LiRo Engineers, Inc.
A LiRo Group Company
690 Delaware Avenue, Buffalo, NY 14209 Telephone 716.882.5476 Facsimile 716.882.9640 www.liro.com

Mr. Steven Moeller
Project Manager
New York State Department of Environmental Conservation
270 Michigan Avenue, Buffalo, NY 14203

November 30, 2020

Re: Shallow Bedrock Biological Amendments and Zero Valent Iron Pilot Test – Work Plan
Call Out # 134697: Former Vibratech, Inc., 537 East Delevan Avenue, Buffalo, NY
Standby Investigation and Remediation Services Contract (C100061)
New York State Department of Conservation (NYSDEC) Site #915165

Dear Mr. Moeller,

LiRo Engineers, Inc. (LiRo) has prepared this *Shallow Bedrock Biological Amendments and Zero Valent Iron Pilot Test – Work Plan* in support of New York State Department of Environmental Conservation (NYSDEC) remedial investigation at the Vibratech, Inc. site located at 537 East Delavan Avenue, Buffalo, NY (Site) (see Figures 1 and 2) in response to Call Out #134697.

The purpose of the pilot test is to evaluate a single well, one-time, gravity injection/infiltration of Biological Amendments (i.e. 3-D Microemulsion and Bio-Dechlor Inoculum [BDI] Plus) and Zero Valent Iron (S-Micro ZVI) into the shallow overburden/bedrock (i.e. A-Zone) groundwater aquifer to reduce concentrations of chlorinated and petroleum volatile organic compounds and 1,4-Dioxane at the Site.

All amendment materials are manufactured by Regenesis, Inc., and were selected after an evaluation of remedial technologies as summarized in the *Bedrock Investigation and Groundwater Monitoring Report – Vibratech, Inc.,* dated October 29, 2020. The design of the amendments (see Appendix A) was completed by Regenesis and is based upon current Site data. The total volume of mixed amendments for the entire Pilot Test is approximately 1,150 gallons. A summary of amendment mixture ratios and total volumes is presented in Table 1.

For the injection/infiltration, monitoring well MW-11-03A has been selected as the injection location based upon its construction (depth of screen) and its location relative to other monitoring wells and other Site features such as storm sewers. LiRo will provide mixing tank/containers and all necessary equipment to gravity feed biological amendments and ZVI into this well in the sequence and quantity detailed in Table 1. Empirical field data collected from MW-11-03A on November 5, 2020, reported sustainable infiltration rates between 1.29 gallons per minute (gpm) and 2.76 gpm (see Appendix B). Given the design volumes and the anticipated infiltration rates, the estimated time required to infiltrate approximately 1,150 gallons of mixed amendments, by gravity, into MW-11-03A is between 8 and 16 hours. This time estimate does not include mobilization and baseline (pre-injection) groundwater field measurements and sampling.

Prior to and after infiltration of the amendments, LiRo will conduct field measurements of surrounding wells and complete four rounds of groundwater sampling with laboratory analysis. A list of field parameters to be measured at selected monitoring wells is provided on Table 2. A summary of groundwater sample laboratory analyses to be performed is provided on Table 3. Table 4 provides a proposed schedule for the pilot test.

All work shall conform to the following:
1) Pilot Test requirements as defined in Tables 1 through 4,
2) Regenesis, Inc., recommendations (Appendix A),
3) Vibratech Quality Assurance Project Plan (QAPP), dated September 2018,
4) Vibratech Field Sampling Plan (FSP), dated September 2018,
5) Site Specific Health and Safety Plan (SSHSP), dated June 2018,
6) Laboratory Testing to be performed by NYSDEC (Table 3), and

7) Calibration of all field instruments/equipment to manufacturer recommendations.

LiRo will provide to NYSDEC documentation of purchased materials used prior to the start of the pilot test.

After completion and receipt of analytical results, LiRo will prepare a Pilot Test Report, in Draft and Final versions for NYSDEC review.

Should you have any questions regarding this matter please contact me anytime at 716-882-5476 ext. 417.

Sincerely,

LiRo Engineers, Inc.

Craig Taylor
Project Manager

Cc: LiRo File 17-013-0289
Steven Frank (LiRo)

Attachments

Table 1	Material Application Volumes and Mixing Ratios
Table 2	Field Measurements
Table 3	Groundwater Parameters, Sample Numbers and Locations
Table 4	Proposed Schedule
Figure 1	Sample Location
Figure 2	Site Map
Appendix A	Regenesis Design and Material Sheets
Appendix B	Boring Log and Field Infiltration Test

TABLES

TABLE 1
MATERIAL APPLICATION VOLUMES AND MIXING RATIOS
SHALLOW BEDROCK BIOLOGICAL AUGMENTATION AND ZERO VALENT IRON PILOT TEST
NYSDEC – VIBRATECH, SITE #915165
537 EAST DELAVAN AVENUE, BUFFALO, NEW YORK

Infiltration Sequence and Material		Total Amount of Amendment to Apply	Gallons of Water to Add for Application	Total Volume of Liquid to Apply	Mixing Ratios by Volume (Amendment/Water)
1	3-D Microemulsion (Nutrient Mixture)	48 gallons	911 gallons (potable water, pH neutral)	959 gallons	0.052689 gallons of 3-D Microemulsion per gallon of water (200 ml/gallon) (5.3% solution by volume) or 5.27 gallons of 3-D Microemulsion per 100 gallons of water
2	S-Micro ZVI (Zero Valent Iron)	33 gallons	0 gallons	33 gallons	No Mixing required Amendment is a liquid
3	BDI Plus (Active Biological Amendment)	2.37 gallons	90 gallons of de- oxygenated water (requires N_2 purge)	92.37 gallons	0.026333 gallons of BDI Plus per gallon of water (100 ml/gallon) (2.3% solution by volume) or 2.37 gallons of BDI Plus per 90 gallons of de-oxygenated water
4	Post Application Flush	No Amendment	50 gallons (pH neutral potable water)	50 gallons	50 gallons applied the day after infiltration is complete to flush well riser and screen

