building No. 2 beneath the sidewalk on Walnut Street.

- One 1,000-gallon UST under the sidewalk along Walnut Street in front of Building No. 4.

The 10,000-gallon, 5,500 gallon, and 2,500-gallon USTs were reportedly closed-in-place by filling with concrete, and the remaining tanks have been removed from the Site.

1.3 Known and Suspected Environmental Conditions

Previous investigations have confirmed that historic operations have impacted the Site, which will require remediation prior to redevelopment. The Remedial Investigation (RI) was performed in support of the BCP to determine the nature and extent of impacts from these known and suspect environmental conditions on this parcel. The 2021-2022 RI and previous investigations conclude the following:

Soil/Fill

The RI results confirm soil contamination exists beneath the building near groundwater monitoring well MW2 where a localized source of trichloroethene (TCE) was identified. Chlorinated VOC (cVOC) in the soil/fill will continue to contribute to groundwater contamination if not remediated.

Groundwater

The groundwater results indicate an overburden groundwater contamination source near overburden well MW2 and toward well BMW2. The sample recovered at well MW2 contained TCE at a concentration of 620,000 µg/L compared to its NYSDEC Class GA groundwater quality standard/guidance value (GWQS/GV) of 5 µg/L. Lower TCE concentrations (generally below 1,000 ug/L) have been observed along the western portion of the building. Groundwater contamination extends beyond the overburden soil/fill to the Lockport Dolostone and Rochester Shale bedrock units.

1.4 Parameters of Interest

Based on the previous investigations, previous Site uses, and RI activities, constituents of potential concern (COPCs) in soil and groundwater at the Site include:

- Subsurface Soil/Fill – cVOCs
- Groundwater – cVOCs
- Soil Vapor – cVOCs

1.5 Overview of Remedial Activities

Roux personnel will be on-site to observe and perform remedial activities. The field activities to be completed as part of the remediation are described below.

1. In-situ injection for the purpose of cVOC remediation.
2. Waste characterization sampling.
3. Remedial excavation of soil/fill.
4. Sub-slab soil vapor treatment.
5. Post-injection performance groundwater monitoring.
6. Water management (building sump/trench water removal).
7. Restoration of the concrete building floor acting as Site cover.

2. Organizational Structure

This section of the HASP describes the lines of authority, responsibility, and communication as they pertain to health and safety functions at the Site. The purpose of this Section is to identify the personnel who impact the development and implementation of the HASP and to describe their roles and responsibilities. This Section also identifies other contractors and subcontractors involved in work operations and establishes the lines of communication among them for health and safety matters. The organizational structure described in this Section is consistent with the requirements of 29CFR 1910.120(b)(2). This section will be reviewed by the Project Manager and updated as necessary to reflect the current organizational structure at this Site.

2.1 Roles and Responsibilities

Roux personnel on the Site must comply with the minimum requirements of this HASP. The specific responsibilities and authority of management, safety and health, and other personnel on this Site are detailed in the following paragraphs.

2.1.1 Corporate Health and Safety Director

The Roux Corporate Health and Safety Director is ***Mr. Brian Hobbs.*** The Corporate Health and Safety Director responsible for developing and implementing the Health and Safety program and policies for Roux and consulting with corporate management to ensure adequate resources are available to properly implement these programs and policies. The Corporate Health and Safety Director coordinates Roux's Health and Safety training and medical monitoring programs and assists project management and field staff in developing site-specific health and safety plans.

2.1.2 Project Manager

The Project Manager for this Site is ***Ms. Lori Riker.*** The Project Manager has the responsibility and authority to direct all Roux work operations at the Site. The Project Manager coordinates safety and health functions with the Site Safety and Health Officer (SSHO) and bears ultimate responsibility for proper implementation of this HASP. They may delegate authority to expedite and facilitate any application of the program, including modifications to the overall project approach as necessary to circumvent unsafe work conditions. Specific duties of the Project Manager include:

- Preparing and coordinating the Site work plan.
- Providing Roux workers with work assignments and overseeing their performance.
- Coordinating health and safety efforts with the SSHO.
- Reviewing the emergency response coordination plan to assure its effectiveness.
- Serving as the primary liaison with Site contractors and the property owner.

2.1.3 Site Safety and Health Officer

The SSHO for this Site is ***Mr. Paul W. Werthman***. The SSHO reports to the Project Manager. The SSHO is on-site or readily accessible to the Site during work operations and has the authority to halt Site work if unsafe conditions are detected. The specific responsibilities of the SSHO are:

- Managing the safety and health functions for Roux personnel on the Site.
- Serving as the point of contact for safety and health matters.
- Ensuring that Roux field personnel working on the Site have received proper training (per 29CFR Part 1910.120(e)), that they have obtained medical clearance to wear respiratory protection (per 29CFR Part 1910.134), and that they are properly trained in the selection, use and maintenance of personal protective equipment, including qualitative respirator fit testing.
- Performing or overseeing Site monitoring as required by the HASP.
- Assisting in the preparation and review of the HASP.
- Maintaining site-specific safety and health records as described in this HASP.
- Coordinating with the Project Manager, Site Workers, and Contractor's SSHO as necessary for safety and health efforts.

2.1.4 Site Workers

Site workers are responsible for: complying with this HASP or a more stringent HASP, if appropriate (i.e., Contractor and Subcontractor's HASP); using proper personal protective equipment (PPE); reporting unsafe acts and conditions to the SSHO; and following the safety and health instructions of the Project Manager and SSHO.

2.1.5 Other Site Personnel

Other Site personnel who will have health and safety responsibilities will include the Drilling Contractor, who will be responsible for developing, implementing, and enforcing a HASP equally stringent or more stringent than Roux's HASP. Roux assumes no responsibility for the health and safety of anyone outside its direct employ. Each Contractor's HASP shall cover all non-Roux Site personnel. Each Contractor shall assign a SSHO who will coordinate with Roux's SSHO as necessary to ensure effective lines of communication and consistency between contingency plans.

In addition to Roux and Contractor personnel, other individuals who may have responsibilities in the work zone include subcontractors and governmental agencies performing Site inspection work (i.e., NYSDEC). The Contractor shall be responsible for ensuring that these individuals have received OSHA-required training (29CFR 1910.120(e)), including initial, refresher and site-specific training, and shall be responsible for the safety and health of these individuals while they are on-site.

3. Hazard Evaluation

Due to the presence of certain contaminants at the Site, the possibility exists that workers will be exposed to hazardous substances during field activities. The principal points of exposure would be through direct contact with groundwater. Other points of exposure may include incidental ingestion of soil, and through the inhalation of contaminated particles or vapors. In addition, the use of drilling equipment will also present conditions for potential physical injury to workers. Adherence to the medical evaluations, worker training relative to chemical hazards, safe work practices, proper personal protection, environmental monitoring, establishment work zones and Site control, appropriate decontamination procedures and contingency planning outlined herein will reduce the potential for chemical exposures and physical injuries.

3.1 Chemical Hazards

As discussed in Section 1.3, historic activities have potentially resulted in impacts to Site soils and groundwater. Table 1 lists exposure limits for airborne concentrations of the COPCs identified in Section 1.4 of this HASP. Brief descriptions of the toxicology of the COPCs and related health and safety guidance and criteria are provided below.

- **Trichloroethene (CAS #79-01-6)** is a chlorinated hydrocarbon with a sweet smell. Also known as TCE, it was commonly used in degreasing operations. Acute (short-term) and chronic (long-term) inhalation exposure to TCE can affect the human central nervous system (CNS), with symptoms such as dizziness, headaches, confusion, euphoria, facial numbness, and weakness.

- **Tetrachloroethene (CAS #127-18-4)** was formerly widely used in dry cleaning operations as a solvent. Tetrachloroethene (PCE) is harmful by ingestion inhalation and skin absorption. Exposure can cause dermatitis, dizziness, nausea, liver, and kidney damage. This compound is a suspected carcinogen.

- **Cis-1,2-Dichloroethene (CAS #156-59-2)** is a highly flammable organochloride with a sharp odor. Also known as cis-1,2-DCE, it is a breakdown product of the anaerobic reduction of trichloroethene or TCE, which affects the central nervous system.

- **Vinyl Chloride (CAS #75-01-4)** is a breakdown product of TCE and is classified by EPA as a human carcinogen. Acute (short-term) exposure to high levels of vinyl chloride (VC) in air has resulted in CNS effects, such as dizziness, drowsiness, and headaches in humans. Chronic (long-term) exposure to vinyl chloride through inhalation and oral exposure in humans has resulted in liver damage.

With respect to the anticipated remedial activities discussed in Section 1.5, possible routes of exposure to the above-mentioned contaminants are presented in Table 2. The use of proper respiratory equipment, as outlined in Section 7.0 of this HASP, will minimize the potential for exposure to airborne contamination. Exposure to contaminants through dermal and other routes will also be minimized by using protective clothing (Section 7.0), safe work practices (Section 6.0), and proper decontamination procedures (Section 12.0).

3.2 Physical Hazards

Remedial field activities at the Harrison Place Site may present the following physical hazards:

- Physical injury during use of heavy construction equipment such as backhoes, excavators, and drilling equipment.
- Heat/cold stress to employees during the summer/winter months (see Section 10).
- Slip and fall injuries due to rough, uneven terrain and/or open excavations.

These hazards represent only some of the possible means of injury that may be present during remedial operations and sampling activities at the Site. Since it is impossible to list all potential sources of injury, it shall be the responsibility of the individual to exercise proper care and caution during all phases of the work.

4. Training

4.1 Site Workers

Personnel performing remedial activities at the Site (such as, but not limited to, equipment operators and general laborers) and who may be exposed to hazardous substances, health hazards, or safety hazards and their supervisors/managers responsible for the Site shall receive training in accordance with 29CFR 1910.120(e) before they are permitted to engage in operations in the exclusion zone or contaminant reduction zone. This training includes an initial 40-hour Hazardous Waste Site Worker Protection Course, an 8-hour Annual Refresher Course after the initial 40-hour training, and 3 days of actual field experience under the direct supervision of a trained, experienced supervisor. Additional site-specific training shall also be provided by the SSHO prior to the start of field activities. A description of topics to be covered by this training is provided below.

4.1.1 Initial and Refresher Training

Initial and refresher training is conducted by a qualified instructor as specified under OSHA 29CFR 1910.120(e)(5) and is specifically designed to meet the requirements of OSHA 29CFR 1910.120(e)(3) and 1910.120(e)(8). The training covers, as a minimum, the following topics:

- OSHA HAZWOPER regulations.
- Site safety and hazard recognition, including chemical and physical hazards.
- Medical monitoring requirements.
- Air monitoring, permissible exposure limits, and respiratory protection level classifications.
- Appropriate use of PPE, including chemical compatibility and respiratory equipment selection and use.
- Work practices to minimize risk.
- Work zones and Site control.
- Safe use of engineering controls and equipment.
- Decontamination procedures.
- Emergency response and escape.
- Confined space entry procedures.
- Heat and cold stress monitoring.
- Elements of a Health and Safety Plan.
- Spill containment.

Initial training also incorporates workshops for PPE and respiratory equipment use (Levels A, B and C), and respirator fit testing. Records and certification received from the course instructor documenting each employee's successful completion of the training identified above are maintained on file at Roux's Buffalo, NY office. Contractors and Subcontractors are required to provide similar documentation of training for all their personnel who will be involved in on-site work activities.

Any employee who has not been certified as having received health and safety training in conformance with 29CFR 1910.120(e) is prohibited from working in the exclusion and contamination reduction zones, or to engage in any on-site work activities that may involve exposure to hazardous substances or wastes.

4.1.2 Site Training

Site workers are given a copy of the HASP and provided with a site-specific briefing prior to the commencement of work to ensure that employees are familiar with the HASP and the information and requirements it contains. The Site briefing shall be provided by the SSHO prior to initiating field activities and shall include:

- Names of personnel and alternates responsible for Site safety and health.
- Safety, health, and other hazards present on the Site.
- The site layout including work zones and places of refuge.
- The emergency communications system and emergency evacuation procedures.
- Use of PPE.
- Work practices by which the employee can minimize risks from hazards.
- Safe use of engineering controls and equipment on the site.
- Medical surveillance, including recognition of symptoms and signs of over-exposure as described in Section 5 of this HASP.
- Decontamination procedures as detailed in Section 12 of this HASP.
- The emergency response plan as detailed in Section 15 of this HASP.
- Confined space entry procedures, if required, as detailed in Section 13 of this HASP.
- The spill containment program as detailed in Section 9 of this HASP.
- Site control as detailed in Section 11 of this HASP.

Supplemental health and safety briefings will also be conducted by the SSHO on an as-needed basis during the work. Supplemental briefings are provided as necessary to notify employees of any changes to this HASP due to information gathered during ongoing Site characterization and analysis. Conditions for which the SSHO may schedule additional briefings include but are not limited to a change in Site conditions (e.g., based on monitoring results); changes in the work schedule/plan; newly discovered hazards; and safety incidents occurring during Site work.

4.2 Supervisor Training

On-site safety and health personnel who are directly responsible for or who supervise the safety and health of workers engaged in hazardous waste operations (i.e., SSHO) shall receive, in addition to the appropriate level of worker training described in Section 4.1, above, 8 additional hours of specialized supervisory training, in compliance with 29CFR 1910.120(e)(4).

4.3 Emergency Response Training

Emergency response training is addressed in Attachment A of this HASP, Emergency Response Plan.

4.4 Site Visitors

Each Contractor's SSHO will provide a site-specific briefing to Site visitors and other non-Roux personnel who enter the Site beyond the Site entry point. The site-specific briefing will provide information about Site hazards, the Site layout including work zones and places of refuge, the emergency communications system and emergency evacuation procedures, and other pertinent safety and health requirements as appropriate.

Site visitors will not be permitted to enter the exclusion zone or contaminant reduction zones unless they have received the level of training required for Site workers as described in Section 4.1.

5. Medical Monitoring

Medical monitoring examinations are provided to Roux employees as stipulated under 29CFR Part 1910.120(f). These exams include initial employment, annual and employment termination physicals for Roux employees involved in hazardous waste site field operations. Post-exposure examinations are also provided for employees who may have been injured, received a health impairment, or developed signs or symptoms of over-exposure to hazardous substances or were accidentally exposed to substances at concentrations above the permissible exposure limits without necessary personal protective equipment. Such exams are performed as soon as possible following development of symptoms or the known exposure event.

Medical evaluations are performed by Health Works, an occupational health care provider under contract with Roux. Health Works is in the Seneca Square Plaza, 1900 Ridge Road, West Seneca, New York 14224. The facility can be reached at (716) 823-5050 to schedule routine appointments or post-exposure examinations.

Medical evaluations are conducted according to the Roux Medical Monitoring Program and include an evaluation of the workers' ability to use respiratory protective equipment. The examinations include:

- Occupational/medical history review.
- Physical exam, including vital sign measurement.
- Spirometry testing.
- Eyesight testing.
- Audio testing (minimum baseline and exit, annual for employees routinely exposed to greater than 85db).
- EKG (for employees >40 years age or as medical conditions dictate).
- Chest X-ray (baseline and exit, and every 5 years).
- Blood biochemistry (including blood count, white cell differential count, serum multiplastic screening).
- Medical certification of physical requirements (i.e., sight, musculoskeletal, cardiovascular) for safe job performance and to wear respiratory protection equipment.

The purpose of the medical evaluation is to determine an employee's fitness for duty on hazardous waste sites; and to establish baseline medical data. In conformance with OSHA regulations, Roux will maintain and preserve medical records for a period of 30 years following termination of employment. Employees are provided with a copy of the physician's post-exam report and have access to their medical records and analyses.

6. Safe Work Practices

Roux employees shall conform to the following safe work practices during on-site work activities conducted within the exclusion and contamination reduction zones:

- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth contact is strictly prohibited.
- The hands and face must be thoroughly washed upon leaving the work area and prior to engaging in any activity indicated above.
- Respiratory protective equipment and clothing must be worn by all personnel entering the Site as required by the HASP or as modified by the Site safety officer. Excessive facial hair (i.e., beards, long mustaches, or sideburns) that interferes with the satisfactory respirator-to-face seal is prohibited.
- Contact with surfaces/materials either suspected or known to be contaminated will be avoided to minimize the potential for transfer to personnel, cross contamination and need for decontamination.
- Medicine and alcohol can synergize the effects of exposure to toxic chemicals. Due to possible contraindications, use of prescribed drugs should be reviewed with the Roux occupational physician. Alcoholic beverages and illegal drug intake are strictly forbidden during the workday.
- Personnel shall be familiar with standard operating safety procedures and additional instructions contained in this Health and Safety Plan.
- On-site personnel shall use the “buddy” system. No one may work alone (i.e., out of earshot or visual contact with other workers) in the exclusion zone.
- Personnel and equipment in the contaminated area shall be minimized, consistent with effective Site operations.
- Employees have the obligation to immediately report and if possible, correct unsafe work conditions.
- Use of contact lenses on-site will not be permitted. Spectacle kits for insertion into full-face respirators will be provided for Roux employees, as requested, and required.

The recommended specific safety practices for working around the contractor’s equipment (e.g., backhoes, bulldozers, excavators, drill rigs etc.) are as follows:

- Although the Contractor and subcontractors are responsible for their equipment and safe operation of the Site, Roux personnel are also responsible for their own safety.
- Subsurface work will not be initiated without first clearing underground utility services.
- Heavy equipment should not be operated within 20 feet of overhead wires. This distance may be increased if windy conditions are anticipated or if lines carry high voltage. The Site should also be sufficiently clear to ensure the project staff can move around the heavy machinery safely.

- Care should be taken to avoid overhead wires when moving heavy equipment from location to location.

- Hard hats, safety boots and safety glasses should be worn in the vicinity of heavy equipment. Hearing protection is also recommended.

- The work Site should be kept neat. This will prevent personnel from tripping and will allow for fast emergency exit from the Site.

- Proper lighting must be provided when working at night.

- Construction activities should be discontinued during an electrical storm or severe weather conditions.

- The presence of combustible gases should be checked before igniting any open flame.

- Personnel shall stand upwind of any construction operation when not immediately involved in sampling/logging/observing activities.

- Personnel will not approach the edge of an unsecured trench/excavation closer than two feet.

7. Personal Protective Equipment

7.1 Equipment Selection

Personal protective equipment (PPE) will be donned when work activities may result in exposure to physical or chemical hazards beyond acceptable limits, and when such exposure can be mitigated through appropriate PPE. The selection of PPE will be based on an evaluation of the performance characteristics of the PPE relative to the requirements and limitations of the Site, the task-specific conditions and duration, and the hazards and potential hazards identified at the Site.

Equipment designed to protect the body against contact with known or suspect chemical hazards are grouped into four categories according to the degree of protection afforded. These categories designated A through D consistent with United States Environmental Protection Agency (USEPA) Level of Protection designation, are:

- **Level A:** Should be selected when the highest level of respiratory, skin and eye protection is needed.
- **Level B:** Should be selected when the highest level of respiratory protection is needed, but a lesser level of skin protection is required. Level B protection is the minimum level recommended on initial Site entries until the hazards have been further defined by on-site studies. Level B (or Level A) is also necessary for oxygen-deficient atmospheres.
- **Level C:** Should be selected when the types of airborne substances are known, the concentrations have been measured and the criteria for using air-purifying respirators are met. In atmospheres where no airborne contaminants are present, Level C provides dermal protection only.
- **Level D:** Should not be worn on any Site with elevated respiratory or skin hazards. This is generally a work uniform providing minimal protection.

OSHA requires the use of certain PPE under conditions where an immediate danger to life and health (IDLH) may be present. Specifically, OSHA 29CFR 1910.120(g)(3)(iii) requires use of a positive pressure self-contained breathing apparatus, or positive pressure air-line respirator equipped with an escape air supply when chemical exposure levels present a substantial possibility of immediate serious injury, illness, or death, or impair the ability to escape. Similarly, OSHA 29CFR 1910.120(g)(3)(iv) requires donning totally encapsulating chemical protective suits (with a protection level equivalent to Level A protection) in conditions where skin absorption of a hazardous substance may result in a substantial possibility of immediate serious illness, injury, or death, or impair the ability to escape.

In situations where the types of chemicals, concentrations, and possibilities of contact are unknown, the appropriate level of protection must be selected based on professional experience and judgment until the hazards can be further characterized. The individual components of clothing and equipment must be assembled into a full protective ensemble to protect the worker from site-specific hazards, while at the same time minimizing hazards and drawbacks of the personal protective gear itself. Ensemble components are detailed below for levels A/B, C, and D protection.

7.2 Protection Ensembles

7.2.1 Level A/B Protection Ensemble

Level A/B ensembles include similar respiratory protection; however, Level A provides a higher degree of dermal protection than Level B. Use of Level A over Level B is determined by comparing the concentrations of identified substances in the air with skin toxicity data and assessing the effect of the substance (by its measured air concentrations or splash potential) on the small area of the head and neck unprotected by Level B clothing. The recommended PPE for level A/B is:

- Pressure-demand, full-face piece self-contained breathing apparatus (MSHA/ NIOSH-approved) or pressure-demand supplied-air respirator with escape self-contained breathing apparatus (SCBA).
- Chemical-resistant clothing. For Level A, clothing consists of totally encapsulating chemical resistant suit. Level B incorporates hooded one-or two-piece chemical splash suit.
- Inner and outer chemical resistant gloves.
- Chemical-resistant safety boots/shoes.
- Hardhat.

