

PILOT TEST WORK PLAN

HERS Industrial Park, Mukilteo, Washington

Prepared for: Russell Road Industrial Park, LLC

Project No. 140252 • February 1, 2023



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February 1, 2023

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Acronyms

3DME	3D Microemulsion
Aspect	Aspect Consulting, LLC
cVOC	chlorinated volatile organic compound
CUL	Cleanup level
EAB	enhanced anaerobic bioremediation
Ecology	Washington Department of Ecology
FFS	Focused Feasibility Study
gpm	gallons per minute
ISCR	<i>In Situ</i> Chemical Reduction
mg/kg	milligrams/kilograms
mg/L	milligrams per liter
µg/L	micrograms per liter
MTCA	Model Toxics Control Act
PCE	tetrachloroethylene
PTWP	Pilot Test Work Plan
RI/FS	Remedial Investigation/Feasibility Study
RRIP	Russell Road Industrial Park LLC
ROI	radius of influence
SAP	Sampling Analysis Plan
SMZVI	Sulfidated Micro-Zero-Valent Iron
TCE	trichloroethylene
TEF	toxic equivalency factor
VCP	Voluntary Cleanup Program

1 Introduction

This Pilot Test Work Plan (PTWP) has been prepared by Aspect Consulting, LLC (Aspect) on behalf of Russell Road Industrial Park LLC (RRIP). RRIP is conducting a cleanup of the property located at 4403 Russell Road in Mukilteo, Washington (the Property) under the Washington State Department of Ecology (Ecology) Voluntary Cleanup Program (VCP). The site, where contamination released at the Property has come to be located, includes the Property and portions of adjacent properties (collectively referred to as the Site; VCP Site number NW1554).

The 2021 Revised Focused Feasibility Study (Revised FFS; Aspect, 2021) selected a cleanup action alternative combining *in situ* chemical reduction (ISCR) and enhanced anaerobic bioremediation (EAB) to treat chlorinated volatile organic compounds (cVOCs) in soil and groundwater. In a letter from Ecology dated February 9, 2022 (Ecology, 2022), Ecology concurred with the selected alternative and the included pilot test. This Pilot Test is being conducted to assess the effectiveness, cost, and design parameters of the recommended cleanup action. Pilot testing activities include direct-push injection of zero-valent iron- and organic carbon-based remediation reagents into the site subsurface and subsequent performance monitoring.

1.1 Objectives

This Pilot Test was designed to assess the effectiveness, cost, and design parameters of using ISCR/EAB to treat cVOCs in groundwater at the Site. The Pilot Test was designed based on the following objectives:

- 1) **Evaluate ability to deliver and distribute reagent in the shallow groundwater zone.** We will evaluate the ability to inject the planned injection volumes of the designed reagent mixture. Reagent distribution will be evaluated by monitoring for reagent breakthrough at nearby monitoring wells during injection.
- 2) **Reduce cVOC concentrations in the MW-16 source area.** Reducing source area cVOC concentrations will reduce the downgradient treatment burden and accelerate cleanup across the Site.
- 3) **Estimate design parameters for implementing ISCR.** Design parameters include radius of influence (ROI), injection-volume relationship, injection pressure thresholds, and reagent dosing.
- 4) **Evaluate performance downgradient of the injection points.** Downgradient (northwest) of the injection area, cVOC concentrations are reduced through physical flushing as ISCR-treated water flows downgradient. This will be evaluated based on changes in biogeochemical conditions and cVOC concentrations brought on by reagent injection.
- 5) **Evaluate ability to manage secondary effects.** Effective ISCR/EAB treatment often causes secondary effects that should be expected and managed. These

include the generation and potential accumulation of methane and PCE dechlorination byproducts. The design in this PTWP includes monitoring and evaluation of these secondary effects.

These objectives will serve as the basis for performance evaluation during the pilot test. The following sections described the planned pilot test activities.

1.2 Preliminary Schedule and Reporting

The scope of Pilot Test activities and reporting outlined in this PTWP will be implemented according to the following estimated schedule:

- Baseline Monitoring: Prior to conducting Pilot Injections
- Pilot Injections: March 2023
- Performance Monitoring Event 1: June 2023
- Performance Monitoring Event 2: September 2023
- Performance Monitoring Event 3: March 2024

Performance monitoring results will be evaluated and summarized after each event. Recommendations for next steps will be provided after the final event, and the Pilot Test will be formally documented in a subsequent work plan. A more detailed description of the performance monitoring schedule can be found in Section 4.2.

2 Pre-Injection Activities and Coordination

This section describes the planning and field activities to be performed prior to *in situ* injections.

2.1 Roles and Responsibilities

Environmental Consultant and Engineer (Aspect) – Aspect is the environmental consulting firm operating on behalf of RRIP and is the engineer of record for the *in situ* treatments. On behalf of the Owner, Aspect will obtain injection permits, oversee injection activities, and direct subcontractors.