Notes:
1) All materials are to be infiltrated by gravity into a single location (MW-11-03A)

TABLE 2
FIELD MEASUREMENTS
SHALLOW BEDROCK BIOLOGICAL AUGMENTATION AND ZERO VALENT IRON PILOT TEST
NYSDEC – VIBRATECH, SITE #915165
537 EAST DELAVAN AVENUE, BUFFALO, NEW YORK

Field Parameter	Instrument/Equipment	Resolution (Accuracy)	Frequency	Location
Water Level/Free Product`	Electronic Water Level Meter with Oil Interface Probe	0.01 feet (+/-0.01 feet)	Prior to each sampling event with additional monitoring as determined in the field.	Well Locations (count 16) 1) Injection Well: MW-11-03A 2) MW-10-03A 3) MW-07-03A 4) LMW-06B 5) LMW-06C 6) MW-08-03A 7) LMW-04A 8) MW-01-10A 9) MW-02-10A 10) MW-03-10A 11) MW-06-10A 12) LMW-02A 13) LMW-02B 14) LMW-02C 15) MW-05-94A 16) MW-13-03A
Purge Rate	Low Stress/Flow pump	0.25 gpm (+/- 0.1 gpm)	Injection Well (MW-11-03A) (when practicable) and at each groundwater monitoring location prior to each sampling event.	
pH	Flow Cell with Multi-Parameter YSI Type Probe or equal	0.1 Standard Units (SU) (+/- 0.2 SU)		
Temperature (Temp)		0.01 Degrees Centigrade (C^o) (+/- 0.15 C_o)		
Conductivity (Cond)		0.1 micro Siemens/Centimeter (mS/cm) (+/- 0.5%)		
Dissolved Oxygen (DO)		0.01 milligram/liter (mg/L)		
Oxygen Reduction Potential (ORP)		0.1 millivolts (mV) (+/- 20 mV)		
Salinity		0.01 parts per thousand (+/- 1 %)		
Turbidity		0.1 nephelometric turbidity units (NTU) (+/- 5%)		
Iron (i.e. ferrous of Fe^2)	HACH Kit Model IR-18C	0.2 milligrams per Liter (mg/L) (+/- 1 mg/L)		
Total Dissolved Iron (i.e. ferric or Fe^3)	HACH Test Strips	1 milligrams per Liter (mg/L) (+/- 1 mg/L)		

TABLE 3
GROUNDWATER PARAMETERS, SAMPLE NUMBERS AND LOCATIONS
SHALLOW BEDROCK BIOLOGICAL AUGMENTATION AND ZERO VALENT IRON PILOT TEST
NYSDEC – VIBRATECH, SITE #915165
537 EAST DELAVAN AVENUE, BUFFALO, NEW YORK

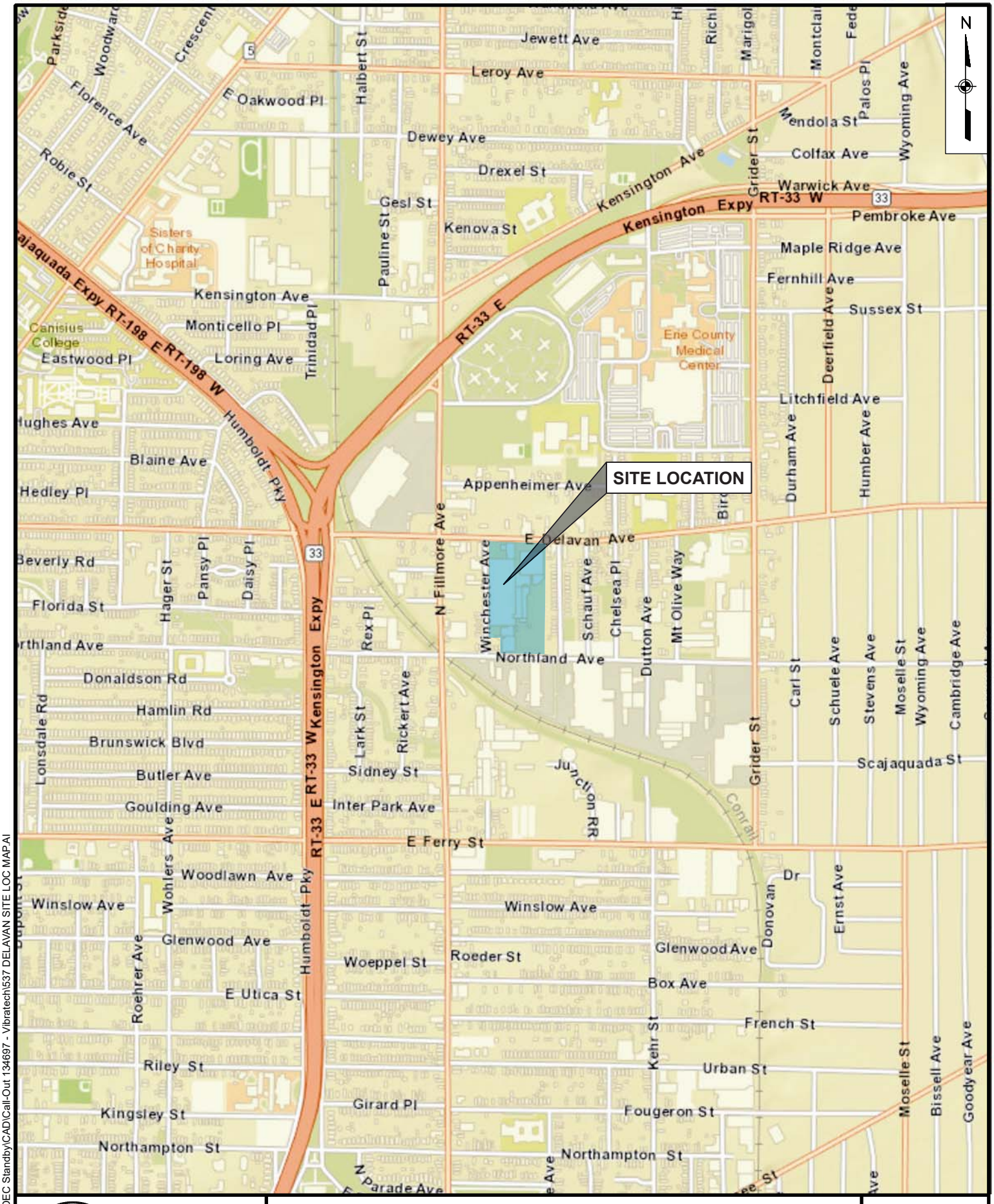
	Parameters	Method	Number of Events	Locations	Number of Samples per Event
1	Target Compound List (TCL) Volatile Organic Compounds (VOCs)[1]	USEPA 8260C	Event Count = 4 1) Baseline (Prior to Inj.) 2) 30-days (Post Inj.) 3) 90-days (Post Inj.) 4) 180-days (Post Inj.)	Well Locations (count 16) 1) Injection Well: MW-11-03A 2) MW-10-03A 3) MW-07-03A 4) LMW-06B 5) LMW-06C 6) MW-08-03A 7) LMW-04A 8) MW-01-10A 9) MW-02-10A 10) MW-03-10A 11) MW-06-10A 12) LMW-02A 13) LMW-02B 14) LMW-02C 15) MW-05-94A 16) MW-13-03A	16 Samples per Event 5 Parameters (Baseline Event) 7 Parameters (30, 90 & 180-Day Events) 64 Total Samples 416 Total Analysis
2	1,4-Dioxane[1]	USEPA 8270D SIM			
3	Dissolved Gases in Water: Acetylene, Methane, Ethene, and Ethane	Standard Methods			
4	Metabolic Acids: lactic, pyruvic, acetic, propionic, and butyric				
5	Total Iron	USEPA 3005-FE			
6	Total Ferrous Iron (i.e. Fe^{2})				

