

Ms. Charlotte B. Theobald  
New York State Dept. of Environmental Conservation (NYSDEC)  
Division of Environmental Remediation, Region 8  
6274 East Avon Lima Road  
Avon, NY 14414-9519

Subject:

Pilot Test Work Plan  
235 Metro Park Brighton Site (Site No. 828150)  
Town of Brighton, Monroe County, New York

Dear Ms. Theobald:

The purpose of this document is to present a brief written plan describing proposed pilot testing activities as discussed during our recent phone call for the property located at 235 Metro Park (i.e., the Site) in the Town of Brighton, Monroe County, New York. Previously, a Remedial Action Work Plan (RAWP) was submitted to the New York State Department of Environmental Conservation (NYSDEC) on July 22, 2015 and is pending approval. As discussed on the phone, we kindly request on behalf of Fischbach, LLC that approval of the RAWP be rescheduled to be undertaken following completion of the proposed pilot testing activities. The RAWP describes the full-scale design and implementation of the Site remedy selected in the Record of Decision (ROD) (NYSDEC 2012). ARCADIS proposes to complete pilot testing activities, also specified in the ROD, to further assess the overall feasibility of conducting site-wide injections in low-permeability soils before negotiating building access and proceeding with full-scale remediation activities. In addition as discussed, the pilot results will be used to further refine injection point locations (including any in the building interior) both to analyze and better insure the efficacy of the approach, as well as respond to concerns raised by the building tenant concerning some of the injection locations previously proposed, including those inside the building.

## Background

The Site is situated on approximately five acres of land located in the Town of Brighton, Monroe County, New York. **Figure 1** shows the site boundaries and general layout. The Site is located in a commercial and light industrial park and situated approximately four miles south of downtown Rochester and west of Monroe Community College. Features of the Site include a building with a footprint of approximately 20,000 square feet that has a loading dock, an approximate 36,500

Imagine the result

ARCADIS of New York, Inc.  
50 Fountain Plaza  
Suite 600  
Buffalo  
New York 14202  
Tel 716 667 0900  
Fax 716 667 0279  
[www.arcadis-us.com](http://www.arcadis-us.com)

ENVIRONMENT DIVISION

Date:

October 20, 2015

Contact:

Ben Girard

Phone:

716-667-6645

Email:

[ben.girard@arcadis.com](mailto:ben.girard@arcadis.com)

Our ref:

04124094.0001

square foot parking lot, vacant grassy areas and landscaped lawn. The building is currently being used for label manufacturing and associated office space.

Historically, a variety of light industrial/commercial enterprises have occupied the Site. Development and usage of the Site began in 1968 and included business operations that impacted environmental site media with chlorinated solvents.

### Site Conceptual Model

The site geology consists of unconsolidated low-permeability soils (of lacustrine and glacial origin) overlying sedimentary bedrock (shale). As shown on **Figure 2**, the main lithologic unit underlying the Site is an undifferentiated clay and silt and extends down to approximately 65 to 68 feet below ground surface (bgs).

The primary groundwater constituents of concern have been identified as chlorinated volatile organic compounds (CVOCs). Recent groundwater monitoring results are summarized on **Figure 3** and in **Attachment 1**. Less than 15 percent of the baseline groundwater monitoring results (6 of 44 samples collected between December 2013 and April 2014) exhibited total CVOC detections greater than the 1,000 µg/L action level proposed for enhanced reductive dechlorination (ERD) treatment in the draft RAWP. The highest CVOC detection was noted at soil boring SB-08 (4,500 µg/L, December 2013) located near monitoring well MW-4S.

Several monitoring wells have been installed at the Site in deeper unconsolidated sediments above bedrock (i.e., wells denoted with a D in the well id) as shown on **Figure 2**. None of the deeper wells are impacted with CVOCs except for MW-4D (67.5 to 77.5 ft bgs), where the total CVOC concentrations were 185 µg/L in April 2014. The deeper impacts were approximately an order of magnitude less than the shallow CVOC detections at MW-4S (2,186 µg/L from 6 to 16 ft bgs). The presence of CVOC degradation products such as dichloroethene (DCE) and vinyl chloride (VC) indicates that natural attenuation is occurring at the Site via intrinsic reductive dechlorination processes.

During the baseline groundwater investigation, vapor samples were also collected from indoor air and sub-slab soil gas (inside the building on the property) and analyzed for VOCs. Vapor readings for the constituents identified as COCs in groundwater did not exceed indoor air screening criteria. Overall, the remedial strategy for groundwater involves the injection of biological and/or chemical reagents in the higher concentration areas (i.e., where total CVOCs are greater than 1,000 µg/L) to accelerate the natural attenuation processes that are occurring at the Site. Additional information on the baseline investigation is presented in the draft RAWP.

## Technical Approach for Pilot Testing

Pilot testing is proposed to collect site-specific data to support future remedial activities at the Site. Specific pilot test objectives include:

- Determination of the optimal injection rate, pressure, and effective injection radius for successful reagent distribution;
- Assessment of effectiveness and longevity of preferred reagents (as described in the draft RAWP) to enhance reductive dechlorination of CVOCs;
- Assessment of effectiveness and longevity of a methane inhibitor to suppress methane generation.

Pilot test data will be evaluated to determine the feasibility of conducting injection-based remediation in the low-permeability soils at the Site.

## Proposed Scope of Work

Pilot testing is proposed for three different areas at the Site as shown in **Figure 4**. The scope for each test is summarized in **Table 1** and further described in the following sections:

**Table 1**  
**Summary of Pilot Testing Activities**

Test Area	Wells	CVOCs (µg/L)	Injection Method	Reagent	Tracer
1	MW-10 MW-20	3,476	Low Pressure (< 10 psi)	EVO	Fluorescein
2	MW-4S	2,181	Low Pressure (< 10 psi)	EVO, Methane Inhibitor	Fluorescein
3	MW-19	375	Higher Pressure (< 200 psi)	ZVI/Cellulose Blend, Methane Inhibitor	ZVI

EVO – emulsified vegetable oil ; ZVI – zero-valent iron ; psi - pounds per square inch

Prior to the start of intrusive activities, the following site planning and notifications will be conducted: (1) site access will be coordinated with the property owner; (2) utility markouts will be conducted; and (3) injection permit documentation will be submitted and approved by the EPA Region 2 Underground Injection Control (UIC) Program. Following completion of intrusive activities, direct-push locations will be abandoned in accordance with industry standards.

Pilot Test Area 1 (MW-10, MW-20)

A low-pressure direct-push injection (DPI) test will be conducted in Pilot Test Area 1 by injecting a dilute solution of emulsified vegetable oil (EVO) mixed with a fluorescent tracer, while monitoring for breakthrough at MW-10 and MW-20. Following the injection test, performance monitoring will be conducted for up to six months. Additional detail is provided below:

Injection Test Set-Up: An injection test will be conducted by injecting a two-percent solution of EVO (RNAS, Newman Zone) mixed with a fluorescent tracer (40 mg/L of sodium fluorescein, Ozark Underground Laboratories) at three DPI locations (DPI-01, DPI-02, and DPI-03). Additional information on the proposed reagents is provided in **Attachment 2**. Direct-push injection locations will be spaced on a target injection radius of approximately five feet and positioned sufficiently close to MW-10 and MW-20 to use these existing monitoring wells for dose response monitoring during the injection test. As shown in the **Table 2**, a target volume of 200 gallons will be injected at each location into a temporary screen deployed from approximately 10 to 14 feet below ground surface. The dosing calculations are presented in **Attachment 3**.

Injectors will be conducted simultaneously at low pressures (less than 10 pounds [lbs] per square inch [psi]) and then followed by a clean water flush of approximately 10 gallons to clear the direct-push rods and injection tooling of injection solution. The injection tool will consist of a retractable screen to laterally inject fluids over a four-foot interval. A schematic of the injection tooling is presented in **Attachment 4**.

**Table 2**  
**Pilot Injection Program – Test Area 1**

Injection Points	Target Depth (ft bgs)	Target Injection Radius (ft)	Target Concentration	Target Volume (gallons)	Target Pressure (psi)
DPI-01	10 to 14	5	2% EVO, 40 mg/L FI	200	< 10
DPI-02	10 to 14	5	2% EVO, 40 mg/L FI	200	< 10
DPI-03	10 to 14	5	2% EVO, 40 mg/L FI	200	< 10

FI - Fluorescein

Injection Test Monitoring: Time-series monitoring will be conducted at both the direct-push injection locations and adjacent monitoring wells (MW-10 and MW-20) during the injection event. Injection pressure, rate, and volume will be recorded at each direct-push location. Depth to water measurements will be collected to determine the degree of water-table mounding during injection, while visual groundwater samples will be

collected at identified monitoring wells to monitor for breakthrough of the injection solution. (Visual samples refer to grab groundwater samples collected with a bailer during an injection event that are visually inspected for evidence of a tracer). Time-series visual monitoring will be conducted at a frequency of one sample every 15 to 30 gallons of solution injected. As shown in **Table 3**, select injection solution and monitoring well samples will be submitted for laboratory analysis of total organic carbon (TOC), dissolved organic carbon (DOC), and fluorescein dye to determine the relative breakthrough concentration. Injection-phase monitoring samples will be collected using a dedicated bailer; general water quality monitoring is not required.

**Table 3**  
**Injection Test Monitoring Program – Test Area 1**

Injection Solution	Injection Parameter Monitoring (DPI Locations)	Groundwater Visual Sampling (MW-10, MW-20)	Groundwater Analysis (MW-10, MW-20)
Collect one batch sample of the injection solution for TOC, DOC, and fluorescein	Monitor injection rate, pressure, volume every 15 to 30 gallons injected	Measure depth to water, collect bailer grab visual samples every 15 to 30 gallons injected	Select five visual samples per well for analysis of TOC, DOC, and fluorescein

Performance Monitoring: Following the injection test, groundwater samples will be collected for VOCs, dissolved gasses (methane, ethane, and ethene), dissolved iron, sulfate, TOC, and fluorescein dye at MW-10 and MW-20. Samples will be collected at approximately one, three, and six month intervals. Performance monitoring samples will be collected using low-flow sampling methods with a peristaltic or bladder pump, while collecting general water quality parameters (pH, temperature, specific conductance, dissolved oxygen, oxidation-reduction potential, and turbidity). Vapor-phase VOC and methane readings will be collected from the wellhead using appropriate air monitoring equipment at the start of each sampling event. The performance monitoring program is presented in **Table 4**.

**Table 4**  
**ERD Performance Monitoring Program –Test Area 1**

Month	Wells	Groundwater Analysis and Field Readings	Wellhead Readings
1	MW-10 MW-20	VOCs, TOC, Dissolved Iron, Sulfate, Dissolved Gasses (Methane, Ethane, Ethene), Fluorescein, Water Quality Parameters	VOCs, Methane Vapor
3			
6			

Pilot Test Area 2 (MW-4S)

The general approach and set-up for the injection test in Pilot Test Area 2 is similar to Pilot Test Area 1 with one primary difference; a methane inhibitor (Red Yeast Rice [RYR] extract) will be added to the injection solution. Methane is generated as a natural byproduct of organic carbon utilization by anaerobic microbes and does not impede biodegradation of CVOs. However, methane gas is a general health and safety concern when conducting injection-based remediation near buildings, which could be required at this site. RYR extract is a non-hazardous natural source of a statin compound (known as Monacolin K or Lovastatin), which has been used in the cattle industry for decades to suppress methane generation in cows. It is also used in cholesterol medication in humans. Although this product has a long history of use in other industries, application for in situ remediation is relatively new. To date, it has been successfully demonstrated in bench testing and deployed at a few field sites by the manufacturer (Provectus). Additional information on RYR extract is provided in **Attachment 2**. This site is a candidate for using RYR since a working strength concentration should persist in the injection area for some time due to the low groundwater velocity at the Site. The manufacturer recommends a working strength concentration of 75 milligrams per Liter (mg/L). The presence and rate of methane generation between Pilot Test Area 1 and 2 will be evaluated to assess the effectiveness and longevity of the inhibitor.

In summary, a low-pressure DPI test will be conducted by injecting a dilute solution of EVO mixed with a fluorescent tracer and methane inhibitor, while monitoring for breakthrough at MW-4S. Following the injection test, performance monitoring will be conducted for up to six months. Additional details are provided below:

Injection Test Set-Up: An injection test will be conducted by injecting a two-percent solution of EVO mixed with RYR extract (Provectus, Provect-Methane Inhibitor) and 40 mg/L of sodium fluorescein at three direct-push locations (DPI-04, DPI-05, and DPI-06). Direct-push injection locations will be spaced on a target injection radius of five feet and positioned sufficiently close to MW-4S to use this well as a dose response monitoring location during the test. A target volume of 200 gallons will be injected into a temporary screen deployed from approximately 8 to 12 feet below ground surface. Dosing calculations are presented in **Attachment 3**.

Injections will be conducted simultaneously at low pressure (less than 10 psi) and followed by a clean water flush of up to 10 gallons to clear the direct-push rods and injection tooling of injection solution.

**Table 5**  
**Pilot Injection Program – Test Area 2**

Injection Points	Target Depth (ft bgs)	Target Injection Radius (ft)	Target Concentration	Target Volume (gallons)	Target Pressure (psi)
DPI-04	8 to 12	5	2% EVO, 40 mg/L FI, 75 mg/L RYR	200	< 10
DPI-04	8 to 12	5	2% EVO, 40 mg/L FI, 75 mg/L RYR	200	< 10
DPI-06	8 to 12	5	2% EVO, 40 mg/L FI, 75 mg/L RYR	200	< 10

Injection Test Monitoring: Time-series monitoring will be conducted at both the direct-push injection locations and at an adjacent monitoring well (MW-4S) during the injection event. The injection pressure, rate, and volume will be recorded at each direct-push location. Depth to water measurements will be recorded to determine the degree of water-table mounding during injection while visual groundwater samples will be collected at monitoring well MW-4S to monitor for breakthrough of the injection solution. Time-series visual monitoring will be conducted at a frequency of one sample every 15 to 30 gallons of solution injected. As shown in **Table 6**, select injection solution and monitoring well samples will be submitted for laboratory analysis of TOC, DOC, and fluorescein dye to determine the relative breakthrough concentration. Injection-phase monitoring samples will be collected using a dedicated bailer; general water quality monitoring is not required.

**Table 6**  
**Injection Test Monitoring Program – Test Area 2**

Injection Solution	Injection Parameters (DPI Locations)	Injection Test Monitoring (MW-4S)	Groundwater Samples (MW-4S)
Collect one batch sample of the injection solution for TOC, DOC, and fluorescein	Monitor injection rate, pressure, volume every 15 to 30 gallons injected	Measure depth to water, collect bailer grab visual samples every 15 to 30 gallons injected	Select five visual samples per well for analysis of TOC, DOC, and fluorescein

Performance Monitoring: Following the injection test, groundwater samples will be collected for VOCs, dissolved gasses (methane, ethane, and ethene), dissolved iron, sulfate, TOC, and fluorescein dye at MW-4S. Samples will be collected at approximately one, three, and six month intervals using the same methodology previously described. Vapor-phase VOC and methane readings will be collected from



the wellhead using appropriate air monitoring equipment at the start of each sampling event. The ERD performance monitoring program is presented in **Table 7**.

**Table 7**  
**ERD Performance Monitoring Program – Test Area 2**

Month	Wells	Groundwater Analysis and Field Readings	Wellhead Readings
1	MW-4S	VOCs, TOC, Dissolved Iron, Sulfate, Dissolved Gasses (Methane, Ethane, Ethene), Fluorescein, Water Quality Parameters	VOCs, Methane Vapor
3			
6			

#### Pilot Test Area 3 (MW-19)

The general approach and set-up for the injection test in Pilot Test Area 3 differs from the other locations. A higher pressure DPI test will be conducted by injecting a slurry of zero-valent iron (ZVI) and cellulose material. Monitoring will be conducted at MW-19 during injection. After injection, direct-push soil borings will be advanced to confirm reagent distribution based on visual observations of embedded ZVI/cellulose material in the soil matrix. Performance monitoring will also be conducted for up to six months at MW-19. Additional details are provided below:

Injection Test Set-Up: An injection test will be conducted by injecting a 29-percent slurry of a ZVI/cellulose blend (Provectus, Provect IR) at one direct-push location (DPI-09). The ZVI/cellulose blend formulation provided by Provectus is premixed with RYR extract. Additional information on the proposed reagents is provided in **Attachment 2**. The injection method is a major consideration when using ZVI because the material can be strained by the soil matrix, limiting distribution. The ZVI/cellulose blend (Provect IR) selected for this pilot test is micro-scale in size. The industry standard for reagent injection of this material is to inject at a sufficient pressure to create preferential pathways in the soil matrix extending outward from the point of injection. These fractures create “lances” of embedded ZVI/cellulose material that then serve as a reactive matrix to promote chemical and biological reduction of CVOs. This injection approach will be pilot tested in Area 3.

As shown in **Table 8**, the direct-push injection location will target a 100 square foot area near MW-19. A target mass of 192 lbs of ZVI/cellulose material will be injected based on soil mass ratio of 0.4 percent. Prior to injection, a slurry will be prepared based on a water to ZVI blend mixing ratio of 0.4 gallons of water per pound of material (per vendor’s specifications). The injection will be conducted in 2-foot intervals using an injection pressure activated valve with a cracking pressure of



approximately 100 psi. A slurry comprised of 40 gallons of water mixed with 96 lbs of ZVI material (per interval) will be injected at 10 and 12 ft bgs at the locations shown on **Figure 4**. Dosing calculations are provided in **Attachment 3**.