Drilling and Injection Subcontractor (the Driller) – Aspect will contract a Washington State-licensed driller to implement the reagent injections. The Driller is responsible for providing the necessary injection equipment and implementing the reagent injections according to the PTWP. The Driller will also be responsible for supplying water and submitting injection point notices of intent to the Washington State Department of Ecology (Ecology). Aspect is evaluating the potential for an on-site water supply, and the Driller shall verify water availability with Aspect prior to mobilization.

Other Subcontractors – Other subcontractors are necessary to complete Pilot Test activities, including analytical laboratories (Friedman & Bruya), remediation- and investigation-derived waste disposal (DH Environmental), and private utility locator (APS). The reagent vendor (Regenesis) is responsible for supplying the reagent chemistry. The subcontractors will conduct their portion of the PTWP activities in accordance with the scope of their subcontract.

2.2 Utility Clearance

Prior to initiation of any subsurface work, a utility survey will be performed. At a minimum, this utility survey will include a public utility locate (i.e., “one-call”), a private utility locate, and a review of available public and/or private as-built drawings. Prior to the locates, the proposed injection locations will be identified at the Site. If necessary, a vacuum truck will be mobilized to “clear” proposed boring locations to a shallow depth prior to drilling.

Utilities shown on Figure 2 should be considered approximate and for general awareness only. Actual utility markings at the time of this work will be used to determine final drilling locations.

2.3 Baseline Groundwater Monitoring

Groundwater monitoring data will be collected to establish baseline conditions for performance evaluation. This monitoring event will include groundwater elevation gauging, sample collection, and laboratory analysis. The following wells will be sampled during the baseline monitoring event: MW-16, MW-12, MW-11, MW-21, MW-20, and MW-1. Performance monitoring analytes and monitoring wells are described in detail in Section 4.2.

3 Injection Design

This section describes the Pilot Test injections that will be performed to treat chlorinated solvents in soil and groundwater.

3.1 Reagent Selection

Injectable *in situ* remediation reagents can be broadly categorized on a spectrum from coarse-grained granular media to soluble reagents. Granular media have higher treatment capacity and increased longevity but are difficult to distribute evenly in the subsurface. Soluble reagents are generally consumed quickly, but distribute more evenly, resulting in better contact with contaminants and a more continuous treatment zone. Regenesys' Sulfidated Micro-Zero-Valent Iron (SMZVI) and 3D Microemulsion (3DME) were selected as complimentary ISCR and EAB treatment reagents due to their balance of longevity, injectability, and efficacy for treating cVOCs. Product information sheets and safety data sheets for each reagent can be found in Appendix A.

SMZVI was selected as the ISCR reagent because it contains a suspension of micro-scale iron particles in glycerol that distributes well in the subsurface, striking a balance between distribution and treatment capacity. In addition, the sulfidated nature of the ZVI particles enhances cVOC treatment efficiency and kinetics in comparison to other available ZVIs. However, because the ZVI particles do not flow with groundwater or diffuse into groundwater, treatment by ZVI particles requires groundwater to flow through the treatment zone where the ZVI particles have been deposited. Low groundwater velocities with variable flow directions at the Site may result in uneven treatment using ZVI alone, therefore an EAB reagent will be added to the treatment mixture to compliment ZVI treatment.

3DME was selected as the EAB reagent because the combination of soluble organic carbon source (lactate) and emulsified oil-like compounds (fatty acid esters) strike a balance between providing an easily fermentable substrate that can jump-start microbial activity and drive complete biodegradation of cVOCs while providing a longer-lasting substrate with the potential to sustain treatment for years. Additionally, because of its chemical composition, 3DME provides better solubility and advective transport of the long-lasting substrate (fatty acid esters) than comparable emulsified oils, which makes it particularly well suited to complement ISCR treatment using ZVI.

Regenesys will supply SMZVI and 3DME in plastic, 55-gallon (gal) drums.

Further general information regarding screening, selection, and description of ISCR and EAB technologies can be found in the Revised FFS.

3.2 Injection Layout

The Pilot Test layout is shown on Figure 2 and includes injection and monitoring locations. Treatment mixture will be injected at four locations. Three locations will be located south of MW-16 to treat the residual source mass that is sustaining downgradient groundwater concentrations. Those locations, IP-1 through IP-3, will be spaced 11 feet apart, aligned perpendicular to groundwater flow. The volumes injected will be designed

and field-monitored to achieve a 7-foot radius of influence, resulting in overlapping radii to create a continuous treatment transect.

The vertical injection interval was selected based on soil and groundwater sampling results. Soil analytical results from locations AB-5 through AB-10, which indicate that the majority of soil contamination is located near the weathered/unweathered till contact, approximately 12 to 17 feet below ground surface (bgs; Aspect, 2021). The treatment interval is also based on the screened intervals of MW-16, MW-12, and MW-1, which all exceed groundwater cleanup levels and are screened 5 to 15 feet bgs.