7.2.2 Level C Protection Ensemble

Level C protection is distinguished from Level B by the equipment used to protect the respiratory system, assuming the same type of chemical-resistant clothing is used. The main selection criterion for Level C is that conditions permit wearing an air-purifying device. The device (when required) must be an air-purifying respirator (MSHA/NIOSH-approved) equipped with filter cartridges. Cartridges must be able to remove the substances encountered. Respiratory protection will be used only with proper fitting, training, and the approval of a qualified individual. In addition, an air-purifying respirator can be used only if oxygen content of the atmosphere is at least 19.5% in volume; substances are identified and concentrations measured; substances have adequate warning properties; the individual passes a qualitative fit-test for the mask; and an appropriate cartridge/canister is used, and its service limit concentration is not exceeded. Recommended PPE for Level C conditions includes:

- Full-face piece, air-purifying respirator equipped with MSHA/NIOSH-approved organic vapor/acid gas/dust/mist combination cartridges or as designated by the SSHO.
- Chemical-resistant clothing (hooded, one or two-piece chemical splash suit or disposable chemical-resistant one-piece suit).
- Inner and outer chemical-resistant gloves.
- Chemical-resistant safety boots/shoes.
- Hardhat.

An air-monitoring program is part of all response operations when atmospheric contamination is known or suspected. It is particularly important that the air be monitored thoroughly when personnel are wearing air-purifying respirators. Continual surveillance using direct-reading instruments is needed to detect any changes in air quality necessitating a higher level of respiratory protection.

7.2.3 Level D Protection Ensemble

As indicated above, Level D protection is primarily a work uniform. It can be worn in areas where only boots can be contaminated, where there are no inhalable toxic substances and where the atmosphere contains at least 19.5% oxygen. Recommended PPE for Level D includes:

- Coveralls
- Safety boots/shoes
- Safety glasses or chemical splash goggles
- Hardhat
- Optional gloves, escape mask, face shield

7.2.4 Recommended Level of Protection for Site Tasks

Based on current information regarding both the contaminants suspected to be present at the Site and the various tasks that are included in the remedial activities, the minimum required levels of protection for these tasks shall be as identified in Table 3.

8. Exposure Monitoring

8.1 General

Based on the results of historic sample analysis and the nature of the proposed work activities at the Site, the possibility exists that organic vapors and/or particulates may be released to the air during intrusive construction activities. Ambient breathing zone concentrations may at times exceed the permissible exposure limits (PELs) established by OSHA for the individual compounds (see Table 1), in which case respiratory protection will be required. Respiratory and dermal protection may be modified (upgraded or downgraded) by the SSHO based upon real-time field monitoring data. Weekly CAMP summary tables will be provided to the NYSDOH project manager on a weekly basis. Both the Department and NYSDOH project managers will be notified within one business day of any CAMP exceedances that require corrective actions or shut down of work.

8.1.1 On-Site Work Zone Monitoring

Roux personnel will conduct routine, real-time air monitoring during intrusive construction phases such as excavation, backfilling, drilling, etc. The work area will be monitored at regular intervals using a photoionization detector (PID) and a particulate meter. Observed values will be recorded and maintained as part of the permanent field record.

Additional air monitoring measurements may be made by Roux personnel to verify field conditions during subcontractor oversight activities. Monitoring instruments will be protected from surface contamination during use. Additional monitoring instruments may be added if the situations or conditions change. Monitoring instruments will be calibrated in accordance with manufacturer's instructions before use.

8.1.2 Off-Site Community Air Monitoring

In addition to on-Site monitoring within the work zone(s), continuous monitoring at the upwind and downwind portion of the Site perimeter will be conducted for volatile organics and particulates. This will provide a real-time method for determination of vapor and/or particulate releases to the surrounding community from ground intrusive investigation work.

Ground intrusive activities are defined in the Generic Community Air Monitoring Plan (see Attachment C). Ground intrusive activities include drilling proposed injection points. Non-intrusive activities include the collection of groundwater samples from existing wells or the collection of soil and sediment samples. Continuous monitoring is required for ground intrusive activities and periodic monitoring is required for non-intrusive activities. Periodic monitoring consists of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring while bailing a well, and taking a reading prior to leaving a sampling location. This may be upgraded to continuous if the sampling location is near individuals not involved in the Site activity (i.e., on a curb of a busy street). The action levels below will be used during periodic monitoring.

8.2 Monitoring Action Levels

8.2.1 On-Site Work Zone Action Levels

The PID, or other appropriate instrument(s), will be used by Roux personnel to monitor organic vapor concentrations as specified in this HASP. In addition, fugitive dust/particulate concentrations will be monitored during major soil intrusion (i.e., well/boring installation) using a real-time particulate monitor as specified in this plan. In the absence of such monitoring, appropriate respiratory protection for particulates shall be donned. Sustained readings obtained in the breathing zone may be interpreted (compared to other Site conditions) as follows for Roux personnel:

- Total atmospheric concentrations of unidentified vapors or gases ranging from 0 to 1 ppm above background on the PID) - Continue operations under Level D (see Attachment A).

- Total atmospheric concentrations of unidentified vapors or gases yielding sustained readings from >1 ppm to 5 ppm above background on the PID (vapors not suspected of containing high levels of chemicals toxic to the skin) - Continue operations under Level C (see Attachment A).

- Total atmospheric concentrations of unidentified vapors or gases yielding sustained readings of >5 ppm to 50 ppm above background on the PID - Continue operations under Level B (see Attachment 1), re-evaluate and alter (if possible) construction methods to achieve lower vapor concentrations.

- Total atmospheric concentrations of unidentified vapors or gases above 50 ppm on the PID - Discontinue operations and exit the work zone immediately.

The particulate monitor will be used to monitor respirable dust concentrations during intrusive activities and during handling of Site soil/fill. Action levels based on the instrument readings shall be as follows:

- Less than 50 mg/m3 - Continue field operations.

- 50-150 mg/m^3 - Don dust/particulate mask or equivalent

- Greater than 150 mg/m^3 - Don dust/particulate mask or equivalent. Initiate engineering controls to reduce respirable dust concentration (viz., wetting of excavated soils or tools at discretion of SSHO).

Readings from the field equipment will be recorded and documented on the appropriate Project Field Forms. Instruments will be calibrated daily before use and the procedure will be documented on the appropriate Project Field Forms.

8.2.2 Community Air Monitoring Action Levels

In addition to the action levels prescribed in Section 8.2.1 for Roux personnel on-site, the following criteria shall also be adhered to for the protection of downwind receptors consistent with NYSDOH requirements (Attachment C):

Organic Vapor Perimeter Monitoring:

- If the sustained ambient air concentration of organic vapors at the downwind perimeter of the exclusion zone exceeds 5 ppm above background for the 15-minute average, work activities will be temporarily halted and monitoring continued. If the sustained organic vapor decreases below 5 ppm over background, work activities can resume with continued monitoring.

- If the sustained ambient air concentration of organic vapors at the downwind perimeter of the exclusion zone are greater than 5 ppm over background but less than 25 ppm for the 15-minute average, activities can resume provided that: the organic vapor level 200 feet downwind of the working site or half the distance to the nearest off-site residential or commercial structure, whichever is less, but in no case less than 20 feet, is below 5 ppm over background; and more frequent intervals of monitoring, as directed by the SSHO, are conducted.

- If the sustained organic vapor level is above 25 ppm at the perimeter of the exclusion zone for the 15-minute average, the SSHO must be notified, and work activities shut down. The SSHO will determine when re-entry of the exclusion zone is possible and will implement downwind air monitoring to ensure vapor emissions do not impact the nearest off-site residential or commercial structure at levels exceeding those specified in the ***Organic Vapor Contingency Monitoring Plan*** below. All readings will be recorded and will be available for NYSDEC and New York State Department of Health (NYSDOH) personnel to review.

Organic Vapor Contingency Monitoring Plan:

- If the sustained organic vapor level is greater than 5 ppm over background 200 feet downwind from the work area or half the distance to the nearest off-site residential or commercial property, whichever is less, all work activities must be halted.

- If, following the cessation of the work activities or as the result of an emergency, sustained organic levels persist above 5 ppm above background 200 feet downwind or half the distance to the nearest off-site residential or commercial property from the work area, then the air quality must be monitored within 20 feet of the perimeter of the nearest off-site residential or commercial structure (20-foot zone).

- If efforts to abate the emission source are unsuccessful and if sustained organic vapor levels approach or exceed 5 ppm above background within the 20-foot zone for more than 30 minutes or are sustained at levels greater than 10 ppm above background for longer than one minute, then the ***Major Vapor Emission Response Plan*** (see below) will automatically be placed into effect.

Major Vapor Emission Response Plan:

Upon activation, the following activities will be undertaken:

- All Emergency Response Contacts as listed in this HASP and the Emergency Response Plan (Attachment A) will be advised.

- The local police authorities will immediately be contacted by the SSHO and advised of the situation.

- Frequent air monitoring will be conducted at 30-minute intervals within the 20-foot zone. If two sustained successive readings below action levels are measured, air monitoring may be halted or modified by the SSHO.

The following personnel are to be notified in the listed sequence if the Major Vapor Emission Plan is activated:

Responsible Person	Contact	Phone Number
SSHO	Police	911
SSHO	State Emergency Response Hotline	(800) 457-7362

Additional emergency numbers are listed in the Emergency Response Plan included as Attachment A.

Explosive Vapors:

- Sustained atmospheric concentrations of greater than 10% LEL in the work area - Initiate combustible gas monitoring at the downwind portion of the Site perimeter.

- Sustained atmospheric concentrations of greater than 10% LEL at the downwind Site perimeter – Halt work and contact local Fire Department.

Airborne Particulate Community Air Monitoring

- Respirable (PM-10) particulate monitoring will be performed on a continuous basis at the upwind and downwind perimeter of the exclusion zone. The monitoring will be performed using real-time monitoring equipment capable of measuring PM-10 and integrating over a period of 15-minutes for comparison to the airborne particulate action levels. The equipment will be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration will be visually assessed during all work activities. All readings will be recorded and will be available for NYSDEC and NYSDOH review. Readings will be interpreted as follows:

- If the downwind PM-10 particulate level is 100 micrograms per cubic meter (ug/m^3) greater than the background (upwind perimeter) reading for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression provided that the downwind PM-10 particulate levels do not exceed 150 ug/m^3 above the upwind level and that visible dust is not migrating from the work area.

- If, after implementation of dust suppression techniques downwind PM-10 levels are greater than 150 ug/m^3 above the upwind level, work activities must be stopped, and dust suppression controls re-evaluated. Work can resume provided that supplemental dust suppression measures and/or other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 ug/m^3 of the upwind level and in preventing visible dust migration.

Pertinent emergency response information including the telephone number of the Fire Department is included in the Emergency Response Plan (Attachment A).

9. Spill Release/Response

This section of the HASP describes the potential for and procedures related to spills or releases of known or suspected petroleum and/or hazardous substances on the Site. The purpose of this section of the HASP is to plan appropriate response, control, countermeasures, and reporting, consistent with OSHA requirements in 29CFR 1910.120(b)(4)(ii)(J) and (j)(1)(viii). The spill containment program addresses the following elements:

- Potential hazardous material spills and available controls.
- Initial notification and evaluation.
- Spill response.
- Post-spill evaluation.

9.1 Potential Spills and Available Controls

An evaluation was conducted to determine the potential for hazardous material and oil/petroleum spills at this Site. For this evaluation, hazardous materials posing a significant spill potential are:

- CERCLA Hazardous Substances as identified in 40CFR Part 302, where such materials pose the potential for release above their corresponding Reportable Quantity (RQ).
- Extremely Hazardous Substances as identified in 40CFR Part 355, Appendix A, where such materials pose the potential for release above their corresponding RQ.
- Hazardous Chemicals as defined under Section 311(e) of the Emergency Planning and Community Right-To-Know Act of 1986, where such chemicals are present or will be stored above 10,000 lbs.
- Toxic Chemicals as defined in 40CFR Part 372, where such chemicals are present or will be stored above 10,000 lbs.
- Chemicals regulated under 6NYCRR Part 597, where such materials pose the potential for release above their corresponding RQ.

Oil/petroleum products are considered to pose a significant spill potential whenever the following situations occur:

- The potential for a “harmful quantity” of oil (including petroleum and non-petroleum-based fuels and lubricants) to reach navigable waters of the U.S. exists. Harmful quantities are considered by USEPA to be volumes that could form a visible sheen on the water or violate applicable water quality standards.
- The potential for any amount of petroleum to reach any waters of NY State, including groundwater, exists. Petroleum, as defined by NY State in 6NYCRR Part 613, is a petroleum-based heat source, energy source, or engine lubricant/ maintenance fluid.

- The potential for any release, to soil or water, of petroleum from a bulk storage facility regulated under 6NYCRR Part 613. A regulated petroleum storage facility is defined by NY State as a site having stationary tank(s) and intra-facility piping, fixtures, and related equipment with an aggregate storage volume of 1,100 gallons or greater.

9.2 Initial Spill Notification and Evaluation

Any worker who discovers a hazardous substance or oil/petroleum spill will immediately notify the Project Manager and SSHO. The worker will, to the best of his/her ability, report the material involved, the location of the spill, the estimated quantity of material spilled, the direction/flow of the spill material, related fire/explosion incidents, if any, and any associated injuries. The Emergency Response Plan presented in Attachment 2 of this HASP will be immediately implemented if an emergency release has occurred.

Following initial reporting of a spill, the Project Manager will make an evaluation as to whether the release exceeds RQ levels. If an RQ level is exceeded, the Project Manager will notify the Site owner and NYSDEC at 1-800-457-7362 within 2 hours of spill discovery. The Project Manager will also determine what additional agencies (e.g., USEPA) are to be contacted regarding the release, and will follow up with written reports as required by the applicable regulations.

9.3 Spill Response

For spill situations, the following general response guidelines will apply:

- Only those personnel involved in overseeing or performing containment operations will be allowed within the spill area. If necessary, the area will be roped, ribboned, or otherwise blocked off to prevent unauthorized access.

- Appropriate PPE, as specified by the SSHO, will be donned before entering the spill area.

- Ignition points will be extinguished/removed if fire or explosion hazards exist.

- Surrounding reactive materials will be removed.

- Drains or drainage in the spill area will be blocked to prevent inflow of spilled materials or applied materials.

For minor spills, the Contractor will maintain a Spill Control and Containment Kit in the Field Office or other readily accessible storage location. The kit will consist of, at a minimum, a 50 lb. bag of “speedy dry” granular absorbent material, absorbent pads, shovels, empty 5-gallon pails and an empty open-top 55-gallon drum. Spilled materials will be absorbed and shoveled into a 55-gallon drum for proper disposal. Impacted soils will be hand-excavated to the point that no visible signs of contamination remain and drummed with the absorbent.

In the event of a major release or a release that threatens surface water, a spill response contractor will be called to the Site. The response contractor may use heavy equipment (e.g., excavator, backhoe, etc.) to berm the soils surrounding the spill Site or create diversion trenching to mitigate overland migration or release to navigable waters. Where feasible, pumps will be used to transfer free liquid to storage containers. Spill control/cleanup contractors in the Western New York area that may be contacted for assistance include:

- The Environmental Service Group: (716) 695-6720
- NOCO Environmental: (800) 662-6776

9.4 Post-Spill Evaluation

If a reportable quantity of hazardous material or oil/petroleum is spilled as determined by the Project Manager, a written report will be prepared as indicated in Section 9.2. The report will identify the root cause of the spill, type and amount of material released, date/time of release, response actions, agencies notified and/or involved in cleanup, and procedures to be implemented to avoid repeat incidents. In addition, all re-useable spill cleanup and containment materials will be decontaminated, and spill kit supplies/disposable items will be replenished.

10. Heat/Cold Stress Monitoring

Depending on when remedial work activities will be completed at the Site, measures will be taken to minimize heat/cold stress to Roux employees. The SSHO and/or his or her designee will be responsible for monitoring Roux field personnel for symptoms of heat/cold stress.

10.1 Heat Stress Monitoring

Personal protective equipment may place an employee at risk of developing heat stress, a common and potentially serious illnesses often encountered at construction, landfill, waste disposal, industrial or other unsheltered sites. The potential for heat stress is dependent on several factors, including environmental conditions, clothing, workload, physical conditioning, and age. PPE may severely reduce the body's normal ability to maintain temperature equilibrium (via evaporation and convection) and require increased energy expenditure due to its bulk and weight.

Proper training and preventive measures will mitigate the potential for serious illness. Heat stress prevention is particularly important because once a person suffers from heat stroke or heat exhaustion, that person may be predisposed to additional heat related illness. To avoid heat stress, the following steps should be taken:

- Adjust work schedules.
- Modify work/rest schedules according to monitoring requirements.
- Mandate work slowdowns as needed.
- Perform work during cooler hours of the day if possible or at night if adequate lighting can be provided.
- Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods.
- Maintain worker's body fluids at normal levels. This is necessary to ensure that the cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water lost in sweat (i.e., eight fluid ounces must be ingested for approximately every 1 lb of weight lost). The normal thirst mechanism is not sensitive enough to ensure that enough water will be consumed to replace lost perspiration. When heavy sweating occurs, workers should be encouraged to drink more.
- Train workers to recognize the symptoms of heat related illness.

<u>Heat-Related Illness - Symptoms:</u>

- Heat rash may result from continuous exposure to heat or humid air.
- Heat cramps are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include muscle spasms and pain in the hands, feet, and abdomen.
- Heat exhaustion occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include pale, cool, moist skin; heavy sweating; dizziness; nausea; fainting.

- Heat stroke is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical help must be obtained. Signs and symptoms are red, hot, usually dry skin; lack of or reduced perspiration; nausea; dizziness and confusion; strong, rapid pulse; coma.

The monitoring of personnel wearing protective clothing should commence when the ambient temperature is 70 degrees Fahrenheit or above. For monitoring the body's recuperative ability to excess heat, one or more of the following techniques should be used as a screening mechanism.

- Heart rate may be measured by the radial pulse for 30 seconds as early as possible in the resting period. The rate at the beginning of the rest period should not exceed 100 beats per minute. If the rate is higher, the next work period should be shortened by 10 minutes (or 33%), while the length of the rest periods stay the same, If the pulse rate is 100 beats per minute at the beginning of the nest rest period, the following work cycle should be further shortened by 33%.

- Body temperature may be measured orally with a clinical thermometer as early as possible in the resting period. Oral temperature at the beginning of the rest period should not exceed 99.6 degrees Fahrenheit. If it does, the next work period should be shortened by 10 minutes (or 33%), while the length of the rest period remains the same. However, if the oral temperature exceeds 99.6 degrees Fahrenheit at the beginning of the next period, the work cycle may be further shortened by 33%. Oral temperature should be measured at the end of the rest period to make sure that it has dropped below 99.6 degrees Fahrenheit. No Roux employee will be permitted to continue wearing semi-permeable or impermeable garments when his/her oral temperature exceeds 100.6 degrees Fahrenheit.

10.2 Cold Stress Monitoring

Exposure to cold conditions may result in frostbite or hypothermia, each of which progresses in stages as shown below.

- **Frostbite** occurs when body tissue (usually on the extremities) begins to freeze. The three states of frostbite are:

    1. **Frost nip** - This is the first stage of the freezing process. It is characterized by a whitened area of skin, along with a slight burning or painful sensation. Treatment consists of removing the victim from the cold conditions, removal of boots and gloves, soaking the injured part in warm water (102 to 108 degrees Fahrenheit) and drinking a warm beverage. Do not rub skin to generate friction/ heat.

    2. **Superficial Frostbite** - This is the second stage of the freezing process. It is characterized by a whitish gray area of tissue, which will be firm to the touch but will yield little pain. The treatment is identical for Frost nip.

    3. **Deep Frostbite** - In this final stage of the freezing process the affected tissue will be cold, numb and hard and will yield little to no pain. Treatment is identical to that for Frost nip.

- **Hypothermia** is a serious cold stress condition occurring when the body loses heat at a rate faster than it is produced. If untreated, hypothermia may be fatal. The stages of hypothermia may not be clearly defined or visible at first, but generally include:

  1. Shivering

  2. Apathy (i.e., a change to an indifferent or uncaring mood)

  3. Unconsciousness

  4. Bodily freezing

  Employees exhibiting signs of hypothermia should be treated by medical professionals. Steps that can be taken while awaiting help include:

  1. Remove the victim from the cold environment and remove wet or frozen clothing. (Do this carefully as frostbite may have started.)

  2. Perform active re-warming with hot liquids for drinking (Note: do not give the victim any liquid containing alcohol or caffeine) and a warm water bath (102 to 108 degrees Fahrenheit).

  3. Perform passive re-warming with a blanket or jacket wrapped around the victim.

In any potential cold stress situation, it is the responsibility of the SSHO to encourage the following:

- Education of workers to recognize the symptoms of frostbite and hypothermia.
- Workers should dress warmly, with more layers of thin clothing as opposed to one thick layer.
- Personnel should remain active and keep moving.
- Personnel should be allowed to take shelter in a heated area, as necessary.
- Personnel should drink warm liquids (no caffeine or alcohol if hypothermia has set in).
- For monitoring the body's recuperation from excess cold, oral temperature recordings should occur:
  - At the discretion of the SSHO when suspicion is based on changes in a worker's performance or mental status.
  - At a worker's request.
  - As a screening measure, two times per shift, under unusually hazardous conditions (e.g., wind chill less than 20 degrees Fahrenheit or wind chill less than 30 degrees Fahrenheit with precipitation).
  - As a screening measure, whenever anyone worker on-site develops hypothermia.