An injection tool with a pressure-activated tip will be used to inject the material as a slurry over a small vertical interval. A conceptual diagram of the injection tool is provided in **Attachment 4**. Injection activities will be closely monitored while slowly increasing the injection pressure until sufficient pressure has been applied to open the injection tool and distribute the reagent. An upper pressure limit of 200 psi has been established based on experience using this injection approach at other sites. As discussed in the section on Injection Plan Modification and Spill Prevention below, if visual observations of ground disturbance are observed such as reagent daylighting to the surface, injection rates and pressures will be reduced before continuing with the injection event. After the reagent has been injected, a clean water flush of approximately 10 gallons will be added to clear the direct-push rods and injection tooling of injection solution.

**Table 8**  
**Pilot Injection Program – Test Area 3**

Injection Points	Target Depth (ft bgs)	Target Injection Area (ft)	Target Slurry Volume (gal)	% Solids	ZVI/ Cellulose Mass (lbs)	Target Pressure (psi)
DPI-07	10	10 X 10	40	29%	96	< 200 psi
	12	10 X 10	40	29%	96	< 200 psi

**Injection Test Monitoring:** Time-series monitoring will be conducted at both the direct-push injection location (DPI-09) and at an adjacent monitoring well (MW-19) during the injection event. The injection pressure, rate, and volume will be recorded at the direct-push injection location. Continuous depth to water measurements and water quality parameters will be recorded at MW-19 using a downhole probe and datalogger (In Situ Troll 9500). Periodic water-levels will also be collected at adjacent monitoring wells (MW-15S, MW-2, and MW-3) to evaluate the potential for mounding during the injection. At the end of the injection event, samples will be collected from the injection solution and from MW-19 and then submitted for laboratory analysis of total and dissolved iron. MW-19 will be sampled via low-flow methods and dissolved iron samples will be field filtered with a 0.45 micron filter prior to sample collection. After the injection event is completed, up to 9 direct-push points will be advanced (to a depth of approximately 15 feet) around the ZVI injection point at the locations shown on **Figure 4**. Soils will be logged and inspected for embedded ZVI/cellulose material as a visual indicator of reagent distribution. These results will be used to determine an effective radius of influence of the reagent. The injection test monitoring program is summarized in **Table 9**.

**Table 9**  
**Injection Test Monitoring Program – Test Area 3**

Injection Solution	Injection Parameters (DPI Locations)	Injection Test Monitoring	Post-Injection Test Monitoring
Collect one batch sample of the injection solution for total iron, dissolved iron, TOC, DOC	Monitor injection rate, pressure, volume every 15 to 30 gallons injected	Install Water Quality Data Logger in MW-19 during injection test; Collect periodic water-levels at MW-15S, MW-3, MW-2	Advance up to 9 direct-push points around the injection point, inspect soil cores for evidence of reagent distribution

Performance Monitoring: Following the injection test, groundwater samples will be collected for VOCs, dissolved gasses (including acetylene, which can be generated during chemical reduction processes), dissolved iron, sulfate, and TOC at MW-19. Samples will be collected at approximately one, three, and six month intervals using the same methodology previously described. Vapor-phase VOC and methane readings will be collected from the wellhead using appropriate air monitoring equipment at the start of each sampling event.

**Table 10**  
**ERD Performance Monitoring Program - Test Area 3**

Month	Wells	Groundwater Analysis and Field Readings	Wellhead Readings
1	MW-19	VOCs, TOC, Dissolved Iron, Sulfate, Dissolved Gasses (Methane, Ethane, Ethene, Acetylene), Fluorescein, Water Quality Parameters	VOCs, Methane Vapor
3			
6			

### Injection Plan Modification and Spill Prevention

Based on the conditions encountered in the field, adjustments may be made to the proposed injection testing activities; including changes to the target injection volumes, injection rates, pressures, and injection intervals. If reagent solution is observed to daylight to the ground surface, injection rates will be reduced before continuing with the injection. Any reagent solution observed to discharge to the ground surface via daylighting, will be recovered to the extent possible and disposed of as non-hazardous waste. Engineering controls will be used to ensure that potential reagent spills or surfaced fluids are contained and kept away from storm water sewers.

**Quality Assurance/Quality Control Considerations**

Field activities will be conducted in accordance with the Quality Assurance Project Plan (QAPP) presented in the draft RAWP. Environmental samples collected and submitted for laboratory analysis of Target Compound List (TCL) VOCs (and Tentatively Identified Compounds [TICs]), total/dissolved iron, sulfate, TOC, and DOC by ALS Environmental of Rochester, New York. Aqueous samples collected for dissolved gases (methane, ethane, ethene, and acetylene) will be analyzed by PACE Laboratories in Pittsburgh, Pennsylvania. Aqueous samples collected for fluorescein dye will be analyzed by Ozark Underground Laboratories of Protem, Missouri. Dissolved iron and DOC will be field filtered with a 0.45 micron filter. Laboratory methods are summarized in **Table 11**.

**Table 11**  
**Aqueous Analytical Methods**

Analysis	Field Filter	Method	Lab
TCL VOCs + TICs	No	EPA 8260	ALS
TOC	No	SM 5310	ALS
DOC	Yes	SM 5310	ALS
Dissolved Iron	Yes	EPA 6020	ALS
Total Iron	No	EPA 6020	ALS
Sulfate	No	EPA 9056	ALS
Methane, Ethene, Ethane	No	AM20GAX	Pace
Acetylene	No	AM20GAX	Pace
Fluorescein	No	Lab Specific	Ozark

Pilot test laboratory data will be reported in a Level II data deliverable. If non dedicated or reusable sampling equipment is used, equipment blanks will be collected for VOCs at a rate of one equipment blank per 20 environmental samples per monitoring event. Trip blanks will be submitted for VOC analysis at a rate of one trip blank per VOC cooler. A quality review of each laboratory report will be conducted along with a Level II data validation for VOCs.

**Progress Reporting**

A progress report documenting pilot testing activities will be prepared and submitted for NYSDEC review approximately eight months after injection test activities are completed. Upon report submittal to NYSDEC, a conference call or project meeting

will be scheduled with the NYSDEC to discuss the pilot test findings and path forward recommendations. Based on the outcome of this discussion, the draft RAWP, previously submitted in July 2015, will be amended.

**Schedule**

Pilot test field activities are planned to begin in late November 2015. The actual start date is dependent on NYSDEC approval, UIC application approval, property owner notification, contractor availability, and weather conditions. NYSDEC will be notified two weeks prior to mobilization.

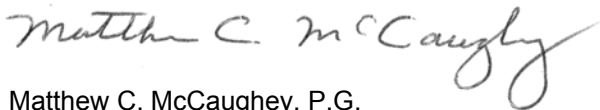
If you have any questions or comments relating to the enclosed, please do not hesitate to call me at 716.667.6645.

Sincerely,

ARCADIS U.S., INC.



Ben Girard  
Project Manager



Matthew C. McCaughey, P.G.  
Principal Geologist

Copies:

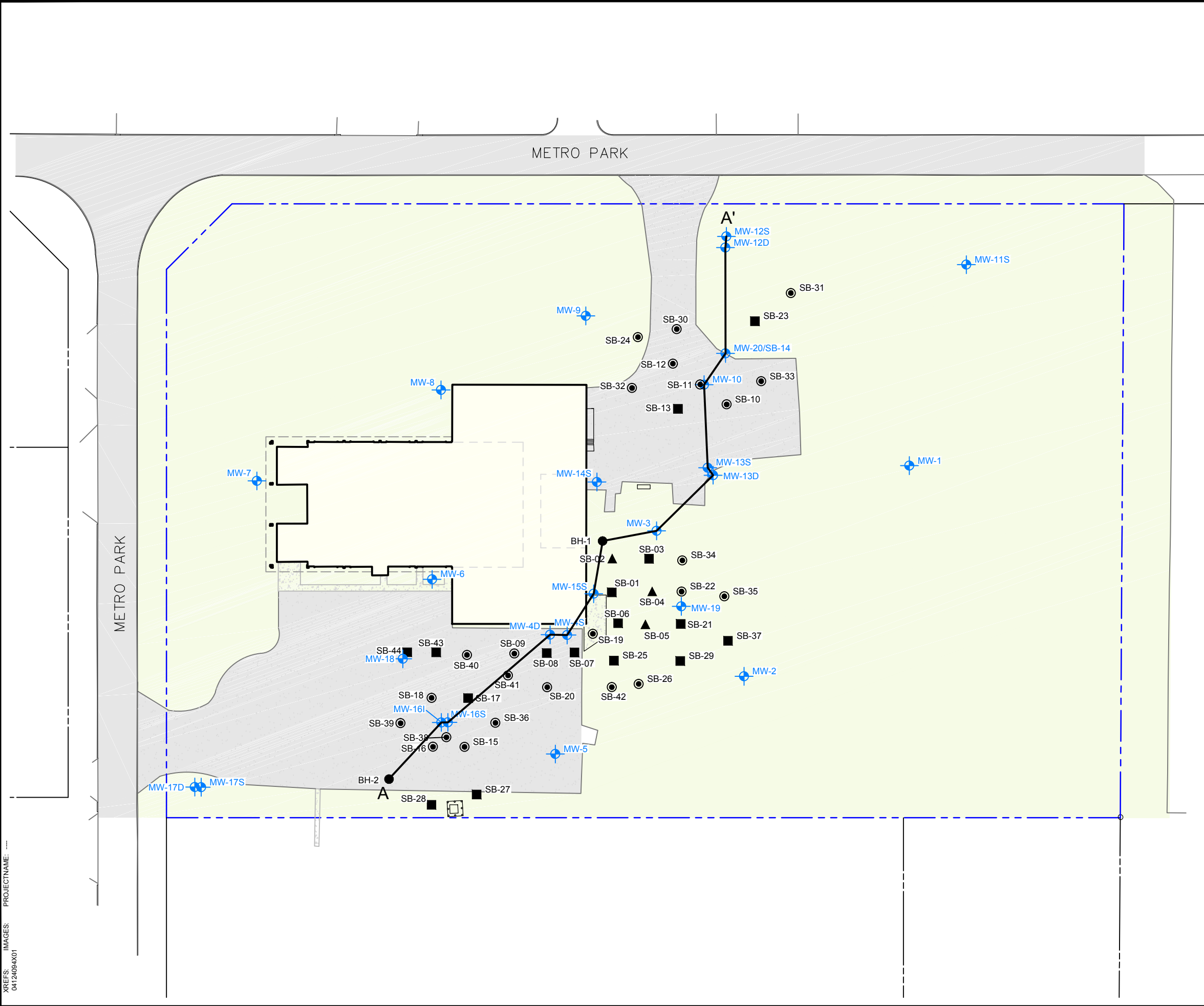
L. Arnold – Chartis  
J. Picciotti – Harris Beach  
D. McNaughton – NYSDOH  
M. Mohiuddin - Arcadis

Figure 1 – Site Features  
Figure 2 – Geologic Cross-Section  
Figure 3 – Current Groundwater Conditions (2013-2014)  
Figure 4 – Pilot Test Areas

Attachment 1 – CVOC Concentrations  
Attachment 2 – Reagent Information  
Attachment 3 – Dosing Calculations  
Attachment 4 - Injection Tooling Diagrams

## Figures

CITY:CRANBURY,NJ DIV:GROUP:ENVCAD DR:IMEYER LD:IMEYER PIC:S:CARETSKY PM:B:GIRARD TMB:GIRARD LYS:OPION="OFF="REF"  
G:\ENVCAD\CRANBURY\ACT04\24094\000\001\000\04\24094B02.dwg LAYOUT: 1. SAVED: 9/25/2015 3:29 PM ACADVER: 10.1S (LMS TECH) PAGESETUP: --- PLOTSTYLETABLE: PLT:FULL CTB PLOTTED: 10/5/2015 1:35 PM BY: MEYER, JULIE  
XREFS: IMAGES: PROJECTNAME: 04124094X01



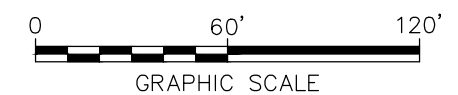
**LEGEND:**

- PROPERTY BOUNDARY
- MONITORING WELL LOCATION
- MIP LOCATION
- HPT LOCATION
- VAP SAMPLE
- SOIL BORING

- CROSS SECTION LOCATION
- GRASS AREA
- BUILDING
- PAVED AREAS

**SOURCE:**

- BASEMAP PROVIDED BY PASSERO ASSOCIATES, DATED 10.1.2008, DRAWING ALTA/ACSM LAND AND TITLE SURVEY.