The injection locations will be laid out according to the following:

- IP-2 will be offset 5 feet from MW-16
- IP-1 will be located as close to the former Intermec and King Machine building as is feasible, and offset 11 feet from IP-2
- IP-3 will be offset 11 feet from IP-2
- IP-4 will be located 5 feet upgradient of MW-5.

Distances from each injection point to each well within 20 feet of that point will be field-measured prior to drilling, and injection order and operational monitoring locations will be checked by the Aspect project manager prior to drilling. Field-measured distances may be used to adjust injection order and breakthrough monitoring locations described in Section 4.1. Photos of the injection locations, nearby wells, and former drain location D29 will be taken prior to drilling.

3.3 Drilling and Injection Methods

This section describes the drilling and injection equipment and methods to be used during the Pilot Test. All injections will be performed via direct-push injection points using a Geoprobe® 7800-series drill rig or equivalent to advance injection rods to target treatment depths. Smaller, lighter-weight rigs may not be able to advance drill rods to the target depth in the weathered till. The following injection methods and equipment will be used:

- **Injection Intervals.** Intervals will be injected starting from the bottom or top depending on the tooling and method that is determined to be most effective.
- **Injection Sequencing.** Points will be injected one-at-a-time. Points closest to monitoring wells will be injected first. Where possible, points will be injected in an alternating pattern so adjacent points are not injected sequentially, to minimize mounding and to minimize “pushing” groundwater from one end of the injection area to the other. The order of injections will be IP-1, IP-4, IP-2, then IP-3.
- **Injection Tooling.** Different down-hole injection tooling will be evaluated to determine the most applicable at the Site. Tooling options include:
 - “Groundwater sampling” tools also known as “retractable screen” tools with 1- to 4-foot-long screens and retractable protective outer casing over the

screen will be the first choice as the preferred injection tooling based on the moderate-permeability soils observed at the Site.

- “Top-down” solid-stem tools with a 2.25-inch-diameter tip and tail, with a smaller-diameter perforated section of pipe between them may also be used as a first choice, depending on driller preference.
 - If the preferred tooling is determined to be ineffective for injection, distribution, or efficiency then the following options will be available and may be tested:
 - Pressure-activated injection tools containing a single row of ports and an integrated check valve are designed to prevent clogging by native soil while the probe is advanced.
 - Expendable tip tools are the least preferred option, to be used only after troubleshooting has been conducted on all other methods.
- **Pumps.** A pump capable of generating 400 pounds per square inch (psi) while pumping at 8 gallons per minute (gpm) is recommended. Injection in weathered, glacially consolidated till routinely requires greater than 200 psi. A diaphragm pump or progressive cavity (e.g., Moyno) pump would be suitable for the consistent flow they generate.
 - **Flow and Pressure.** Injections will begin at low pressures (<50 psi) targeting a flow rate between 3 and 8 gpm. Injection pressures will be increased until at least 3 gpm is achieved and decreased if 8 gpm is exceeded. If pressure exceeds 500 psi, pause work and consult with the Aspect project manager. Pressure and flow will be monitored as pressure is adjusted. If flow declines or pressure increases beyond those specified, remaining injection volume for that point may be injected into an adjacent injection interval or offset (i.e., “step-out”) injection locations.
 - **High Pressure Injection.** Overall, injection via low pressures is preferred because it generally results in more even distribution of reagent. However, if a flow rate of 1 gpm is not achievable using non-fracturing pressures, hydraulic fracturing of the target interval will be evaluated as a method to achieve reagent delivery and distribution (Suthersan et al., 2017). Fracturing is indicated by a decrease in pressure and a corresponding increase in flow rate.
 - **Surfacing.** Injection at a given interval will be stopped if reagent is observed at ground surface. Reagent can unintentionally flow to ground surface through the injection borehole annulus or through adjacent wells, boreholes, or other infrastructure. If surfacing occurs, the injection point may be advanced to the next depth interval to resume injection. If surfacing is observed at multiple intervals, injection may be stopped at that location, and remaining volume for that point may be injected at an offset location if fracturing has not occurred.
 - **Injection Point Abandonment.** After injection, direct-push injection points will be abandoned using hydrated bentonite chips or grout in accordance with WAC 173-160-451.

3.4 Treatment Design and Mixture

Reagent dosing and batch volumes are shown in Table 1 and are based on injection hydraulics and chemical dosing rates.

Injection volumes were calculated based on an assumed mobile porosity, which is the fraction of soil volume that groundwater or injection fluid can readily flow through. This design assumes that the injection fluid will occupy 100 percent of the mobile porosity that the target injection volume is designed to fill. This design assumption will be evaluated during breakthrough monitoring (Section 4.1). A target injection volume of 800 gallons (gal) per point, equating to 80 gal per vertical foot of injection interval, was calculated. If the mobile porosity is determined to be different from the design mobile porosity during monitoring, the total injection volume may be adjusted for subsequent injection points by adjusting the volume of water added to the mixture.