Notes:
1) Excluded from parameter list for the Baseline sampling event (i.e. previous routine groundwater sampling results will be used for baseline).

TABLE 4
PROPOSED SCHEDULE
SHALLOW BEDROCK BIOLOGICAL AUGMENTATION AND ZERO VALENT IRON PILOT TEST
NYSDEC – VIBRATECH, SITE #915165
537 EAST DELAVAN AVENUE, BUFFALO, NEW YORK

	TASK	TIME REQUIRED FOR TASKS		RESPONSIBLE PARTY
		INDIVIDUAL TASK DURATION (DAYS)	CUMULATIVE DAYS (Relative to Injection)	
1	Mobilization	21	-24	LiRo
2	Baseline Sampling	3	-3	LiRo
3	Injection of Biological Amendments and Zero Valent Iron	3	0	LiRo
4	Baseline Laboratory Analysis Report	21	21	NYSDEC - Lab
5	Draft Baseline Sampling Laboratory Tables to NYSDEC	7	28	LiRo
6	30-Day Sampling	3	33	LiRo
7	30-Day Laboratory Analysis Report	21	54	NYSDEC - Lab
8	Draft 30-Day Laboratory Tables to NYSDEC	7	61	LiRo
9	90-Day Sampling	3	93	LiRo
10	90-Day Laboratory Analysis Report	21	114	NYSDEC - Lab
11	Draft 90-Day Laboratory Tables to NYSDEC	7	121	LiRo
12	180-Day Sampling	3	183	LiRo
13	180-Day Laboratory Analysis Report	21	204	NYSDEC - Lab
14	Draft Report to NYSDEC	21	225	LiRo
15	NYSDEC Comments on Draft	14	239	NYSDEC
16	Final Draft Report to NYSDEC	14	253	LiRo
17	NYSDEC Comments on Final Draft	14	267	NYSDEC
18	Final Report to NYSDEC	14	281	LiRo