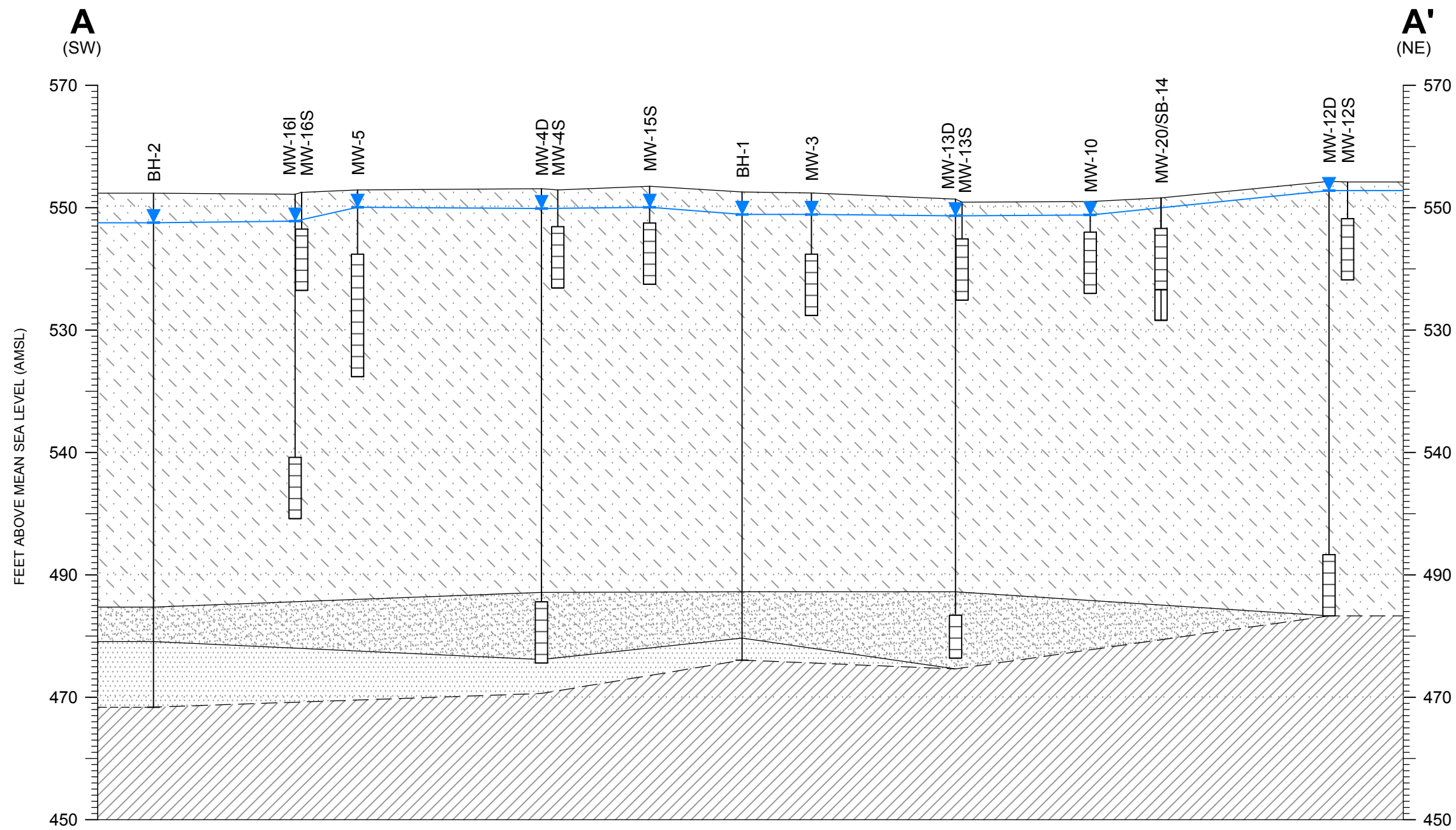
235 METRO PARK SITE  
BRIGHTON, NEW YORK  
NYSDEC SITE # 828150

**SITE FEATURES**





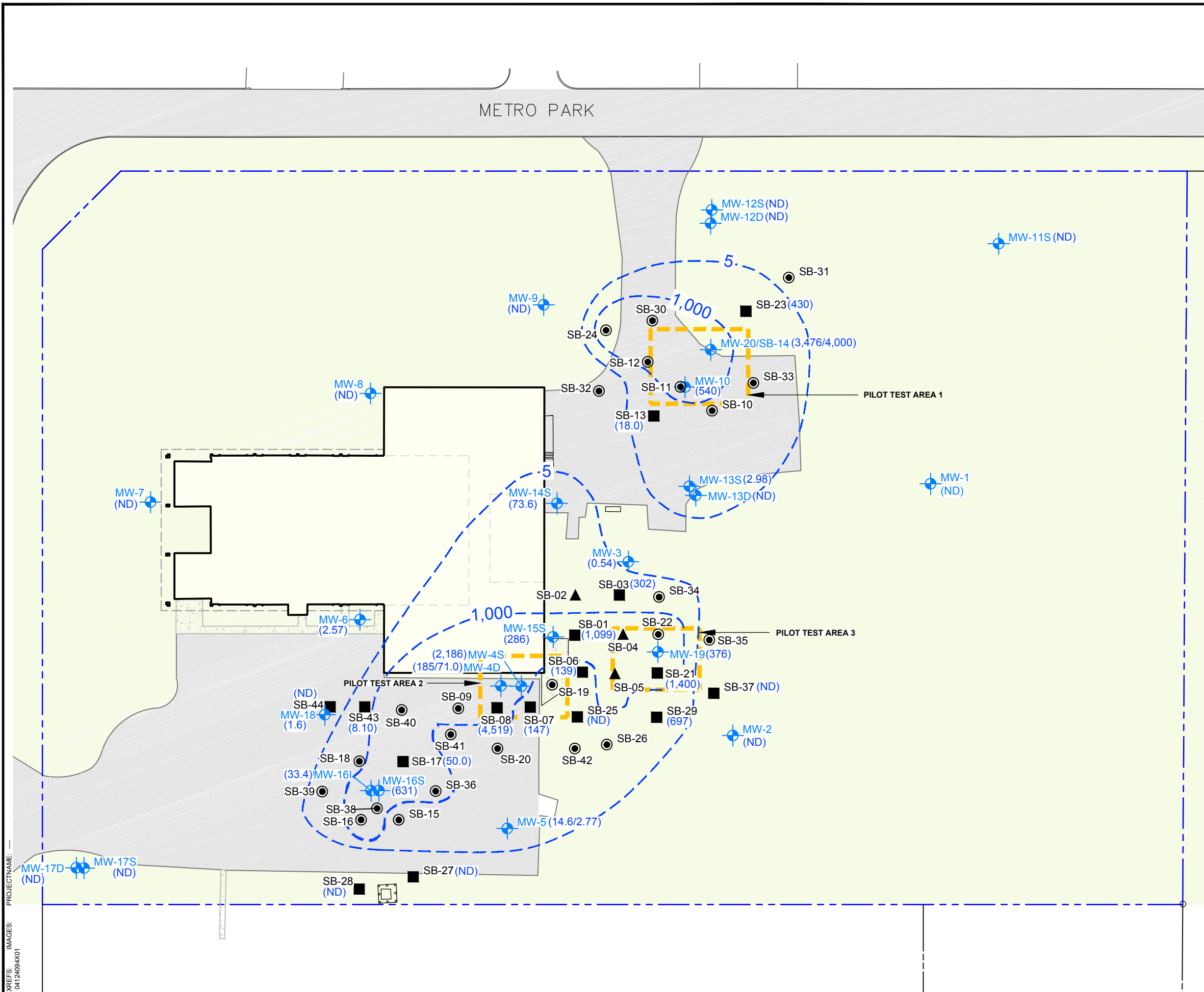
CITY:CRANBURY,NJ DIV:GROUP:ENVCAD DE:MEYER LD:MEYER PIC:S.CARETSKY PM:B.GIRARD TMB:GIRARD LYT:OPION="OFF=REF"  
G:\ENVCAD\CRANBURY\ACT04\24094\001\00100\04124094\01.dwg LAYOUT: 2, SAVED: 9/25/2015 3:30 PM ACADVER: 19.1S (LMS TECH) PAGES: 10, PLOTSTYLETABLE: PLT:FULL.CTB PLOTTED: 10/5/2015 1:39 PM BY: MEYER, JULIE  
XREFS: IMAGES: PROJECTNAME: 04124094X01












235 METRO PARK SITE  
BRIGHTON, NEW YORK  
NYSDEC SITE # 828150

**GEOLOGIC CROSS SECTION A-A'**



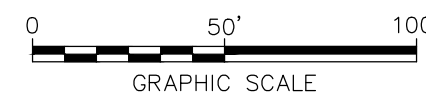


PROPERTY BOUNDARY

-  MONITORING WELL LOCATION  
 MIP LOCATION  
 HPT LOCATION  
 VAP SAMPLE  
 ISOCONCENTRATION CONTOUR (ug/L)  
 TOTAL CVOC CONCENTRATION (ug/L)  
 GRASS AREA  
 BUILDING  
 PAVED AREA

1. ISO-CONCENTRATION CONTOURS ARE BASED ON TOTAL CVOC CONCENTRATIONS OF DATA COLLECTED WINTER 2013/2014.
2. CVOC RESULTS ARE THE SUMMATION OF PCE, TCE, CIS-1,2-DCE, TRANS-1,2-DCE, 1,1-DCE, VINYL CHLORIDE, 1,1,1-TCA, AND 1,1-DCA
3. ALL RESULTS SHOWN IN MICROGRAMS PER LITER (ug/L).
4. CVOC - CHLORINATED VOLATILE ORGANIC COMPOUND
5. ND - NOT DETECTED
6. MORE THAN ONE TOTAL CVOC RESULT AT MW-4D AND MW-5 INDICATES RESULTS FROM MORE THAN ONE SAMPLING EVENT.

1. BASEMAP PROVIDED BY PASSERO ASSOCIATES, DATED 10.1.2008,  
DRAWING ALTA/ACSM LAND AND TITLE SURVEY.

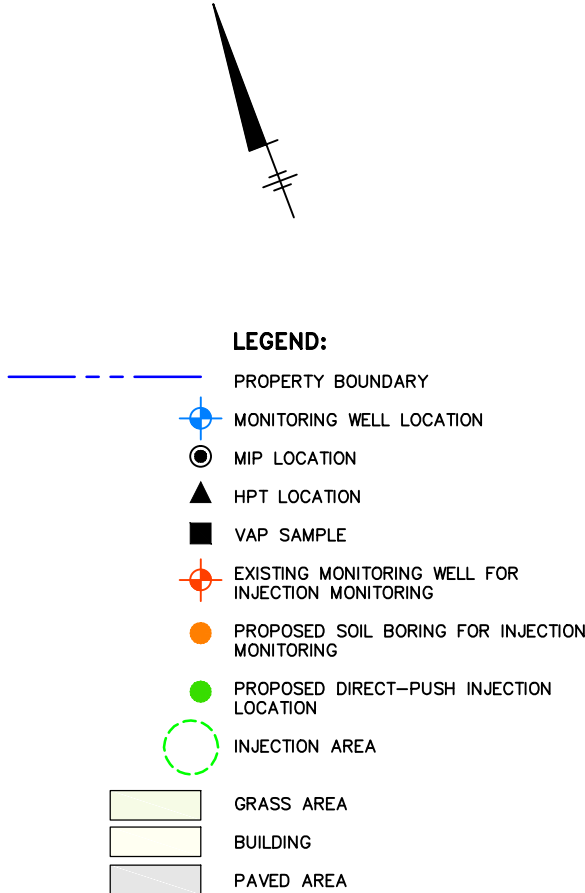
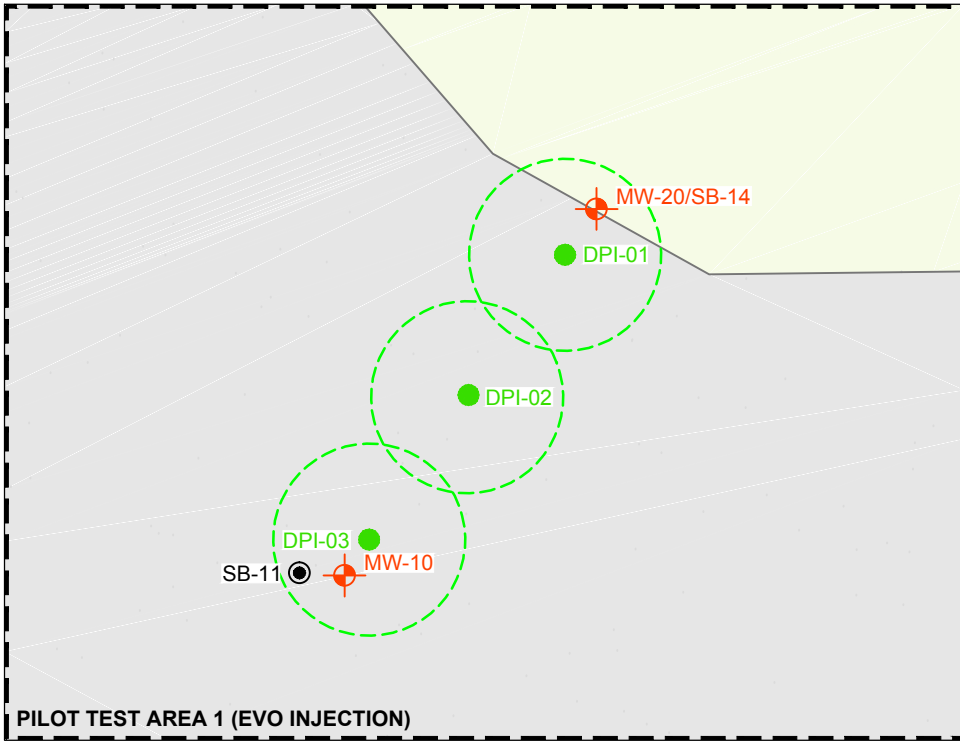
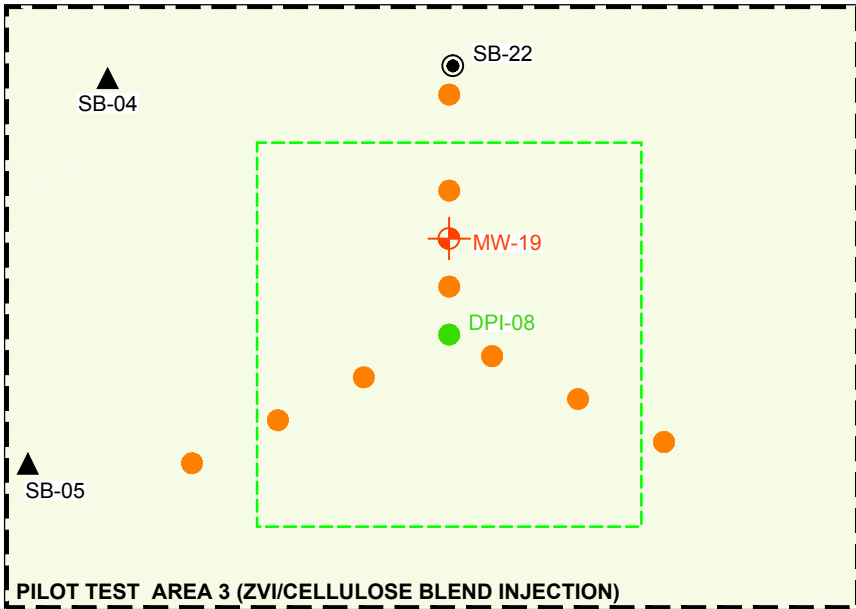
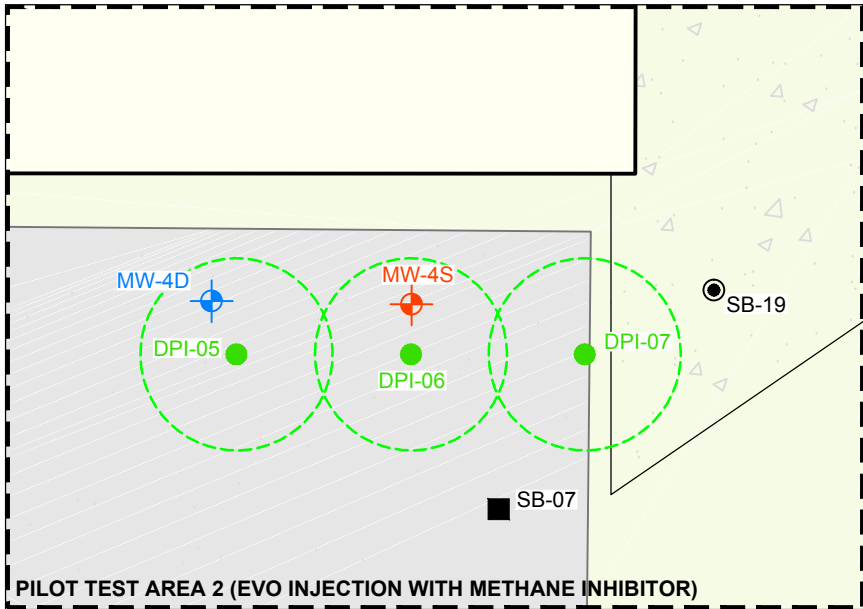


235 METRO PARK SITE  
BRIGHTON, NEW YORK  
NYSDEC SITE # 828150

## CURRENT GROUNDWATER CONDITIONS (2013-2014)

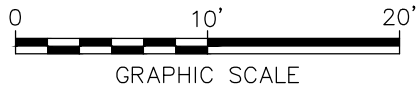


FIGURE  
3



**SOURCE:**

1. BASEMAP PROVIDED BY PASSERO ASSOCIATES, DATED 10.1.2008, DRAWING ALTA/ACSM LAND AND TITLE SURVEY.



235 METRO PARK SITE  
BRIGHTON, NEW YORK  
NYSDEC SITE # 828150

## PILOT TEST AREAS



**Attachment 1**

CVOC Concentrations

**Attachment 1**  
**Summary of Recent CVOC Groundwater Detections**  
**235 Metro Park Brighton Site**  
**Town of Brighton, Monroe County, New York**  
**Site No. 828150**

Sample ID/Location	Sample Date	Sample Interval (feet bgs)	1,1,1-TCE (µg/L)	1,1-DCA (µg/L)	PCE (µg/L)	TCE (µg/L)	cis-1,2-DCE (µg/L)	trans-1,2-DCE (µg/L)	1,1-DCE (µg/L)	Vinyl Chloride (µg/L)	Total CVOC (3) (µg/L)
<b>Groundwater Standard (1)</b>			<b>5</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>2</b>	<b>--</b>
SB-01/HPT-01	12/13/13	11-15	180	210 D	ND(1)	41	390 D	8.4	170	100	1099
SB-03/HPT-03	12/18/13	12-16	130	40	ND(5)	14	65	ND(5)	42	11	302
SB-06/HPT-06	12/17/13	13-17	14	50	ND(5)	13	29	ND(5)	8.6	24	139
SB-07/HPT-07	12/17/13	6-10	ND(5)	19	ND(5)	ND(5)	110	6.3	ND(5)	12	147
SB-08/HPT-08	12/17/13	8-12	56	93	ND(50)	3700 D	420	ND(50)	120	130	4519
SB-13/HPT-13	12/18/13	10-15	ND(5)	ND(5)	18	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	18.0
SB-14/HPT-14	12/18/13	13-17	ND(250)	ND(250)	4000	ND(250)	ND(250)	ND(250)	ND(250)	ND(250)	4000
SB-17/HPT-17	12/18/13	5-7	ND(5)	ND(5)	ND(5)	ND(5)	40	ND(5)	ND(5)	10	50.0
SB-21/HPT-21	12/19/13	8-12	ND(25)	ND(25)	760	450	190	ND(25)	ND(25)	ND(25)	1400
SB-23/HPT-23	02/12/14	7-11	ND(13)	ND(13)	430	ND(13)	ND(13)	ND(13)	ND(13)	ND(13)	430
SB-25/HPT-25	12/19/13	20-24	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND
SB-27/HPT-27	12/20/13	14-18	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND
SB-28/HPT-28	12/20/13	16-20	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND
SB-29/HPT-29	12/20/13	12-16	ND(5)	12	13	140	200 D	140	12	180	697
SB-37/HPT-37	02/12/14	16-20	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND
SB-43/HPT-43	03/27/14	9-13	ND(5)	ND(5)	8.1	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	8.10
SB-44/HPT-44	03/27/14	9-13	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND
MW-01	04/15/14	6-16	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND
MW-02	04/15/14	5-15	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND
MW-03	04/10/14	10-20	ND(1)	0.54 J	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	0.54
MW-04S	04/09/14	6-16	26	27	4.6 J	1,900	160	ND(10)	40	28	2186
MW-04D	04/10/14	67.5-77.5	ND(1)	2.3	6.2	44	120	1.8	1.8	8.4	185
	05/14/14		ND(1)	0.77 J	3.5	17	45	ND(1)	0.86 J	3.9	71.0
MW-05	04/15/14	10.5-30.5	0.54 J	6.1	ND(1)	ND(1)	5.9	ND(1)	2.1	ND(1)	14.6
	05/14/14		ND(1)	2.2 J	ND(1)	ND(1)	0.57 J	ND(1)	ND(1)	ND(1)	2.77
MW-06	04/15/14	10-20	1.4	0.44 J	ND(1)	ND(1)	0.73 J	ND(1)	ND(1)	ND(1)	2.57
MW-07	04/14/14	6.5-16.5	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND
MW-08	04/14/14	4.5-14.5	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND
MW-09	04/14/14	13.5-23.5	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND
MW-10	04/11/14	5-15	ND(5)	ND(5)	530	9.8	ND(5)	ND(5)	ND(5)	ND(5)	540
MW-11S	04/15/14	6-16	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND
MW-12S	04/11/14	6-16	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND
MW-12D	05/14/14	61-71	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND
MW-13S	04/11/14	6-16	ND(1)	ND(1)	ND(1)	0.68 J	2.3	ND(1)	ND(1)	ND(1)	2.98
MW-13D	05/14/14	68-75	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND
MW-14S	04/11/14	6-16	23	7.8	ND(1)	ND(1)	6.3	0.33 J	34	2.2	73.6
MW-15S	04/10/14	6-16	2.7	14	ND(1)	51	170	11	2.4	35	286
MW-16S	04/15/14	6-16	ND(1)	58	ND(1)	ND(1)	420 D	16	6.5	130	631
MW-16I	05/14/14	43-53	ND(1)	2.1	ND(1)	ND(1)	26	0.98 J	ND(1)	4.3	33.4
MW-17S	04/14/14	6-16	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND
MW-17D	05/14/14	52-62	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND(1)	ND
MW-18	04/15/14	10-20	0.36 J	0.25 J	ND(1)	ND(1)	0.99 J	ND(1)	ND(1)	ND(1)	1.60
MW-19	04/10/14	5-15	4	2.4	180 D	130	44	8.1	1.5	5.6	376
MW-20	04/11/14	5-15	ND(20)	ND(20)	3,400	76	ND(20)	ND(20)	ND(20)	ND(20)	3476

**Notes**

- (1) Indicates the constituent was not detected at the PQL. The value preceding the ND indicates the PQL.  
(2) Shading indicates that the result exceeds the NYSDEC TOGS 1.1.1 Water Quality Standard or Guidance Value  
(3) CVOC results are the summation of PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, vinyl chloride, 1,1,1-TCA, and 1,1-DCA.  
D - Compound quantitated using a secondary dilution  
J - Indicates that the analyte was detected at a concentration less than the practical quantitation limit (PQL).