A target dosing percentage of 3 percent 3DME by volume was selected based on the moderately low contaminant concentrations to be treated.

Dosing of ZVI is designed as a percentage of the soil mass within the area to be treated. The ZVI dosing of 0.05% by mass selected for this injection is relatively low to prevent clogging of soil pores and allow for permeation of the injection mixture into the soil matrix. Additionally, a low iron dosing was selected based on its use as a secondary treatment mechanism, as described in Section 3.1.

4 Monitoring

Monitoring is required to ensure cleanup is performed according to design parameters (operational monitoring) as well as to evaluate treatment performance (performance monitoring). This section describes the methods for operational and performance monitoring of injections.

4.1 Operational Monitoring

Groundwater monitoring during injection, referred to as operational monitoring, will be used to determine geochemical and physical response to injections.

- **Injection rate, volume, and pressure.** The injection rate and pressure at each injection point will be monitored continuously by the Driller, and a value for each will be recorded for each interval of injection. Injection pressures will be managed to achieve reasonable injection flow rates (3-8 gpm) and to avoid formation fracturing, if possible. Formation fracturing would be indicated by a loss in pressure and associated increase in injection flow rate. The total of each reagent injected, total volume injected, and total flush water volume per point and per depth interval will also be recorded. A blank injection monitoring log is provided in Appendix B. Additional information regarding expected pressures and flow rates is provided in Section 3.3.
- **Water level monitoring.** Water levels will be measured at MW-16, MW-12, MW-13, and MW-7 at the beginning and end of each day, and after completion of each injection point. A blank field log is provided in Appendix B.
- **Breakthrough monitoring.** Breakthrough monitoring is performed during injections to determine the volume of mixture that must be injected for solution to arrive at nearby wells. This volume is used to establish the volume-ROI relationship via calculation of mobile porosity, and may be used to adjust subsequent injection volumes. Breakthrough monitoring will occur during injection into the closest point adjacent to a monitoring well and may be continued at subsequent points if breakthrough is not observed.

Breakthrough monitoring will consist of purging groundwater through an Aqua TROLL 500 at a low (~300 milliliters per minute) flow rate using a peristaltic pump. The Aqua TROLL will be programmed to record field parameters at 1-minute intervals. The purge water will also be visually observed to verify Aqua TROLL readings. Depth to water will be measured manually using a water level indicator, and the readings will be entered into the Aqua TROLL data table. Aspect will use the data to calculate mobile porosity and verify subsequent injection volumes with the Aspect project manager prior to injection at the following injection locations.

MW-16 will be monitored during injection at IP-1 and IP-2 until breakthrough is observed. MW-12 and MW-7 will be monitored during injection at IP-3. MW-1 will be monitored during injection at IP-4.

4.2 Performance Monitoring

Performance monitoring consisting of groundwater sampling and analysis will be conducted to evaluate the objectives described in Section 2. Monitoring wells will be sampled prior to injections, and at regular intervals thereafter. Locations and frequencies are based on their vertical and horizontal proximity to the injection points. The analytes to be evaluated are listed in Table 2 and the sampling locations and frequencies are summarized in Table 3. The duration of monitoring and number and frequency of monitoring events may change based on monitoring results. The following wells will be sampled during the baseline monitoring event, prior to injections: MW-16, MW-12, MW-11, MW-21, MW-20, and MW-1.

Groundwater samples will be collected using standard low-flow purging and sampling techniques. The static water level will be measured in each well prior to purging and sampling and field parameters of temperature, pH, electrical conductance (specific conductance), dissolved oxygen, and redox potential will be monitored and recorded during purging.

5 Remediation- and Investigation-Derived Waste Management

Drilling, monitoring, and injection work to implement the remedy may generate the following types and quantities of waste, which may contain cVOCs and/or remediation reagents:

- Groundwater purged during operational and performance monitoring (one 55-gallon drum)
- Drilling equipment decontamination water (four 55-gallon drums)
- Excess remediation reagent (not anticipated)
- Injection solution and/or groundwater from surfacing/daylighting during injections (not anticipated)
- Drilling cuttings from injection points (not anticipated)

Waste will be collected and stored on the property in United States Department of Transportation-approved steel drums. The drums will be designated as F-listed hazardous waste pending laboratory analysis and clearly labeled with a description of contents. Water will be segregated and consolidated into the fewest number of drums to the extent possible, to be disposed of off-site in accordance with federal, state, and local regulations.