FIGURES

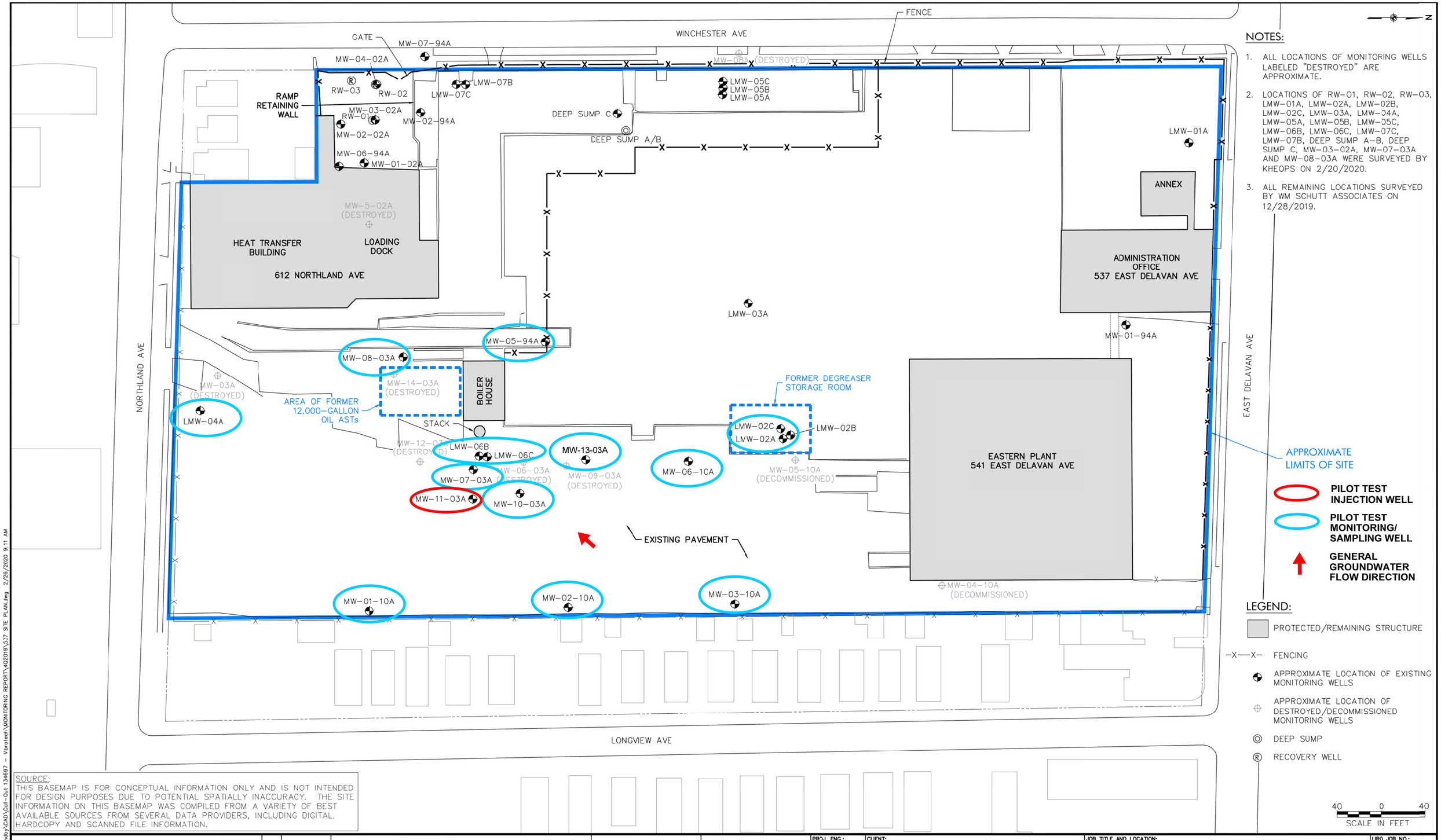


J:\17-013-0289 NYSDEC Standby\CAD\Call-Out 134697 - Vibratech\537 DELAVAN SITE LOC MAP.AI

LiRo-Engineers, Inc.
690 Delaware Ave.
Buffalo, New York

537 EAST DELAVAN AVENUE
SITE LOCATION MAP

1



NOTES:

1. ALL LOCATIONS OF MONITORING WELLS LABELED "DESTROYED" ARE APPROXIMATE.
2. LOCATIONS OF RW-01, RW-02, RW-03, LMW-01A, LMW-02A, LMW-02B, LMW-02C, LMW-03A, LMW-04A, LMW-05A, LMW-05B, LMW-05C, LMW-06B, LMW-06C, LMW-07C, LMW-07B, DEEP SUMP A-B, DEEP SUMP C, MW-03-02A, MW-07-03A AND MW-08-03A WERE SURVEYED BY KHEOPS ON 2/20/2020.
3. ALL REMAINING LOCATIONS SURVEYED BY WM SCHUTT ASSOCIATES ON 12/28/2019.

APPROXIMATE LIMITS OF SITE

PILOT TEST INJECTION WELL

PILOT TEST MONITORING/ SAMPLING WELL

GENERAL GROUNDWATER FLOW DIRECTION

LEGEND:

- PROTECTED/REMAINING STRUCTURE
- -X--X- FENCING
- APPROXIMATE LOCATION OF EXISTING MONITORING WELLS
- APPROXIMATE LOCATION OF DESTROYED/DECOMMISSIONED MONITORING WELLS
- DEEP SUMP
- (R) RECOVERY WELL

40 0 40
SCALE IN FEET

SOURCE:
THIS BASEMAP IS FOR CONCEPTUAL INFORMATION ONLY AND IS NOT INTENDED FOR DESIGN PURPOSES DUE TO POTENTIAL SPATIALLY INACCURACY. THE SITE INFORMATION ON THIS BASEMAP WAS COMPILED FROM A VARIETY OF BEST AVAILABLE SOURCES FROM SEVERAL DATA PROVIDERS, INCLUDING DIGITAL, HARDCOPY AND SCANNED FILE INFORMATION.

NO.	DATE	DESCRIPTION

REVISIONS

LiRo Engineers, Inc.
690 Delaware Avenue
Buffalo, New York

PROJ. ENG.:	M.J.W.
DESIGNED BY:	M.P.B.
CHECKED BY:	M.J.W
DRAWN BY:	A.M.K.
DATE:	OCTOBER 2019
SCALE:	AS SHOWN

CLIENT: NEW YORK STATE OF OPPORTUNITY Department of Environmental Conservation

JOB TITLE AND LOCATION:
537 EAST DELAVAN AVENUE
BUFFALO, NEW YORK
NYSDEC SITE NUMBER 915165

DRAWING TITLE:
PILOT TEST INJECTION, SAMPLING AND MONITORING WELL LOCATIONS

LIRO JOB NO.: 17-013-0289
SHEET 2 OF 8
FIGURE NO.: 2

J:\17-013-0289 NYSDEC Standby\CAD\Coll-Out 134697 - Vbrotech\MONITORING REPORT\402019\537 SITE PLAN.dwg 2/26/2020 9:11 AM

APPENDIX A
(Regenesis Design and Material Sheets)

REGENESIS

Project Information		
Former Vivratec Inc. Site		
Buffalo, New York 14209		
Pilot Study of dissolved phase COCs in fractured bedrock		
Prepared For:		
Thomas Fralick (LiRo Engineers Inc.)		
Target Treatment Zone (TTZ) Info	**Unit**	**Value**
Areal Extent	sq ft	1,256
Top Treat Depth	ft	5.0
Bot Treat Depth	ft	20.0
Vertical Treatment Interval	ft	15.0
Treatment Zone Volume	ft^3	18,840
Treatment Zone Volume	cy	698
Soil Type	---	Onondaga Limestone
Porosity	cm^3/cm^3	0.02
Effective Porosity	cm^3/cm^3	0.02
Treatment Zone Pore Volume	gals	2,819
Treatment Zone Effective Pore Volume	gals	2,819
Fraction Organic Carbon (foc)	g/g	0.005
Soil Density	g/cm^3	1.67
Soil Density	lb/ft^3	104
Soil Weight	lbs	2.0E+06
Hydraulic Conductivity	ft/day	10.0
Hydraulic Conductivity	cm/sec	3.53E-03
Hydraulic Gradient	ft/ft	0.022
GW Velocity	ft/day	11.00
GW Velocity	ft/yr	402
Contaminant Mass	**Unit**	**Value**
Dissolved Phase Contaminant Mass	lbs	0
Sorbed Phase Contaminant Mass	lbs	2
Competing Electron Acceptor Mass	lbs	2
Total Mass Contributing to H2 Demand	**lbs**	**4**
Mass Flux and 3DME Demand	**Unit**	**Value**
Groundwater Flux	L/day	0
Stoichiometric 3DME Demand	lbs	15
Total Mass Flux 3DME Demand	lbs	0
Toral 3DME Demand	**lbs**	**15**
Application Dosing		
3-D Microemulsion to be Applied	**lbs**	**400**
S-MZVI to be Applied	**lbs**	**500**
BDI Plus to be Applied	**liters**	**9**