**Abbreviations**

bgs	below ground surface
CVOCs	chlorinated volatile organic compounds
µg/L	micrograms per Liter
ND	non-detect
1,1,1-TCA	1,1,1-Trichloroethane
1,1-DCA	1,1-Dichloroethane
1,1-DCE	1,1-Dichloroethene
cis-1,2-DCE	cis-1,2-Dichloroethene
PCE	Tetrachloroethene
trans-1,2-DCE	trans-1,2-Dichloroethene
TCE	Trichloroethene

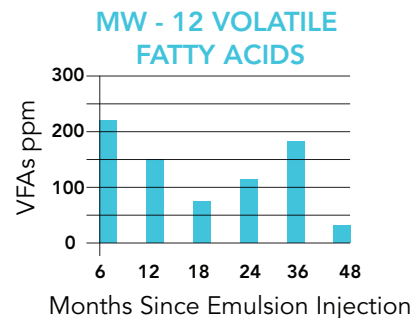
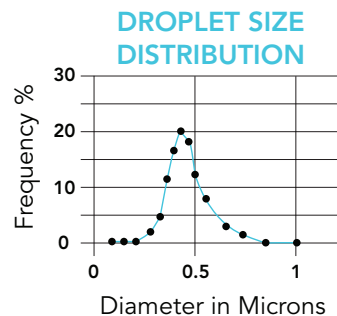
## **Attachment 2**

Reagent Information

# Newman Zone

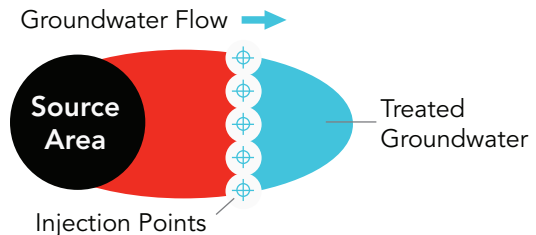
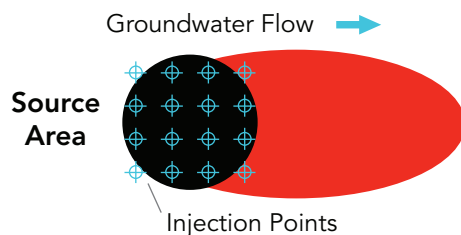
## A Balance Of Fast And Slow Release Electron Donors

Newman Zone® is an electron donor for enhancing the in situ anaerobic bioremediation of chlorinated solvents, nitrated explosives (RDX, HMX, TNT), selected toxic metals (chrome VI), perchlorate and nitrate. Newman Zone® has both fast and slow-release electron donors. Lactate stimulates microbial growth within hours of injection and rapidly produces anaerobic conditions in the subsurface. Vegetable oil droplets are retained on soil particles and slowly ferment to hydrogen and volatile fatty acids which support anaerobic biodegradation for as long as five years after injection.



## Application

Newman Zone® emulsions contain a minimum of 50 percent vegetable oil by volume in concentrated form. The emulsion is usually diluted to 5 percent or less oil by volume prior to injection. After dilution the emulsion has a low viscosity similar to water allowing it to be applied by direct push injections, injection wells, water circulation systems and even direct application to source area excavations prior to backfilling. Common treatment configurations include an injection grid used to treat contaminant source areas and bio-barriers to treat dissolved plumes.



## Benefits – The Smallest Emulsion Droplet Size in the Industry

Newman Zone® is an oil-in-water emulsion consisting of oil droplets between 0.15 and 0.60 microns in size with a median size of 0.30 microns. Our uniquely small oil droplet size maximizes mobility in silt and clay soils and allows for excellent stability when blended with oxygen scavengers, buffers and other amendments prior to injection. The large droplet emulsions provided by other companies can result in oil/water separation, limited distribution or reduced soil permeability.

## Experience – Over a Decade of Results From Millions of Pounds Delivered!

Newman Zone® was the first factory produced small droplet emulsified oil product on the market. Since the first production run in 2002 we have delivered millions of pounds of emulsion to thousands of sites around the world.



# Newman Zone

## A Balance Of Fast And Slow Release Electron Donors

### Product Content

Chemical Name	CAS Number	Composition
Soybean Oil (food grade)	8001-22-7	>46%
Sodium-L-Lactate	867-56-1	4%
Sodium Bicarbonate (buffered formulations only)	144-55-8	1%
Food Additives / Emulsifiers / Preservatives	Proprietary	<10%
Water		45%

### Product Characteristics

Parameter	Unit	Specification
Density	g/cm <sup>3</sup>	0.99
Particle Size	um	0.15 - 0.60
Flash Point	°F/	>540 (closed cup)
Appearance		White opaque liquid

### Packaging

Newman Zone® is available in 5-gallon pails (40 pounds net) and 275-gallon totes (2,100 pounds net). For large projects bulk emulsion can be delivered in either Agmark iso-tanks (47,500 pounds net typical) or food grade tanker truck loads (48,000 pounds net typical).

### Storage

The small droplet Newman Zone® emulsion is kinetically stable and pasteurization prevents microbial spoilage. We keep inventory in chilled storage where the shelf-life can exceed five years. Newman Zone® can be stored on-site for 2-4 months without refrigeration. Avoid freezing conditions. Temperatures that average below 25 degrees Fahrenheit may result in frozen emulsion.

### Safety

No protective equipment is necessary under normal use conditions. All ingredients consist of food or food grade additives.

## SAFETY DATA SHEET

### Newman Zone – Buffered Non-ionic Formulation 190-6730

Prepared to U.S. OSHA, CMA, ANSI, Canadian WHMIS Standards, Australian WorkSafe, Japanese Industrial Standard JIS Z 7250:2000, and European Directives

#### 1. PRODUCT IDENTIFICATION

<b>TRADE NAME (AS LABELED):</b>	<b>Newman Zone – Buffered Non-ionic Formulation 190-6730</b>
<b>SYNONYMS:</b>	None known
<b>CAS#:</b>	Mixture
<b>PRODUCT USE:</b>	This product is used for soil and ground water remediation. It is formulated and processed using food grade additives, following packaging, sanitation and storage as required by Best Practices used for Food products.
<b>CHEMICAL SHIPPING NAME/CLASS:</b>	Non-Regulated Material
<b>U.N. NUMBER:</b>	None
<b>MANUFACTURER'S NAME:</b>	<b>RNAS Remediation Products</b>
<b>ADDRESS:</b>	6712 West River Road, Brooklyn Center, MN 55430
<b>BUSINESS PHONE:</b>	1-763-585-6191
<b>EMERGENCY PHONE:</b>	1-800-424-9300 (Chemtrec 24 Hr Service – Emergency Only)
<b>DATE OF CURRENT REVISION:</b>	June 25, 2014
<b>DATE OF LAST REVISION:</b>	May 20, 2013

#### 2. HAZARD IDENTIFICATION

**EMERGENCY OVERVIEW:** This product is a white liquid with a vegetable oil odor.

**Health Hazards:** Not expected to cause adverse health effects when used as intended. Prolonged or repeated exposure may cause irritation to skin. May cause irritation to eyes upon contact. Inhalation of vapors/sprays or mist may cause respiratory irritation. Ingestion of large amounts of this product may cause gastrointestinal irritation.

**Flammability Hazards:** This product is a Non-Flammable liquid with a flash point of >540°F (>282°C)

**Reactivity Hazards:** None known

**Environmental Hazards:** The Environmental effects of this product have not been investigated. Release of this product is not anticipated to have significant adverse effects in the aquatic environment.

US DOT SYMBOLS

CANADA (WHMIS) SYMBOLS

EUROPEAN and (GHS) Hazard Symbols

Non-Regulated Material

"Not Controlled"

None  
Signal Word: **None**

#### EU LABELING AND CLASSIFICATION:

This product does not meet the definition of a hazardous substance or preparation as defined by the European Union Council Directives 67/548/EEC, 1999/45/EC, 1272/2008/EC and subsequent Directives.

#### EU HAZARD CLASSIFICATION OF INGREDIENTS PER DIRECTIVE 1272/2008/EC:

**None of the ingredients are listed in Annex I**

Substances not listed either individually or in group entries must be self classified.

#### OSHA HAZARD CLASSIFICATION:

These chemicals are not considered hazardous by OSHA

#### Component(s) Contributing to Classification(s)

All Ingredients

#### GHS Hazard Classification(s):

None known

#### Hazard Statement(s):

None known

#### Precautionary Statement(s):

None known

#### HEALTH HAZARDS OR RISKS FROM EXPOSURE:

**SYMPTOMS OF OVEREXPOSURE BY ROUTE OF EXPOSURE:** The most significant routes of overexposure for this product are by contact with skin or eyes, inhalation of vapors and ingestion. The symptoms of overexposure are described below.

#### ACUTE:

**INHALATION:** Not expected to cause adverse health effects when used as intended. Inhalation of vapors/mist/spray may cause respiratory irritation.

**CONTACT WITH SKIN:** Not expected to cause adverse health effects when used as intended. Prolonged and

## SAFETY DATA SHEET

### Newman Zone – Buffered Non-ionic Formulation 190-6730

repeated contact may cause irritation to skin.

**EYE CONTACT:** Direct eye contact can cause irritation with redness, tearing and blurred vision.

**INGESTION:** Under normal conditions of intended use, this material is not expected to be an ingestion hazard. Ingestion of large quantities may cause gastrointestinal irritation, nausea and vomiting.

**CHRONIC:** None known

**TARGET ORGANS:** **Acute:** Skin, Respiratory System and Eyes **Chronic:** None known

### 3. COMPOSITION AND INFORMATION ON INGREDIENTS

Hazardous Ingredients:	WT%	CAS#	EINECS #	Hazard Classification	Risk Phrases
Food Grade Soybean Oil	45 - 50%	8001-22-7	232-274-4	None	None Known
Water	30 – 40%	7732-18-5	231-791-2	None	None Known
Food Grade Sodium-L-lactate	3 – 7%	867-56-1	212-762-3	None	None Known
Proprietary Food Grade Surfactant Blend	3 – 7%	Proprietary	Not Listed in ESIS	None	None Known
Sodium Bicarbonate	1 - 2%	144-55-8	205-633-8	None	None Known
Balance of other ingredients is less than 1% in concentration (or 0.1% for carcinogens, reproductive toxins, or respiratory sensitizers).					

NOTE: ALL WHMIS required information is included in appropriate sections based on the ANSI Z400.1-2010 format. This product has been classified in accordance with the hazard criteria of the CPR and the SDS contains all the information required by the CPR, EU Directives and the Japanese Industrial Standard JIS Z 7250: 2000.

### 4. FIRST-AID MEASURES

**EYE CONTACT:** If product enters the eyes, open eyes while under gentle running water for at least 15 minutes. Seek medical attention if irritation persists.

**SKIN CONTACT:** Wash skin thoroughly with soap and water after handling. Seek medical attention if irritation develops and persists.

**INHALATION:** If breathing becomes difficult, remove victim to fresh air. If necessary, use artificial respiration to support vital functions. Seek medical attention.

**INGESTION:** If product is swallowed, call physician or poison control center for most current information. If professional advice is not available, do not induce vomiting. Never induce vomiting or give diluents (milk or water) to someone who is unconscious, having convulsions, or who cannot swallow. Seek medical advice. Take a copy of the label and/or SDS with the victim to the health professional.

**MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:** None known

**RECOMMENDATIONS TO PHYSICIANS:** Treat symptoms and eliminate overexposure.

### 5. FIRE-FIGHTING MEASURES

**FLASH POINT:** Non-Flammable with flash point >540°F (>282°C)

**AUTOIGNITION TEMPERATURE:** Not Available

**FLAMMABLE LIMITS (in air by volume, %):** Lower NA Upper NA

**FIRE EXTINGUISHING MATERIALS:** Use fire extinguishing methods below:

Water Spray: Yes Carbon Dioxide: Yes

Foam: Yes Dry Chemical: Yes

Halon: Yes Other: Any "C" Class

**UNUSUAL FIRE AND EXPLOSION HAZARDS:** Not considered a fire or explosion hazard.

Explosion Sensitivity to Mechanical Impact: No

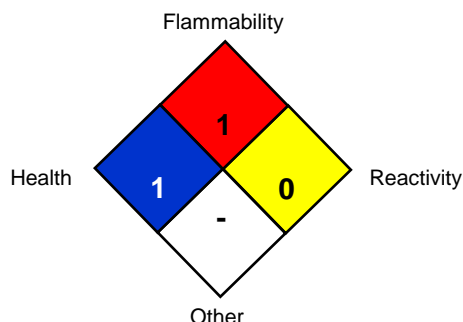
Explosion Sensitivity to Static Discharge: No

**SPECIAL FIRE-FIGHTING PROCEDURES:** Incipient fire responders should wear eye protection. Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. Isolate materials not yet involved in the fire and protect personnel. Move containers from fire area if this can be done without risk; otherwise, cool with carefully applied water spray. If possible, prevent runoff water from entering storm drains, bodies of water, or other environmentally sensitive areas.

## SAFETY DATA SHEET

Newman Zone – Buffered Non-ionic Formulation 190-6730

### NFPA RATING SYSTEM



### HMIS RATING SYSTEM

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM			
HEALTH HAZARD (BLUE)			1
FLAMMABILITY HAZARD (RED)			1
PHYSICAL HAZARD (YELLOW)			0
PROTECTIVE EQUIPMENT			
EYES	RESPIRATORY	HANDS	BODY
	See Sect 8		See Sect 8
For Routine Industrial Use and Handling Applications			

Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe \* = Chronic hazard

## 6. ACCIDENTAL RELEASE MEASURES

**SPILL AND LEAK RESPONSE:** Stop the flow of material, if this can be done safely. Contain discharged material. Absorb spill using an absorbent, non-combustible material such as earth, sand, or vermiculite. Place in a proper container for disposal. Dispose of in accordance with U.S. Federal, State, and local hazardous waste disposal regulations and those of Canada and its Provinces, those of Australia, Japan and EU Member States (see Section 13, Disposal Considerations).

## 7. HANDLING and STORAGE

**WORK PRACTICES AND HYGIENE PRACTICES:** As with all chemicals, avoid getting this product ON YOU or IN YOU. Wash thoroughly after handling this product. Use good hygiene practices.

**STORAGE AND HANDLING PRACTICES:** Store in original container. Keep container closed when not in use. Store in a cool, dry location. Avoid freezing or extended storage in high temperatures and away from incompatible materials.

## 8. EXPOSURE CONTROLS - PERSONAL PROTECTION

Chemical Name	CAS#	ACGIH TLV	OSHA TWA
Blend of Food Grade Soybean Oil	8001-22-7	10 mg/m <sup>3</sup> Oil Mists	15 mg/m <sup>3</sup> Oil Mists
Food Grade Sodium-L-lactate	867-56-1	Not Listed	Not Listed
Proprietary Food Grade Surfactant Blend	Proprietary	Not Listed	Not Listed
Sodium Bicarbonate	144-55-8	Not Listed	Not Listed

**VENTILATION AND ENGINEERING CONTROLS:** Use with adequate ventilation to ensure exposure levels are maintained below the limits provided above.

*The following information on appropriate Personal Protective Equipment is provided to assist employers in complying with OSHA regulations found in 29 CFR Subpart I (beginning at 1910.132) or equivalent standard of Canada, or standards of EU member states (including EN 149 for respiratory PPE, and EN 166 for face/eye protection), and those of Japan. Please reference applicable regulations and standards for relevant details.*

**RESPIRATORY PROTECTION:** Not required when using this product. Maintain airborne contaminant concentrations below guidelines listed above, if applicable. If necessary, use only respiratory protection authorized in the U.S. Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), equivalent U.S. State standards, Canadian CSA Standard Z94.4-93, the European Standard EN149, or EU member states.