References

- Aspect Consulting, LLC (Aspect), 2021, Revised Focused Feasibility Study, HERS Industrial Park, Mukilteo, Washington, November 2021.
- Suthersan, S. S., Horst, J., Schnobrich, M., Welty, N., and McDonough, J., 2017, Remediation engineering: design concepts, CRC press.
- Washington State Department of Ecology (Ecology), 2022, Opinion Pursuant to WAC 173-340-515(5) on Remedial Action, HERS Industrial Park, 4403-4480 Russell Road, Mukilteo, Washington, February 9, 2022.

Limitations

Work for this project was performed for the Russell Road Industrial Park LLC (Client), and this report was prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. This report does not represent a legal opinion. No other warranty, expressed or implied, is made.

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TABLES

Table 1. Injection Design

Project No. 140252, HERS Industrial Park, Mukilteo, Washington

Parameter	Value	Units	Notes
Injection Point Layout			
Target treatment area	616	ft ²	Based on radius of influence of four locations
Number of injection points	4	points	
Target radius of influence (ROI)	7	ft	
Injection point spacing	11	ft	
Target treatment interval	7-17	feet bgs	Based on Revised FFS Section 1.3.3.1
Target treatment interval thickness	10	ft	
SMZVI Dosing			
Soil density	1.7	tons/yard ³	Relatively high density based on glacially consolidated till
Soil mass of treatment volume	775,392	lbs	
Target iron dosing	0.05%	lbs/lbs	Relatively low based on chemical reduction as a secondary treatment mechanism; based on Regeneration recommendation
Target iron treatment mass	388	lbs	
Target SMZVI mass	1000	lbs	Based on 40% iron content of SMZVI, rounded to 500-lbs package size
3DME Dosing			
Dosing by injection volume	3%		Percent of total injection volume that is 3DME, based on experience and Regeneration recommendation
Target 3DME volume	96	gal	
Injection Point Hydraulics			
Total porosity	35%		
Total pore volume	16,120	gal	
Design Mobile Porosity	7%		Estimated for weathered till. May be adjusted based on operational monitoring.
Injection volume as % of Mobile Porosity	100%		As percentage of mobile pore volume.
Injection volume per vertical foot	81	gal/ft	
Target Injection volume per point	800	gal	Rounded to simplify batch quantities.
Total injection volume	3,200	gal	
Reagent Dosing and Batching			
3DME target total mass	800	lbs	Equal to two drums
3DME target total volume	96	gal	Assumes 3DME density of 8.33 lbs/gal
SMZVI target total mass	1000	lbs	Equal to two drums
SMZVI target total volume	67	gal	Assumes SMZVI density of 15 lbs/gal
3DME per vertical foot	2.4	gal/ft	
SMZVI per vertical foot	1.7	gal/ft	
Mix water per vertical foot	76	gal/ft	
3DME per point	24.0	gal/point	equal to one half drum
SMZVI per point	16.7	gal/point	equal to one half drum
Mix water per point	759	gal/point	
Total Quantities			
Total 3DME required	2	drums	
Total SMZVI required	2	drums	
Total Mix Water Required	3,100	gal	Rounded up to nearest 100 gal

Notes:

% - percent

3DME - Three-dimension microemulsion

ft - feet

gal - gallons

lbs - pounds

ROI - radius of influence

SMZVI - sulfidated micro zero valent iron

Table 2. Performance Monitoring Analyte List

Project No. 140252, HERS Industrial Park, Mukilteo, Washington

Analyte	Analytical Method	Purpose
CVOCs		
Chlorinated Volatile Organic Compounds	EPA 8260C	COCs
MNA Analytes		
Chlorinated Volatile Organic Compounds	EPA 8260C	COCs
Dissolved gases; ethane, ethene, methane	RSK-175	Degradation end-product (ethene and ethane); redox indicator (methane)
Total Organic Carbon (TOC)	EPA 415.1 (or SW-846 Method 9060)	Electron donor
Nitrate, Nitrite, Sulfate	EPA 300.0	Electron acceptor/redox Indicator
Iron (Dissolved) ¹	EPA 6020 or 6010B	Electron acceptor/redox indicator
Field Parameters		
Total Dissolved Solids	Multi-parameter meter	Field parameter, reagent tracer
Specific conductance	Multi-parameter meter	Field parameter, reagent tracer
Dissolved oxygen	Multi-parameter meter	Electron acceptor/redox Indicator
pH	Multi-parameter meter	Geochemical indicator
ORP	Multi-parameter meter	Geochemical indicator
Turbidity	Turbidimeter	Field parameter, reagent tracer

Notes:

1. Dissolved metals analysis will be field-filtered using a 0.45 micron filter.

Table 3. Performance Monitoring Schedule

Project No. 140252, HERS Industrial Park, Mukilteo, Washington

	Location	Baseline	Event 1	Event 2	Event 3
Time Elapsed Since Injection (months)		Pre-Injection	3	6	12
MW-16	Injection area	MNA	MNA	MNA	MNA
MW-1	Injection area	MNA	MNA	MNA	MNA
MW-12	5 feet downgradient of injections	MNA	MNA	MNA	MNA
MW-11	45 feet downgradient of injections	CVOCs	-	CVOCs	CVOCs
MW-21	80 feet downgradient of injections	CVOCs	-	-	CVOCs
MW-20	90 feet downgradient of injections	CVOCs	-	-	CVOCs

Notes:

1) See Table 2 for a detailed description of each analyte group. Field parameters will be collected prior to sampling at each well.