Any person developing moderate hypothermia (a core body temperature of 92 degrees Fahrenheit) will not be allowed to return to work for 48 hours without the recommendation of a qualified medical doctor.

11. Work Zones and Site Control

Work zones around the areas designated for construction activities will be established daily and communicated to employees and other Site users by the SSHO. It shall be each Contractor's Site Safety and Health Officer's responsibility to ensure that Site workers are aware of the work zone boundaries and to enforce proper procedures in each area. The zones will include:

- Exclusion Zone ("Hot Zone"): The area where contaminated materials may be exposed, excavated, or handled and all areas where contaminated equipment or personnel may travel. Flagging tape will delineate the zone. Personnel entering the Exclusion Zone must wear the prescribed level of personal protective equipment identified in Section 7.

- Contamination Reduction Zone: The zone where decontamination of personnel and equipment takes place. Any potentially contaminated clothing, equipment and samples must remain in the Contamination Reduction Zone until decontaminated.

- Support Zone: The part of the site that is considered non-contaminated or "clean." Support equipment will be in this zone, and personnel may wear normal work clothes within this zone.

In the absence of other task-specific work zone boundaries established by the SSHO, the following boundaries will apply to investigation and construction activities involving disruption or handling of Site soils or groundwater:

- Exclusion Zone: 50-foot radius from the outer limit of the sampling/construction activity.

- Contaminant Reduction Zone: 100-foot radius from the outer limit of the sampling/construction activity.

- Support Zone: Areas outside the Contaminant Reduction Zone.

Access of non-essential personnel to the Exclusion and Contamination Reduction Zones will be strictly controlled by the SSHO. Only personnel who are essential to the completion of the task will be allowed access to these areas and only if they are wearing the prescribed level of protection. Entrance of personnel must be approved by the SSHO.

The SSHO will maintain a Health and Safety Logbook containing the names of Roux workers and their level of protection. The zone boundaries may be changed by the SSHO as environmental conditions warrant, and to respond to the necessary changes in work locations on-site.

12. Decontamination

12.1 Decontamination for Roux Employees

The degree of decontamination required is a function of a particular task and the environment within which it occurs. The following decontamination procedure will remain flexible, thereby allowing the decontamination crew to respond appropriately to the changing environmental conditions that may arise at the Site. Roux personnel on-site shall follow the procedure below, or the Contractor's procedure (if applicable), whichever is more stringent.

- **Station 1 - Equipment Drop:** Deposit visibly contaminated (if any) re-useable equipment used in the contamination reduction and exclusion zones (tools, containers, monitoring instruments, radios, clipboards, etc.) on plastic sheeting.

- **Station 2 - Boots and Gloves Wash and Rinse:** Scrub outer boots and outer gloves. Deposit tape and gloves in waste disposal container.

- **Station 3 - Tape, Outer Boot and Glove Removal:** Remove tape, outer boots and gloves. Deposit tape and gloves in waste disposal container.

- **Station 4 - Canister or Mask Change:** If worker leaves exclusive zone to change canister (or mask), this is the last step in the decontamination procedure. Worker's canister is exchanged, new outer gloves and boot cover donned, and worker returns to duty.

- **Station 5 - Outer Garment/Face Piece Removal**: Protective suit removed and deposited in separate container provided by Contractor. Face piece or goggles are removed if used. Avoid touching face with fingers. Face piece and/or goggles deposited on plastic sheet. Hard hat removed and placed on plastic sheet.

- **Station 6 - Inner Glove Removal:** Inner gloves are the last personal protective equipment to be removed. Avoid touching the outside of the gloves with bare fingers. Dispose of gloves in waste disposal container.

Following PPE removal, personnel shall wash hands, face and forearms with absorbent wipes. If field activities proceed for duration of 6 consecutive months or longer, shower facilities will be provided for worker use in accordance with OSHA 29CFR 1910.120(n).

12.2 Decontamination for Medical Emergencies

In the event of a minor, non-life-threatening injury, personnel should follow the decontamination procedures as defined, and then administer first-aid.

In the event of a major injury or other serious medical concern (e.g., heat stroke), immediate first aid is to be administered and the victim transported to the hospital in lieu of further decontamination efforts unless exposure to a Site contaminant would be considered "Immediately Dangerous to Life or Health."

12.3 Decontamination of Field Equipment

The Contractor in accordance with this approved HASP in the Contamination Reduction Zone will conduct decontamination of heavy equipment. As a minimum, this will include manually removing heavy soil contamination, followed by steam cleaning on an impermeable pad.

Roux personnel will conduct decontamination of tools used for sample collection purposes. It is expected that tools will be constructed of nonporous, nonabsorbent materials (i.e., metal), which will aid in the decontamination effort. Any tool or part of a tool made of porous, absorbent material (i.e., wood) will be placed into suitable containers and prepared for disposal.

Decontamination of bailers, split-spoons, spatula knives, and other tools used for environmental sampling and examination shall be as follows:

- Disassemble the equipment.
- Water wash to remove visible foreign matter.
- Wash with detergent.
- Rinse parts with distilled-deionized water.
- Allow to air dry.
- Wrap parts in aluminum foil or polyethylene.

13. Confined Space Entry

OSHA 29CFR 1910.146 identifies a confined space as a space that is large enough and so configured that an employee can physically enter and do assigned work, has limited or restricted means for entry and exit, and is not intended for continuous employee occupancy. Confined spaces include, but are not limited to, trenches, storage tanks, process vessels, pits, sewers, tunnels, underground utility vaults, pipelines, sumps, wells, and excavations.

Confined space entry by Roux employees is not anticipated to be necessary to complete the remedial activities identified in Section 2.0. If the scope of work changes or confined space entry appears necessary, the Project Manager will be consulted to determine if feasible engineering alternatives to confined space entry can be implemented. If confined space entry by Roux employees cannot be avoided through reasonable engineering measures, task-specific confined space entry procedures will be developed, and a confined-space entry permit will be issued through Roux's corporate Health and Safety Director. Roux employees shall not enter a confined space without these procedures and permits in place.

14. Fire Prevention and Protection

14.1 General Approach

Recommended practices and standards of the National Fire Protection Association (NFPA) and other applicable regulations will be followed in the development and application of Project Fire Protection Programs. When required by regulatory authorities, the project management will prepare and submit a Fire Protection Plan for the approval of the contracting officers, authorized representative, or other designated official. Essential considerations for the Fire Protection Plan will include:

- Proper Site preparation and safe storage of combustible and flammable materials.
- Availability of coordination with private and public fire authorities.
- Adequate job-site fire protection and inspections for fire prevention.
- Adequate indoctrination and training of employees.

14.2 Equipment and Requirements

Fire extinguishers will be provided by each Contractor and are required on heavy equipment and in each field trailer. Fire extinguishers will be inspected, serviced, and maintained in accordance with the manufacturer's instructions. As a minimum, extinguishers shall be checked monthly and weighed semi-annually, and recharged if necessary. Recharge or replacement shall be mandatory immediately after each use.

14.3 Flammable and Combustible Substances

Storage, handling or use of flammable and combustible substances will be under the supervision of qualified persons. Tanks, containers and pumping equipment, whether portable or stationary, used for the storage and handling of flammable and combustible liquids, will meet the recommendations of the National Fire Protection Association.

14.4 Hot Work

If the scope of work necessitates welding or blowtorch operation, the hot work permit presented in Attachment B will be completed by the SSHO and reviewed/issued by the Project Manager.

15. Emergency Information

In accordance with OSHA 29CFR Part 1910, an Emergency Response Plan is attached to this HASP as Attachment A. The hospital route map is presented within Attachment A as Figure A1.

16. Reference

New York State Department of Environmental Conservation. *DER-10; Technical Guidance for Site Investigation and Remediation.* May 2010.

TABLES

TABLE 1
TOXICITY DATA FOR CONSTITUENTS OF POTENTIAL CONCERN

HARRISON PLACE SITE
LOCKPORT, NEW YORK

Parameter	Synonyms	CAS No.	Code	Concentration Limits [1]		
				PEL	TLV	IDLH
Volatile Organic Compounds (VOCs): ppm						
Cis-1,2-Dichloroethene	Cis-1,2-DCE	156-59-2	*none*	200	200	1000
Tetrachloroethene	Perc, PCE	127-18-4	Ca	100	25	150
Trichloroethene	TCE	79-01-6	Ca	100	50	1000
Vinyl Chloride	VC	75-01-4	Ca	1	1	ND

Notes:

1. Concentration limits as reported by NIOSH Pocket Guide to Chemical Hazards, February 2004 (NIOSH Publication No. 97-140, fourth printing with changes and updates).

Explanation:

Ca = NIOSH considers constituent to be a potential occupational carcinogen.
IDLH = Immediately Dangerous to Life or Health.
ND indicates that an IDLH has not been determined.

TLV = Threshold Limit Value, established by American Conference of Industrial Hygienists (ACGIH), equals the maximum exposure concentration allowable for 8 hours/day @ 40 hours/week.

TLVs are the amounts of chemicals in the air that almost all healthy adult workers are predicted to be able to tolerate without adverse effects. There are three types.
TLV-TWA (TLV-Time-Weighted Average) which is averaged over the normal eight-hour day/forty-hour work week. (Most TLVs.)
TLV-STEL or Short Term Exposure Limits are 15 minute exposures that should not be exceeded for even an instant. It is not a stand alone value but is accompanied by the TLV-TWA.
It indicates a higher exposure that can be tolerated for a short time without adverse effect as long as the total time weighted average is not exceded.
TLV-C or Ceiling limits are the concentration that should not be exceeded during any part of the working exposure.
Unless the initials "STEL" or "C" appear in the Code column, the TLV value should be considered to be the eight-hour TLV-TWA.
PEL = Permissible Exposure Limit, established by OSHA, equals the maximium exposure conconcentration allowable for 8 hours per day @ 40 hours per week

TABLE 2
POTENTIAL ROUTES OF EXPOSURE TO THE CONSTITUENTS OF POTENTIAL CONCERN

HARRISON PLACE SITE
LOCKPORT, NEW YORK

Activity [1]	Direct Contact with Soil/Fill	Inhalation of Vapors or Dust	Direct Contact with Water
Remedial Action Tasks			
1. Remedial injection activities (in-situ cVOC remediation)	X	X	X
2. Waste characterization sampling	X	X	X
3. Excavation of impacted soil/fill, off-site disposal & backfill	X	X	X
4. Subslab soil vapor treatment	X	X	
5. Post-injection performance groundwater monitoring			X
6. On-site water treatment (building sump/trench water removal/disposal)			X
7. Restoration of concrete building floor acting as Site cover		X	

Notes:

1. Activity as described in Section 1.5 of the Health and Safety Plan.

TABLE 3
REQUIRED LEVELS OF PROTECTION FOR REMEDIAL TASKS

HARRISON PLACE SITE
LOCKPORT, NEW YORK

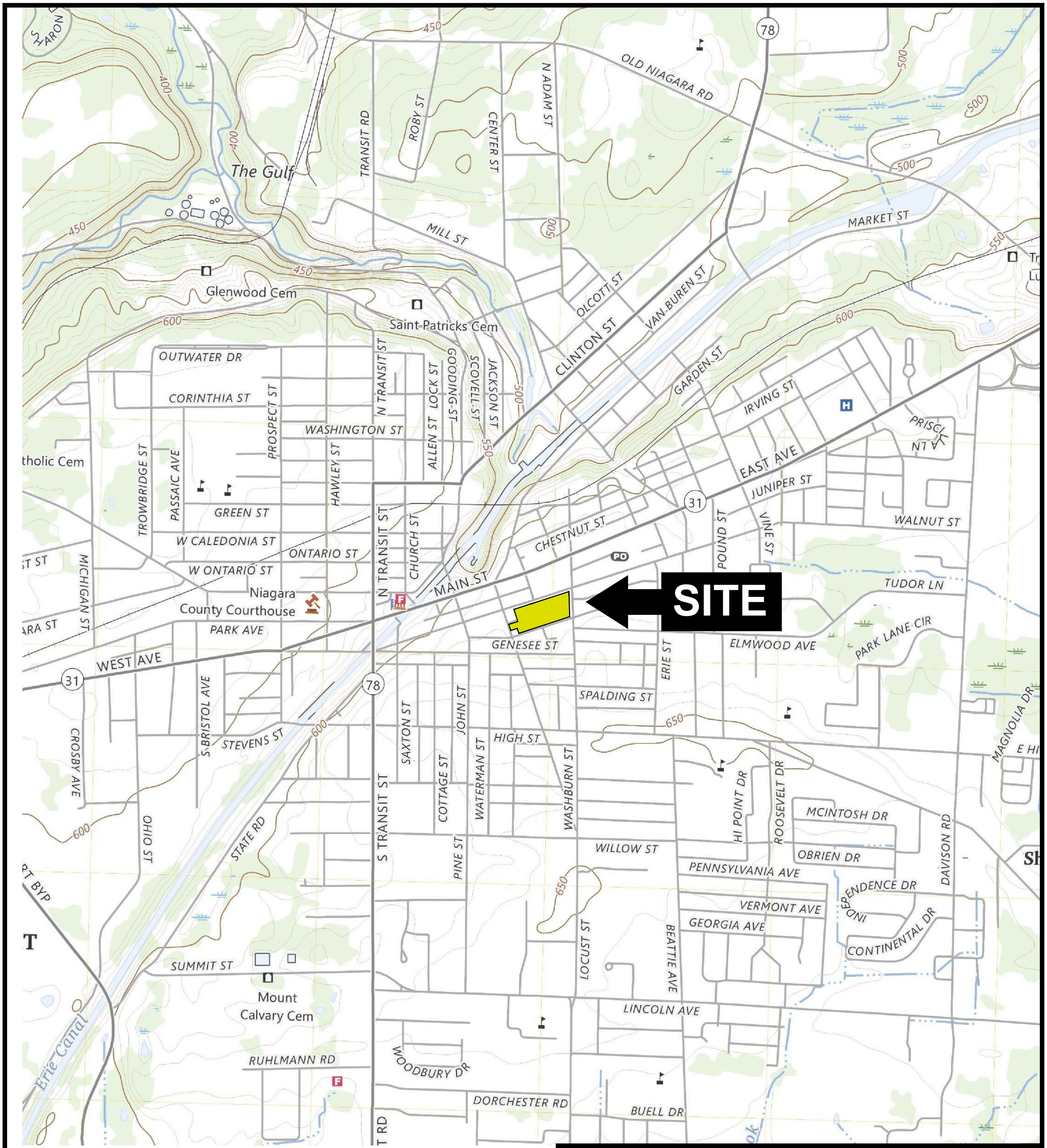
Activity	Respiratory Protection[1]	Clothing	Gloves[2]	Boots[2,3]	Other Required PPE/ Modifications[2,4]
Remedial Action Tasks					
1. Remedial injection activities (in-situ cVOC remediation)	Level D (upgrade to Level C if necessary)	Work Uniform or Tyvek	L/N	outer: L inner: STSS	HH SGSS
2. Waste characterization sampling	Level D (upgrade to Level C if necessary)	Work Uniform or Tyvek	L/N	outer: L inner: STSS	HH SGSS
3. Excavation of impacted soil/fill, off-site disposal & backfill	Level D (upgrade to Level C if necessary)	Work Uniform or Tyvek	L/N	outer: L inner: STSS	HH SGSS
4. Subslab soil vapor treatment	Level D (upgrade to Level C if necessary)	Work Uniform or Tyvek	L/N	outer: L inner: STSS	HH SGSS
5. Post-injection performance groundwater monitoring	Level D (upgrade to Level C if necessary)	Work Uniform or Tyvek	L/N	outer: L inner: STSS	HH SGSS
6. On-site water treatment (building sump/trench water removal/disposal)	Level D (upgrade to Level C if necessary)	Work Uniform or Tyvek	L/N	outer: L inner: STSS	HH SGSS
7. Restoration of concrete building floor acting as Site cover	Level D (upgrade to Level C if necessary)	Work Uniform or Tyvek	L/N	outer: L inner: STSS	HH SGSS

Notes:

1. Respiratory equipment shall conform to guidelines presented in Section 7.0 of this HASP. Level C requirement is an air-purifying respirator equiped with organic compound/acid gas/dust cartridge.
2. HH = hardhat; L= Latex; L/N = latex inner glove, nitrile outer glove; N = Nitrile; S = Saranex; SG = safety glasses; SGSS = safety glasses with sideshields; STSS = steel toe safety shoes.
3. Latex outer boot (or approved overboot) required whenever contact with contaminated materials may occur. SSHO may downgrade to STSS (steel-toed safety shoes) if contact will be limited to cover/replacement soils.
4. Dust masks shall be donned as directed by the SSHO (site safety and health officer) or site safety technician whenever potentially contaminated airborne particulates (i.e., dust) are present in significant amounts in the breathing zone. Goggles may be substituted with safety glasses w/side-shields whenever contact with contaminated liquids is not anticipated.

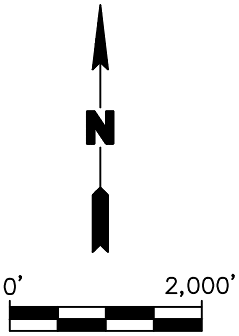
FIGURES

1. Site Vicinity and Location Map



QUADRANGLE LOCATION

SOURCE:
USGS, 2023, LOCKPORT, NY
7.5 MINUTE TOPOGRAPHIC QUADRANGLE



Title:

SITE LOCATION & VICINITY MAP
HEALTH AND SAFETY PLAN
HARRISON PLACE SITE

BCP SITE NO. C932177
LOCKPORT, NEW YORK

Prepared for:

KEARNEY REALITY & DEVELOPMENT GROUP, INC.

ROUX

Compiled by: CNK	Date: NOVEMBER 2023	FIGURE
Prepared by: CNK	Scale: AS SHOWN	1
Project Mgr: LER	Project: 0684-022-001	
File: FIGURE 1; SITE VICINITY AND LOCATION MAP.DWG		

F:\CAD\BENCHMARK\KEARNEY REALTY AND DEVELOPMENT GROUP\RAWP\HASP\FIGURE 1; SITE VICINITY AND LOCATION MAP.DWG

ATTACHMENTS

A. Emergency Response Plan

B. Hot Work Permit Form

C. Community Air Monitoring Plan

ATTACHMENT A

Emergency Response Plan

Emergency Response Plan

Harrison Place Site
BCP Site No. C932177
Lockport, NY

November 2023

Prepared for:

Kearney Realty & Development Group, Inc.
57 US Route 6, Suite 207
Baldwin Place, NY 10505

Prepared by:

Roux Environmental Engineering
and Geology, D.P.C.
2558 Hamburg Turnpike, Suite 300
Buffalo, New York 4218

Environmental Consulting
& Management
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rouxinc.com

Table of Contents

Figures

1. General

This report presents the site-specific Emergency Response Plan (ERP) referenced in the Site Health and Safety Plan (HASP) prepared for Remedial activities at the Harrison Place Site, located at Harrison Place, 210 Walnut Street, Lockport, New York. This attachment of the HASP describes potential emergencies that may occur at the Site; procedures for responding to those emergencies; roles and responsibilities during emergency response; and training all workers must receive to follow emergency procedures. This ERP also describes the provisions this Site has made to coordinate its emergency response planning with other contractors on-site and with off-site emergency response organizations.

This ERP is consistent with the requirements of 29CFR 1910.120(l) and provides the following site-specific information:

- Pre-emergency planning.
- Personnel roles, lines of authority, and communication.
- Emergency recognition and prevention.
- Safe distances and places of refuge.
- Evacuation routes and procedures.
- Decontamination procedures.
- Emergency medical treatment and first aid.
- Emergency alerting and response procedures.
- Critique of response and follow-up.
- Emergency personal protective equipment (PPE) and equipment.

2. Pre-Emergency Planning

This Site has been evaluated for potential emergency occurrences, based on site hazards, the required work tasks, the site topography, and prevailing weather conditions. The results of that evaluation indicate the potential for the following site emergencies to occur at the locations indicated.

Type of Emergency:

1. Medical, due to physical injury

Source of Emergency:

1. Slip/trip/fall

Location of Source:

1. Non-specific

3. On-Site Emergency Response Equipment

Emergency procedures may require specialized equipment to facilitate worker rescue, contamination control and reduction, or post-emergency clean up. Emergency response equipment available on the Site is listed below. The equipment inventory and storage locations are based on the potential emergencies described above. This equipment inventory is designed to meet on-site emergency response needs and any specialized equipment needs off-site responders might require because of the hazards at this Site but not ordinarily stocked.

Any additional PPE required and stocked for emergency response is also listed below. During an emergency, the Emergency Response Coordinator (ERC) is responsible for specifying the level of PPE required for emergency response. At a minimum, PPE used by emergency responders will comply with Section 7.0, Personal Protective Equipment, of this HASP. Emergency response equipment is inspected at regular intervals and maintained in good working order. The equipment inventory is replenished as necessary to maintain response capabilities.

Emergency Equipment	Quantity	Location
First Aid Kit	1	Site Vehicle
Chemical Fire Extinguisher	2 (minimum)	Heavy equipment and Site Vehicle

Emergency PPE	Quantity	Location
Full-face respirator	1 for each worker	Site Vehicle
Eye Wash Solution	2 (minimum)	Site Vehicle
Chemical-resistant suits	4 (minimum)	Site Vehicle

4. Emergency Planning Maps

An area-specific map of the Site will be developed daily during performance of field activities. The map will be marked to identify critical on-site emergency planning information, including emergency evacuation routes, a place of refuge, an assembly point, and the locations of key site emergency equipment. Site zone boundaries will be shown to alert responders to known areas of contamination. There are no major topographical features, however the direction of prevailing winds/weather conditions that could affect emergency response planning are also marked on the map. The map will be posted at the site-designated place of refuge and inside the Roux personnel field vehicle.