**EYE PROTECTION:** Safety glasses or goggles are recommended to avoid eye contact. If necessary, refer to U.S. OSHA 29 CFR 1910.133, Canadian Standards, and the European Standard EN166, Australian Standards, or relevant Japanese Standards.

**SKIN PROTECTION:** Wear impervious gloves for prolonged or repeated exposure as appropriate to task when using this product. If necessary, refer to U.S. OSHA 29 CFR 1910.138, the European Standard DIN EN 374, the appropriate Standards of Canada, Australian Standards, or relevant Japanese Standards.

## SAFETY DATA SHEET

### Newman Zone – Buffered Non-ionic Formulation 190-6730

**BODY PROTECTION:** Use body protection appropriate to task being performed. If necessary, refer to appropriate Standards of Canada, or appropriate Standards of the EU, Australian Standards, or relevant Japanese Standards.

## 9. PHYSICAL and CHEMICAL PROPERTIES

**APPEARANCE (Physical State) and COLOR:** This product is a white liquid with a vegetable oil odor.

**ODOR:** Slight

**ODOR THRESHOLD:** Not Applicable

**pH:** 7.0

**MELTING/FREEZING POINT:** Not Available

**BOILING POINT:** Not Available

**FLASH POINT:** >540°F (>282°C) (For pure soybean oil)

**EVAPORATION RATE (n-BuAc=1):** Not Available

**FLAMMABILITY (SOLID, GAS):** Not Applicable

**UPPER/LOWER FLAMMABILITY OR EXPLOSION LIMITS:** Not Available

**VAPOR PRESSURE (mm Hg @ 20°C (68°F):** Not Available

**VAPOR DENSITY:** Not Available

**RELATIVE DENSITY:** Not Available

**SPECIFIC GRAVITY:** 0.99

**SOLUBILITY IN WATER:** Dispersible in water

**WEIGHT PER GALLON:** Not Available

**PARTITION COEFFICIENT (n-octanol/water):** Not Available

**AUTO-IGNITION TEMPERATURE:** Not Available

**DECOMPOSITION TEMPERATURE:** Not Available

**VISCOSITY:** 23.6 cPs @ 20°C

## 10. STABILITY and REACTIVITY

**STABILITY:** Stable under conditions of normal storage and use.

**HAZARDOUS DECOMPOSITION PRODUCTS:** Thermal decomposition products include oxides of carbon.

**MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE:** Strong oxidizing materials.

**POSSIBILITY OF HAZARDOUS REACTIONS:** Will not occur.

**CONDITIONS TO AVOID:** Incompatible materials

## 11. TOXICOLOGICAL INFORMATION

### TOXICITY DATA:

No LD50 Data available for this product.

**SUSPECTED CANCER AGENT:** Ingredients within this product are not found on the following lists: FEDERAL OSHA Z LIST, NTP, IARC, or CAL/OSHA and therefore are not considered to be, nor suspected to be, cancer-causing agents by these agencies.

**IRRITANCY OF PRODUCT:** No specific data available

**SENSITIZATION TO THE PRODUCT:** This product is not a skin and respiratory sensitizer

**REPRODUCTIVE TOXICITY INFORMATION:** No information concerning the effects of this product and its components on the human reproductive system.

## 12. ECOLOGICAL INFORMATION

ALL WORK PRACTICES MUST BE AIMED AT ELIMINATING ENVIRONMENTAL CONTAMINATION.

**ENVIRONMENTAL STABILITY:** No specific data available on this product.

**CHEMICAL EFFECT ON PLANTS, ANIMALS AND AQUATIC LIFE:** This product is not expected to cause significant harm to plants, animals or aquatic life.

**WATER ENDANGERMENT CLASS:** Water endangering in accordance with EU Guideline 91/155-EWG – Not Determined.

**SPECIFIC AVAILABLE COMPONENT INFORMATION:** No additional data available at this time.

## 13. DISPOSAL CONSIDERATIONS

## SAFETY DATA SHEET

### Newman Zone – Buffered Non-ionic Formulation 190-6730

**PREPARING WASTES FOR DISPOSAL:** Waste disposal must be in accordance with appropriate U.S. Federal, State, and local regulations, those of Canada, Australia, EU Member States and Japan.

**EU Waste Code:** Not determined

## 14. TRANSPORTATION INFORMATION

US DOT, IATA, IMO, ADR:

**U.S. DEPARTMENT OF TRANSPORTATION (DOT) SHIPPING REGULATIONS:** This product is classified (per 49 CFR 172.101) by the U.S. Department of Transportation, as follows.

**PROPER SHIPPING NAME:** Non-Regulated Material

**HAZARD CLASS NUMBER and DESCRIPTION:** None

**UN IDENTIFICATION NUMBER:** None

**PACKING GROUP:** NA

**DOT LABEL(S) REQUIRED:** None

**NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER:** None

**RQ QUANTITY:** None

**MARINE POLLUTANT:** The components of this product are not designated by the Department of Transportation to be Marine Pollutants (49 CFR 172.101, Appendix B).

INTERNATIONAL AIR TRANSPORT ASSOCIATION SHIPPING INFORMATION (IATA): This product is not considered as dangerous goods.

INTERNATIONAL MARITIME ORGANIZATION SHIPPING INFORMATION (IMO): This product is not considered as dangerous goods.

EUROPEAN AGREEMENT CONCERNING THE INTERNATIONAL CARRIAGE OF DANGEROUS GOODS BY ROAD (ADR): This product is not considered by the United Nations Economic Commission for Europe to be dangerous goods.

## 15. REGULATORY INFORMATION

### UNITED STATES REGULATIONS:

**U.S. SARA REPORTING REQUIREMENTS:** The components of this product are subject to the reporting requirements of Sections 302, 304, and 313 of Title III of the Superfund Amendments and Reauthorization Act as follows: None

**U.S. SARA THRESHOLD PLANNING QUANTITY:** There are no specific Threshold Planning Quantities for the components of this product. The default Federal SDS submission and inventory requirement filing threshold of 10,000 lbs (4,540 kg) therefore applies, per 40 CFR 370.20.

**U.S. CERCLA REPORTABLE QUANTITY (RQ):** None

**U.S. TSCA INVENTORY STATUS:** The components of this product are listed on the TSCA Inventory or are exempted from listing.

**OTHER U.S. FEDERAL REGULATIONS:** None

**CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65):** Ingredients within this product are not on the Proposition 65 Lists.

### CANADIAN REGULATIONS:

**CANADIAN DSL/NDL INVENTORY STATUS:** The components of this product are on the DSL Inventory, or are exempted from listing.

**OTHER CANADIAN REGULATIONS:** Not applicable.

### CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) PRIORITIES SUBSTANCES LISTS:

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the SDS contains all of the information required by those regulations.

**CANADIAN WHMIS CLASSIFICATION and SYMBOLS:** This product is "Not Controlled:" per WHMIS Controlled Product Regulations

### EUROPEAN ECONOMIC COMMUNITY INFORMATION:

This product does not meet the definition of a hazardous substance or preparation as defined by the European Union Council Directives 67/548/EEC, 1999/45/EC, 1272/2008/EC and subsequent Directives.

See Section 2 for Details

**AUSTRALIAN INFORMATION FOR PRODUCT:** The components of this product are listed on the International Chemical Inventory list.

### JAPANESE INFORMATION FOR PRODUCT:

**JAPANESE MINISTER OF INTERNATIONAL TRADE AND INDUSTRY (MITI) STATUS:** The components of this product are not listed as Class I Specified Chemical Substances, Class II Specified Chemical Substances, or Designated Chemical Substances by the Japanese MITI.



## **SAFETY DATA SHEET**

### **Newman Zone – Buffered Non-ionic Formulation 190-6730**

**JAPANESE ENCS INVENTORY:** The components of this product are on the ENCS Inventory as indicated in the section on International Chemical Inventories, below.

**POISONOUS AND DELETERIOUS SUBSTANCES CONTROL LAW:** No component of this product is a listed Specified Poisonous Substance under the Poisonous and Deleterious Substances Control Law.

#### **INTERNATIONAL CHEMICAL INVENTORIES:**

Listing of the components on individual country Chemical Inventories is as follows:

Asia-Pac: Listed or Exempt from listing

Australian Inventory of Chemical Substances (AICS): Listed or Exempt from listing

Korean Existing Chemicals List (ECL): Listed or Exempt from listing

Japanese Existing National Inventory of Chemical Substances (ENCS): Listed or Exempt from listing

Philippines Inventory of Chemicals and Chemical Substances (PICCS): Listed or Exempt from listing

Swiss Giftlist List of Toxic Substances: Listed or Exempt from listing

U.S. TSCA: Listed

## **16. OTHER INFORMATION**

#### **ABBREVIATIONS AND ACRONYMS:**

EPA: United States Environmental Protection Agency

ARD: European Agreement concerning the International Carriage of Dangerous Goods by Road

IMDG: International Maritime Code for Dangerous Goods

DOT: US Department of Transportation

IATA: International Air Transport Association

ACGIH: American Conference of Governmental Industrial Hygienists

NFPA: National Fire Protection Association (USA)

HMIS: Hazardous Materials Identification System (USA)

**PREPARED BY:** Paul Eigbrett – (**GHS MSDS Compliance PLUS**)

**DATE OF PRINTING:** June 25, 2014

The information contained herein is believed to be accurate but is not warranted to be so. Data and calculations are based on information furnished by the manufacturer of the product and manufacturers of the components of the product. Users are advised to confirm in advance of the need that information is current, applicable and suited to the circumstances of use. Remediation and Natural Attenuation Services Inc. assumes no responsibility for injury to vendee or third party person proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Furthermore, Remediation and Natural Attenuation Services Inc. assumes no responsibility for injury caused by abnormal use of this material even if reasonable safety procedures are followed.

**END OF SDS SHEET**





Health	2
Fire	1
Reactivity	0
Personal Protection	E

## Material Safety Data Sheet

### Fluorescein MSDS

#### Section 1: Chemical Product and Company Identification

**Product Name:** Fluorescein

**Catalog Codes:** SLF1135, SLF1645

**CAS#:** 2321-07-5

**RTECS:** LM5075000

**TSCA:** TSCA 8(b) inventory: Fluorescein

**CI#:** Not available.

**Synonym:** CI Solvent Yellow 94; Spiro[isobenzofuran-1(3H),9'-[9H]xanthen]-3-one, 3'6'-dihydroxy-; 2-(6-Hydroxy-3-oxo-(3H)-xanthen-9-yl)benzoic acid; D & C Yellow #7; Fluorescein, alcohol soluble.

**Chemical Name:** Fluorescein

**Chemical Formula:** C<sub>20</sub>H<sub>12</sub>O<sub>5</sub>

#### Contact Information:

**Sciencelab.com, Inc.**

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: [ScienceLab.com](http://ScienceLab.com)

**CHEMTREC (24HR Emergency Telephone), call:**

1-800-424-9300

**International CHEMTREC, call:** 1-703-527-3887

**For non-emergency assistance, call:** 1-281-441-4400

#### Section 2: Composition and Information on Ingredients

##### Composition:

Name	CAS #	% by Weight
Fluorescein	2321-07-5	100

**Toxicological Data on Ingredients:** Fluorescein LD50: Not available. LC50: Not available.

#### Section 3: Hazards Identification

**Potential Acute Health Effects:** Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

##### Potential Chronic Health Effects:

CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. Repeated or prolonged exposure is not known to aggravate medical condition.

#### Section 4: First Aid Measures

**Eye Contact:**

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention.

**Skin Contact:**

In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

**Serious Skin Contact:**

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

**Inhalation:**

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

**Serious Inhalation:** Not available.

**Ingestion:**

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

**Serious Ingestion:** Not available.

## Section 5: Fire and Explosion Data

**Flammability of the Product:** May be combustible at high temperature.

**Auto-Ignition Temperature:** Not available.

**Flash Points:** CLOSED CUP: Higher than 93.3°C (200°F).

**Flammable Limits:** Not available.

**Products of Combustion:** These products are carbon oxides (CO, CO<sub>2</sub>).

**Fire Hazards in Presence of Various Substances:**

Slightly flammable to flammable in presence of open flames and sparks, of heat. Non-flammable in presence of shocks.

**Explosion Hazards in Presence of Various Substances:**

Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

**Fire Fighting Media and Instructions:**

SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

**Special Remarks on Fire Hazards:** Not available.

**Special Remarks on Explosion Hazards:** Not available.

## Section 6: Accidental Release Measures

**Small Spill:**

Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

**Large Spill:**

Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system.

## Section 7: Handling and Storage

**Precautions:**

Keep locked up.. Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If you feel unwell, seek medical attention and show the label when possible. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents.

**Storage:** Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 24°C (75.2°F).

## Section 8: Exposure Controls/Personal Protection

### Engineering Controls:

Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

### Personal Protection:

Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

### Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

**Exposure Limits:** Not available.

## Section 9: Physical and Chemical Properties

**Physical state and appearance:** Solid. (Solidcrystalline powder.)

**Odor:** Not available.

**Taste:** Not available.

**Molecular Weight:** 332.31 g/mole

**Color:** Yellow (Yellowish-Red) to Red.

**pH (1% soln/water):** Not applicable.

**Boiling Point:** Not available.

**Melting Point:** 315°C (599°F)

**Critical Temperature:** Not available.

**Specific Gravity:** Not available.

**Vapor Pressure:** Not applicable.

**Vapor Density:** Not available.

**Volatility:** Not available.

**Odor Threshold:** Not available.

**Water/Oil Dist. Coeff.:** Not available.

**Ionicity (in Water):** Not available.

**Dispersion Properties:** See solubility in water, methanol, acetone.

### Solubility:

Easily soluble in acetone. Soluble in methanol, hot alcohol, glacial acetic acid, alkali hydroxides, and carbonates. Insoluble in cold water, diethyl ether, petroleum ether, benzene.

## Section 10: Stability and Reactivity Data

**Stability:** The product is stable.

**Instability Temperature:** Not available.

**Conditions of Instability:** Excess heat, excess dust generation, incompatible materials

**Incompatibility with various substances:** Reactive with oxidizing agents.

**Corrosivity:** Non-corrosive in presence of glass.

**Special Remarks on Reactivity:** Not available.

**Special Remarks on Corrosivity:** Not available.

**Polymerization:** Will not occur.

## Section 11: Toxicological Information

**Routes of Entry:** Inhalation. Ingestion.

**Toxicity to Animals:**

LD50: Not available. LC50: Not available.

**Chronic Effects on Humans:** MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast.

**Other Toxic Effects on Humans:** Hazardous in case of skin contact (irritant), of ingestion, of inhalation.

**Special Remarks on Toxicity to Animals:** Not available.

**Special Remarks on Chronic Effects on Humans:** Not available.

**Special Remarks on other Toxic Effects on Humans:**

Acute Potential Health Effects: Skin: May cause skin irritation. Eyes: Causes eye irritation. Ingestion: May cause irritation of the gastrointestinal (digestive) tract. Inhalation: may cause respiratory tract irritation. The toxicological properties of this substance have not been fully investigated.

## Section 12: Ecological Information

**Ecotoxicity:** Not available.

**BOD5 and COD:** Not available.

**Products of Biodegradation:**

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

**Toxicity of the Products of Biodegradation:** The product itself and its products of degradation are not toxic.

**Special Remarks on the Products of Biodegradation:** Not available.

## Section 13: Disposal Considerations

**Waste Disposal:**

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

## Section 14: Transport Information

**DOT Classification:** Not a DOT controlled material (United States).

**Identification:** Not applicable.

**Special Provisions for Transport:** Not applicable.

## Section 15: Other Regulatory Information

### Federal and State Regulations:

TSCA 8(b) inventory: Fluorescein SARA 313 toxic chemical notification and release reporting: Fluorescein

**Other Regulations:** EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

### Other Classifications:

**WHMIS (Canada):** Not controlled under WHMIS (Canada).

### DSCL (EEC):

R36/38- Irritating to eyes and skin. S24/25- Avoid contact with skin and eyes. S37- Wear suitable gloves. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

### HMIS (U.S.A.):

**Health Hazard:** 2

**Fire Hazard:** 1

**Reactivity:** 0

**Personal Protection:** E

### National Fire Protection Association (U.S.A.):

**Health:** 2

**Flammability:** 1

**Reactivity:** 0

**Specific hazard:**

### Protective Equipment:

Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Splash goggles.

## Section 16: Other Information

**References:** Not available.

**Other Special Considerations:** Not available.

**Created:** 10/10/2005 08:18 PM

**Last Updated:** 05/21/2013 12:00 PM

*The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall ScienceLab.com be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if ScienceLab.com has been advised of the possibility of such damages.*

## Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 06/05/2014

Reviewed on 06/05/2014

### \* 1 Identification

· **Product identifier**

· **Trade name: Provect-CH4 Methanogenic Inhibitor/ERD Supplement**

· **Product description**

Remediation product or supplement for use in controlling methane production and reducing methane concentrations in ground water, soil gas/vapor and indoor air. Can be used in landfill management and in various environmental applications associated with the treatment of soil, sediment and groundwater. Not for use in potable water sources.

· **Details of the supplier of the safety data sheet**

· **Manufacturer/Supplier:**

Provectus Environmental Products

2871 W. Forest Road

Suite 2

Freeport, IL 61032

Phone: 815-650-2230

Fax: 815-650-2232

www.provectusenvironmental.com

· **Emergency telephone number:** 815-650-2230

### \* 2 Hazard(s) identification

· **Classification of the substance or mixture**

The substance is not classified according to the Globally Harmonized System (GHS).