3-D Microemulsion®, S-MZVI®, CRS®, BDI® Plus Application Design Summary

Pilot Study of dissolved phase COCs in fractured bedrock		
Treatment Type	**Grid**	
Treatment Areal Extent (sq ft)	1,256	Input special application instructions here as needed.
Spacing Within Rows (ft)	0	
Spacing Between Rows (ft)	0	
DPT Injection Points	1	
Top Application Depth (ft bgs)	5	**Field Mixing Ratios**
Bottom Application Depth (ft bgs)	20	3DME Concentrate per Pt (gals)
3DME to be Applied (lbs)	**400**	48
3DME to be Applied (gals)	48	Mix Water per Pt (gals)
3DME Mix %	5%	911
Volume Water (gals)	**911**	3DME Mix Volume per Pt (gals)
3DME Mix Volume (gals)	959	959
S-MZVI to be Applied (lbs)	**500**	S-MZVI Volume per Pt (gals)
S-MZVI Volume (gals)	33	33
BDI Plus to be Applied (L)	**9**	BDI Volume per Pt (L)
BDI Plus Mix Water Volume (gals)	90	9.0
Total Application Volume (gals)	**1,084**	Volume per pt (gals)
		1084
Prepared by: Keith M Gaskill, LPG, Sr Design Specialist		Volume per vertical ft (gals)
Date: 10/29/2020		72

Technical Notes/Discussion

Assumptions/Qualifications

In generating this preliminary estimate, Regenesis relied upon professional judgment and site specific information provided by others. Using this information as input, we performed calculations based upon known chemical and geologic relationships to generate an estimate of the mass of product and subsurface placement required to affect remediation of the site.

REGENESIS developed this Scope of Work in reliance upon the data and professional judgments provided by those whom completed the earlier environmental site assessment(s). The fees and charges associated with the Scope of Work were generated through REGENESIS' proprietary formulas and thus may not conform to billing guidelines, constraints or other limits on fees. REGENESIS does not seek reimbursement directly from any government agency or any governmental reimbursement fund (the "Government"). In any circumstance where REGENESIS may serve as a supplier or subcontractor to an entity which seeks reimbursement from the Government for all or part of the services performed or products provided by REGENESIS, it is the sole responsibility of the entity seeking reimbursement to ensure the Scope of Work and associated charges are in compliance with and acceptable to the Government prior to submission. When serving as a supplier or subcontractor to an entity which seeks reimbursement from the Government, REGENESIS does not knowingly present or cause to be presented any claim for payment to the Government.

REGENESIS

Purchasing Information

Former Vivratec Inc. Site	--	Pilot Study of dissolved phase COCs in fractured bedrock
3-D Microemulsion to be Applied	**lbs**	**400**
S-MZVI to be Applied	**lbs**	**500**
BDI Plus to be Applied	**liters**	**9**
3-D Microemulsion Cost	$	$1,700
S-MZVI Cost	$	$4,190
BDI Plus Cost	$	$1,782
Subtotal Product Cost	**$**	**$7,672**
Estimated Tax and Freight %	%	15%
Estimated Tax and Freight Cost*	$	$1,151
Estimated Total Product Cost	**$**	**$8,823**

***Note that the combined tax and freight costs are preliminary estimates only. Please contact your local sales manager or Customer Service at 949-366-8000 to obtain a shipping quote. You will be asked to provide a ship-to address and estimated time of delivery.**

Currently Available Packaging Options

Package Type**	# of packages	lbs required
3DME-400 lb poly drums	1	400
S-MZVI-500 lb poly drums	1	500
BDI-18 Liter kegs	1	--

****Total Project cost is only an estimate; actual project cost may change as the final scope and/or RRS proposal are developed.**

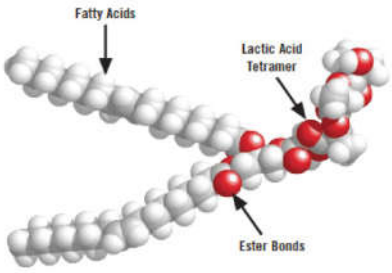
*****Available Package Types are subject to change.**

3-D Microemulsion® Factory Emulsified Technical Description

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

Example of 3-D Microemulsion

FIGURE 1: THE 3-D MICROEMULSION MOLECULAR STRUCTURE



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

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

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

3-D Microemulsion® Factory Emulsified Technical Description

Chemical Composition

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

Properties

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

Storage and Handling Guidelines

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

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

Applications

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

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

Health and Safety

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

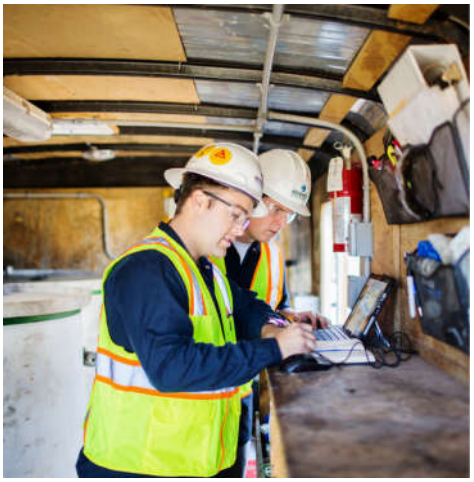
REGENESIS®

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

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.