5. Emergency Contacts

The following identifies the emergency contacts for this ERP.

Project Manager: ***Lori Riker***
Work: (716) 856-0599
Mobile: (716) 474-7510

Corporate Health and Safety Director: ***Brian Hobbs***
Work: (631) 630-2419
Mobile: (631) 807-0193

Site Safety and Health Officer (SSHO): ***Paul W. Werthman***
Work: (716) 856-0599
Mobile: (716) 997-9584

EASTERN NIAGARA HOSPITAL:	(716) 514-5700
FIRE:	911
AMBULANCE:	911
LOCKPORT POLICE:	911
NY EMERGENCY RESPONSE HOTLINE:	(800) 457-7362
NATIONAL RESPONSE HOTLINE:	(800) 424-8802
NYSDOH:	(716) 847-4385
NYSDEC:	(716) 851-7220
NYSDEC 24-HOUR SPILL HOTLINE:	(800) 457-7252

The Site location is:
210 Walnut Street
Lockport, New York 14094
Site Phone Number: (Insert Cell Phone or Field Trailer): ____________________

6. Emergency Alerting & Evacuation

Internal emergency communication systems are used to alert workers to danger, convey safety information, and maintain site control. Any effective system can be employed. Two-way radio headsets or field telephones are often used when work teams are far from the command post. Hand signals and air-horn blasts are also commonly used. Every system <u>must</u> have a backup. It shall be the responsibility of each contractor's SSHO to ensure personnel entering the site understand an adequate method of internal communication. Unless personnel are otherwise informed, the following signals shall be used.

1. Emergency signals by portable air horn, siren, or whistle: two short blasts, personal injury; continuous blast, emergency requiring site excavation.

2. Visual signals: hand gripping throat, out of air/cannot breathe; hands on top of head, need assistance; thumbs up, affirmative/ everything is OK; thumbs down, no/negative; grip partner's wrist or waist, leave area immediately.

If evacuation notice is given, site workers leave the worksite with their respective buddies, if possible, by way of the nearest exit. Emergency decontamination procedures detailed in Section 12.0 of the HASP are followed to the extent practical without compromising the safety and health of site personnel. The evacuation routes and assembly area will be determined by conditions at the time of the evacuation based on wind direction, the location of the hazard source, and other factors as determined by rehearsals and inputs from emergency response organizations. Wind direction indicators are located so that workers can determine a safe up wind or cross wind evacuation route and assembly area if not informed by the emergency response coordinator at the time the evacuation alarm sounds. Since work conditions and work zones within the site may be changing on daily basis, it shall be the responsibility of the construction SSHO to review evacuation routes and procedures as necessary and to inform all Roux workers of any changes.

Personnel exiting the Site will gather at a designated assembly point. To determine that everyone has successfully exited the site, personnel will be accounted for at the assembly site. If any worker cannot be accounted for, notification is given to the SSHO (***Paul W. Werthman***) so that appropriate action can be initiated. Contractors and subcontractors on this site have coordinated their emergency response plans to ensure that these plans are compatible, and that source(s) of potential emergencies are recognized, alarm systems are clearly understood, and evacuation routes are accessible to all personnel relying upon them.

7. Extreme Weather Conditions

In the event of adverse weather conditions, the SSHO in conjunction with the Contractor's SSHO will determine if engineering operations can continue without sacrificing the health and safety of site personnel. Items to be considered prior to determining if work should continue include but are not limited to:

- Potential for heat/cold stress.
- Weather-related construction hazards (e.g., flooding or wet conditions producing undermining of structures or sheeting, high wind threats, etc.).
- Limited visibility.
- Potential for electrical storms.
- Limited site access/egress (e.g., due to heavy snow)

8. Emergency Medical Treatment & First Aid

Personnel Exposure:

The following general guidelines will be employed in instances where health impacts threaten to occur acute exposure is realized:

- Skin Contact: Use copious amounts of soap and water. Wash/rinse affected area for at least 15 minutes. Decontaminate and provide medical attention. Eyewash stations will be provided on site. If necessary, transport to Hospital.

- Inhalation: Move to fresh air and, if necessary, transport to Hospital.

- Ingestion: Decontaminate and transport to Hospital.

Personal Injury:

Minor first-aid will be applied on-site as deemed necessary. In the event of a life-threatening injury, the individual should be transported to Hospital via ambulance. The SSHO will supply available chemical specific information to appropriate medical personnel as requested.

First aid kits will conform to Red Cross and other applicable good health standards and shall consist of a weatherproof container with individually sealed packages for each type of item. First aid kits will be fully equipped before being sent out on each job and will be checked weekly by the SSHO to ensure that the expended items are replaced.

Directions to UPMC Chautauqua Emergency Department (see Figure A1):

The following directions describe the best route from the Site to Eastern Niagara Hospital located 1.0 mile away:

- Head east on Walnut Street

- Turn left onto Washburn Street

- Turn right onto East Avenue

- Eastern Niagara Hospital is located on the left at 521 East Avenue, Lockport, New York

9. Emergency Response Critique & Record Keeping

Following an emergency, the SSHO and Project Manager shall review the effectiveness of this ERP in addressing notification, control, and evacuation requirements. Updates and modifications to this ERP shall be made accordingly. It shall be the responsibility of each contractor to establish and assure adequate records of the following:

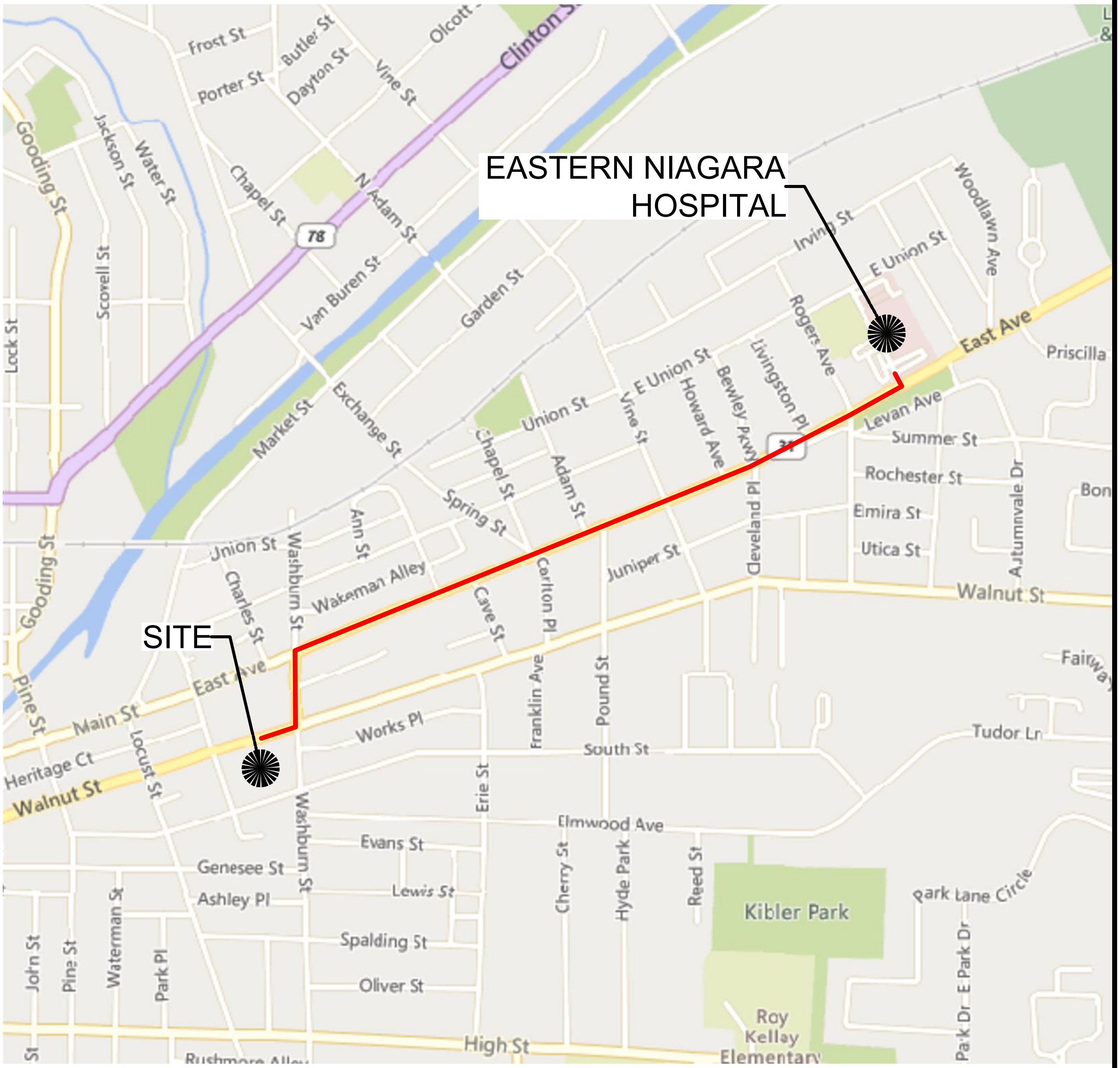
- Occupational injuries and illnesses.
- Accident investigations.
- Reports to insurance carrier or State compensation agencies.
- Reports required by the client.
- Records and reports required by local, state, federal and/or international agencies.
- Property or equipment damage.
- Third party injury or damage claims.
- Environmental testing logs.
- Explosive and hazardous substances inventories and records.
- Records of inspections and citations.
- Safety training.

10. Emergency Response Training

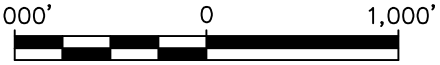
Persons who enter the worksite, including visitors, shall receive a site-specific briefing about anticipated emergency situations and the emergency procedures by the SSHO. Where this site relies on off-site organizations for emergency response, the training of personnel in those off-site organizations has been evaluated and is deemed adequate for response to this site.

FIGURES

1. Hospital Route Map



-HEAD EAST ON WALNUT STREET
-TURN LEFT ONTO WASHBURN STREET
-TURN RIGHT ONTO EAST AVENUE
-EASTERN NIAGARA HOSPITAL IS ON THE LEFT
LOCATED AT 521 EAST AVENUE, LOCKPORT, NY



Title:

HOSPITAL ROUTE MAP
EMERGENCY RESPONSE PLAN
HARRISON PLACE SITE

BCP SITE NO. C932177
LOCKPORT, NEW YORK

Prepared for:

KEARNEY REALITY & DEVELOPMENT GROUP, INC.

ROUX

Compiled by: CNK	Date: NOVEMBER 2023	FIGURE
Prepared by: CNK	Scale: AS SHOWN	1
Project Mgr: LER	Project: 0684-022-001	
File: FIGURE A1; HOSPITAL ROUTE MAP.DWG		

F:\CAD\BENCHMARK\KEARNEY REALTY AND DEVELOPMENT GROUP\RAWP\HASP\ATTACHMENT A; EMERGENCY RESPONSE PLAN\FIGURE A1; HOSPITAL ROUTE MAP.DWG

ATTACHMENT B

Hot Work Permit Form

ROUX

HOT WORK PERMIT

PART 1 - INFORMATION

Issue Date:

Date Work to be Performed: Start: Finish (permit terminated):

Performed By:

Work Area:

Object to be Worked On:

PART 2 - APPROVAL

(for 1, 2 or 3: mark Yes, No or NA)*

Will working be on or in: Finish (permit terminated):

1. Metal partition, wall, ceiling covered by combustible material? yes no
2. Pipes, in contact with combustible material? yes no
3. Explosive area? yes no

* = If any of these conditions exist (marked "yes"), a permit will not be issued without being reviewed and approved by Thomas H. Forbes (Corporate Health and Safety Director). Required Signature below.

PART 3 - REQUIRED CONDITIONS**

(Check all conditions that must be met)

	PROTECTIVE ACTION		PROTECTIVE EQUIPMENT
	Specific Risk Assessment Required		Goggles/visor/welding screen
	Fire or spark barrier		Apron/fireproof clothing
	Cover hot surfaces		Welding gloves/gauntlets/other:
	Move movable fire hazards, specifically		Wellintons/Knee pads
	Erect screen on barrier		Ear protection: Ear muffs/Ear plugs
	Restrict Access		B.A.: SCBA/Long Breather
	Wet the ground		Respirator: Type:
	Ensure adequate ventilation		Cartridge:
	Provide adequate supports		Local Exhaust Ventilation
	Cover exposed drain/floor or wall cracks		Extinguisher/Fire blanket
	Fire watch (must remain on duty during duration of permit)		Personal flammable gas monitor
	Issue additional permit(s):		

Other precautions:

** Permit will not be issued until these conditions are met.

SIGNATURES

Orginating Employee: Date:

Project Manager: Date:

Part 2 Approval: Date:

ATTACHMENT C

Community Air Monitoring Plan

Appendix C1
New York State Department of Health
Generic Community Air Monitoring Plan

Overview

A Community Air Monitoring Plan (CAMP) requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work area when certain activities are in progress at contaminated sites. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities did not spread contamination off-site through the air.

The generic CAMP presented below will be sufficient to cover many, if not most, sites. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical- specific monitoring with appropriately-sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH.

Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

Community Air Monitoring Plan

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for VOCs and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring. If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate DEC/NYSDOH staff.

Continuous monitoring will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. “Periodic” monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

VOC Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions, particularly if wind direction changes. The monitoring work should be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

1. If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

2. If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.

3. If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.

4. All 15-minute readings must be recorded and be available for State (DEC and NYSDOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations should be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment must be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

1. If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.

2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m^3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m^3 of the upwind level and in preventing visible dust migration.

3. All readings must be recorded and be available for State (DEC and NYSDOH) and County Health personnel to review.

December 2009

Appendix C2
Fugitive Dust and Particulate Monitoring

A program for suppressing fugitive dust and particulate matter monitoring at hazardous waste sites is a responsibility on the remedial party performing the work. These procedures must be incorporated into appropriate intrusive work plans. The following fugitive dust suppression and particulate monitoring program should be employed at sites during construction and other intrusive activities which warrant its use:

1. Reasonable fugitive dust suppression techniques must be employed during all site activities which may generate fugitive dust.

2. Particulate monitoring must be employed during the handling of waste or contaminated soil or when activities on site may generate fugitive dust from exposed waste or contaminated soil. Remedial activities may also include the excavation, grading, or placement of clean fill. These control measures should not be considered necessary for these activities.

3. Particulate monitoring must be performed using real-time particulate monitors and shall monitor particulate matter less than ten microns (PM10) with the following minimum performance standards:

(a) Objects to be measured: Dust, mists or aerosols;
(b) Measurement Ranges: 0.001 to 400 mg/m3 (1 to 400,000 :ug/m3);
(c) Precision (2-sigma) at constant temperature: +/- 10 :g/m3 for one second averaging; and +/- 1.5 g/m3 for sixty second averaging;
(d) Accuracy: +/- 5% of reading +/- precision (Referred to gravimetric calibration with SAE fine test dust (mmd= 2 to 3 :m, g= 2.5, as aerosolized);
(e) Resolution: 0.1% of reading or 1g/m3, whichever is larger;
(f) Particle Size Range of Maximum Response: 0.1-10;
(g) Total Number of Data Points in Memory: 10,000;
(h) Logged Data: Each data point with average concentration, time/date and data point number
(i) Run Summary: overall average, maximum concentrations, time/date of maximum, total number of logged points, start time/date, total elapsed time (run duration), STEL concentration and time/date occurrence, averaging (logging) period, calibration factor, and tag number;
(j) Alarm Averaging Time (user selectable): real-time (1-60 seconds) or STEL (15 minutes), alarms required;
(k) Operating Time: 48 hours (fully charged NiCd battery); continuously with charger;
(l) Operating Temperature: -10 to 50° C (14 to 122° F);
(m) Particulate levels will be monitored upwind and immediately downwind at the working site and integrated over a period not to exceed 15 minutes.

4. In order to ensure the validity of the fugitive dust measurements performed, there must be appropriate Quality Assurance/Quality Control (QA/QC). It is the responsibility of the remedial party to adequately supplement QA/QC Plans to include the following critical features: periodic instrument calibration, operator training, daily instrument performance (span) checks, and a record keeping plan.

5. The action level will be established at 150 ug/m3 (15 minutes average). While conservative,

this short-term interval will provide a real-time assessment of on-site air quality to assure both health and safety. If particulate levels are detected in excess of 150 ug/m3, the upwind background level must be confirmed immediately. If the working site particulate measurement is greater than 100 ug/m3 above the background level, additional dust suppression techniques must be implemented to reduce the generation of fugitive dust and corrective action taken to protect site personnel and reduce the potential for contaminant migration. Corrective measures may include increasing the level of personal protection for on-site personnel and implementing additional dust suppression techniques (see paragraph 7). Should the action level of 150 ug/m3 continue to be exceeded work must stop and DER must be notified as provided in the site design or remedial work plan. The notification shall include a description of the control measures implemented to prevent further exceedances.

6. It must be recognized that the generation of dust from waste or contaminated soil that migrates off-site, has the potential for transporting contaminants off-site. There may be situations when dust is being generated and leaving the site and the monitoring equipment does not measure PM10 at or above the action level. Since this situation has the potential to allow for the migration of contaminants off-site, it is unacceptable. While it is not practical to quantify total suspended particulates on a real-time basis, it is appropriate to rely on visual observation. If dust is observed leaving the working site, additional dust suppression techniques must be employed. Activities that have a high dusting potential--such as solidification and treatment involving materials like kiln dust and lime--will require the need for special measures to be considered.

7. The following techniques have been shown to be effective for the controlling of the generation and migration of dust during construction activities:

(a) Applying water on haul roads;
(b) Wetting equipment and excavation faces;
(c) Spraying water on buckets during excavation and dumping;
(d) Hauling materials in properly tarped or watertight containers;
(e) Restricting vehicle speeds to 10 mph;
(f) Covering excavated areas and material after excavation activity ceases; and
(g) Reducing the excavation size and/or number of excavations.

Experience has shown that the chance of exceeding the 150ug/m3 action level is remote when the above-mentioned techniques are used. When techniques involving water application are used, care must be taken not to use excess water, which can result in unacceptably wet conditions. Using atomizing sprays will prevent overly wet conditions, conserve water, and provide an effective means of suppressing the fugitive dust.

8. The evaluation of weather conditions is necessary for proper fugitive dust control. When extreme wind conditions make dust control ineffective, as a last resort remedial actions may need to be suspended. There may be situations that require fugitive dust suppression and particulate monitoring requirements with action levels more stringent than those provided above. Under some circumstances, the contaminant concentration and/or toxicity may require additional monitoring to protect site personnel and the public. Additional integrated sampling and chemical analysis of the dust may also be in order. This must be evaluated when a health and safety plan is developed and when appropriate suppression and monitoring requirements are established for protection of health and the environment.

APPENDIX C

Injection Amendment Product SDS & Technical Data Sheets

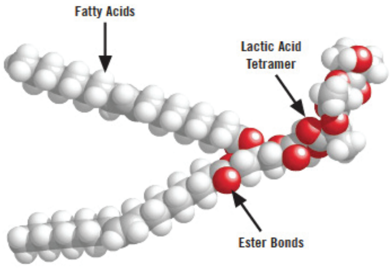
3-D MICROEMULSION
Factory Emulsified

3-D Microemulsion® Factory Emulsified Technical Description

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

Example of 3-D Microemulsion

FIGURE 1: THE 3-D MICROEMULSION MOLECULAR STRUCTURE



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

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

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

3-D® MICROEMULSION
Factory Emulsified

3-D Microemulsion® Factory Emulsified Technical Description

Chemical Composition

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

Properties

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

Storage and Handling Guidelines

Storage
Store in original tightly closed container
Store in a cool, dry, well-ventilated place
Store away from incompatible materials
Recommended storage containers: plastic-lined steel, plastic, glass, aluminum, stainless steel, or reinforced fiberglass

Handling
Avoid contact with eyes, skin, and clothing
Provide adequate ventilation
Wear appropriate personal protective equipment
Observe good industrial hygiene practices

Applications

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

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

Health and Safety

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

REGENESIS®

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

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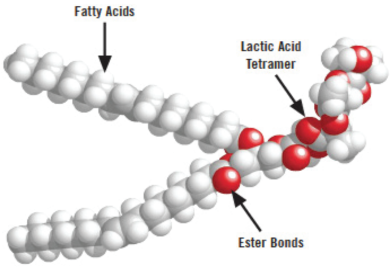

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- Appearance – White emulsion
- Odor – Not detectable
- Vapor Pressure – None
- Non-hazardous

Storage and Handling Guidelines

Storage
Store in original tightly closed container
Store in a cool, dry, well-ventilated place
Store away from incompatible materials
Recommended storage containers: plastic-lined steel, plastic, glass, aluminum, stainless steel, or reinforced fiberglass

Handling
Avoid contact with eyes, skin, and clothing
Provide adequate ventilation
Wear appropriate personal protective equipment
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Applications

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REGENESIS
Technology-Based Solutions for the Environment

SAFETY DATA SHEET

1. Identification

Product identifier	**3-D Microemulsion® Factory Emulsified**
Other means of identification	None.
Recommended use	Remediation of soils and groundwater.
Recommended restrictions	None known.

Manufacturer/Importer/Supplier/Distributor information

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

2. Hazard(s) identification

Physical hazards	Not classified.	
Health hazards	Skin corrosion/irritation	Category 2
	Serious eye damage/eye irritation	Category 1
OSHA defined hazards	Not classified.	