CVOCs = well will be sampled for CVOCs during this event

MNA = well will be sampled for MNA analytes during this event

- = well will not be sampled during this event

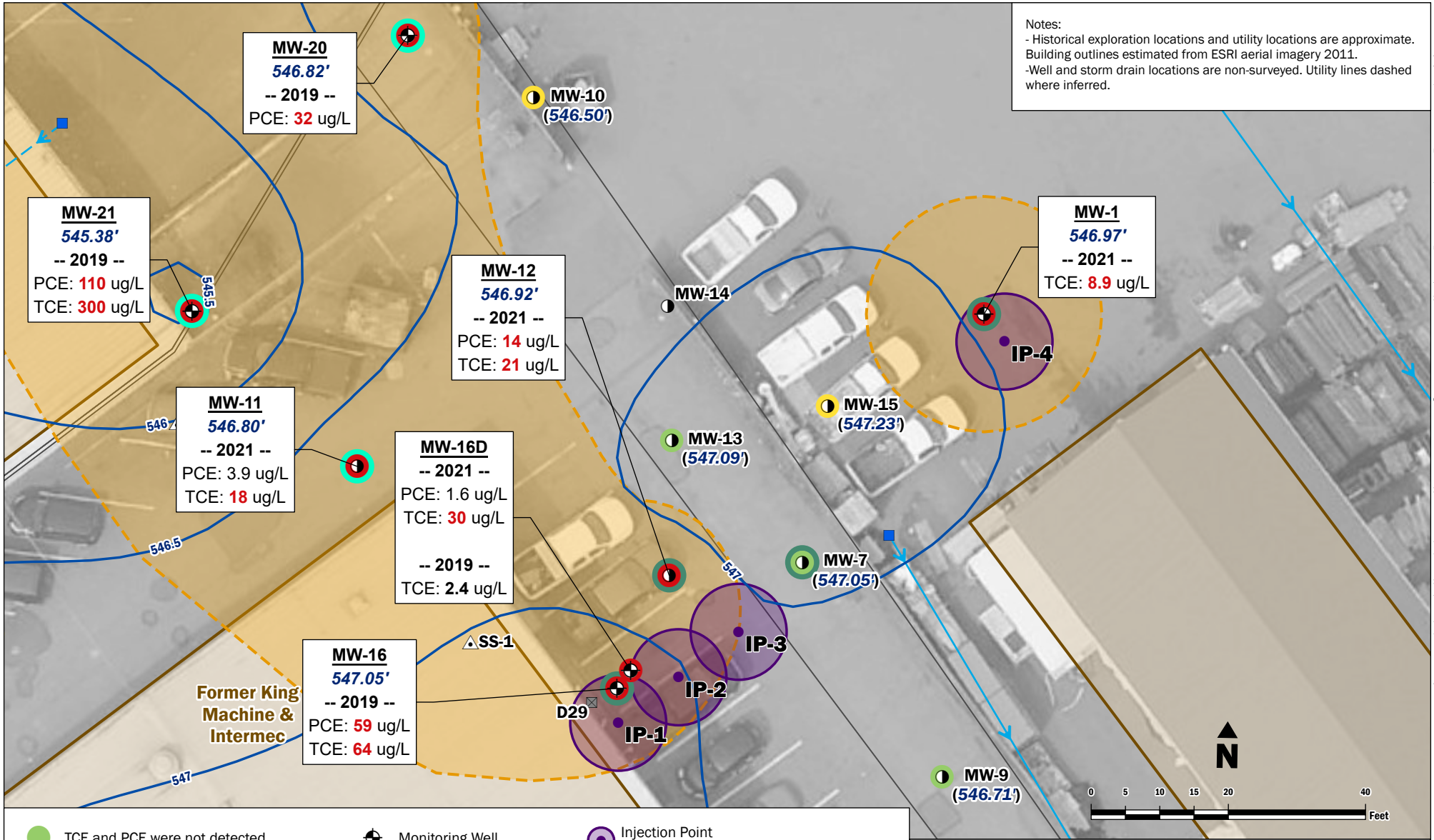
FIGURES



Vicinity Map

Pilot Test Work Plan
HERS Industrial Park
Mukilteo, Washington

	DEC-2022	BY: ALN / RAP	FIGURE NO. 1
	PROJECT NO. 140252	REVISED BY: EAC	



Notes:
- Historical exploration locations and utility locations are approximate.
- Building outlines estimated from ESRI aerial imagery 2011.
- Well and storm drain locations are non-surveyed. Utility lines dashed where inferred.