S-MicroZVI is Best in Class For

- ☑ Longevity
- ☑ Reactivity
- ☑ Transport

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.

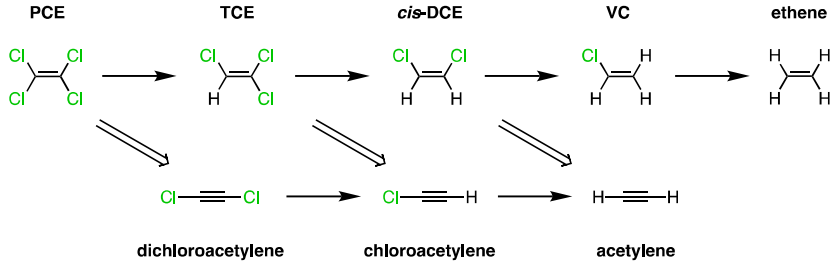


Figure 1: *Chlorinated ethene degradation pathways and products. The top pathway with single line arrows represent the reductive dechlorination (hydrogenolysis) pathway. The lower pathway with downward facing double line arrows represent the beta-elimination pathway.*

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.

REGENESIS®

www.regenesis.com

Corporate Headquarters
1011 Calle Sombra, San Clemente CA 92673 USA
Tel: +1 949.366.8000

European Offices (UK, Ireland, Belgium and Italy)
Email: europe@regenesis.com
Tel: +44 (0)1225 61 81 61

BDI PLUS® Technical Description

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.

Species of Dehalococcoides sp. (DHC)

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

Remedial Design Assumptions and Qualifications

Cost Estimate Disclaimer: The cost listed assumes conditions set forth within the proposed scope of work and assumptions and qualifications. Changes to either could impact the final cost of the project. This may include final shipping arrangements, sales tax or application related tasks such as product storage and handling, access to water, etc. If items listed need to be modified, please contact Regenesis for further evaluation.

Shipping Estimates: Shipping estimates are valid for 30 days. All shipping charges are estimates and actual freight charges are calculated at the time of invoice. Additional freight charges may be assessed for any accessorial requested at the time of delivery. The estimate included within assumes standard shipping.

Standard delivery is between 8am -5pm Monday –Friday. *accessorial – can include, but not limited to lift gate and pallet jack at delivery, inside delivery, time definite deliveries, and delivery appointments.

Please communicate any requirements for delivery with the customer service department at the time the order is placed.

Return Policy: To initiate a return please contact your local sales manager for an RMA. A 15% re-stocking fee will be charged for all returned goods. Return freight must be prepaid. All requests to return product must be in original condition and no product will be accepted for return after 90 days from date of delivery.

Professional Judgement: In generating this estimate, REGENESIS relied upon professional judgment and site specific information provided by others. Using this information as input, we performed calculations based upon known chemical and geologic relationships to generate an estimate of the mass of product and subsurface placement required to affect remediation of the site.

REGENESIS developed this Scope of Work in reliance upon the data and professional judgments provided by those whom completed the earlier environmental site assessment(s), and in reliance upon REGENESIS' prior experience on similar project sites. The fees and charges associated with the Scope of Work were generated through REGENESIS' proprietary formulas and thus may not conform to billing guidelines, constraints or other limits on fees. REGENESIS does not seek reimbursement directly from any government agency or any governmental reimbursement fund (the "Government"). In any circumstance where REGENESIS may serve as a supplier or subcontractor to an entity which seeks reimbursement from the Government for all or part of the services performed or products provided by REGENESIS, *it is the sole responsibility of the entity seeking reimbursement to ensure the Scope of Work and associated charges are in compliance with and acceptable to the Government prior to submission*. When serving as a supplier or subcontractor to an entity which seeks reimbursement from Government, REGENESIS does not knowingly present or cause to be presented any claim for payment to the government.

REGENESIS
1011 Calle Sombra
San Clemente, CA 92673-6244
Tel: 949.366.8000 • Fax: 949.366.8090

Terms and Conditions
Products and Services

1. PAYMENT TERMS. Net 30 Days. Accounts outstanding after 30 days will be assessed 1.5% monthly interest. Volume discount pricing will be rescinded on all accounts outstanding over 90 days. An early payment discount of 1.5% Net 10 is available for cash or check payments only. We accept Master Card, Visa and American Express.

2. RETURN POLICY. A 15% re-stocking fee will be charged for all returned goods. All requests to return product must be pre-approved by seller. Returned product must be in original condition and no product will be accepted for return after a period of 90 days.

3 FORCE MAJEURE. Seller shall not be liable for delays in delivery or services or failure to manufacture or deliver due to causes beyond its reasonable control, including but not limited to acts of God, acts of buyer, acts of military or civil authorities, fires, strikes, flood, epidemic, war, riot, delays in transportation or car shortages, or inability to obtain necessary labor, materials, components or services through seller's usual and regular sources at usual and regular prices. In any such event Seller may, without notice to buyer, at any time and from time to time, postpone the delivery or service dates under this contract or make partial delivery or performance or cancel all or any portion of this and any other contract with buyer without further liability to buyer. Cancellation of any part of this order shall not affect Seller's right to payment for any product delivered or service performed hereunder.

4. LIMITED WARRANTY. Seller warrants the product(s) sold and services provided as specified on face of invoice, solely to buyer. Seller makes no other warranty of any kind respecting the product and services, and expressly DISCLAIMS ALL OTHER WARRANTIES OF WHATEVER KIND RESPECTING THE PRODUCT AND SERVICES, INCLUDING ALL WARRANTIES OF MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE AND NON-INFRINGEMENT.

5. DISCLAIMER. Where warranties to a person other than buyer may not be disclaimed under law, seller extends to such a person the same warranty seller makes to buyer as set forth herein, subject to all disclaimers, exclusions and limitations of warranties, all limitations of liability and all other provisions set forth in the Terms and Conditions herein. Buyer agrees to transmit a copy of the Terms and Conditions set forth herein to any and all persons to whom buyer sells, or otherwise furnishes the products and/or services provided buyer by seller and buyer agrees to indemnify seller for any liability, loss, costs and attorneys' fees which seller may incur by reason, in whole or in part, of failure by buyer to transmit the Terms and Conditions as provided herein.