Label elements

Signal word	Danger
Hazard statement	Causes skin irritation. Causes serious eye damage.
Precautionary statement	
Prevention	Wash thoroughly after handling. Wear protective gloves. Wear eye/face protection.
Response	If on skin: Wash with plenty of water. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a poison center/doctor. If skin irritation occurs: Get medical advice/attention. Take off contaminated clothing and wash before reuse.
Storage	Store away from incompatible materials.
Disposal	Dispose of waste and residues in accordance with local authority requirements.
Hazard(s) not otherwise classified (HNOC)	None known.

3. Composition/information on ingredients

Mixtures

Chemical name	CAS number	%
HRC-PED	823190-10-9	50-51
Water	7732-18-5	35-36
Sodium lactate	72-17-3	13-14

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

4. First-aid measures

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

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

5. Fire-fighting measures

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

6. Accidental release measures

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

7. Handling and storage

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

8. Exposure controls/personal protection

Occupational exposure limits	No exposure limits noted for ingredient(s).
Biological limit values	No biological exposure limits noted for the ingredient(s).

Appropriate engineering controls	Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. Eye wash facilities and emergency shower must be available when handling this product.
Individual protection measures, such as personal protective equipment	
Eye/face protection	Wear approved, tight fitting indirect vented or non-vented safety goggles where splashing is probable. Face shield is recommended.
Skin protection	
Hand protection	Wear appropriate chemical resistant gloves. Rubber or vinyl-coated gloves are recommended.
Other	Wear appropriate chemical resistant clothing.
Respiratory protection	If engineering controls do not maintain airborne concentrations below recommended exposure limits (where applicable) or to an acceptable level (in countries where exposure limits have not been established), an approved respirator must be worn.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
General hygiene considerations	Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

Appearance	
Physical state	Liquid.
Form	Emulsion.
Color	White.
Odor	Odorless.
Odor threshold	Not available.
pH	Not available.
Melting point/freezing point	Not available.
Initial boiling point and boiling range	212 °F (100 °C)
Flash point	> 199.9 °F (> 93.3 °C) Closed Cup
Evaporation rate	Not available.
Flammability (solid, gas)	Not applicable.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	Not available.
Flammability limit - upper (%)	Not available.
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Relative density	1 - 1.2
Solubility(ies)	
Solubility (water)	Soluble.
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	Not available.

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Undergoes hydrolysis in water to form lactic acid and soybean oil.

Possibility of hazardous reactions	No dangerous reaction known under conditions of normal use.
Conditions to avoid	Avoid temperatures exceeding the flash point. Contact with incompatible materials.
Incompatible materials	Strong oxidizing agents. Bases. Acids.
Hazardous decomposition products	Thermal decomposition or combustion may produce: carbon oxides, phosphorus compounds, metal oxides.

11. Toxicological information

Information on likely routes of exposure

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

Information on toxicological effects

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

Respiratory or skin sensitization

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

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

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

12. Ecological information

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

13. Disposal considerations

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

14. Transport information

DOT

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

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

15. Regulatory information

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

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

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

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

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical	Yes

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

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

Not regulated.

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

Not regulated.

Safe Drinking Water Act (SDWA)	Not regulated.

US state regulations

US. Massachusetts RTK - Substance List

Not regulated.

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

Not listed.

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

Not listed.

US. Rhode Island RTK

Not regulated.

US. California Proposition 65

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

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes

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

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

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

Issue date	09-April-2015
Revision date	-
Version #	01
Further information	HMIS® is a registered trade and service mark of the American Coatings Association (ACA).
HMIS® ratings	Health: 3 Flammability: 1 Physical hazard: 0
NFPA ratings	
Disclaimer	Regenesis cannot anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use. The information in the sheet was written based on the best knowledge and experience currently available.

3-D Microemulsion (3DMe)™

INSTALLATION INSTRUCTIONS

High-Volume, Wide-Area, Micro-Emulsion Application

Introduction

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

Material Overview Handling and Safety

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

Micro-Emulsion Production 3DMe to Water Ratio

3DMe concentrate should be mixed with water on a volume to volume (v/v) basis to produce a micro-emulsion starting at 10 parts water: 1 part 3DMe. Although micro-emulsions can be easily produced using greater water volumes than 10 parts, e.g. 20 to 50 parts water to 1 part 3DMe, the initial micro-emulsion should never be produced below a ratio of less than 10 parts water: 1 part 3DMe v/v. **WARNING: Do not attempt to produce a micro-emulsion at less than 10 parts water to 1 part 3DMe ratio v/v. This will produce an undesirable and unstable solution.**

The field production of 3DMe micro-emulsion is a very simple procedure; however, it is critical that the user follow the mixing directions outlined below. Never attempt to add water to the 3DMe as this will produce an undesirable and unstable large emulsion. Always add the 3DMe to a large volume of water.

As indicated previously the 10:1 ratio of water to 3DMe v/v is the minimum water ratio that can be used, a greater ratio (more dilute solution) can easily be achieved and is governed by: A) the volume of 3DMe required to treat the estimated contaminant mass, B) the pore volume in which the material is applied, C) the time available for installation (gallons/pump rate), and C) the estimated volume of 3DMe micro-emulsion that the target zone will accept over the time period allocated for installation.

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

It is important that the user plan in advance the v/v 3DMe/water ratio to be employed at a project site. The resulting volume of solution will dictate the site water requirements and the time required for injection, etc. If upon injection of greater than 10:1 3DMe micro-emulsion, the subsurface does not readily accept the volume of solution as designed, the user can adjust downward the v/v water to 3DMe ratio until a more concentrated suspension is produced (this solution should never drop below the required 10 parts water:1 part 3DMe v/v production ratio). For more information on designing a 3DMe/water ratios to meet specific site conditions, please contact Regenesis Technical Services.

Direct Push Application Requirements

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

In general, Regenesis strongly recommends application of the 3DMe micro-emulsion using an injection pump with a minimum delivery rate of three gallons per minute (gpm) and a pressure rating of between 150 to 200 pounds per square inch (psi). **Note: the <u>injection pump requirements are different than the requirements of the mixing pump</u> (see Mixing to Generate 3DMe Micro-emulsion).** High pressure, positive displacement pumps and progressive cavity pumps are appropriate for injecting 3DMe. For low permeability lithologies (clay, silt) higher pressure pumps (800-1600 psi) may be necessary, while for more permeable lithologies (gravel, sand) a lower pressure pump may be adequate. Examples of appropriate pumps are: Rupe Models 6-2200, 9-1500 and 9-1600 (positive displacement), Geoprobe® GS-2000 (positive displacement) and DP-800 (progressive cavity), Yamada (air diaphragm), Moyno (progressive cavity), and Wilden (air diaphragm). Delivery rate is a critical factor in managing installation time and costs. Generally, higher delivery rates (>6 gpm) are more cost effective for these types of applications but pump selection should be on a site specific basis and account for the volume of 3DMe solution and specific aquifer conditions present at the site.

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

Producing the 3DMe Micro-Emulsion

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

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

<u>To ensure that proper micro-emulsion suspension is generated Regenesis suggests a two-step process that simply requires mixing at least 10 parts water to 1 part 3DMe concentrate using water at a temperature ≥ 60°F.</u>

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

Step 2) to calculate the volume of water necessary to produce a 10:1 v/v micro-emulsion, each bucket of 3DMe concentrate containing 3.7 gallons of material should be mixed with 37 gallons of water.

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

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

Application of Micro-Emulsion Using Direct-Push Methods

1) Prior to the installation of the micro-emulsion, any surface or overhead impediments should be identified as well as the location of all underground structures. Underground structures include but are not limited to: utility lines, tanks, distribution piping, sewers, drains, and landscape irrigation systems.

2) The planned installation locations should be adjusted to account for all impediments and obstacles.

3) Pre-mark the installation locations, noting any points that may have different vertical application requirements or total depth.

4) Set up the direct-push unit over each specific point and follow the manufacturer's standard operating procedures (SOP). Care should be taken to assure that probe holes remain vertical.

5) For most applications, Regenesis suggests using drive rods with an O.D. of at least 1.25-inches and an I.D. of at least 0.625-inches I.D (Geoprobe or equivalent). However, the lithologic conditions at some sites may warrant the use of larger 2.125-inch O.D./1.5-inch I.D. drive rods.

6) The most typical type of sub-assembly currently being used is designed for 1.25-inch direct-push rods and is manufactured by Geoprobe. Other brands of drive rods can also be used but require the fabrication of a sub-assembly that allows for a connection between the pump and drive rod.

7) For mixing large volumes of the micro-emulsion, Regenesis recommends using a Magnum Products LLC model MWT500 water trailer (fitted with centrifugal recirculation pump) or equivalent unit. However, single large volume poly tanks are adequate. We suggest filling the tank with an appropriate quantity (e.g. from the example above 222 gallons) of water before start of mixing operations. The tank should be configured so that both a hose and a fire hydrant or larger water tank can be connected to it simultaneously and filled with water quickly and easily. This will dramatically reduce the time needed to fill the tank with mixing water.

8) Regenesis highly recommends preparing the micro-emulsion before pushing any drive rods into the subsurface. NOTE: it is best if the micro-emulsion is produced a single day application volumes.

9) After the micro-emulsion mixing/shearing step has been completed as described above, the micro-emulsion is ready to be applied. Check to see if a hose has already been attached to the inlet side of the centrifugal pump. If this has not been done, do so now.

10) If a non-water trailer tank is being used for mixing the micro-emulsion a stand alone centrifugal pump and hose system should be used for the shearing and mixing operations.

11) Advance drive rods through the ground surface, as necessary, following SOP.

12) Push the drive rod assembly with an expendable tip to the desired maximum depth. Regenesis suggests pre-counting the number of drive rods needed to reach depth prior to starting injection activities to avoid any miscalculations.

13) After the drive rods have been pushed to the desired depth, the rod assembly should be withdrawn three to six inches. The expendable tip can be dropped from the drive rods, following SOP.

14) If an injection tool is used instead of a direct-push rod with an expendable tip, the application of material can take place without any preliminary withdrawal of the rods.

15) In some cases, introduction of a large column of air may be problematic. This is particularly the case in deep injections (>50 ft) with large diameter rods (>1.5-inch O.D.). To prevent the injection of air into the aquifer during the application, fill the drive rods with 3DMe emulsion after they have been pushed to the desired depth and before the disposable tip has been dropped or before the injection tip is operational.

16) Transfer the appropriate quantity of the micro-emulsion from the water trailer to the working/application pump hopper or associated holding tank.

17) A volume check should be performed prior to the injection of the micro-emulsion. Determining the volume discharged per unit time/stroke using a graduated bucket and stopwatch or stroke counter.

18) Start the pump and use the graduated bucket to determine how many gallons of micro-emulsion are delivered each minute or stroke per unit volume.

19) Connect the 1.25-inch O.D., 1-inch I.D. delivery hose to the pump outlet and the appropriate sub-assembly. Circulate the micro-emulsion through the hose and the sub-assembly to displace any air present in the system.

20) Connect the sub-assembly to the drive rod. After confirming that all of the connections are secure, pump the micro-emulsion through the delivery system to displace any water or other fluids in the rods.

21) The pump engine RPM and hydraulic settings should remain constant throughout the day to maintain a constant discharge rate.

22) The material is now ready to be installed in the subsurface. Use the pumps discharge rate as calculated in step 18 to determine the withdrawal rate of the drive rods needed for the application.

23) Slowly withdraw the drive rods using Geoprobe Rod Grip or Pull Plate Assembly (Part AT1222-For 1.25-inch drive rods). While slowly withdrawing single lengths of drive rod (three or four feet), pump the pre-determined volume of micro-emulsion into the aquifer across the desired treatment interval.

24) Remove one or two sections of the drive rod at a time. The drive rod may contain some residual material so Regenesis suggests placing it in a clean, empty bucket and allowing the material to drain. Eventually, the material recovered in the bucket should be returned to the pump hopper for reuse.

25) Observe any indications of aquifer refusal such as “surfacing” around the injection rods or previously installed injection points. If aquifer acceptance appears to be low, allow enough time for the aquifer to equilibrate prior to removing the drive rod.

26) Repeat steps 19 through 25 until treatment of the entire contaminated vertical zone has been achieved.

27) Install an appropriate seal, such as bentonite, above the micro-emulsion injection zone. The seal should span across the entire vadose zone. Depending on soil conditions and local regulations, a bentonite seal using chips or pellets can be used. If the injection hole remains open more than three or four feet below the ground surface sand can be used to fill the hole and provide a base for the bentonite seal. The installation of an appropriate seal assures that

the micro-emulsion remains properly placed and prevents contaminant migration from the surface. If the micro-emulsion continues to “surface” up the direct-push borehole, an oversized disposable drive tip or wood plug/stake can be used to temporarily plug the hole until the aquifer equilibrates and the material stops surfacing.

28) Remove and clean the drive rods as necessary.

29) Finish the borehole at the surface as appropriate (concrete or asphalt cap, if necessary).

30) Periodically compare the pre- and post-injection discharge rates of the micro-emulsion in the pump hopper or holding tank using any pre-marked volume levels. If volume level indicators are not on the pumps hopper or holding tank use a pre-marked dipstick or alternatively temporary mark the hopper or holding tank with known quantities/volumes of water using a carpenter’s grease pencil (Kiel crayon).

31) Move to the next probe point, repeating steps 11 through 29.

Helpful Hints

1) *Application in Cold Weather Settings*

As discussed in the Material Overview, Handling, and Safety section, cold weather tends to increase the viscosity of 3DMe as well as decrease the ease of micro-emulsion formation. To optimize an application in cold weather settings Regenesis recommends maintaining the 3DMe concentrate and the associated water at a temperature ≥60°F (16°C). The following procedures can be used to facilitate the production and installation of a 10:1 v/v 3DMe micro-emulsion.

- Raise and maintain the temperature of the HRC-A to at least 60°F (16°C) prior to mixing with water. A hot water bath can be used to heat up the 3DMe concentrate buckets. A Rubbermaid fiberglass Farm Trough Stock Tank (Model 4242-00-GRAY) has been used for this process. This trough can hold up to 16 buckets of 3DMe concentrate.
- Hot water (approximately 130-170°F or 54-77°C) should be added to the tank after the buckets of 3DMe have been placed inside. The hot water should be delivered from a heated pressure washer (Hotsy® Model No. 444 or equivalent) or steam cleaner unit.
- It is equally critical that a moderate water temperature (>60°F or 16°C) be used in the production of the micro-emulsion. If on-site water supply is below 60°F use a hot water or steam cleaner to generate a small volume (e.g. 5-10% of total water volume) of hot water (130–170°F/54-77°C). This small volume of hot water should be added to remaining cold water volume to raise the total volume temperature to >60°F. When the 3DMe concentrate and water each reach a minimum temperature of 60°F or 16°C the two materials are ready for mixing.

- Upon achieving a minimum temperature of 60°F or 16°C (approximately 10-20 minutes). When the 3DMe and the associated water volumes have reached a minimum temperature of 60°F or 16°C (approximately 10-20 minutes) they are ready for mixing.

- In exceptionally harsh winter temperature settings use of a separate insulated pump containment structure and insulated delivery hoses may be necessary.

- Use a pump with a heater unit.
- Periodically check the temperature of the material in the hopper.
- Re-circulate the 3DMe micro-emulsion through the pump and hose to maintain temperature adequate temperatures.
- Care should be taken to avoid the re-circulation of material volumes that exceed the volume of the pump hopper or holding tank.

Table 1: Equipment Volume and 3DMe Micro-Emulsion Weight per Unit Length of Hose (Feet)

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

2) *Pump Cleaning*

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

NOTE:

Before using the Rupe Pump, check the following:

- Fuel level prior to engaging in pumping activities (it would be best to start with a full tank)
- Remote control/pump stroke counter LCD display [if no display is present, the electronic counter will need to be replaced (Grainger Stock No. 2A540)]

Monitor pump strokes by observing the proximity switches (these are located on the top of the piston).

3) *Bedrock Applications*

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

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

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

For further assistance or questions please contact Regenesis Technical Services at 949-366-8000.

3-D MicroEmulsion™
HRC ADVANCED®

S-MicroZVI Specification Sheet

S-MicroZVI Technical Description

S-MicroZVI® is an *In Situ* Chemical Reduction (ISCR) reagent that promotes the destruction of many organic pollutants and is most commonly used with chlorinated hydrocarbons. It is engineered to provide an optimal source of micro-scale zero valent iron (ZVI) that is both easy to use and delivers enhanced reactivity with the target contaminants via multiple pathways. S-MicroZVI can destroy many chlorinated contaminants through a direct chemical reaction (**see Figure 1**). S-MicroZVI will also stimulate anaerobic biological degradation by rapidly creating a reducing environment that is favorable for reductive dechlorination.

Sulfidated ZVI

S-MicroZVI is composed of colloidal, sulfidated zero-valent iron particles suspended in glycerol using proprietary environmentally acceptable dispersants. The passivation technique of sulfidation, completed using proprietary processing methods, provides unparalleled reactivity with chlorinated hydrocarbons like PCE and TCE and increases its stability and longevity by minimizing undesirable side reactions.

S-MicroZVI is Best in Class For

☑ Longevity
☑ Reactivity
☑ Transport

In addition to superior reactivity, S-MicroZVI is designed for easy handling that is unmatched by any ZVI product on the market. Shipped as a liquid suspension, S-MicroZVI requires no powder feeders, no thickening with guar, and pneumatic or hydraulic fracturing is not mandatory. When diluted with water prior to application, the resulting suspension is easy to inject using either direct push or permanent injection wells.

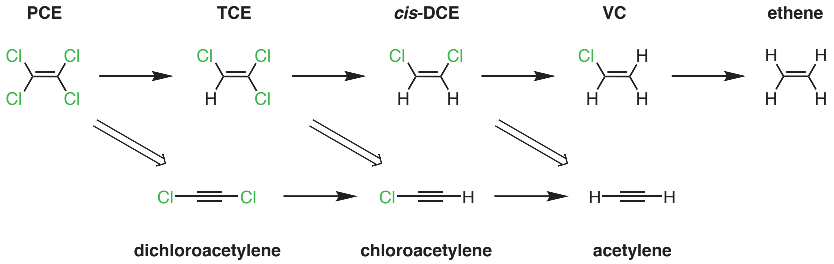

Figure 1: *Chlorinated ethene degradation pathways and products. The top pathway with single line arrows represent the reductive dechlorination (hydrogenolysis) pathway. The lower pathway with downward facing double line arrows represent the beta-elimination pathway.*

To see a list of treatable contaminants, view the S-MicroZVI treatable contaminants guide.

S-MicroZVI®
Sulfidated Zero-Valent Iron

S-MicroZVI Specification Sheet

Chemical Composition

Iron, powders CAS 7439-89-6
Iron (II) sulfide CAS 1317-37-9
Glycerol CAS 56-81-8

Properties

Physical State: Liquid
Form: Viscous metallic suspension
Color: Dark gray
Odor: Slight
pH: Typically 7-9 as applied
Density: 15 lb/gal

Storage and Handling Guidelines

Storage:

- Use within four weeks of delivery
- Store in original containers
- Store at temperatures below 95F°
- Store away from incompatible materials

Handling:

- Never mix with oxidants or acids
- Wear appropriate personal protective equipment
- Do not taste or swallow
- Observe good industrial hygiene practices

Applications

S-MicroZVI is diluted with water on site and easily applied into the subsurface through low-pressure injections. S-MicroZVI can also be mixed with products like 3-D Microemulsion® or PlumeStop® prior to injection.

Health and Safety

The material is relatively safe to handle; however, avoid contact with eyes, skin and clothing. OSHA Level D personal protection equipment including: vinyl or rubber gloves and eye protection are recommended when handling this product. Please review the Safety Data Sheet for additional storage, and handling requirements here: S-MicroZVI SDS.

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REGENESIS
Technology-Based Solutions for the Environment

SAFETY DATA SHEET

1. Identification

Product identifier	**S-MicroZVI or S-MZVI**
Other means of identification	None.
Recommended use	Remediation of contaminants in soil and groundwater.
Recommended restrictions	None known.
Manufacturer/Importer/Supplier/Distributor information	
Company Name	Regenesis
Address	1011 Calle Sombra San Clemente, CA 92673 USA
General information	949-366-8000
E-mail	CustomerService@regenesis.com
Emergency phone number	For Hazardous Materials Incidents ONLY (spill, leak, fire, exposure or accident), call CHEMTREC 24/7 at:
USA, Canada, Mexico	1-800-424-9300
International	1-703-527-3887

2. Hazard(s) identification

Physical hazards	Not classified.
Health hazards	Not classified.
OSHA defined hazards	Not classified.
Label elements	
Hazard symbol	None.
Signal word	None.
Hazard statement	The mixture does not meet the criteria for classification.
Precautionary statement	
Prevention	Observe good industrial hygiene practices.
Response	Wash hands after handling.
Storage	Store away from incompatible materials.
Disposal	Dispose of waste and residues in accordance with local authority requirements.
Hazard(s) not otherwise classified (HNOC)	None known.
Supplemental information	Contact with acids liberates very toxic gas.

3. Composition/information on ingredients

Mixtures

Chemical name	CAS number	%
Glycerol	56-81-5	40 - 50
Zero valent iron	7439-89-6	30 - 50
Iron(II) sulfide	1317-37-9	1 - 4

Composition comments	All concentrations are in percent by weight unless otherwise indicated. Components not listed are either non-hazardous or are below reportable limits.