· **Label elements**

· **GHS label elements** Non-Regulated Material

· **Hazard pictograms** Non-Regulated Material

· **Signal word** Non-Regulated Material

· **Hazard statements** Non-Regulated Material

· **Classification system:**

· **NFPA ratings (scale 0 - 4)**



· **HMIS-ratings (scale 0 - 4)**

HEALTH	0	Health = 0
FIRE	0	Fire = 0
REACTIVITY	0	Reactivity = 0

### \* 3 Composition/information on ingredients

Proprietary Red Yeast Rice Extrac	90-100%
-----------------------------------	---------

· **Chemical characterization: Mixtures**

· **Description:** Mixture of the substances listed below with nonhazardous additions.

· **Dangerous components:**

112926-00-8	Precipitated silica (Silica-Amorphous)	0-10%
-------------	--	-------

### \* 4 First-aid measures

· **Description of first aid measures**

· **General information:** No special measures required.

(Contd. on page 2)

## Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 06/05/2014

Reviewed on 06/05/2014

**Trade name: Provect-CH4 Methanogenic Inhibitor/ERD Supplement**

(Contd. of page 1)

- **After inhalation:** Supply fresh air; consult doctor in case of complaints.
- **After skin contact:** Generally the product does not irritate the skin.
- **After eye contact:** Rinse opened eye for several minutes under running water.
- **After swallowing:** Give large amounts of water. If symptoms persist consult doctor.
- **Most important symptoms and effects, both acute and delayed** No further relevant information available.
- **Indication of any immediate medical attention and special treatment needed**  
No further relevant information available.

### 5 Fire-fighting measures

- **Extinguishing media**
- **Suitable extinguishing agents:**  
CO2, extinguishing powder or water spray. Fight larger fires with water spray or alcohol resistant foam.
- **Special hazards arising from the substance or mixture** No further relevant information available.
- **Advice for firefighters**
- **Protective equipment:** No special measures required.

### \* 6 Accidental release measures

- **Personal precautions, protective equipment and emergency procedures** Not required.
- **Environmental precautions:** Do not allow to enter sewers/ surface or ground water.
- **Methods and material for containment and cleaning up:** Pick up mechanically.
- **Reference to other sections**  
See Section 7 for information on safe handling.  
See Section 8 for information on personal protection equipment.  
See Section 13 for disposal information.

### \* 7 Handling and storage

- **Precautions for safe handling** No special measures required.
- **Information about protection against explosions and fires:** No special measures required.
- **Conditions for safe storage, including any incompatibilities**
- **Storage:**
- **Requirements to be met by storerooms and receptacles:** No special requirements.
- **Information about storage in one common storage facility:** Not required.
- **Further information about storage conditions:** None.
- **Specific end use(s)** No further relevant information available.

### \* 8 Exposure controls/personal protection

- **Additional information about design of technical systems:** No further data; see section 7.
- **Control parameters**

· **Components with occupational exposure limits:**

**112926-00-8 Precipitated silica (Silica-Amorphous)**

PEL 20mppcf or 80mg/m3 /%SiO2

REL Long-term value: 6 mg/m<sup>3</sup>  
See Pocket Guide App. C

TLV TLV withdrawn

- **Additional information:** The lists that were valid during the creation were used as basis.

(Contd. on page 3)



## Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 06/05/2014

Reviewed on 06/05/2014

**Trade name: Provect-CH4 Methanogenic Inhibitor/ERD Supplement**

(Contd. of page 2)

- **Exposure controls**
- **Personal protective equipment:**
- **General protective and hygienic measures:**  
The usual precautionary measures for handling chemicals should be followed.
- **Breathing equipment:** Not required.
- **Protection of hands:** Not required.
- **Eye protection:** Not required.

### \* 9 Physical and chemical properties

- **Information on basic physical and chemical properties**
- **General Information**
- **Appearance:**
  - Form:** Powder
  - Color:** Dark red
- **Odor:** Slight chocolate
- **Odor threshold:** Not determined.
- **pH-value:** Not applicable.
- **Change in condition**
  - Melting point/Melting range:** Not determined.
  - Boiling point/Boiling range:** Undetermined.
- **Flash point:** Not applicable.
- **Flammability (solid, gaseous):** Not determined.
- **Ignition temperature:**
  - Decomposition temperature:** Not determined.
- **Auto igniting:** Product is not selfigniting.
- **Danger of explosion:** Product does not present an explosion hazard.
- **Explosion limits:**
  - Lower:** Not determined.
  - Upper:** Not determined.
- **Vapor pressure:** Not applicable.
- **Density:** Not determined.
- **Relative density** Not determined.
- **Vapour density** Not applicable.
- **Evaporation rate** Not applicable.
- **Solubility in / Miscibility with Water:** Cold Water Soluble.
- **Partition coefficient (n-octanol/water):** Not determined.
- **Viscosity:**
  - Dynamic:** Not applicable.
  - Kinematic:** Not applicable.
- **Solvent content:**
  - Organic solvents:** 0.0 %
  - Solids content:** 100.0 %

(Contd. on page 4)

## Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 06/05/2014

Reviewed on 06/05/2014

**Trade name: Provect-CH4 Methanogenic Inhibitor/ERD Supplement**

(Contd. of page 3)

· **Other information**

No further relevant information available.

### \* 10 Stability and reactivity

- **Reactivity** No further relevant information available.
- **Chemical stability** Product is stable under normal conditions.
- **Thermal decomposition / conditions to be avoided:** No decomposition if used according to specifications.
- **Possibility of hazardous reactions** No dangerous reactions known.
- **Conditions to avoid** No further relevant information available.
- **Incompatible materials:** No further relevant information available.
- **Hazardous decomposition products:** No dangerous decomposition products known.

### \* 11 Toxicological information

· **Information on toxicological effects**

· **Acute toxicity:**

· **Primary irritant effect:**

· **on the skin:** No irritant effect.

· **on the eye:** No irritating effect.

· **Sensitization:** No sensitizing effects known.

· **Additional toxicological information:**

The product is not subject to classification according to internally approved calculation methods for preparations:

When used and handled according to specifications, the product does not have any harmful effects according to our experience and the information provided to us.

· **Carcinogenic categories**

· **IARC (International Agency for Research on Cancer)**

None of the ingredients is listed.

· **NTP (National Toxicology Program)**

None of the ingredients is listed.

· **OSHA-Ca (Occupational Safety & Health Administration)**

None of the ingredients is listed.

### 12 Ecological information

· **Toxicity**

· **Aquatic toxicity:** No further relevant information available.

· **Persistence and degradability** No further relevant information available.

· **Bioaccumulative potential** No further relevant information available.

· **Mobility in soil** No further relevant information available.

· **Additional ecological information:**

· **General notes:** Water hazard class 1 (Self-assessment): slightly hazardous for potable water

· **Results of PBT and vPvB assessment**

· **PBT:** Not applicable.

· **vPvB:** Not applicable.

· **Other adverse effects** No further relevant information available.

### \* 13 Disposal considerations

· **Waste treatment methods**

· **Recommendation:** Smaller quantities can be disposed of with household waste.

(Contd. on page 5)

## Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 06/05/2014

Reviewed on 06/05/2014

**Trade name: Provect-CH4 Methanogenic Inhibitor/ERD Supplement**

(Contd. of page 4)

- **Uncleaned packagings:**
- **Recommendation:** Disposal must be made according to official regulations.

### 14 Transport information

- **UN-Number**
- **DOT, ADR, ADN, IMDG, IATA** Non-Regulated Material
- **UN proper shipping name**
- **DOT, ADR, ADN, IMDG, IATA** Non-Regulated Material
- **Transport hazard class(es)**
- **DOT, ADR, ADN, IMDG, IATA**
- **Class** Non-Regulated Material
- **Packing group**
- **DOT, ADR, IMDG, IATA** Non-Regulated Material
- **Environmental hazards:**
- **Marine pollutant:** No
- **Special precautions for user** Not applicable.
- **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code** Not applicable.
- **UN "Model Regulation":** -

### \* 15 Regulatory information

- **Safety, health and environmental regulations/legislation specific for the substance or mixture**
- **Sara**

#### · **Section 355 (extremely hazardous substances):**

None of the ingredients is listed.

#### · **Section 313 (Specific toxic chemical listings):**

None of the ingredients is listed.

#### · **TSCA (Toxic Substances Control Act):**

None of the ingredients is listed.

#### · **Proposition 65**

#### · **Chemicals known to cause cancer:**

None of the ingredients is listed.

#### · **Chemicals known to cause reproductive toxicity for females:**

None of the ingredients is listed.

#### · **Chemicals known to cause reproductive toxicity for males:**

None of the ingredients is listed.

#### · **Chemicals known to cause developmental toxicity:**

None of the ingredients is listed.

#### · **Carcinogenic categories**

#### · **EPA (Environmental Protection Agency)**

None of the ingredients is listed.

#### · **TLV (Threshold Limit Value established by ACGIH)**

None of the ingredients is listed.

(Contd. on page 6)

## Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 06/05/2014

Reviewed on 06/05/2014

**Trade name: Provect-CH4 Methanogenic Inhibitor/ERD Supplement**

(Contd. of page 5)

· <b>NIOSH-Ca (National Institute for Occupational Safety and Health)</b>		
None of the ingredients is listed.		
· <b>GHS label elements</b> Non-Regulated Material		
· <b>Hazard pictograms</b> Non-Regulated Material		
· <b>Signal word</b> Non-Regulated Material		
· <b>Hazard statements</b> Non-Regulated Material		
· <b>National regulations:</b>		
The product is subject to be labeled according with the prevailing version of the regulations on hazardous substances.		
· <b>State Right to Know</b>		
	Proprietary Red Yeast Rice Extract	90-99%
112926-00-8	Precipitated silica (Silica-Amorphous)	2-12%
All ingredients are listed.		
· <b>Chemical safety assessment:</b> A Chemical Safety Assessment has not been carried out.		

### 16 Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

· **Date of preparation / last revision** 06/05/2014 / 3

· **Abbreviations and acronyms:**

ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)

IMDG: International Maritime Code for Dangerous Goods

DOT: US Department of Transportation

IATA: International Air Transport Association

ACGIH: American Conference of Governmental Industrial Hygienists

EINECS: European Inventory of Existing Commercial Chemical Substances

ELINCS: European List of Notified Chemical Substances

CAS: Chemical Abstracts Service (division of the American Chemical Society)

NFPA: National Fire Protection Association (USA)

HMS: Hazardous Materials Identification System (USA)

· **\* Data compared to the previous version altered.**

SDS / MSDS Created by MSDS Authoring Services ([www.MSDSAuthoring.com](http://www.MSDSAuthoring.com))

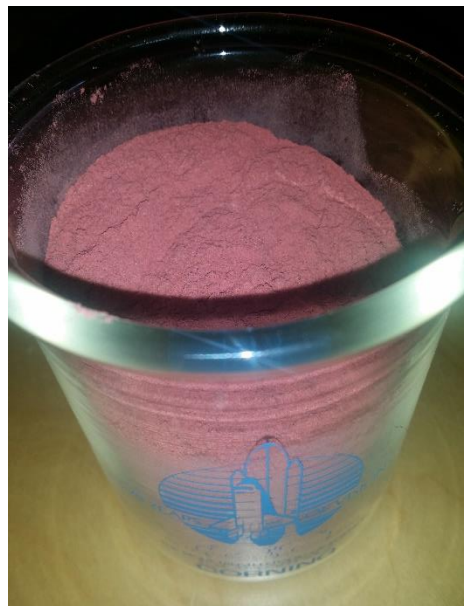
## Provect-CH4™

### Methane Inhibitor / ERD and ISCR Supplement

#### TECHNOLOGY DESCRIPTION

Provect-CH4 is a food-grade, natural source of Monacolin K (otherwise known as Lovastatin) that is used to prevent methane (CH<sub>4</sub>) production by inhibiting the growth and proliferation of methanogenic Archaea. In environmental remediation applications, it can be used as a supplement to conventional enhanced reductive dehalogenation (ERD) and *in situ* chemical reduction (ISCR) amendments rendering them safer and more effective. These include:

- ◆ Oils
- ◆ Emulsified Oils
- ◆ Sugars (lactate, dextrose, glucose)
- ◆ Other carbon sources (e.g., molasses, whey)
- ◆ Plant based carbon (e.g., cellulose and hemi-cellulose)
- ◆ Carbon + ZVI amendments (conventional ISCR reagents)



With widely varying degrees of success, other approaches such as managing pH and using slower-release, cellulose based carbon sources (lignolytic bacteria are not commonly thought to produce methane) have attempted to manage methane production during remedial applications. However, Provect-CH4 is the only reagent designed **to actively control the production of methane** in a safe, reliable and predictable manner (US Patent Office Scalzi *et al*, 2013, 2014). In addition to the safety issues, associated with elevated methane in groundwater, soil gas, and indoor air, this effect also promotes more efficient use of the hydrogen donor.

#### WHAT IS THE PROBLEM WITH METHANE?

There are recognized benefits to methanogens and of limited methanogenesis. For example, i) methanogens are known to play important roles in synergistic microbial ecology, ii) their metabolic activity can help maintain anoxic conditions in treatment zones (through seasonal changes), and iii) the activity of methane mono-oxygenases and other enzymes can stimulate co-metabolic activity of TCE/DCE/VC in redox-recovery zones. Hence, limited production of methane is part of a healthy ERD/ISCR application. However, excessive methane production can be dangerous and represents a costly waste of amendment.

**Cost and Efficiency Issues:** Production of methane is a direct indication that hydrogen generated from the electron donor amendments was used by methanogens instead of the target microbes (e.g., *Dehalococcoides spp.*), substantially reducing application efficiency. **Table 1** (below) presents a site example where hydrogen demand is calculated for a highly aerobic and oxidized source area measuring approximately 1,850 cubic yards. Hydrogen demand for complete dechlorination of all PCE and TCE mass to ethene within this source area example, including both adsorbed and dissolved contaminants, is less than the amendment consumed to generate 20 mg/L of methane. The same is true of reducing all dissolved oxygen, nitrate, sulfate, and bio-available iron and manganese competing electron acceptors within the hypothetical treatment zone. So, even though this example site is highly oxidized with relatively high total concentrations of PCE and TCE, generating just 20 mg/L of methane constitutes greater than 33% of the total amendment consumption based on moles of H<sub>2</sub>.

**Table 1. H Demand for Complete Dechlorination of PCE/TCE in Hypothetical Source Area**

Constituent	Groundwater Concentration (mg/L)	Molecular Weight (g/mol)	Moles of H <sub>2</sub> to Reduce Mole Analyte	Moles of H <sub>2</sub> Acceptor In Treatment Area
<b>Contaminant Electron Acceptors (To End Product Ethene)</b>				
Tetrachloroethene (PCE)	10.0	165.8	4	1,393
Trichloroethene (TCE)	7.0	131.4	3	364
cis-1,2-Dichloroethene (cDCE)	0.0	96.9	2	0
Vinyl Chloride (VC)	0.0	62.5	1	0
<b>Complete Dechlorination (Soil+Groundwater) Subtotal</b>				<b>1,757</b>
<b>Native Electron Acceptors</b>				
Dissolved Oxygen	9.0	32	2	199
Nitrate (as Nitrogen)	9.0	62	3	682
Sulfate	50.0	96.1	4	736
Fe <sup>+2</sup> Formation from Fe <sup>+3</sup>	20.0	55.8	0.5	63
Mn <sup>+2</sup> Formation from Mn <sup>+4</sup>	10.0	54.9	1	64
<b>Baseline Geochemistry Subtotal</b>				<b>1,745</b>
<b>Hydrogen Waste for Methane Formation</b>				
Methane Formed	20.0	16	4	1,769
<b>Initial Treatment Area Hydrogen Usage</b>				<b>5,271</b>

**Potential Health and Safety Issues:** Methane is considered to be a major greenhouse gas. It is explosive, with an LEL of 5% and an UEL of 15%. As a result of the microbial fermentation process, methane will be produced in most situations following the addition of any conventional ERD or ISCR amendment. Excessive and extended production of methane can result in elevated in groundwater concentrations (as high as 1,000 ppm have been reported) which can lead to accumulation in soil gas subsequently impacting indoor air. While this is perhaps more relevant in urban settings where methane can accumulate in basements, under slabs/foundations and/or migrate along utility corridors, excessive methane production has also been observed in more rural settings and other open spaces.

**New and Emerging Regulatory Issues:** State specific regulations for methane in groundwater have been promulgated, with others pending for soil gas and indoor air. For example, current regulations for methane in groundwater vary from ca. 10 to 28 mg CH<sub>4</sub>/L (Indiana Department of Environmental Management, 2014). Notably, several ERD projects which intended to use liquid carbon (emulsified oils) sources have failed to receive regulatory approval due to issues associated with excessive production of methane during previous technology applications (Personal Communication - State of California; State of Minnesota). As a result, many remedial practitioners proactively design contingencies for conventional ERD/ISCR implementation in the event that methane exceeds a threshold level ranging from 1 to 10 ppm groundwater. These contingencies often entail expensive and extensive systems for treating methane in soil gas/vapor captured via SVE systems.