6. LIMITATION OF SELLER'S LIABILITY AND LIMITATION OF BUYER'S REMEDY. Seller's liability on any claim of any kind, including negligence, for any loss or damage arising out of, connected with, or resulting from the manufacture, sale, delivery, resale, repair or use of any goods or performance of any services covered by or furnished hereunder, shall in no case exceed the lesser of (1) the cost of repairing or replacing goods and repeating the services failing to conform to the forgoing warranty or the price of the goods and/or services or part thereof which gives rise to the claim. IN NO EVENT SHALL SELLER BE LIABLE FOR SPECIAL INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING LOST PROFITS, OR FOR DAMAGES IN THE NATURE OF PENALTIES.

7. INDEMNIFICATION. Buyer agrees to defend and indemnify seller of and from any and all claims or liabilities asserted against seller in connection with the manufacture, sale, delivery, resale or repair or use of any goods, and performance of any services, covered by or furnished hereunder arising in whole or in part out of or by reason of the failure of buyer, its agents, servants, employees or customers to follow instructions, warnings or recommendations furnished by seller in connection with such goods and services, by reason of the failure of buyer, its agents, servants, employees or customers to comply with all federal, state and local laws applicable to such goods and services, or the use thereof, including the Occupational Safety and Health Act of 1970, or by reason of the negligence or misconduct of buyer, its agents, servants, employees or customers.

8. EXPENSES OF ENFORCEMENT. In the event seller undertakes any action to collect amounts due from buyer, or otherwise enforce its rights hereunder, Buyer agrees to pay and reimburse Seller for all such expenses, including, without limitation, all attorneys and collection fees.

9. TAXES. Liability for all taxes and import or export duties, imposed by any city, state, federal or other governmental authority, shall be assumed and paid by buyer. Buyer further agrees to defend and indemnify seller against any and all liabilities for such taxes or duties and legal fees or costs incurred by seller in connection therewith.

10. ASSISTANCE AND ADVICE. Upon request, seller in its discretion will furnish as an accommodation to buyer such technical advice or assistance as is available in reference to the goods and services. Seller assumes no obligation or liability for the advice or assistance given or results obtained, all such advice or assistance being given and accepted at buyer's risk.

11. SITE SAFETY. Buyer shall provide a safe working environment at the site of services and shall comply with all applicable provisions of federal, state, provincial and municipal safety laws, building codes, and safety regulations to prevent accidents or injuries to persons on, about or adjacent to the site.

12. INDEPENDENT CONTRACTOR. Seller and Buyer are independent contractors and nothing shall be construed to place them in the relationship of partners, principal and agent, employer/employee or joint ventures. Neither party will have the power or right to bind or obligate the other party except as may be expressly agreed and delegated by other party, nor will it hold itself out as having such authority.

13. REIMBURSEMENT. Seller shall provide the products and services in reliance upon the data and professional judgments provided by or on behalf of buyer. The fees and charges associated with the products and services thus may not conform to billing guidelines, constraints or other limits on fees. Seller does not seek reimbursement directly from any government agency or any governmental reimbursement fund (the "Government"). In any circumstance where seller may serve as a supplier or subcontractor to an entity which seeks reimbursement from the Government for all or part of the services performed or products provided by seller, it is the sole responsibility of the buyer or other entity seeking reimbursement to ensure the products and services and associated charges are in compliance with and acceptable to the Government prior to submission. When serving as a supplier or subcontractor to an entity which seeks reimbursement from the Government, seller does not knowingly present or cause to be presented any claim for payment to the Government.

14. APPLICABLE LAW/JURISDICTION AND VENUE. The rights and duties of the parties shall be governed by, construed, and enforced in accordance with the laws of the State of California (excluding its conflict of laws rules which would refer to and apply the substantive laws of another jurisdiction). Any suit or proceeding hereunder shall be brought exclusively in state or federal courts located in Orange County, California. Each party consents to the personal jurisdiction of said state and federal courts and waives any objection that such courts are an inconvenient forum.

15. ENTIRE AGREEMENT. This agreement constitutes the entire contract between buyer and seller relating to the goods or services identified herein. No modifications hereof shall be binding upon the seller unless in writing and signed by seller's duly authorized representative, and no modification shall be effected by seller's acknowledgment or acceptance of buyer's purchase order forms containing different provisions. Trade usage shall neither be applicable nor relevant to this agreement, nor be used in any manner whatsoever to explain, qualify or supplement any of the provisions hereof. No waiver by either party of default shall be deemed a waiver of any subsequent default.

APPENDIX B
(Boring Log and Field Infiltration Test)

537 East Delavan Avenue – Former Vibratech
November 5, 2020
Infiltration Tests at MW-11-03A

Test #1

DTW 9.73 ft toic
DTB 13.57 ft toic
Water Column 3.84 ft of water.

Volume Injected 8 gallons.
Single infiltration feed line from water reservoir to well.
Head in reservoir allowed to drop.

Start infiltration 9:17:00
End Infiltration 9:23:12
Duration 0:06:12
8 gallons / 6.2 minutes = 1.29 gpm

Additional manual water levels were not possible during the test due to the slug of distilled water rendering the WL meter inoperative (i.e. no electrical conductivity)

Test #2

DTW 10.14 ft toic
DTB 13.57 ft toic
Water Column 3.43 ft of water.

Volume Injected 23 gallons.
Two infiltration feed lines from water reservoir to well.
Reservoir was replenished with new water during test to maintain a constant head for as long as possible. Head in reservoir allowed to drop only during last 8 gallons.