4. First-aid measures

Inhalation	Move to fresh air. Call a physician if symptoms develop or persist.
Skin contact	Wash off with soap and water. Get medical attention if irritation develops and persists.

Eye contact	Rinse with water. Get medical attention if irritation develops and persists.
Ingestion	Rinse mouth. Get medical attention if symptoms occur.
Most important symptoms/effects, acute and delayed	Direct contact with eyes may cause temporary irritation.
Indication of immediate medical attention and special treatment needed	Treat symptomatically.
General information	Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

5. Fire-fighting measures

Suitable extinguishing media	Water fog. Foam. Dry chemical powder. Carbon dioxide (CO2).
Unsuitable extinguishing media	None known.
Specific hazards arising from the chemical	During fire, gases hazardous to health may be formed. Combustion products may include: carbon oxides, iron oxides.
Special protective equipment and precautions for firefighters	Self-contained breathing apparatus and full protective clothing must be worn in case of fire.
Fire fighting equipment/instructions	Move containers from fire area if you can do so without risk.
Specific methods	Use standard firefighting procedures and consider the hazards of other involved materials.
General fire hazards	This material will not burn until the water has evaporated. Residue can burn. When dry may form combustible dust concentrations in air.

6. Accidental release measures

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

7. Handling and storage

Precautions for safe handling	Avoid prolonged exposure. Observe good industrial hygiene practices.
Conditions for safe storage, including any incompatibilities	Store in original tightly closed container. Store away from incompatible materials (see Section 10 of the SDS).

8. Exposure controls/personal protection

Occupational exposure limits

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value	Form
Glycerol (CAS 56-81-5)	PEL	5 mg/m3	Respirable fraction.
		15 mg/m3	Total dust.

Biological limit values	No biological exposure limits noted for the ingredient(s).
Appropriate engineering controls	Good general ventilation should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level.

Individual protection measures, such as personal protective equipment

Eye/face protection	Wear safety glasses with side shields (or goggles).

Skin protection	
Hand protection	Wear appropriate chemical resistant gloves. Suitable gloves can be recommended by the glove supplier.
Skin protection	
Other	Wear suitable protective clothing.
Respiratory protection	In case of insufficient ventilation, wear suitable respiratory equipment.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
General hygiene considerations	Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

Appearance	
Physical state	Liquid.
Form	Viscous metallic suspension.
Color	Dark gray
Odor	Slight.
Odor threshold	Not available.
pH	7 - 8 (When mixed with water) 10 (As shipped)
Melting point/freezing point	Not available.
Initial boiling point and boiling range	Not available.
Flash point	Not available.
Evaporation rate	Not available.
Flammability (solid, gas)	Not applicable.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	Not available.
Flammability limit - upper (%)	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Relative density	Not available.
Solubility(ies)	
Solubility (water)	Not available.
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	3000 cP (77 °F (25 °C))
Other information	
Explosive properties	Not explosive.
Oxidizing properties	Not oxidizing.

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Material is stable under normal conditions.
Possibility of hazardous reactions	Contact with acids will release highly flammable and highly toxic hydrogen sulfide gas. Can react with some acids with the evolution of hydrogen.
Conditions to avoid	Contact with incompatible materials. Avoid drying out product. May generate combustible dust if material dries.
Incompatible materials	Strong oxidizing agents. Acids.

Hazardous decomposition products	No hazardous decomposition products are known.

11. Toxicological information

Information on likely routes of exposure

Inhalation	Spray mist may irritate the respiratory system. For dry material: Dust may irritate respiratory system.
Skin contact	Prolonged or repeated exposure may cause minor irritation.
Eye contact	Direct contact with eyes may cause temporary irritation.
Ingestion	May cause discomfort if swallowed.
Symptoms related to the physical, chemical and toxicological characteristics	Direct contact with eyes may cause temporary irritation.

Information on toxicological effects

Acute toxicity	Not expected to be acutely toxic.

Components	Species	Test Results
Glycerol (CAS 56-81-5)		
Acute		
Dermal		
LD50	Rabbit	> 18700 mg/kg
Oral		
LD50	Rat	27200 mg/kg

Skin corrosion/irritation	Prolonged skin contact may cause temporary irritation.
Serious eye damage/eye irritation	Direct contact with eyes may cause temporary irritation.
Respiratory or skin sensitization	
Respiratory sensitization	Not a respiratory sensitizer.
Skin sensitization	This product is not expected to cause skin sensitization.
Germ cell mutagenicity	No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.
Carcinogenicity	Not classifiable as to carcinogenicity to humans.

IARC Monographs. Overall Evaluation of Carcinogenicity

Not listed.

NTP Report on Carcinogens

Not listed.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1053)

Not regulated.

Reproductive toxicity	This product is not expected to cause reproductive or developmental effects.
Specific target organ toxicity - single exposure	Not classified.
Specific target organ toxicity - repeated exposure	Not classified.
Aspiration hazard	Not an aspiration hazard.
Further information	Contains an ingredient known to produce adverse effects in a small percentage of hypersensitive individuals exhibited as respiratory distress and allergic skin reactions.

12. Ecological information

Ecotoxicity	The product is not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.

Components		Species	Test Results
Glycerol (CAS 56-81-5)			
Aquatic			
Acute			
Crustacea	EC50	Daphnia magna	> 10000 mg/l, 24 Hours

Persistence and degradability	No data is available on the degradability of this product.
Bioaccumulative potential	No data available.

Partition coefficient n-octanol / water (log Kow)

Glycerol (CAS 56-81-5)	-1.76

Mobility in soil	No data available.
Other adverse effects	None known.

13. Disposal considerations

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

14. Transport information

DOT

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

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

15. Regulatory information

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

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

Not regulated.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

SARA 304 Emergency release notification

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1053)

Not regulated.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical	No

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

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

Not regulated.

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

Not regulated.

Safe Drinking Water Act (SDWA)	Not regulated.

FEMA Priority Substances Respiratory Health and Safety in the Flavor Manufacturing Workplace

Glycerol (CAS 56-81-5)	Other Flavoring Substances with OSHA PEL's

US state regulations

US. Massachusetts RTK - Substance List

Glycerol (CAS 56-81-5)

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

Glycerol (CAS 56-81-5)

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

Glycerol (CAS 56-81-5)

US. Rhode Island RTK

Glycerol (CAS 56-81-5)

California Proposition 65

California Safe Drinking Water and Toxic Enforcement Act of 2016 (Proposition 65): This material is not known to contain any chemicals currently listed as carcinogens or reproductive toxins. For more information go to www.P65Warnings.ca.gov.

US. California. Candidate Chemicals List. Safer Consumer Products Regulations (Cal. Code Regs, tit. 22, 69502.3, subd. (a))

Zero valent iron (CAS 7439-89-6)

International Inventories

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

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

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

Issue date	27-December-2018
Revision date	-
Version #	01
HMIS® ratings	Health: 1 Flammability: 1 Physical hazard: 0

NFPA ratings

Disclaimer

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

Application Instructions

S-MicroZVI® is a remediation amendment engineered for the *in situ* chemical reduction of chlorinated contaminants. The product features zero valent iron particles that are less than 5 microns in size and are suspended in a glycerol carrier. These materials are strong reductants and should never be combined with acids or oxidizers (see Health and Safety section).

S-MicroZVI Composition

40% sulfidated colloidal ZVI
45% food grade glycerol
15% water-based carrier

Physical Characteristics

Appearance: Dark gray viscous liquid
Viscosity: About 5000 cP (temperature dependent)
Density: 15 lb/gal

Helpful Chemical Property Measurements

The following solution characteristics measurements were obtained on a suspension mixture comprise of 4000 mg/L activated carbon from PlumeStop and 4000 mg/L zero valent iron from S-MicroZVI.

pH = 8.7
ORP = -492 mV
Conductivity = 2.36 mS/cm

Best Practices

Material Handling: S-MicroZVI is packaged in 50 lb buckets, 500 lb drums and 3000 lb totes. Use care/assistance if moving a tote with a pallet jack. A double diaphragm pump should be used to transfer S-MicroZVI from drums and totes into the mixing tank. Centrifugal drum pumps and dosing or metering pumps are not recommended due to the high viscosity of the material. Because of the low mass of S-MicroZVI typically required in the mixing tank, a bucket or similar container should be used to batch the ZVI material by weight or volume.

Mixing: S-MicroZVI should be homogenized in its packaging container before adding it into the mixing tank. Pails of S-MicroZVI are best mixed using a hand drill equipped with a paint mixer attachment. Totes and drums of S-MicroZVI should be mixed to a homogeneous consistency at the start of each application day using a 4 ft paint mixer attachment. As with all remedial reagents, it is a best practice to make sure the entire drum/tote is well mixed – including corners & bottom - before transferring into the mixing tank.

Mixing Order: Whenever S-MicroZVI is co-applied with other remedial reagents (PlumeStop®, 3D Microemulsion®, pH modifiers, etc.), the order of addition should be as follows:

1) Water
2) Other amendments (PlumeStop®, 3DME, etc.)
3) S-MicroZVI

Mix Tank: A conical tank less than 500 gal is recommended for batching. It should be equipped with a mixer than has enough power to gently agitate the mixture. The goal is to keep solids suspended without overly aerating the material.

Cleaning: Always thoroughly rinse all S-MicroZVI containers before disposal. Rinse water from this step should be placed into the mixing tank for application. Inspect tanks for any residue of reagents that were recently used in the tank. If there is any evidence rinse tank thoroughly. A thorough cleaning step should be performed at the end of each work day. This should be accomplished by flushing the entire injection system with municipal water.

Health & Safety

Risk Potential, Hydrogen Sulfide: S-MicroZVI will give off hydrogen sulfide (H2S) gas when exposed to acid. For this reason, it is imperative that low pH (acid) solutions NOT come into contact with solutions containing S-MicroZVI.

In the interest of safety, a hydrogen sulfide detector should be part of every S-MicroZVI application program.

Hydrogen sulfide is toxic, corrosive, and flammable. The threshold of odor detection for hydrogen sulfide is approximately 0.0005 ppm; however, at higher concentrations hydrogen sulfide will suppress the olfactory senses. For this reason, one's sense of smell is not a reliable method of detection, and failure to rely on a hydrogen sulfide detector can lead to overexposure and potentially death. The OSHA Permissible Exposure Limit for an 8-hour timeweighted average is 10 ppm, and hydrogen sulfide is classified as Immediately Dangerous to Life and Health at 100 ppm. With proper handling, no detectable hydrogen sulfide will be produced by S-MicroZVI.

Do not mix S-MicroZVI with acid, this includes HRC or HRC Primer.

- Adding acid to S-MicroZVI can cause hydrogen sulfide to be produced for many hours. If hydrogen sulfide is being produced, work must stop.

Do not combine S-MicroZVI with any oxidizing agent (PersulfOx®, RegenOx®, etc.)

- S-MicroZVI is a strong reductant. Combining
- S-MicroZVI with oxidizers will cause a vigorous exothermic reaction and has the potential to produce hydrogen sulfide.

Preferred Storage Conditions: S-MicroZVI should be stored in cool, dry places if possible. Indoor storage is preferred – if this is not available, seek a covered or shaded spot outdoors.

Shelf Life:** S-MicroZVI should be used within 4 weeks of arrival onsite.

** Shelf life may decrease with extreme temperatures. For situations where prolonged temperature may exceed 90F we advise to use the product as soon as possible. Small amounts of hydrogen gas may evolve from the material during storage. For this reason, buckets, drums, and totes are vented.

Handling Practices: Standard PPE should be used when handling S-MicroZVI. This includes eye protection, gloves and face shield when mixing.

There are some specific characteristics to keep in mind for these materials:

Density: A half-full pail may be heavier than it appears, use care when lifting.
Cleanliness: This product will stain clothes.
Slip concerns: S-MicroZVI can be very slick if spilled. In the event of a spill, use caution as the floor may be very slippery.

Do's & Don'ts

Do

✓ Use a diaphragm pump to transfer S-MicroZVI from totes or drums.
✓ Use a bucket or graduated vessel to measure S-MicroZVI for the mixing tank from totes or drums.
✓ Rinse each mix tank at the end of the day to prevent excess buildup of ZVI solids.
✓ Use tap water for rinsing and cleaning.
✓ Inject the equivalent of a 7-borehole volume of clear water into injection wells and any affected monitoring well upon completion of the injection program.
✓ BDI Plus™ and S-MicroZVI are compatible. Apply BDI Plus as typical.
✓ Use pails of S-MicroZVI within 2-3 days of opening.
✓ Use standard PPE when using S-MicroZVI. This includes safety glasses, face shield, and gloves.

Don't

✗ Use dose pumps, drum pumps, etc. to transfer S-MicroZVI.
✗ Store product below 30 degrees to avoid thickening.
✗ Use buckets that contained RegenOx®, PersulfOx®, HRC®, or HRC Primer.
✗ Leave suspensions containing S-MicroZVI in the mixing tank overnight or for an excess period (4-5 hours).
Ever add acid or oxidizers to S-MicroZVI.
✗ Use sodium bisulfite or other oxygen scavengers. These
✗ are unnecessary with S-MicroZVI.
Use partial pails of S-MicroZVI that were opened for a
✗ previous site.
When batching, add more than 50lb. of total suspension
✗ to pails

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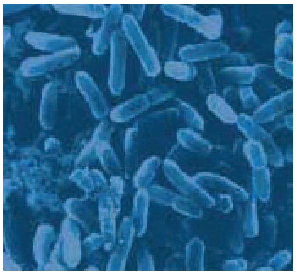
BIO-DECHLOR INOCULUM

BDI PLUS® Technical Description



Species of Dehalococcoides sp. (DHC)

Bio-Dechlor INOCULUM Plus (BDI PLUS®) is an enriched natural consortium containing species of Dehalococcoides sp. (DHC). BDI PLUS has been shown to simulate the rapid and complete dechlorination of chlorinated solvents such as tetrachloroethene (PCE), trichloroethene (TCE), dichloroethene (DCE) and vinyl chloride (VC) to non-toxic end products, ethene, carbon dioxide and water.

The culture also contains microbes capable of dehalogenating halomethanes (e.g., carbon tetrachloride and chloroform) and haloethanes (e.g., 1,1,1-TCA and 1,1-DCA) as well as mixtures of these contaminants.

For a list of treatable contaminants with the use of BDI PLUS, view the Range of Treatable Contaminants Guide

Chemical Composition

- Non-hazardous, naturally-occurring, non-altered anaerobic microbes and enzymes in a water-based medium.

Properties

- Appearance – Murky, yellow to grey water
- Odor – Musty
- pH 6.0 to 8.0
- Density – Approximately 1.0 grams per cubic centimeter (0.9 to 1.1 g/cc)
- Solubility – Soluble in Water
- Vapor Pressure – None
- Non-hazardous

Storage and Handling Guidelines

Storage
Store in original tightly closed container
Store away from incompatible materials
Recommended storage containers: plastic lined steel, plastic, glass, aluminum, stainless steel, or reinforced fiberglass
Store in a cool, dry area at 4-5°C (39 - 41°F)
Material may be stored for up to 3 weeks at 2-4°C without aeration

Handling
Avoid prolonged exposure
Observe good industrial hygiene practices
Wear appropriate personal protective equipment

BIO-DECHLOR
INOCULUM

BDI PLUS® Technical Description

Applications

- BDI PLUS is delivered to the site in liquid form and is designed to be injected directly into the saturated zone requiring treatment.
- Most often diluted with de-oxygenated water prior to injection into either hydraulic push injection points or properly constructed injection wells.
- The typical dilution rate of the injected culture is 10 gallons of deoxygenated water to 1 liter of standard BDI PLUS culture.

Application instructions for this product are contained here BDI PLUS Application Instructions.

Health and Safety

Material is non-hazardous and relatively safe to handle; however avoid contact with eyes and prolonged contact with skin. OSHA Level D personal protection equipment including: vinyl or rubber gloves and safety goggles or a splash shield are recommended when handling this product. An eyewash station is recommended. Please review the Material Safety Data Sheet for additional storage, usage, and handling requirements here: BDI PLUS SDS.

REGENESIS

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

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REGENESIS
Technology-Based Solutions for the Environment

SAFETY DATA SHEET

1. Identification

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

Manufacturer/Importer/Supplier/Distributor information

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

2. Hazard(s) identification

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

3. Composition/information on ingredients

Mixtures

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

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

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

4. First-aid measures

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

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

5. Fire-fighting measures

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

6. Accidental release measures

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

7. Handling and storage

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

8. Exposure controls/personal protection

Occupational exposure limits	No exposure limits noted for ingredient(s).
Biological limit values	No biological exposure limits noted for the ingredient(s).
Appropriate engineering controls	General ventilation normally adequate. Provide eyewash station.

Individual protection measures, such as personal protective equipment

Eye/face protection	Tightly fitting safety goggles.
Skin protection	
Hand protection	The following glove materials are recommended: vinyl or rubber.
Other	Wear suitable protective clothing.
Respiratory protection	Not normally needed. In case of insufficient ventilation, wear suitable respiratory equipment. If engineering controls do not maintain airborne concentrations below recommended exposure limits (where applicable) or to an acceptable level (in countries where exposure limits have not been established), an approved respirator must be worn.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
General hygiene considerations	Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

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

10. Stability and reactivity

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

11. Toxicological information

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

Information on toxicological effects

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

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

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

12. Ecological information

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

13. Disposal considerations

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

14. Transport information

DOT

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

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

15. Regulatory information

US federal regulations

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

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

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

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical No

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

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

Not regulated.

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

Not regulated.

Safe Drinking Water Act (SDWA) Not regulated.

US state regulations

US. Massachusetts RTK - Substance List

Not regulated.

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

Not listed.

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

Not listed.

US. Rhode Island RTK

Not regulated.

US. California Proposition 65

Not Listed.

International Inventories

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

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

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

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

Issue date	12-February-2015
Revision date	-
Version #	01
Further information	HMIS® is a registered trade and service mark of the American Coatings Association (ACA).
HMIS® ratings	Health: 0 Flammability: 0 Physical hazard: 0

NFPA ratings

Disclaimer

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

REGENESIS
Advanced Technologies for Groundwater Resources

Bio-Dechlor INOCULUM PLUS (BDI PLUS™)

Application Instructions

(Direct-Push Injection)

General Information

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

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

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

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

Material Packaging and Safety

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

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

WARNING

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

UNPACKING

1. Carefully remove the container from shipping cooler and stand upright. DO NOT use the plastic sight tube as a handle.
2. Carefully check the container, connectors, valves and tubing for any damage or defects. If defects or damage is observed, do not use. Report any damage to Regenesis at 949-366-8000. A back up set of quick connects is provided in the packaging material.
3. Check and ensure that all valves are in the CLOSED position.

Culture Keg in Cooler

STORAGE

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

SHIPPING

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

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

Specific Installation Procedures

1. The BDI PLUS must be added to the previously prepared "oxygen-free" water before it is installed in the subsurface. The desired amount of BDI PLUS should be carefully discharged into the 55-gal drum containing the appropriate amount of "oxygen free" water. The tables provided below indicates the amount of water that a given amount of BDI PLUS should be mixed with.

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

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

Volume of BDI PLUS™	**Volume of water**
5 liters	50 gal
1 liter	10 gal

Volume of BDI PLUS™ **concentrate**	**Volume of water**
0.5 liters	50 gal
0.1 liter	10 gal

BDI PLUS Dilution Chart

2. The drive rod assembly should be fitted with a disposable tip on the first drive rod and pushed down to the desired depth. This process should be done in accordance with the manufacturer's standard operating procedure (SOP).
3. A sub-assembly connecting the delivery hose to the drive rods and pump should be used. The sub-assembly should be constructed in a manner that allows for the drive rods to be withdrawn while the material is being pumped.
4. Prior to connecting the hose to the sub-assembly a volume check should be completed to determine the volume and weight of product displaced with each pump stroke.
5. After the drive rods have been pushed to the desired depth, the rod assembly should be withdrawn three to six inches so that the disposable tip has room to be dropped.
   a. If an injection tool is used instead of an expendable tip, the application of material can take place without any preliminary withdrawal of the rods.
6. Fill the annular space of the drive rods with water. This will minimize the amount of air introduced to the system.

7. Insert the telescoping suction pipe on the rotary transfer pump into a bung hole on the lid of the 55-gal drum and make sure that the pipe reaches the bottom of the drum. If possible, attach the suction pipe to the bung hole with the 2” bung adapter to ensure that the pump remains securely in place while pumping the Bio-Dechlor INOCULUM mixture from the drum to the pump hopper.
8. Attach the hose to the outlet of the rotary transfer pump making sure that the opposite end of the hose reaches the pump hopper. Open the opposite bung hole on the drum lid to prevent a vacuum then pump the desired amount of BDI PLUS solution into the hopper of the pump.
9. Connect the hose from the grout pump to the drive rod assembly.
10. Start pumping the BDI PLUS product solution.
11. The initial volume of BDI PLUS solution pumped should only be enough to displace the water within the drive rods. Once this is done the actual injection can start.
12. Begin withdrawing the drive rods, in accordance with the manufacturer’s SOP, and start pumping the BDI PLUS solution simultaneously. The dosage should be 0.1 liter per vertical foot or 1 gallon per vertical foot if prepared using the BDI dilution chart. The withdrawal rate should be such that it allows the appropriate quantity of material to be injected into each vertical foot of aquifer being treated. The withdrawal rate should be slow to avoid creating a vacuum. This vacuum can potentially pull a small volume of material to the surface if the drive rods are withdrawn too quickly.
13. In less permeable soils such as clays and silts, there may be difficulty accepting the volume of estimated material. In this case Regenesis recommends using a “step-wise” application approach. For this approach we suggest withdrawing the drive rods in one-foot increments and then injecting the quantity of material required per vertical foot.
14. Look for any indications of aquifer refusal such as:
    - Excessive pump noise or application pressure spikes (e.g. squealing)
    - Surfacing of material through the injection point (“blow-by”)

If acceptance appears to be an issue it is critical that the aquifer is given enough time to equilibrate before breaking down the drive rods and/or removing the hose. The failure to do this can lead to excessive back flow of the BDI PLUS material on personnel, equipment, and the ground surface.