TCE and PCE were not detected.

TCE and/or PCE was detected at a concentration less than the MTCA Method A cleanup level.

TCE and/or PCE was detected at a concentration greater than the MTCA Method A cleanup level.

Estimated Extent of TCE or PCE Above MTCA Method A Cleanup Levels.

Monitoring Well

Soil Gas

Steel Injection Well

Storm Drain

Former Storm Drain

Storm Drain (arrow indicates flow direction)

Injection Point and ROI (7 ft)

Performance and Operational Monitoring Location

Performance Monitoring Location

Building

Groundwater Elevation Contour Line (5/6/2021)

Tax Parcels

Pilot Test Layout

Pilot Test Work Plan
HERS Industrial Park
Mukilteo, Washington

Aspect CONSULTING

JAN-2023

PROJECT NO.
140252

BY:
MWC / DRB / NLK

REVISED BY:
--- / ---

FIGURE NO.

2

Data source credits: None || Basemap Service Layer Credits: NA

Aspect Pro G:\projects\HERSIndustrialPark\140252_HERSIndustrialPark_140252.dwg 11/NOV/2023 11:00:18 1583 SampleArea Washington North FRS 4001 Feet | Data Saved: 1/27/2023 15:25 by jhodie

APPENDIX A

Reagent Information

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.

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.



S-MicroZVI is Best in Class For

- ☒ Longevity
- ☒ Reactivity
- ☒ Transport

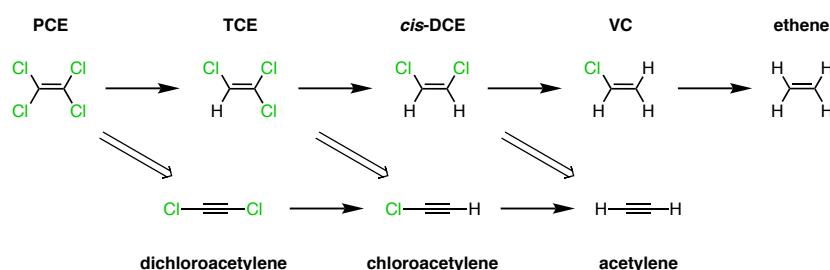


Figure 1: Chlorinated ethene degradation pathways and products. The top pathway with single line arrows represent the reductive dechlorination (hydrogenolysis) pathway. The lower pathway with downward facing double line arrows represent the beta-elimination pathway.

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

S-MicroZVI 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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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@regenesisis.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 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. Show this safety data sheet to the doctor in attendance.

5. Fire-fighting measures

Suitable extinguishing media	Use fire-extinguishing media appropriate for surrounding materials.
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.

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/m ³	Respirable fraction.
		15 mg/m ³	Total dust.

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

Components	Type	Value	Form
Glycerol (CAS 56-81-5)	TWA	5 mg/m ³	Respirable fraction.
		15 mg/m ³	Total dust.
		50 mppcf	Total dust.
		15 mppcf	Respirable fraction.

Biological limit values	No biological exposure limits noted for the ingredient(s).
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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	Property has not been measured.
pH	10 (As shipped) 7 - 8 (When mixed with water)
Melting point/freezing point	Property has not been measured.
Initial boiling point and boiling range	Property has not been measured.
Flash point	Property has not been measured.
Evaporation rate	Property has not been measured.
Flammability (solid, gas)	Not applicable.
Upper/lower flammability or explosive limits	
Explosive limit - lower (%)	Property has not been measured.
Explosive limit - upper (%)	Property has not been measured.
Vapor pressure	Property has not been measured.
Vapor density	Property has not been measured.
Relative density	Property has not been measured.
Solubility(ies)	
Solubility (water)	Property has not been measured.
Partition coefficient (n-octanol/water)	Property has not been measured.
Auto-ignition temperature	Property has not been measured.
Decomposition temperature	Property has not been measured.
Viscosity	3000 cP (77 °F (25 °C))
Other information	
Density	Property has not been measured.
Explosive properties	Not explosive.
Kinematic viscosity	Property has not been measured.
Oxidizing properties	Not oxidizing.

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
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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.
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)		
<u>Acute</u>		
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 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.

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		
<i>Acute</i>		
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 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 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 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 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.

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 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)	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 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	27-December-2018
Revision date	25-May-2022
Version #	02
HMIS® ratings	Health: 1 Flammability: 1 Physical hazard: 0 Personal protection: B

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® 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.

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.

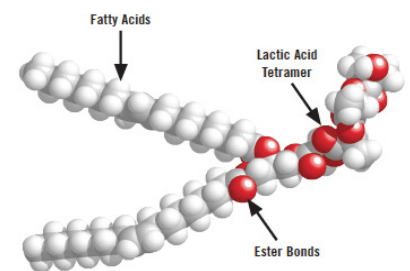
Suspension of 3DME generated by this mixing range from micelles on the order of .02 microns to .05 microns in diameter, to “swollen” micelles, (termed “microemulsions”) which are on the order of .05 to 5 microns in diameter. Once injected into the subsurface in high volumes, the colloidal suspension 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.