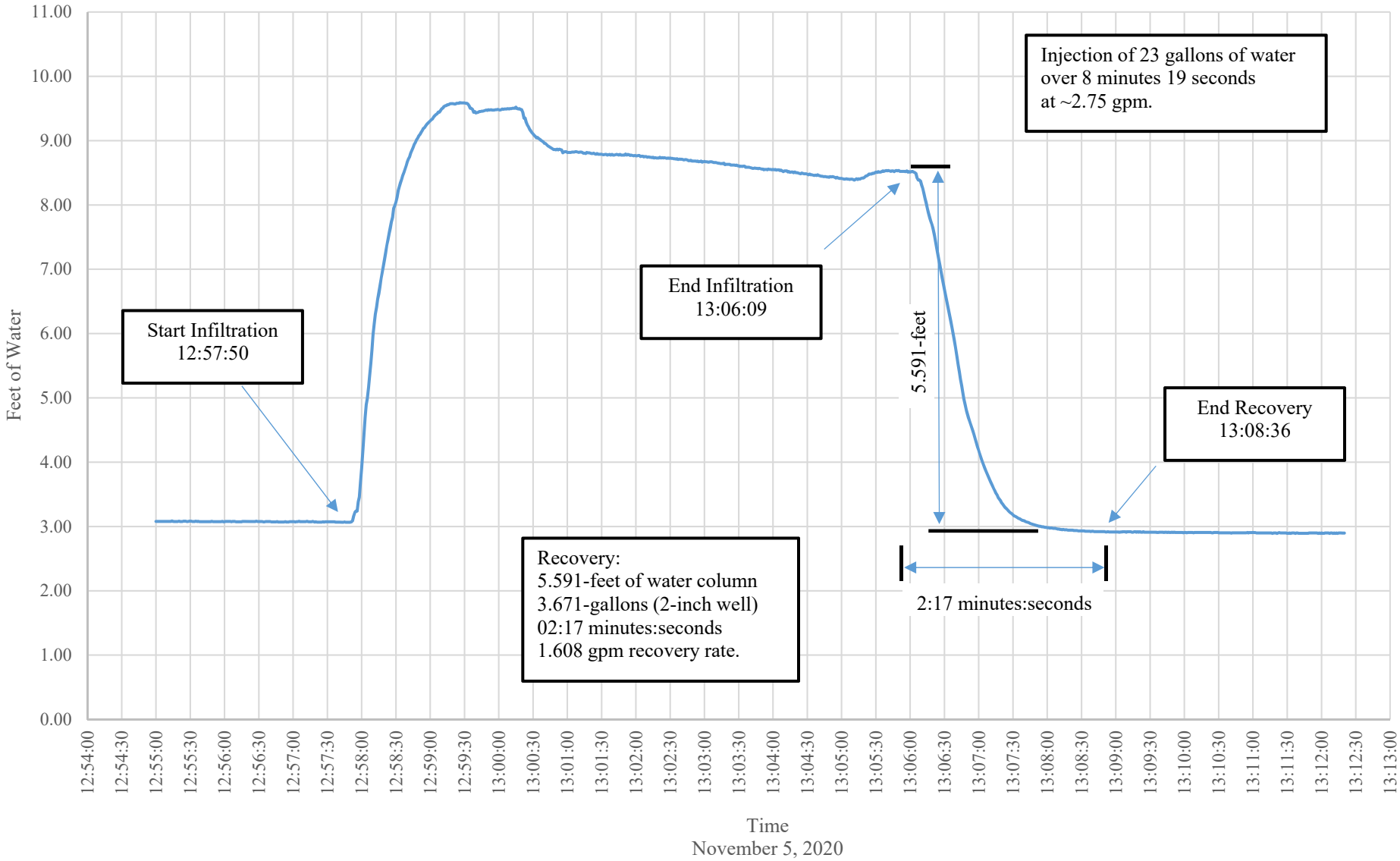
Start infiltration 12:57:50
End Infiltration 13:06:09
Duration 00:08:19
23 gallons / 8.32 minutes = 2.76 gpm

Additional manual water levels were not possible during the test due to interference from infiltrating water.

The well accepted 2.75 gpm for 8 minutes without over topping. Maximum rise in head was ~6.5 feet from static.

A Chart of Datalogger water level data, collected during Test #2, is provided below:

MW-11-03A
INFILTRATION TEST #2
NYSDEC - VIBRATECH, INC.
537 EAST DELAVAN AVENUE, BUFFALO, NY



NATURE'S WAY
ENVIRONMENTAL CONSULTANTS & CONTRACTORS, INC.

CRITTENDEN
(716) 937-6527
SYRACUSE
(315) 635-9818

HOLE NO. MW 11-03 **MW-11-03A** SURF. ELEV. _____

PROJECT Former Vibratech Facility LOCATION See Map

SN	0/6	6/12	12/18	18/24	N	LITH	DESCRIPTION	REC	Core Hole	Well Detail	REMARKS
							Asphalt 0.4			Cement / Bentonite Grout	Asphalt to 0.4 foot over sand and gravel fill to 1.0 foot over coarse silty fill with some gravel to 1.8 feet over Onondaga Limestone Bedrock to end of coring
							Sand and gravel fill 1.0			0.0	
1	21						Moist, dark brown, gravelly (SANDY-SILT) 1.8			1.0	
		50/2" RUN	#1		>50		fill with 20 to 40% gravel and red brick fragments, little very fine size sand			2" PVC Riser Pipe	
							Onondaga Limestone Bedrock, gray, very hard, thinly bedded 2 to 6 inches thick with occasional tight vertical fractures and weathered bedding planes			Bentonite Seal 3.0	
							No Visible Evidence of Petroleum Contamination			4.5	
										2" 10 Slot PVC Screen	
										#2 Size Sand	
		RUN	#2							14.5 Well	
							15.0 Coring Completed at 15.0 feet			15.0 Installation Completed at 14.5 feet	

CORE DATA

RUN #	Int. (ft)	Length (ft)	Rec. (ft)	Rec. %	RQD %
1	1.8 to 12.5	10.7	10.5	98	89%
2	12.5 to 15.0	2.5	2.5	100	94%

LOGGED BY Dale M. Gramza / Senior Geologist SHEET 1 OF 1