15. If BDI PLUS solution continues to "surface" after the drive rods have been completely removed from the borehole a plug may be necessary. Large diameter disposable tips or wood stakes have been used successfully for this purpose.
16. Drive rods should be disconnected after one rod (typically 4 feet in length) has been withdrawn. The drive rods should be placed in a bucket (or equivalent) after they have been disconnected.
17. Complete the installation of the BDI PLUS solution at the designated application rate across the entire targeted vertical interval.
18. After the injection is completed, an appropriate seal should be installed above the vertical interval where the BDI PLUS solution has been placed to prevent contaminant migration. Typically, bentonite powder or chips are used to create this seal. However, consultants should review local regulations before beginning field installation activities to confirm that this approach can be used.
19. Complete the borehole at the surface as appropriate using concrete or asphalt.
20. Repeat steps 7 through 19 until the entire application has been completed. If additional drums of de-oxygenated water are required, prepare as suggested in Step 1.
21. Prior to the installation of BDI PLUS, all surface and overhead impediments should be identified as well as the location(s) of any underground structure(s). Underground structures include but are not limited to: utility lines (gas, electrical, sewer, etc), drain piping, and landscape irrigation systems.
22. The planned injection locations should be adjusted in the field to account for impediments and obstacles.
23. The actual injection locations should be marked prior to the start of installation activities to facilitate the application process.
24. Using an appropriate pump to install the BDI PLUS product is very critical to the success of the application as well as the overall success of the project. Based on our experience in the field, Regenesis strongly recommends using a pump that has a pressure rating of at least 1,000 psi and a delivery rate of at least 3 gallons per minute.

    If the application involves both HRC and BDI PLUS, two separate pumps may be required to facilitate the process. The pump used to deliver HRC to the subsurface should be in accordance with the specifications outlined in the General Guidelines section of the HRC Installation Instructions.

Additional Information

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

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

REGENESIS
Advanced Technologies for Groundwater Resources

1011 Calle Sombra
San Clemente, CA 92673
949-366-8000

PlumeStop® Liquid Activated Carbon™ Technical Description

Distribution of PlumeStop in water

PlumeStop Liquid Activated Carbon is an innovative groundwater remediation technology designed to rapidly remove and permanently degrade groundwater contaminants. PlumeStop is composed of very fine particles of activated carbon (1-2µm) suspended in water through the use of unique organic polymer dispersion chemistry. Once in the subsurface, the material behaves as a colloidal biomatrix, binding to the aquifer matrix, rapidly removing contaminants from groundwater, and expediting permanent contaminant biodegradation.

This unique remediation technology accomplishes treatment with the use of highly dispersible, fast-acting, sorption-based technology, capturing and concentrating dissolved-phase contaminants within its matrix-like structure. Once contaminants are sorbed onto the regenerative matrix, biodegradation processes achieve complete remediation at an accelerated rate.

To see a list of treatable contaminants with the use of PlumeStop, view the Range of Treatable Contaminants Guide.

Chemical Composition

- Water - CAS# 7732-18-5
- Colloidal Activated Carbon ≤2.5 - CAS# µm 7440-44-0
- Proprietary Additives

Properties

- Physical state: Liquid
- Form: Aqueous suspension
- Color: Black
- Odor: Odorless
- pH: 8 - 10

Storage and Handling Guidelines

Storage
Store in original tightly closed container
Store away from incompatible materials
Protect from freezing

Handling
Avoid contact with skin and eyes
Avoid prolonged exposure
Observe good industrial hygiene practices
Wash thoroughly after handling
Wear appropriate personal protective equipment

PlumeStop® Liquid Activated Carbon™ Technical Description

Applications

PlumeStop is easily applied into the subsurface through gravity-feed or low-pressure injection.

Health and Safety

Wash hands after handling. Dispose of waste and residues in accordance with local authority requirements. Please review the Material Safety Data Sheet for additional storage, usage, and handling requirements here: PlumeStop SDS.

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All other trademarks are the property of their respective owners.

REGENESIS

Technology-Based Solutions for the Environment

SAFETY DATA SHEET

1. Identification

Product identifier	**PlumeSTOP®**
Other means of identification	None.
Recommended use	Soil and Groundwater Remediation.
Recommended restrictions	None known.

Manufacturer/Importer/Supplier/Distributor information

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

2. Hazard(s) identification

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

Label elements

Hazard symbol	None.
Signal word	None.
Hazard statement	The mixture does not meet the criteria for classification.

Precautionary statement

Prevention	Observe good industrial hygiene practices.
Response	Wash hands after handling.
Storage	Store away from incompatible materials.
Disposal	Dispose of waste and residues in accordance with local authority requirements.
Hazard(s) not otherwise classified (HNOC)	None known.

3. Composition/information on ingredients

Mixtures

Chemical name	CAS number	%
Water	7732-18-5	>75
Colloidal activated carbon ≤2.5 µm	7440-44-0	<25
Proprietary additives		≤2

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

4. First-aid measures

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

Indication of immediate medical attention and special treatment needed	Treat symptomatically.
General information	If you feel unwell, seek medical advice (show the label where possible). Show this safety data sheet to the doctor in attendance.

5. Fire-fighting measures

Suitable extinguishing media	Carbon dioxide, alcohol-resistant foam, dry chemical, water spray, or water fog.
Unsuitable extinguishing media	None known.
Specific hazards arising from the chemical	During fire, gases hazardous to health may be formed. Combustion products may include: carbon monoxide, carbon dioxide, sodium oxides, metal oxides.
Special protective equipment and precautions for firefighters	Use protective equipment appropriate for surrounding materials.
Fire fighting equipment/instructions	Move containers from fire area if you can do so without risk.
Specific methods	Use standard firefighting procedures and consider the hazards of other involved materials. Use water spray to keep fire-exposed containers cool.
General fire hazards	This material will not burn until the water has evaporated. Residue can burn. When dry may form combustible dust concentrations in air.

6. Accidental release measures

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

7. Handling and storage

Precautions for safe handling	Avoid contact with skin and eyes. Avoid prolonged exposure. Observe good industrial hygiene practices. Wash thoroughly after handling. Wear appropriate personal protective equipment (See Section 8).
Conditions for safe storage, including any incompatibilities	Store in original tightly closed container. Store away from incompatible materials (see Section 10 of the SDS). Protect from freezing.

8. Exposure controls/personal protection

Occupational exposure limits

US. OSHA Table Z-3 (29 CFR 1910.1000)

Components	Type	Value	Form
Colloidal activated carbon ≤2.5 µm (CAS 7440-44-0)	TWA	5 mg/m3	Respirable fraction.
		15 mg/m3	Total dust.

US. NIOSH: Pocket Guide to Chemical Hazards

Components	Type	Value	Form
Colloidal activated carbon ≤2.5 µm (CAS 7440-44-0)	TWA	2.5 mg/m3	Respirable.

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

Individual protection measures, such as personal protective equipment

Eye/face protection	Wear approved chemical safety goggles.
Skin protection	
Hand protection	Rubber, neoprene or PVC gloves are recommended. Wash hands after handling.
Other	Avoid contact with the skin. Wear suitable protective clothing.
Respiratory protection	Not normally needed. In case of insufficient ventilation, wear suitable respiratory equipment. If engineering controls do not maintain airborne concentrations below recommended exposure limits (where applicable) or to an acceptable level (in countries where exposure limits have not been established), an approved respirator must be worn.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
General hygiene considerations	Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

Appearance	
Physical state	Liquid.
Form	Aqueous suspension.
Color	Black.
Odor	Odorless.
Odor threshold	Not available.
pH	8 - 10
Melting point/freezing point	Not available.
Initial boiling point and boiling range	Not available.
Flash point	Not flammable.
Evaporation rate	Not available.
Flammability (solid, gas)	Not applicable.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	Not available.
Flammability limit - upper (%)	Not available.
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Relative density	1 - 1.2
Solubility(ies)	
Solubility (water)	Miscible
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	Not available.

10. Stability and reactivity

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

Hazardous decomposition products	Combustion may produce: carbon oxides.

11. Toxicological information

Information on likely routes of exposure

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

Information on toxicological effects

Acute toxicity	Not expected to be acutely toxic.

Components	Species	Test Results
Colloidal activated carbon ≤2.5 µm (CAS 7440-44-0)		
Acute		
Inhalation		
LC50	Rat	> 8500 mg/m³, air
Oral		
LD50	Rat	> 2000 mg/kg, (Female)

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

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

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

12. Ecological information

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

13. Disposal considerations

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

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

14. Transport information

DOT

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

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

15. Regulatory information

US federal regulations	All components are listed on or exempt from the U.S. EPA TSCA Inventory List. This product is not known to be a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

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

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

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

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical	No

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

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

Not regulated.

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

Not regulated.

Safe Drinking Water Act (SDWA)	Not regulated.

US state regulations

US. Massachusetts RTK - Substance List

Not regulated.

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

Colloidal activated carbon ≤2.5 µm (CAS 7440-44-0)

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

Not listed.

US. Rhode Island RTK

Not regulated.

US. California Proposition 65

Not Listed.

International Inventories

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

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

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

Issue date	26-February-2015
Revision date	-
Version #	01
Further information	HMIS® is a registered trade and service mark of the American Coatings Association (ACA).
HMIS® ratings	Health: 0 Flammability: 0 Physical hazard: 0
NFPA ratings	
Disclaimer	Regenesis cannot anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use. The information in the sheet was written based on the best knowledge and experience currently available.

REGENESIS
Technology-Based Solutions for the Environment

SAFETY DATA SHEET

1. Identification

Product identifier	**PlumeSTOP® Nutrients**
Other means of identification	None.
Recommended use	Soil and Groundwater Remediation.
Recommended restrictions	None known.

Manufacturer/Importer/Supplier/Distributor information

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

2. Hazard(s) identification

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

Label elements

Hazard symbol	None.
Signal word	None.
Hazard statement	The mixture does not meet the criteria for classification.

Precautionary statement

Prevention	Observe good industrial hygiene practices.
Response	Wash hands after handling.
Storage	Store away from incompatible materials.
Disposal	Dispose of waste and residues in accordance with local authority requirements.
Hazard(s) not otherwise classified (HNOC)	None known.
Supplemental information	None.

3. Composition/information on ingredients

Mixtures

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

4. First-aid measures

Inhalation	Move to fresh air. Call a physician if symptoms develop or persist.
Skin contact	Wash off with soap and water. Get medical attention if irritation develops and persists.
Eye contact	Do not rub eyes. Rinse with water. Get medical attention if irritation develops and persists.
Ingestion	Rinse mouth. Get medical attention if symptoms occur.
Most important symptoms/effects, acute and delayed	Dusts may irritate the respiratory tract, skin and eyes.
Indication of immediate medical attention and special treatment needed	Treat symptomatically.
General information	Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

5. Fire-fighting measures

Suitable extinguishing media	Water fog. Foam. Dry chemical powder. Carbon dioxide (CO2). Apply extinguishing media carefully to avoid creating airborne dust.
Unsuitable extinguishing media	None known.
Specific hazards arising from the chemical	During fire, gases hazardous to health may be formed.
Special protective equipment and precautions for firefighters	Self-contained breathing apparatus and full protective clothing must be worn in case of fire.
Fire fighting equipment/instructions	Use water spray to cool unopened containers. Avoid dust formation.
Specific methods	Use standard firefighting procedures and consider the hazards of other involved materials.
General fire hazards	No unusual fire or explosion hazards noted.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures	Keep unnecessary personnel away. Wear appropriate protective equipment and clothing during clean-up. Use a NIOSH/MSHA approved respirator if there is a risk of exposure to dust/fume at levels exceeding the exposure limits. For personal protection, see section 8 of the SDS.
Methods and materials for containment and cleaning up	Avoid the generation of dusts during clean-up. Collect dust using a vacuum cleaner equipped with HEPA filter. This product is miscible in water. Stop the flow of material, if this is without risk. Large Spills: Wet down with water and dike for later disposal. Shovel the material into waste container. Following product recovery, flush area with water. Small Spills: Sweep up or vacuum up spillage and collect in suitable container for disposal. For waste disposal, see section 13 of the SDS.
Environmental precautions	Avoid discharge into drains, water courses or onto the ground.

7. Handling and storage

Precautions for safe handling	Minimize dust generation and accumulation. Provide appropriate exhaust ventilation at places where dust is formed. Practice good housekeeping.
Conditions for safe storage, including any incompatibilities	Store in original tightly closed container. Store in a well-ventilated place. Store away from incompatible materials (see Section 10 of the SDS).

8. Exposure controls/personal protection

Occupational exposure limits

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value	Form
PlumeSTOP® Nutrients (as dust)	PEL	5 mg/m3	Respirable fraction.
		15 mg/m3	Total dust.

US. OSHA Table Z-3 (29 CFR 1910.1000)

Components	Type	Value	Form
PlumeSTOP® Nutrients (as dust)	TWA	5 mg/m3	Respirable fraction.
		15 mg/m3	Total dust.
		50 mppcf	Total dust.
		15 mppcf	Respirable fraction.

US. ACGIH Threshold Limit Values

Components	Type	Value	Form
PlumeSTOP® Nutrients (as dust)	TWA	3 mg/m3	Respirable particles.
		10 mg/m3	Inhalable particles.

Biological limit values	No biological exposure limits noted for the ingredient(s).
Appropriate engineering controls	Ensure adequate ventilation, especially in confined areas. Local exhaust is suggested for use, where possible, in enclosed or confined spaces.

Individual protection measures, such as personal protective equipment

Eye/face protection	Wear safety glasses with side shields (or goggles). Unvented, tight fitting goggles should be worn in dusty areas.
Skin protection	
Hand protection	Wear appropriate chemical resistant gloves. Suitable gloves can be recommended by the glove supplier.
Skin protection	
Other	Wear suitable protective clothing.
Respiratory protection	In case of inadequate ventilation, use MSHA/NIOSH approved dust respirator.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
General hygiene considerations	Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

Appearance	
Physical state	Solid.
Form	Powder.
Color	White.
Odor	Odorless.
Odor threshold	Not available.
pH	Not available.
Melting point/freezing point	Not available.
Initial boiling point and boiling range	Not available.
Flash point	Not available.
Evaporation rate	Not available.
Flammability (solid, gas)	The product is non-combustible.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	Not available.
Flammability limit - upper (%)	Not available.
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Relative density	Not available.
Solubility(ies)	
Solubility (water)	Completely soluble.
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	Not available.
Other information	
Explosive properties	Not explosive.
Oxidizing properties	Not oxidizing.

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Material is stable under normal conditions.

Possibility of hazardous reactions	No dangerous reaction known under conditions of normal use. Ammonia fumes may be released upon heating.
Conditions to avoid	Contact with incompatible materials. Excessive heat.
Incompatible materials	Strong oxidizing agents. Bases.
Hazardous decomposition products	Ammonia fumes may be released upon heating.

11. Toxicological information

Information on likely routes of exposure

Inhalation	Dust may irritate respiratory system.
Skin contact	Dust or powder may irritate the skin.
Eye contact	Dust may irritate the eyes.
Ingestion	Expected to be a low ingestion hazard.
Symptoms related to the physical, chemical and toxicological characteristics	Dusts may irritate the respiratory tract, skin and eyes.

Information on toxicological effects

Acute toxicity	Not expected to be acutely toxic.
Skin corrosion/irritation	Prolonged skin contact may cause temporary irritation.
Serious eye damage/eye irritation	Direct contact with eyes may cause temporary irritation.

Respiratory or skin sensitization

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

IARC Monographs. Overall Evaluation of Carcinogenicity

Not listed.

NTP Report on Carcinogens

Not listed.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not regulated.

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

12. Ecological information

Ecotoxicity	The product is not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.
Persistence and degradability	No data is available on the degradability of this product.
Bioaccumulative potential	No data available.
Mobility in soil	This product is completely water soluble and will disperse in soil.
Other adverse effects	No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation potential, endocrine disruption, global warming potential) are expected from this component.

13. Disposal considerations

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

Waste from residues / unused products Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).

Contaminated packaging Since emptied containers may retain product residue, follow label warnings even after container is emptied. Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport information

DOT

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

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

15. Regulatory information

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

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

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not regulated.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

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

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical No

SARA 313 (TRI reporting)

Chemical name	CAS number	% by wt.
Ammonium sulfate	7783-20-2	40-50

Other federal regulations

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

Not regulated.

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

Not regulated.

Safe Drinking Water Act (SDWA) Not regulated.

US state regulations

US. Massachusetts RTK - Substance List

Ammonium sulfate (CAS 7783-20-2)

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

Not listed.

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

Ammonium sulfate (CAS 7783-20-2)

US. Rhode Island RTK

Not regulated.

US. California Proposition 65

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

International Inventories

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

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

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

Issue date	07-January-2016
Revision date	-
Version #	01
HMIS® ratings	Health: 1 Flammability: 0 Physical hazard: 0
NFPA ratings	
Disclaimer	Regenesis cannot anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use. The information in the sheet was written based on the best knowledge and experience currently available.

PersulfOx® Technical Description

PersulfOx is an *In Situ* Chemical Oxidation (ISCO) reagent that destroys organic contaminants found in groundwater and soil through powerful, yet controlled, chemical reactions. A sodium persulfate-based technology (figure 1), PersulfOx employs a patented catalyst to enhance the oxidative destruction of both hydrocarbons and chlorinated contaminants in the subsurface.


Example of PersulfOx

Typically, sodium persulfate is activated with the addition of heat, chelated metals, hydrogen peroxide, or base in order to generate sulfate radicals. These activation processes are inherently complex, costly and can pose additional health and safety risks. In comparison, PersulfOx is a relatively safe and easy-to-use ISCO agent with a built-in catalyst which activates the persulfate component, generating contaminant-destroying free radicals without the need for the addition of a separate activator. The equation below shows the net complete oxidation of toluene, a constituent of gasoline, by PersulfOx:

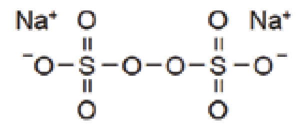

FIGURE 1: SODIUM PERSULFATE CHEMICAL STRUCTURE

For a list of treatable contaminants with the use of PersulfOx, view the Range of Treatable Contaminants Guide

Chemical Composition

- Sodium Persulfate - CAS #7775-27-1
- Sodium Silicate - CAS #1344-09-8

Properties

- pH - 7 to 11.5 at 25°C
- Appearance – White, free-flowing powder, clear to cloudy when mixed with water
- Odor – Not detectable
- Vapor Pressure – None
- Chemical Hazard Classification - Class 5.1 Oxidizer

Storage and Handling Guidelines

Storage
Store locked up
Keep away from heat
Store in a cool, dry place out of direct sunlight

Handling
Minimize dust generation and accumulation
Routine housekeeping should be instituted to ensure that dust does not accumulate on surfaces

PersulfOx® Technical Description

Storage (continued)
Store in original tightly closed container
Store in a well-ventilated place
Do not store near combustible materials
Store away from incompatible materials
Recommended to store at less than 40°C
Provide appropriate exhaust ventilation in places where dust is formed

Handling (continued)
Avoid mixing with combustibles
Avoid contamination
Keep away from clothing and other combustible materials
Wear appropriate personal protective equipment
Avoid breathing dust
Avoid contact with eyes, skin, and clothing
Avoid prolonged exposure
Do not taste or swallow
When using, do not eat, drink or smoke
Wear appropriate personal protective equipment
Wash hands thoroughly after handling
Observe good industrial hygiene practices

Applications

- PersulfOx is mixed with water at a rate of 5% to 20% prior to application.
- For most applications, REGENESIS suggests a 10-15% solution. The resulting mixture has viscosity similar to water.
- Injects into formation through direct push injection points, injection wells or other injection delivery systems.

Application instructions for this product are contained here PersulfOx Application Instructions.

Health and Safety

Material is relatively safe to handle; however, avoid contact with eyes, skin and clothing. OSHA Level D personal protection equipment including: vinyl or rubber gloves, eye protection, and dust mask are recommended when handling this product. Please review the Material Safety Data Sheet for additional storage, usage, and handling requirements here: PersulfOx SDS.

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SAFETY DATA SHEET

1. Identification

Product identifier	**PersulfOx®**
Other means of identification	None.
Recommended use	Soil and Groundwater Remediation.
Recommended restrictions	None known.

Manufacturer/Importer/Supplier/Distributor information

Company Name	REGENESIS
Address	1011 Calle Sombra San Clemente, CA 92673 USA
General information	949-366-8000
E-mail	CustomerService@regenesis.com

Emergency phone number	For Dangerous Goods Incidents ONLY (spill, leak, fire, exposure or accident), call CHEMTREC 24/7 at:
USA, Canada	1-800-424-9300
International	+1 703-741-5970

2. Hazard(s) identification

Physical hazards	Oxidizing solids	Category 3
Health hazards	Acute toxicity, oral	Category 4
	Skin corrosion/irritation	Category 2
	Serious eye damage/eye irritation	Category 2A
	Sensitization, respiratory	Category 1
	Sensitization, skin	Category 1
	Specific target organ toxicity, single exposure	Category 3 respiratory tract irritation
OSHA defined hazards	Not classified.	