## PROVECT-CH4: MODE OF ACTION – HOW DOES IT WORK?

**What is a Methanogen?** In the 1970s, Dr. Carl Woese (1928 to 2012) and his colleagues at the University of Illinois-Urbana studied prokaryotic relationships using DNA sequences and they found that microbes that produce methane – or methanogens - are Archaea (Woese and Fox, 1977). The identification of this new Domain of microorganism was very important for many reasons, but from our limited perspective herein this vast difference in genetic composition means that methanogens are significantly different from typical heterotrophic bacteria and eukaryotes. In other words, *Dehalococcoides ethenogenes* are as different from methanogens as you are.



**What is a Statin?** A Statin can be defined as “a class of lipid-lowering drugs that reduce serum cholesterol levels by inhibiting a key enzyme involved in the biosynthesis of cholesterol”. Lovastatin (C<sub>24</sub>H<sub>36</sub>O<sub>5</sub>; **Figure 2**) is a fungal metabolite isolated from cultures of *Aspergillus terreus* and other organisms. Lovastatin is widely known, potent statin used for decades to lower cholesterol in human blood by inhibiting 3-hydroxyl-3-methylglutaryl-coenzyme A (HMG-CoA) reductase, which is a key enzyme in the cholesterol biosynthesis pathway (Alberts *et al.*, 1980). It was the first statin approved by the United States Food and Drug Administration in 1987 as a hypercholesterolemic drug.

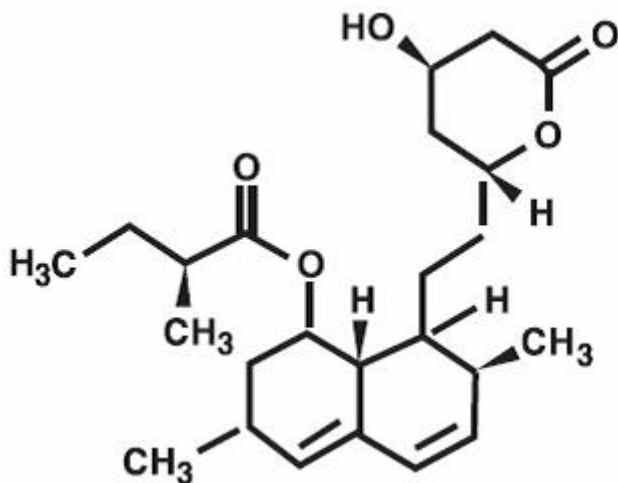


Figure 2. Chemical structure of Lovastatin

**What is Red Yeast (Rice) Extract?** The red yeast rice (RYS) extract that is component of **Provect-CH4** is a substance extracted from rice that has been fermented with a type of yeast called *Monascus purpureus*. Red yeast extract has been used in the cattle industry for decades in efforts to manage rumen microbiology and to control methane production on cows (Henderson *et al.*, 2010). It is also used as a food coloring, food additive/preservative, and is widely consumed by humans. The RYS extract contains a number of monacolins - most importantly, Monacolin K, otherwise known as Lovastatin or Mevinolin. Monacolin K is the only naturally occurring statin compound. In addition to Monacolin K, RYS extract also contains other statins, mono-unsaturated fatty acids, vitamins and other nutrients that will effectively stimulate anaerobic bacteria in the subsurface.

**So – How Does **Provect-CH4** Inhibit a Methanogen?** Monacolin K can inhibit methanogenic archaea because cell membrane production in archaea shares a similar pathway with cholesterol biosynthesis (Miller and Wolin, 2001). More specifically, bacterial cell walls are predominantly comprised of murein (peptidoglycan). Archaea, however, do not produce murein; rather, their cell walls are composed of various sulfated-heteropolysaccharides, proteins and glycoproteins/lipids along with pseudomurein – a structural analogue of murein - which is biosynthesized via activity similar to that of HMG-CoA reductase which yields cholesterol in humans. In the presence of a statin, HMG-CoA reductase is inhibited, pseudomurein biosynthesis pathway is interrupted, and methanogens are restricted from growth and proliferation. And since methanogens are so uniquely different than bacteria, the inhibitory effect of **Provect-CH4** is not observed in microbes that are typically associated with: i) catabolism of organic contaminants (such as pseudomonas species) and/or, ii) halo-respiration/biodegradation of chlorinated solvents (such as *Dehalococcoides* species).

## SAFER, MORE EFFICIENT ERD / ISCR TREATMENT

*In situ* chemical reduction (ISCR) describes the combined effect of stimulated biological oxygen consumption (via fermentation of an organic carbon source), direct chemical reduction with zero-valent iron (ZVI) or other reduced metals. As described by Brown *et al* (2009), the corresponding enhanced thermodynamic decomposition reactions that are

realized at the lowered redox (Eh) conditions allow for more effective mineralization of many constituents of interest (COIs). A number of enhanced reductive dehalogenation (ERD) substrates and other accelerated anaerobic bioremediation technologies exist (e.g., emulsified oils, non-emulsified oils, carbon-based hydrogen release compounds, vegetable matter + ZVI amendments) that facilitate biodegradation of related compounds. **Provect-IR** antimethanogenic ISCR substrate uniquely combines RYR extract with a variety of specially selected reagents in order to induce genuine ISCR conditions and facilitate the destruction of targeted COIs in a safer, more efficacious manner. **Provect-IR** has been used full-scale to ameliorate aquifers impacted by chlorinated solvents, pesticides, heavy metals and other COIs (Provectus Environmental Products, Inc. – <http://www.provectusenvironmental.com/>).

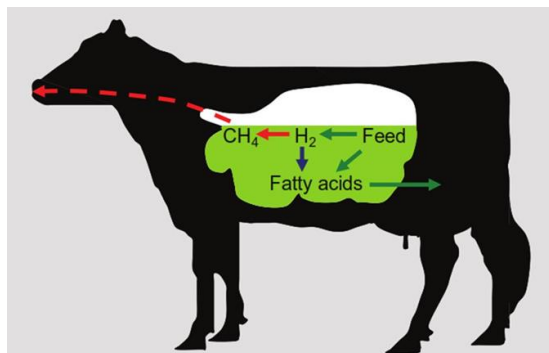


Figure 1. What happens to H<sub>2</sub> when methanogens are inhibited? (By Henderson et al, 2011)

Methanogens are often the dominant hydrogenotrophs (i.e., consumers of hydrogen) in many environments because they have a lower threshold for H<sub>2</sub> than do acetogens, and because the energy yield from the conversion of CO<sub>2</sub> and H<sub>2</sub> to methane is greater than that for conversion to acetate. However, when methanogens are inhibited, acetogens such as *Clostridium* and many other microbes with a broad range of catabolic abilities will thrive and produce acetyl-CoA / acetate and other VFAs from H<sub>2</sub> and CO<sub>2</sub> via the Wood-Ljungdahl pathway (See **Figure 1**). By inhibiting the growth and proliferation of methane producing Archaea, chlororespiring bacteria can become the more dominant bacterial populations. In an anaerobic environmental remediation setting, halo-respiring and other bacteria such as *Desulfobacter* spp. and *Desulfuromonas* spp. will more

effectively utilize the available hydrogen for dechlorination of targeted COIs, and the VFAs will be fermented to ultimately yield CO<sub>2</sub> (Schauder et al., 1986).

## PROOF OF CONCEPT

In collaboration with Western Michigan University, two anaerobic reactors were seeded with biomass that contained an active methanogenic population. The reactors were fed once per week to achieve COD of 2,000 mg/L, and they were operated as anaerobic sequencing batch reactors at 22°C- 24°C. After one week of incubation, silty sand was added to each reactor resulting in a slurry having a solids concentration of 20% by weight. The reactors were allowed to operate for another week with the silty sand, to ensure that the sand did not affect methanogenic activity. During the first two weeks both reactors were operated in an identical manner in order to establish baseline methanogenic conditions. During the third week, **Provect-CH<sub>4</sub>** was added to one reactor to achieve a concentration of 40 mg/L while maintaining the second reactor as an un-amended Control (i.e., no **Provect-CH<sub>4</sub>** added). Because the 40 mg/L dose of **Provect-CH<sub>4</sub>** reduced methane production in the Test reactor so rapidly and completely (see below), it was decided to dose the “Control” reactor with 20 mg/L of **Provect-CH<sub>4</sub>** during the fourth week of operation.

Throughout the study, the volume of biogas produced was measured by periodically withdrawing a gas sample using a glass syringe inserted through a septum the top of each reactor (**Figure 2**). The methane content of the biogas samples was quantified by injecting into a gas



Figure 2. Close up showing biogas being collected with a syringe to monitor



chromatograph with a flame ionization detector (GC-FID). The reactors also had dedicated probes to measure pH and ORP. After each cycle (*i.e.*, before feeding) a probe was inserted into the reactor to measure TDS, and a sample was collected to measure COD. The mixer was turned off during sampling and feeding to minimize the introduction of oxygen into the reactor contents.

## RESULTS:

**Table 1** lists the volume of biogas produced, pH values, and the concentrations of COD, ORP, and TDS measured in the Control and Test reactors during the studies. The volume of biogas produced each feed cycle (*i.e.*, each week) in the reactors ranged between 72-82 ml. Note that the volume of reactor gas produced was not affected by the introduction of silty sand during Week 2 of the Startup period. The COD measurements after each feeding cycle ranged from 56 to 108 mg/L. The reactors were fed 2,000 mg COD/L each cycle, which was apparently rapidly consumed by the anaerobic culture. Values of pH ranged between 6.1 and 6.4. Values of ORP were all close to -300 mV, which is typical of methanogenic conditions. The TDS in the reactors did not change over time, ranging from approximately 1,200 to 1,250 mg/L.

**Table 1. A list of the biogas volume, pH values, and concentrations of COD, ORP, and TDS in the Control and the Test reactors throughout the studies.**

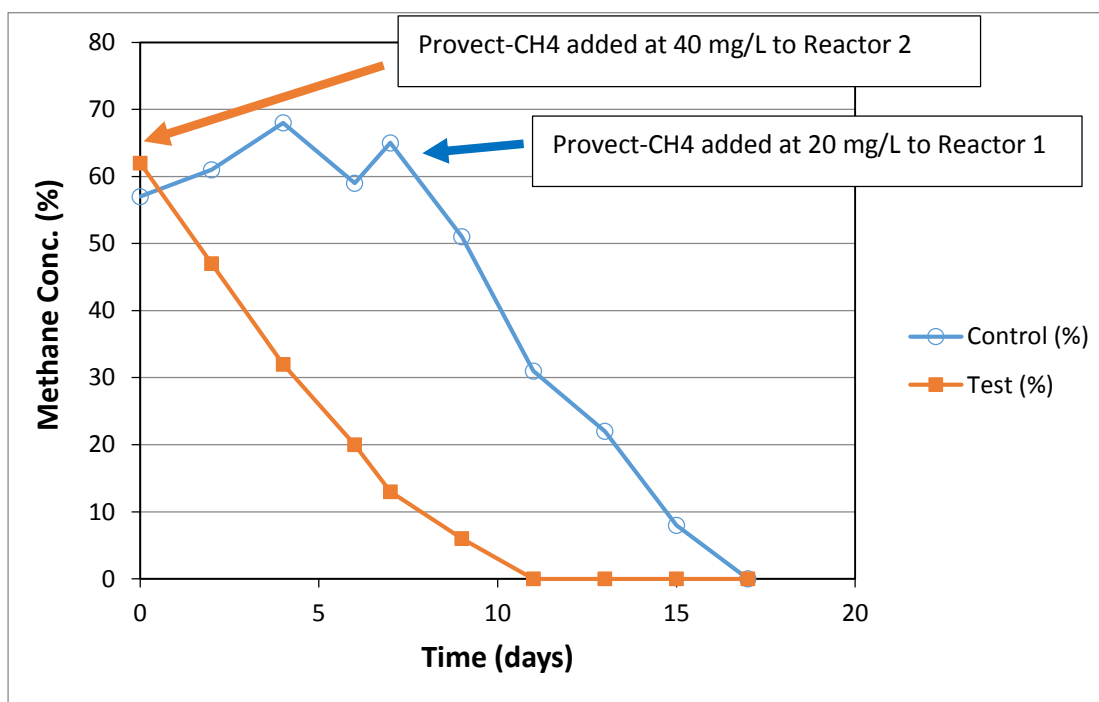
Period	Gas Vol. (mL)	COD (mg/L)	pH	ORP (mV)	TDS (mg/L)
<b>Reactor 1</b>					
<b>Startup-Week 1</b>	81	56	6.4	-302	1213
<b>Startup-Week 2</b>	72	91	6.3	-306	1241
<b>Test-Week 3</b>	75	61	6.2	-289	1258
<b>Test-Week 4 (Provect-CH<sub>4</sub> at 20 mg/L)</b>	73	108	6.3	-296	1220
<b>Reactor 2</b>					
<b>Startup-Week 1</b>	79	72	6.2	-285	1244
<b>Startup-Week 2</b>	75	83	6.2	-298	1265
<b>Test-Week 3 (Provect-CH<sub>4</sub> at 40 mg/L)</b>	82	62	6.1	-306	1263
<b>Test-Week 4</b>	72	97	6.4	-287	1247

Prior to the addition of **Provect-CH<sub>4</sub>**, methane concentrations varied from approximately 55% to 70% (**Table 2**), which indicated an active methanogenic culture. Following the addition of **Provect-CH<sub>4</sub>** at 40 mg/L to Reactor 2 the methane content of biogas was rapidly reduced from 62% to below detection (0.05%) after 11 days (**Figure 3**). With only a single addition of **Provect-CH<sub>4</sub>** to the closed system the methane concentration remained below detection levels until day 17, when the reactors were dismantled. Addition of **Provect-CH<sub>4</sub>** at 20 mg/L to Reactor 1 on Day 7 reduced the methane content of biogas from 65% to below detection (0.05%) by day 17 (*i.e.*, after 10 days). During the Test period, the total volume of biogas produced in either reactor did not change appreciably (Table 1), only the methane concentration of the biogas (the bulk gas contained mostly CO<sub>2</sub>).

**Table 2. Methane Concentrations (%) in Reactor Biogas during the 17 Day Test Period**  
(i.e., after dosing with methane inhibitor).

Activity	Time (days)	Reactor 1 Methane (%)	Reactor 2 Methane (%)
Reactor 2 dosed with Provect-CH4 at 40 mg/L	0	57	62 (+ Provect CH4)
	2	61	47
	4	68	32
	6	59	20
Reactor 1 dosed with Provect-CH4 at 20 mg/L	7	65 (+ Provect CH4)	13
	9	51	6
	11	31	0
	13	22	0
	15	8	0
	17	0	0

**Figure 3. Changes in Methane Concentrations over Time (Table 2 Data).**



## CONCLUSIONS:

These studies demonstrated that in a closed, controlled system **Provect-CH4** effectively shut down methane production in an active methanogenic culture when added at least 20 ppm. In an aquifer setting, a targeted dose of 50 ppm is generally recommended: site specific treatability studies can be conducted to help validate potential effectiveness and optimize the design specifications.

## PRIMARY FEATURES:

**Provect-CH4** is the only ERD/ ISCR supplement that will rapidly improve remedial performance while simultaneously preventing or significantly minimizing the production of methane. The benefits are notable:

- ◆ **More Efficient = More Cost Effective:** Production of methane is a direct indication that the hydrogen generated from the organic carbon amendments was used by methanogens and the amendment has been wasted because it was not utilized by acetogens or dehalorespiration. By inhibiting the growth and proliferation of methane producing Archaea, chlororespiring bacteria can become the more dominant bacterial populations.
- ◆ **Safer:** Methane is explosive with an LEL of 5% and an UEL of 15%. Production of methane will result from the addition of any conventional ERD or ISCR amendment: excessive and extended production of methane can result in elevated in groundwater concentrations (as high as 1,000 ppm have been reported) which can lead to accumulation in soil gas subsequently impacting indoor air. State specific regulations for methane in groundwater have been promulgated, with others pending for soil gas and indoor air.
- ◆ **Ease of Use:** Green and sustainable. All components integrated in a single package. Logistics with no surprises.
- ◆ **Patented Technologies:** Technology end users and their clients are fully protected from all Patent and other legal issues.

## EXAMPLE APPLICATION GUIDELINES (50 ppm Provect-CH4 in groundwater):

### Treatment Zone Dimensions

Width of targeted zone (perpendicular to gw flow)	150	ft
Length of targeted zone (parallel to gw flow)	125	ft
Depth to top of treatment zone	10	ft
Depth to bottom of treatment zone	20	ft
Treatment zone thickness	10	ft
Calculated Volume	187500	ft3

### Methane Inhibitor Calculations

Estimated Porosity	35	%
Calculated impacted liquid	65625	ft3
Methane Inhibitor for Project	204.8	lbs
ROUND TO NEAREST 25 lb		

**\* PLEASE CONTACT US ([info@provectusenv.com](mailto:info@provectusenv.com)) FOR PRICING INFORMATION AND DELIVERY QUOTES.**

#### LITERATURE CITED:

Alberts, A., J. Chen, G. Kuron, V. Hunt, J. Huff, C. Hoffman, J. Rothrock, M. Lopez, H. Joshua, and E. Harris; 1980. Mevinolin: a Highly Potent Competitive Inhibitor of Hydroxymethylglutaryl-coenzyme A Reductase and a Cholesterol-Lowering Agent. Proceedings of the National Academy of Sciences of the United States of America 77:3957-3961.