Example of 3-D Microemulsion

FIGURE 1: THE 3-D MICROEMULSION MOLECULAR STRUCTURE



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.



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SAFETY DATA SHEET

1. Identification

Product identifier 3-D Microemulsion® Factory Emulsified

Other means of identification 3DME

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 USA

General information 949-366-8000

E-mail CustomerService@regenesisis.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 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

Chemical name	CAS number	%
Fatty acid esters	-	40 - 60
Water	7732-18-5	35 - 45
Lactate oligomers	-	2 - 10
Sodium lactate	867-56-1	2 - 10
Surfactant	-	< 1

Composition comments All concentrations are in percent by weight unless otherwise indicated.
Contains no hazardous ingredients 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	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. Prolonged skin contact 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. Show this safety data sheet to the doctor in attendance.
5. Fire-fighting measures	
Suitable extinguishing media	Water fog. Foam. Dry chemical powder. Carbon dioxide (CO ₂).
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 oxides, 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	The product is an aqueous solution. After the water component evaporates, the remaining material will burn.

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	This product is miscible in water. Spilled product may create a slipping hazard. 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	Observe good industrial hygiene practices.
Conditions for safe storage, including any incompatibilities	Store in tightly closed container. Store away from incompatible materials (see Section 10 of the SDS). Recommended storage containers: plastic lined steel, plastic, glass, aluminum, stainless steel, 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 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	Liquid.
Color	White.
Odor	Odorless.
Odor threshold	Not available.
pH	6 - 8
Melting point/freezing point	Property has not been measured.
Initial boiling point and boiling range	212 °F (100 °C)
Flash point	> 199.94 °F (> 93.3 °C) Closed Cup
Evaporation rate	Not available.
Flammability (solid, gas)	Not applicable.

Upper/lower flammability or explosive limits

Explosive limit - lower (%)	Property has not been measured.
Explosive limit - upper (%)	Property has not been measured.
Vapor pressure	Property has not been measured.
Vapor density	Property has not been measured.
Relative density	1 - 1.2
Solubility(ies)	
Solubility (water)	Miscible.
Partition coefficient (n-octanol/water)	Property has not been measured. Property has not been measured.
Auto-ignition temperature	Property has not been measured.
Decomposition temperature	Not applicable as the product is not unstable.
Viscosity	Not available.
Other information	
Density	Property has not been measured.
Explosive properties	Not explosive.
Kinematic viscosity	Property has not been measured.
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	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	No hazardous decomposition products are known.

11. Toxicological information

Information on likely routes of exposure

Inhalation	Spray mists may cause respiratory tract irritation.
Skin contact	May cause mild or temporary skin irritation upon prolonged and excessive contact.
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. Prolonged skin contact may cause temporary irritation.
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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	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	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.
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Components	Species		Test Results
Fatty acid esters (CAS -)			
Aquatic			
Acute			
Algae	EL50	Selenastrum capricornutum	> 854.9 mg/l, 72 hours
Fish	LL50	Pimephales promelas	> 1000 mg/l, 96 hours
Other	EL50	Daphnia sp.	> 1000 mg/l, 48 hours
Persistence and degradability	No data is available on the degradability of this product.		
Bioaccumulative potential	No data available.		
Mobility in soil	The product is completely soluble in water. Expected to be 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 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 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 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.

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)	Yes
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
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	09-April-2015
Revision date	06-May-2022
Version #	04
HMIS® ratings	Health: 1 Flammability: 1 Physical hazard: 0 Personal protection: B

NFPA ratings



Disclaimer

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

APPENDIX B

Blank Field Forms

Injection Monitoring Log

[illegible]

Notes

gpm = gallons per minute

psig = pounds per square inch, gage

gal = gallons

lbs = pounds

ft = feet

bgs = below ground surface

Aspect Consulting

V:\140252 HERS Industrial Park\Deliverables\Pilot Test Work Plan\App B\1 Injection Log

Water Level Monitoring Log

Project No. 140252, HERS Industrial Park

Field Staff: _____

[illegible]

ft btoc = feet below top of casing



WELL NUMBER: _____ Page: ____ of ____

Project Number: _____

Starting Water Level (ft TOC):	
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Casing Stickup (ft): _____

Total Depth (ft TOC):

Casing Diameter (inches): _____

Sample Intake Depth (ft TOC):

3/4" = 0.09 Lpf 2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

[illegible]

Total Casing Volumes Removed:

Ending Total Depth (ft TOC): _____

[illegible]

Parameters measured with (instrument model & serial number):

Disposal of Discharged Water:

Observations/Comments:	
------------------------	--