Label elements

Signal word Danger

Hazard statement May intensify fire; oxidizer. Harmful if swallowed. Causes skin irritation. May cause an allergic skin reaction. Causes serious eye irritation. May cause allergy or asthma symptoms or breathing difficulties if inhaled. May cause respiratory irritation.

Precautionary statement

Prevention Keep away from heat. Keep/Store away from clothing and other combustible materials. Take any precaution to avoid mixing with combustibles. Avoid breathing dust. Wash thoroughly after handling. Do not eat, drink or smoke when using this product. Use only outdoors or in a well-ventilated area. Contaminated work clothing must not be allowed out of the workplace. Wear protective gloves/eye protection/face protection. In case of inadequate ventilation wear respiratory protection.

Response If swallowed: Call a poison center/doctor if you feel unwell. If on skin: Wash with plenty of water. If inhaled: Remove person to fresh air and keep comfortable for breathing. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Call a poison center/doctor if you feel unwell. Rinse mouth. If skin irritation or rash occurs: Get medical advice/attention. If eye irritation persists: Get medical advice/attention. If experiencing respiratory symptoms: Call a poison center/doctor. Take off contaminated clothing and wash before reuse. In case of fire: Use appropriate media to extinguish.

Storage Store in a well-ventilated place. Keep container tightly closed. Store locked up.

Disposal	Dispose of contents/container in accordance with local/regional/national/international regulations.
Hazard(s) not otherwise classified (HNOC)	None known.
Supplemental information	None.

3. Composition/information on ingredients

Mixtures

Chemical name	CAS number	%
Sodium persulfate	7775-27-1	≥90
Silicic acid, sodium salt	1344-09-8	≤10

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

4. First-aid measures

Inhalation	Remove victim to fresh air and keep at rest in a position comfortable for breathing. Oxygen or artificial respiration if needed. Do not use mouth-to-mouth method if victim inhaled the substance. Induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If experiencing respiratory symptoms: Call a POISON CENTER or doctor/physician.
Skin contact	Remove contaminated clothing immediately and wash skin with soap and water. In case of eczema or other skin disorders: Seek medical attention and take along these instructions.
Eye contact	Do not rub eyes. Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention if irritation develops and persists.
Ingestion	Rinse mouth. Never give anything by mouth to a victim who is unconscious or is having convulsions. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs. Get medical advice/attention if you feel unwell.
Most important symptoms/effects, acute and delayed	Severe eye irritation. Symptoms may include stinging, tearing, redness, swelling, and blurred vision. Dusts may irritate the respiratory tract, skin and eyes. Difficulty in breathing. Skin irritation. May cause redness and pain. May cause an allergic skin reaction. Dermatitis. Rash.
Indication of immediate medical attention and special treatment needed	Provide general supportive measures and treat symptomatically. Keep victim warm. Keep victim under observation. Symptoms may be delayed.
General information	Take off all contaminated clothing immediately. Contact with combustible material may cause fire. If you feel unwell, seek medical advice (show the label where possible). Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. Show this safety data sheet to the doctor in attendance. Wash contaminated clothing before reuse.

5. Fire-fighting measures

Suitable extinguishing media	Water spray, fog (flooding amounts).
Unsuitable extinguishing media	Do not use water unless flooding amounts are available. Material reacts with water. Do not use carbon dioxide or other gas filled fire extinguishers; they will have no effect on decomposing persulfates.
Specific hazards arising from the chemical	Greatly increases the burning rate of combustible materials. Containers may explode when heated. During fire, gases hazardous to health may be formed. Combustion products may include: sulfur oxides.
Special protective equipment and precautions for firefighters	Self-contained breathing apparatus and full protective clothing must be worn in case of fire.
Fire fighting equipment/instructions	In case of fire and/or explosion do not breathe fumes. Move containers from fire area if you can do so without risk. Use water spray to cool unopened containers.
Specific methods	Cool containers exposed to flames with water until well after the fire is out. Avoid dust formation.
General fire hazards	May intensify fire; oxidizer. Contact with combustible material may cause fire.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures	Keep unnecessary personnel away. Keep people away from and upwind of spill/leak. Keep away from clothing and other combustible materials. Wear appropriate protective equipment and clothing during clean-up. Avoid inhalation of dust. Use a NIOSH/MSHA approved respirator if there is a risk of exposure to dust/fume at levels exceeding the exposure limits. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Ensure adequate ventilation. Local authorities should be advised if significant spillages cannot be contained. For personal protection, see section 8 of the SDS.

Methods and materials for containment and cleaning up	Eliminate all ignition sources (no smoking, flares, sparks, or flames in immediate area). Avoid dispersal of dust in the air (i.e., clearing dust surfaces with compressed air). Collect dust using a vacuum cleaner equipped with HEPA filter. If sweeping of a contaminated area is necessary use a dust suppressant agent which does not react with the product. Keep combustibles (wood, paper, oil, etc.) away from spilled material. Ventilate the contaminated area. Stop the flow of material, if this is without risk. Spillage collected should be monitored for signs of reaction or decomposition (fuming/smoking). If spilled material is wet, dissolve with large quantity of water. Large Spills: Sweep up or vacuum up spillage and collect in suitable container for disposal. Minimize dust generation and accumulation. Following product recovery, flush area with water. Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination. Never return spills to original containers for re-use. Place all material into loosely covered plastic containers for later disposal. For waste disposal, see section 13 of the SDS.
Environmental precautions	Avoid discharge into drains, water courses or onto the ground.

7. Handling and storage

Precautions for safe handling	Minimize dust generation and accumulation. Routine housekeeping should be instituted to ensure that dusts do not accumulate on surfaces. Keep away from heat. Provide appropriate exhaust ventilation at places where dust is formed. Keep away from clothing and other combustible materials. Take any precaution to avoid mixing with combustibles. Avoid contamination. Wear appropriate personal protective equipment (See Section 8). Avoid breathing dust. Avoid contact with eyes, skin, and clothing. Avoid prolonged exposure. Do not taste or swallow. When using, do not eat, drink or smoke. Wear appropriate personal protective equipment. Wash hands thoroughly after handling. Observe good industrial hygiene practices.
Conditions for safe storage, including any incompatibilities	Store locked up. Keep away from heat. Store in a cool, dry place out of direct sunlight. Store in original tightly closed container. Store in a well-ventilated place. Do not store near combustible materials. Store away from incompatible materials (see Section 10 of the SDS). Recommended storage temperature: less than 40°C.

8. Exposure controls/personal protection

Occupational exposure limits

US. ACGIH Threshold Limit Values

Components	Type	Value
Sodium persulfate (CAS 7775-27-1)	TWA	0.1 mg/m3

Biological limit values	No biological exposure limits noted for the ingredient(s).
Appropriate engineering controls	Good general ventilation should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. If engineering measures are not sufficient to maintain concentrations of dust particulates below the Occupational Exposure Limit (OEL), suitable respiratory protection must be worn. Eye wash facilities and emergency shower must be available when handling this product.

Individual protection measures, such as personal protective equipment

Eye/face protection	Use dust-tight, unvented chemical safety goggles when there is potential for eye contact.
Skin protection	
Hand protection	Wear appropriate chemical resistant gloves. Rubber, neoprene or PVC gloves are recommended. Breakthrough time: > 480 minutes.
Skin protection	
Other	Wear appropriate chemical resistant clothing.
Respiratory protection	If engineering measures are not sufficient to maintain concentrations of dust particulates below the OEL, suitable respiratory protection must be worn. Use a NIOSH/MSHA approved respirator if there is a risk of exposure to dust/fume at levels exceeding the exposure limits. Respirator type: approved respirator with P100 filters.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
General hygiene considerations	Keep from contact with clothing and other combustible materials. Remove and wash contaminated clothing promptly. Keep away from food and drink. 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. Contaminated work clothing should not be allowed out of the workplace.

9. Physical and chemical properties

Appearance	
Physical state	Solid.
Form	Free-flowing powder.
Color	White.
Odor	Odorless.
Odor threshold	Not available.
pH	11.5 (10 % solution, 77 °F (25 °C))
Melting point/freezing point	Not determined.
Initial boiling point and boiling range	Not determined.
Flash point	Not applicable.
Evaporation rate	Not available.
Flammability (solid, gas)	Oxidizer.
Upper/lower flammability or explosive limits	
Explosive limit - lower (%)	Not determined.
Explosive limit - upper (%)	Not determined.
Vapor pressure	Not applicable.
Vapor density	Not applicable.
Relative density	1.5 - 1.8 (68 °F (20 °C))
Solubility(ies)	
Solubility (water)	Soluble in water.
Partition coefficient (n-octanol/water)	No data available.
Auto-ignition temperature	Not determined.
Decomposition temperature	Decomposition will occur upon heating.
Viscosity	Not available.
Other information	
Kinematic viscosity	Not applicable.

10. Stability and reactivity

Reactivity	Greatly increases the burning rate of combustible materials.
Chemical stability	Decomposes on heating.
Possibility of hazardous reactions	Oxidizing, avoid contact with reducing agents.
Conditions to avoid	Heat. Contact with incompatible materials. Avoid dust formation.
Incompatible materials	Acids. Bases. Combustible material. Reducing agents. Metals. Organic compounds.
Hazardous decomposition products	Oxygen. Sulfur oxides.

11. Toxicological information

Information on likely routes of exposure	
Inhalation	May cause allergy or asthma symptoms or breathing difficulties if inhaled. Dust may irritate respiratory system.
Skin contact	Causes skin irritation. May cause an allergic skin reaction.
Eye contact	Causes serious eye irritation.
Ingestion	Harmful if swallowed.
Symptoms related to the physical, chemical and toxicological characteristics	Severe eye irritation. Symptoms may include stinging, tearing, redness, swelling, and blurred vision. Dusts may irritate the respiratory tract, skin and eyes. Difficulty in breathing. Skin irritation. May cause redness and pain. May cause an allergic skin reaction. Dermatitis. Rash.
Information on toxicological effects	
Acute toxicity	Harmful if swallowed.

Components	Species	Test Results
Silicic acid, sodium salt (CAS 1344-09-8)		
Acute		
Dermal		
LD50	Rat	> 5000 mg/kg, 24 Hours
Inhalation		
Vapor		
LC50	Rat	> 2.06 mg/l, 4 Hours
Oral		
LD50	Rat	3400 mg/kg
Sodium persulfate (CAS 7775-27-1)		
Acute		
Dermal		
LD50	Rabbit	> 2000 mg/kg
Inhalation		
LC50	Rat	2950 mg/m³, 4 h
Oral		
LD50	Rat	300 mg/kg

Skin corrosion/irritation	Causes skin irritation.
Serious eye damage/eye irritation	Causes serious eye irritation.
Respiratory or skin sensitization	
Respiratory sensitization	May cause allergy or asthma symptoms or breathing difficulties if inhaled.
Skin sensitization	May cause an allergic skin reaction.
Germ cell mutagenicity	No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.
Carcinogenicity	Not classifiable as to carcinogenicity to humans.

IARC Monographs. Overall Evaluation of Carcinogenicity

Not listed.

NTP Report on Carcinogens

Not listed.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1053)

Not listed.

Reproductive toxicity	This product is not expected to cause reproductive or developmental effects.
Specific target organ toxicity - single exposure	May cause respiratory irritation.
Specific target organ toxicity - repeated exposure	Not classified.
Aspiration hazard	Not an aspiration hazard.
Chronic effects	Prolonged exposure may cause chronic effects.

12. Ecological information

Ecotoxicity The product is not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.

Components		Species	Test Results
Silicic acid, sodium salt (CAS 1344-09-8)			
Aquatic			
Acute			
Algae	EC50	Scenedesmus subspicatus	7.5 mg/l, 72 hours
Crustacea	EC50	Aquatic Invertebrates	1700 mg/l, 48 hours
Fish	LC50	Danio rerio	1108 mg/l, 96 hours
		Oncorhynchus mykiss	>= 260 - <= 310 mg/l, 96 hours

Components		Species	Test Results
	NOEC	Fish	348 mg/l, 96 hours
Sodium persulfate (CAS 7775-27-1)			
Aquatic			
Acute			
Algae	LC50	Algae	320 mg/l, 72 hours
Crustacea	EC50	Abra alba	11 mg/l, 5 days
		Daphnia magna	120 mg/l, 48 hours
Fish	LC50	Oncorhynchus mykiss	76.3 mg/l, 96 hours
		Scophthalmus maximus	107.6 mg/l, 96 hours

Persistence and degradability	The product contains inorganic compounds which are not biodegradable.
Bioaccumulative potential	No data available.
Mobility in soil	No data available.
Other adverse effects	None known.

13. Disposal considerations

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

14. Transport information

DOT	
UN number	UN1505
UN proper shipping name	Sodium persulfate
Transport hazard class(es)	
Class	5.1
Subsidiary risk	-
Label(s)	5.1
Packing group	III
Environmental hazards	
Marine pollutant	No.
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
Special provisions	A1, IB8, IP3, T1, TP33
Packaging exceptions	152
Packaging non bulk	213
Packaging bulk	240
IATA	
UN number	UN1505
UN proper shipping name	Sodium persulphate
Transport hazard class(es)	
Class	5.1
Subsidiary risk	-
Packing group	III
Environmental hazards	No.
ERG Code	5L
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
IMDG	
UN number	UN1505
UN proper shipping name	SODIUM PERSULPHATE

Transport hazard class(es)	
Class	5.1
Subsidiary risk	-
Packing group	III
Environmental hazards	
Marine pollutant	No.
EmS	F-A, S-Q
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code	Not applicable.

15. Regulatory information

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

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

Not regulated.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

SARA 304 Emergency release notification

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1053)

Not listed.

Toxic Substances Control Act (TSCA) All components of the mixture on the TSCA 8(b) inventory are designated “active”.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical	Yes
Classified hazard categories	Oxidizer (liquid, solid, or gas) Acute toxicity (any route of exposure) Skin corrosion or irritation Serious eye damage or eye irritation Respiratory or skin sensitization Specific target organ toxicity (single or repeated exposure)

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

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

Not regulated.

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

Not regulated.

Safe Drinking Water Act (SDWA) Not regulated.

US state regulations

US. Massachusetts RTK - Substance List

Not regulated.

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

Sodium persulfate (CAS 7775-27-1)

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

Not listed.

US. Rhode Island RTK

Not regulated.

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. For more information go to www.P65Warnings.ca.gov.

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Industrial Chemicals (AICIS)	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
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
Taiwan	Taiwan Chemical Substance Inventory (TCSI)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

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

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

Issue date	12-February-2015
Revision date	15-July-2022
Version #	04
HMIS® ratings	Health: 2* Flammability: 0 Physical hazard: 1 Personal protection: I

NFPA ratings

Disclaimer

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

PersulfOx™

CATALYZED PERSULFATE

APPLICATION INSTRUCTIONS

Subsurface application of PersulfOx™ via pressure injection is commonly performed using either direct-push technology (DPT) or wells. PersulfOx is a single-part, sodium persulfate – based *in situ* chemical oxidant with built-in activation. It is a dry white powder that ships as a **DOT 5.1 Class Oxidizer** and should be handled according to regulations governing oxidizers. An MSDS is provided with each shipment.

<u>Pre-Application procedures</u> - Prior to PersulfOx application, Regenesis recommends pre-application test injection using clear water. This procedure is useful in determining if the target zone has hydraulic limitations that would reduce the anticipated volume applied or cause application pressures to exceed the commonly accepted application range. For *in situ* injection projects, Regenesis recommends the injection test volume range 15-20% greater than the single-point design volume.

<u>Solution making procedures</u> - Before application the PersulfOx is mixed with water to create an injection solution. PersulfOx can be mixed into solutions that range from 5% to 20% weight/weight (w/w). For most applications Regenesis suggests a 10-15% w/w solution. The PersulfOx+water solution should be mixed in appropriately sized tanks that match the projects requirements. Upon creation the PersulfOx solution is alkaline and so tanks and related mixing equipment should be configured with chemically resistant materials. When working in areas with cold water temps (temperatures <16°C/ 65°F) users should be aware of lessened overall chemical solubility resulting in relatively longer mix time requirements; in all cases it is recommended that periodic mixing be part of the application process. We recommend slow addition of dry PersulfOx powder to water and mixing during and after PersulfOx addition using appropriately sized power mixing equipment such as drum or tank-type vortex/cyclone mixers. Alternatively, lower volume batch mixing may also be used. Low volume mixing alternatives would include power drills equipped with paint-mixer attachments or chemically resistant centrifugal pumps set up in a recirculation configuration. PersulfOx mixes readily into water when batched at the recommended solution ranges. Once mixed PersulfOx will dissolve and remain in solution but as with all chemical mixtures we recommend that the PersulfOx solution be checked periodically throughout the workday. The PersulfOx solution will be typically have a cloudy white appearance that is associated with the formation of a small amount of flocculent (<1%). This flocculent is associated with minerals present in most mix waters. When adding the PersulfOx to the mix water, follow proper handling and dust precautions (see H&S sheet and MSDS).

APPLICATION INSTRUCTIONS (cont'd)

The following table is a guideline for solution mixing % per bag of PersulfOx in water:

No. of Bags	Weight of Material (lbs.)	Desired Solution (%)	Volume of Water (gallons)	Final PersulfOx volume (gallons)
1	55	5	125	128
1	55	10	59	62
1	55	15	37	40
1	55	20	26	29

Volume of mix water (gallons/vertical foot of injection) can be calculated from the following equation:

$$\frac{\text{PersulfOx lbs/ foot}}{(8.34\ \text{lbs/gal water})(\%\ \text{PersulfOx solids})}\left[1-(\%\ \text{PersulfOx solids})\right]$$

<u>Direct Push (DPT) Applications</u> - It is imperative that the DPT injection holes be properly grouted/sealed upon completion of the injection activities. The purpose of this effort is to seal off any potential pathways to the surface which may allow "day lighting" of injection materials. Whenever possible, the application should be performed by systematically working from the outside to the center of the injection array. This methodology of application will limit the potential for expansion of the plume (also applies to wells).

<u>Well-Applications</u> - Regenesis recommends that injection wells be generally be constructed using ≥2-inch diameter Schedule 80 PVC with a screen slot size ≥0.02-inch. When possible the well seal should consist of a minimum of ≈6-12 inches of fine silica sand placed directly over the well filter pack. This will minimize bentonite infiltration into the well screen/filter pack interval. This should be overlain by ≥3 feet of hydrated and "cured" bentonite seal. The well should be sealed to the surface with cement or cement + bentonite grout (bentonite<10%). Prior to injection of any remedial reagent, Regenesis recommends that the injection wells be "surged and purged" of fine grained particles present in the well bore to the extent practicable.

After each PersulfOx injection event, each injection well should be flushed with clear-water. This clear-water "chaser" should be equivalent to approximately 2-3 borehole volumes. When wells are used for PersulfOx injection, the PersulfOx injection wells and nearby groundwater monitoring wells should be either tightly capped or alternatively equipped with a pressure gauge & relief valve. This will reduce potential for short circuiting to the surface.

Surfacing - From time to time application related surfacing of oxidants or other high volume remedial reagents may occur. Regenesis has co-authored a document that addresses the specifics reagent surfacing before it occurs as well as proper management when it does occur. This document is entitled "Guidelines for Subsurface Injection of In Situ Remedial Reagents within the LARWQCB Region" (ISRR). This document can be found on the LARWQCB Website or on the Regenesis website www.regenesis.com

APPENDIX D

Project Documentation Forms

ROUX

DAILY LOG				
	DATE			
	NO.			
	SHEET		OF	

FIELD ACTIVITY DAILY LOG

PROJECT NAME:	PROJECT NO.
PROJECT LOCATION:	CLIENT:
FIELD ACTIVITY:	
DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:	

TIME	DESCRIPTION

VISITORS ON SITE:	CHANGES FROM PLANS AND SPECIFICATIONS, AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS:
WEATHER CONDITIONS: A.M.:	IMPORTANT TELEPHONE CALLS:
P.M.:	

PERSONNEL ON SITE:

SIGNATURE

DATE:

ROUX

DAILY LOG	DATE			
	REPORT NO.			
	PAGE	OF		

PROBLEM IDENTIFICATION REPORT

Date:

Project:

Job No:

Location:

CQA Monitor(s):

Client:

Contractor:

Contractor's Supervisor:

WEATHER CONDITIONS:

Ambient Air Temp. - A.M.:

Ambient Air Temp. - P.M.:

Wind Direction:

Wind Speed:

Precipitation:

Problem Description:

Problem Location (reference test location, sketch on back of form as appropriate):

Problem Causes:

Suggested Corrective Measures or Variances:

Linked to Corrective Measures Report No. *or Variance Log No.*

Approvals (initial):

CQA Engineer:

Project Manager:

Signed:

CQA Representative

ROUX

DAILY LOG	DATE			
	REPORT NO.			
	PAGE	OF		

CORRECTIVE MEASURES REPORT

Date:

Project:

Job No:

Location:

CQA Monitor(s):

Client:

Contractor:

Contractor's Supervisor:

WEATHER CONDITIONS:

Ambient Air Temp. - A.M.:

Ambient Air Temp. - P.M.:

Wind Direction:

Wind Speed:

Precipitation:

Corrective Measures Undertaken (reference Problem Identification Report No.)

Retesing Location:

Suggested Method of Minimizing Re-Occurrence:

Approvals (initial):

CQA Engineer:

Project Manager:

Signed:

CQA Representative