Brown, R., J. Mueller, A. Seech, J. Henderson and J. Wilson. 2009. Interactions between Biological and Abiotic Pathways in the Reduction of Chlorinated Solvents. Remediation Journal Winter 2009, pages 9-20.

Henderson, G., G.E. Naylor, S.C. Leahy and P.H. Janssen. 2010. Presence of novel, potentially homoacetogenic bacteria in the rumen as determined by the analysis of formyltetrahydrofolate synthetase sequences from ruminants. Appl. Environ. Microbiol. 76:2058-2066.

Miller, T.L. and M.J. Wolin. 2001. Inhibition of growth of Methane-Producing Bacteria of the Rumen Forestomach by Hydroxymethylglutaryl-CoA Reductase Inhibitors. J. Dairy Sci. 84:1445-1448.

Scalzi, M. and A. Karachalios. 2013 and 2014. Inhibition of Methane Production during Anaerobic Reductive Dechlorination. US PTO 13/ 785,840 and CIP 14/268,637.

Schauder, R., B. Eikmanns, R.K. Thauer, F. Widdel and G. Fuchs. 1986. Acetate Oxidation to CO<sub>2</sub> in Anaerobic Bacteria via a Novel Pathway not Involving Reactions of the Citric Acid Cycle. Arch. Microbiol. 145:162-172.

Woese, C.R. and G.E. Fox. 1977. Phylogenetic Structure of the Prokaryotic Domain: the Primary Kingdoms. Proceedings of the National Academy of Sciences of the United States of America 74 (11): 5088-5090.

#### CONTACT US FOR A COMPLIMENTARY SITE EVALUATION

**PROVECTUS ENVIRONMENTAL PRODUCTS, INC.**

**2871 West Forest Road, Suite 2 | Freeport, IL 61032**

**Tel: (815) 650-2230 | Fax: (815) 650-2232 | [Info@Provectusenv.com](mailto:Info@Provectusenv.com)**

**Multiple remedial contracting options available via strategic providers**

**Turn-Key, Risk-Reward, Pay-for Performance, Remedial Guarantees/Warranties**

## Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 05/30/2014

Reviewed on 05/30/2014

### \* 1 Identification

• **Product identifier**

• **Trade name: Provect-IR Antimethanogenic ISCR Reagent**

• **Product description**

Remediation product for the treatment of soil, sediment and groundwater. Not for use in potable water sources.

• **Details of the supplier of the safety data sheet**

• **Manufacturer/Supplier:**

Provectus Environmental Products  
2871 W. Forest Road  
Suite 2  
Freeport, IL 61032  
Phone: 815-650-2230  
Fax: 815-650-2232  
www.provectusenvironmental.com

• **Emergency telephone number:** 815-650-2230

### \* 2 Hazard(s) identification

• **Classification of the substance or mixture**

The product is not classified according to the Globally Harmonized System (GHS).

• **Label elements**

• **GHS label elements** Non-Regulated Material

• **Hazard pictograms** Non-Regulated Material

• **Signal word** Non-Regulated Material

• **Hazard statements** Non-Regulated Material

• **Hazard description:**

CONTAINMENT HAZARD: Any vessel that contains wetted reagent must be vented due to potential pressure build up from fermentation gases.

• **Classification system:**

• **NFPA ratings (scale 0 - 4)**



Health = 0  
Fire = 1  
Reactivity = 0

• **HMIS-ratings (scale 0 - 4)**



Health = 0  
Fire = 1  
Reactivity = 0

### \* 3 Composition/information on ingredients

7439-89-6	iron	5-40%
4075-81-4	calcium dipropionate	2 - 4%
	Proprietary Organic Carbon Sources	48-90%

• **Chemical characterization: Mixtures**

• **Description:** Mixture of the substances listed below with nonhazardous additions.

• **Dangerous components:**

8013-01-2	Yeast extracts	STOT SE 3, H335	0.5 - 2%
-----------	----------------	-----------------	----------

(Contd. on page 2)

## Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 05/30/2014

Reviewed on 05/30/2014

**Trade name: Provect-IR Antimethanogenic ISCR Reagent**

(Contd. of page 1)

9000-30-0	Guar gum	⚠ STOT SE 3, H335; Eye Irrit. 2B, H320; Combustible Dust	0.5 - 2%
7757-83-7	sodium sulphite	⚠ Acute Tox. 4, H302	1 - 2%

• **Additional information:** Product contains red yeast rice

### 4 First-aid measures

- **Description of first aid measures**
- **After inhalation:** Remove person to fresh air. If signs/symptoms continue, get medical attention.
- **After skin contact:** Wash off with soap and water. Get medical attention if irritation develops.
- **After eye contact:** Flush with water for 5 minutes
- **After swallowing:**  
Rinse mouth with water and afterwards drink plenty of milk or water. Call a poison control center or doctor immediately for treatment advice.
- **Most important symptoms and effects, both acute and delayed** No further relevant information available.
- **Indication of any immediate medical attention and special treatment needed**  
No further relevant information available.

### 5 Fire-fighting measures

- **Extinguishing media**
- **Suitable extinguishing agents:**  
CO<sub>2</sub>, extinguishing powder or water spray. Fight larger fires with water spray or alcohol resistant foam.
- **Special hazards arising from the substance or mixture** No further relevant information available.
- **Advice for firefighters**
- **Protective equipment:** No special measures required.

### \* 6 Accidental release measures

- **Personal precautions, protective equipment and emergency procedures** Not required.
- **Environmental precautions:** Do not allow to enter sewers/ surface or ground water.
- **Methods and material for containment and cleaning up:**  
Cover powder spill with plastic sheet or tarp to minimize spreading and keep powder dry. Sweep or vacuum up spillage and place in vented container.
- **Reference to other sections**  
See Section 7 for information on safe handling.  
See Section 8 for information on personal protection equipment.  
See Section 13 for disposal information.

### \* 7 Handling and storage

- **Precautions for safe handling** No special measures required.
- **Information about protection against explosions and fires:** Combustible material
- **Conditions for safe storage, including any incompatibilities**
- **Storage:**
- **Requirements to be met by storerooms and receptacles:**  
CONTAINMENT HAZARD: Any vessel that contains wetted reagent must be vented due to potential pressure build up from fermentation gases.
- **Information about storage in one common storage facility:** Not required.
- **Further information about storage conditions:**  
Keep tightly closed in a dry and cool place. Keep away from open flames, hot surfaces and sources of ignition. Any material that is wetted must be vented due to potential pressure build up from fermentation gases.

(Contd. on page 3)

## Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 05/30/2014

Reviewed on 05/30/2014

**Trade name: Provect-IR Antimethanogenic ISCR Reagent**

(Contd. of page 2)

- **Specific end use(s)** No further relevant information available.

### \* 8 Exposure controls/personal protection

- **Additional information about design of technical systems:** No further data; see section 7.
- **Control parameters**
- **Components with occupational exposure limits:**  
The product does not contain any relevant quantities of materials with critical values that have to be monitored at the workplace.
- **Additional information:**  
Dry or powdered ingredients are combustible. Dispersal of finely divided dust from products into air may form mixtures that are ignitable and explosive. Minimize airborne dust generation and eliminate sources of ignition.
- **Exposure controls**
- **Personal protective equipment:**
- **General protective and hygienic measures:**  
The usual precautionary measures for handling chemicals should be followed.
- **Breathing equipment:** Not required.
- **Protection of hands:** Not required.
- **Eye protection:** Not required.

### \* 9 Physical and chemical properties

- **Information on basic physical and chemical properties**
- **General Information**
- **Appearance:**

Form:	Solid
Color:	Brown to Green
Odor:	Pleasant
Odor threshold:	Not determined.
- **pH-value:** Not applicable.
- **Change in condition**

Melting point/Melting range:	Not determined.
Boiling point/Boiling range:	Undetermined.
- **Flash point:** Not applicable.
- **Flammability (solid, gaseous):** Not determined.
- **Ignition temperature:**

Decomposition temperature:	Not determined.
----------------------------	-----------------
- **Auto igniting:** Product is not selfigniting.
- **Danger of explosion:** Dry or powdered ingredients are combustible. Dispersal of finely divided dust from products into air may form mixtures that are ignitable and explosive. Minimize airborne dust generation and eliminate sources of ignition.
- **Explosion limits:**

Lower:	Not determined.
Upper:	Not determined.
- **Vapor pressure:** Not applicable.
- **Density:** Not determined.

(Contd. on page 4)



## Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 05/30/2014

Reviewed on 05/30/2014

**Trade name: Provect-IR Antimethanogenic ISCR Reagent**

(Contd. of page 3)

- **Relative density** Not determined.
- **Vapour density** Not applicable.
- **Evaporation rate** Not applicable.
- **Solubility in / Miscibility with Water:** Soluble.
- **Partition coefficient (n-octanol/water):** Not determined.
- **Viscosity:**
  - Dynamic:** Not applicable.
  - Kinematic:** Not applicable.
- **Solvent content:**
  - Organic solvents:** 0.0 %
  - Solids content:** 100.0 %
- **Other information** No further relevant information available.

### 10 Stability and reactivity

- **Reactivity** No further relevant information available.
- **Chemical stability** Product is stable under normal conditions.
- **Thermal decomposition / conditions to be avoided:** No decomposition if used according to specifications.
- **Possibility of hazardous reactions** No dangerous reactions known.
- **Conditions to avoid** No further relevant information available.
- **Incompatible materials:** No further relevant information available.
- **Hazardous decomposition products:** No dangerous decomposition products known.

### \* 11 Toxicological information

- **Information on toxicological effects**
- **Acute toxicity:**
- **Primary irritant effect:**
- **on the skin:** No irritant effect.
- **on the eye:** Product dust may cause eye irritation.
- **Sensitization:** No sensitizing effects known.
- **Additional toxicological information:**  
The product is not subject to classification according to internally approved calculation methods for preparations.  
When used and handled according to specifications, the product does not have any harmful effects according to our experience and the information provided to us.
- **Carcinogenic categories**

#### • **IARC (International Agency for Research on Cancer)**

None of the ingredients is listed.

#### • **NTP (National Toxicology Program)**

None of the ingredients is listed.

#### • **OSHA-Ca (Occupational Safety & Health Administration)**

None of the ingredients is listed.

### 12 Ecological information

- **Toxicity**
- **Aquatic toxicity:** No further relevant information available.

(Contd. on page 5)



## Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 05/30/2014

Reviewed on 05/30/2014

**Trade name: Provect-IR Antimethanogenic ISCR Reagent**

(Contd. of page 4)

- **Persistence and degradability** No further relevant information available.
- **Bioaccumulative potential** No further relevant information available.
- **Mobility in soil** No further relevant information available.
- **Additional ecological information:**
- **General notes:** Water hazard class 1 (Self-assessment): slightly hazardous for water
- **Results of PBT and vPvB assessment**
- **PBT:** Not applicable.
- **vPvB:** Not applicable.
- **Other adverse effects** No further relevant information available.

### 13 Disposal considerations

- **Waste treatment methods**
- **Recommendation:** Smaller quantities can be disposed of with household waste.
- **Uncleaned packagings:**
- **Recommendation:** Disposal must be made according to official regulations.
- **Recommended cleansing agent:** Water, if necessary with cleansing agents.

### \* 14 Transport information

- **UN-Number**
- **DOT, ADR, ADN, IMDG, IATA** Non-Regulated Material
- **UN proper shipping name**
- **DOT, ADR, ADN, IMDG, IATA** Non-Regulated Material
- **Transport hazard class(es)**
- **DOT, ADR, ADN, IMDG, IATA**
- **Class** Non-Regulated Material
- **Packing group**
- **DOT, ADR, IMDG, IATA** Non-Regulated Material
- **Environmental hazards:**
- **Marine pollutant:** No
- **Special precautions for user** Not applicable.
- **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code** Not applicable.
- **UN "Model Regulation":** -

### 15 Regulatory information

- **Safety, health and environmental regulations/legislation specific for the substance or mixture**
- **Sara**

#### • **Section 355 (extremely hazardous substances):**

None of the ingredients is listed.

#### • **Section 313 (Specific toxic chemical listings):**

None of the ingredients is listed.

#### • **TSCA (Toxic Substances Control Act):**

7439-89-6	iron
4075-81-4	calcium dipropionate
8013-01-2	Yeast extracts
9000-30-0	Guar gum
7757-83-7	sodium sulphite

(Contd. on page 6)

## Safety Data Sheet (SDS)

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 05/30/2014

Reviewed on 05/30/2014

**Trade name: Provect-IR Antimethanogenic ISCR Reagent**

(Contd. of page 5)

• **Proposition 65**

• **Chemicals known to cause cancer:**

None of the ingredients is listed.

• **Chemicals known to cause reproductive toxicity for females:**

None of the ingredients is listed.

• **Chemicals known to cause reproductive toxicity for males:**

None of the ingredients is listed.

• **Chemicals known to cause developmental toxicity:**

None of the ingredients is listed.

• **Carcinogenic categories**

• **EPA (Environmental Protection Agency)**

None of the ingredients is listed.

• **TLV (Threshold Limit Value established by ACGIH)**

None of the ingredients is listed.

• **NIOSH-Ca (National Institute for Occupational Safety and Health)**

None of the ingredients is listed.

• **GHS label elements** Non-Regulated Material

• **Hazard pictograms** Non-Regulated Material

• **Signal word** Non-Regulated Material

• **Hazard statements** Non-Regulated Material

• **National regulations:**

The product is subject to be labeled according with the prevailing version of the regulations on hazardous substances.

• **State Right to Know**

7439-89-6	iron	5-40%
4075-81-4	calcium dipropionate	2-4%
8013-01-2	Yeast extracts	0.5-2%
	⚠ STOT SE 3, H335	
9000-30-0	Guar gum	0.5-2%
	⚠ STOT SE 3, H335; Eye Irrit. 2B, H320; Combustible Dust	
7757-83-7	sodium sulphite	1-2%
	⚠ Acute Tox. 4, H302	
	Proprietary Organic Carbon Sources	48-90%

All ingredients are listed.

• **Chemical safety assessment:** A Chemical Safety Assessment has not been carried out.

### 16 Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

• **Date of preparation / last revision** 05/30/2014 / 6

• **Abbreviations and acronyms:**

ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)

IMDG: International Maritime Code for Dangerous Goods

DOT: US Department of Transportation

IATA: International Air Transport Association

(Contd. on page 7)

## **Safety Data Sheet (SDS)**

OSHA HazCom 2012 Standard 29 CFR 1910.1200. Prepared to GHS Rev03.

Printing date 05/30/2014

Reviewed on 05/30/2014

**Trade name: Provect-IR Antimethanogenic ISCR Reagent**

(Contd. of page 6)

ACGIH: American Conference of Governmental Industrial Hygienists  
EINECS: European Inventory of Existing Commercial Chemical Substances  
ELINCS: European List of Notified Chemical Substances  
CAS: Chemical Abstracts Service (division of the American Chemical Society)  
NFPA: National Fire Protection Association (USA)  
HMIS: Hazardous Materials Identification System (USA)  
Acute Tox. 4: Acute toxicity, Hazard Category 4  
Eye Irrit. 2B: Serious eye damage/eye irritation, Hazard Category 2B  
STOT SE 3: Specific target organ toxicity - Single exposure, Hazard Category 3

• **\* Data compared to the previous version altered.**

SDS / MSDS Created by MSDS Authoring Services ([www.MSDSAuthoring.com](http://www.MSDSAuthoring.com))

#### OVERVIEW

Provect-IR™ Antimethanogenic *In Situ* Chemical Reduction (ISCR) Reagent is designed to treat persistent organic and/or inorganic contaminants present in the subsurface environment. It is unique in its composition:

- Zero-Valent Iron 10% (weight basis), average particle size = 15 µm yields 25 ft ZVI surface area / lb product
- Integrated Vitamins, minerals and nutrients (yeast extract) specially selected for anaerobes
- Chemical oxygen scavenger to maintain reduced condition
- Multiple, Complex, Hydrophilic, Timed-Release organic carbon sources (plant materials, Kelp, Calcium Propionate) @ 390 g H donor / lb product
- METHANE INHIBITORS to increase safety and efficiency



#### MATERIAL PACKAGING, HANDLING AND STORAGE



Provect-IR can be specially formulated to meet site-specific needs. The standard formulation contains 10% ZVI and is packaged as a dry powder in 50-lb easy-open (NO SHARPS), polyethylene-lined, recycled paper bags or, upon request, in 2,000 lb Supersacks. Typical shipments entail multiple units of 4x4 wooden pallets containing 40 bags x 50 lbs/ bag = 2,000 lbs reagent per pallet. Each pallet is neatly wrapped in water-resistant plastic, but direct exposure to rain should be avoided.

#### GENERAL HEALTH AND SAFETY GUIDELINES

Provect-IR is non-hazardous and safe to handle. The use of standard personal protective equipment is always recommended, including safety glasses, steel-toe boots, gloves, hearing protection (in the proximity of loud machinery) and hard hat. Dust mask may be desired when working with the material under certain conditions. The SDS is posted on our web site at the following link: [Click Here!](#)

## SLURRY PREPARATION

Provect-IR is mixed with clean water on site to yield an aqueous slurry (see **Table 1** for field mixing guidelines). Experienced injection contractors can easily manage (mix, transport/pump, and inject) slurry containing between 20% and 30% solids (defined as the mass of dry Provect-IR divided by the total mass of slurry, including the water). For situations where more volume is desired, slurry density can be decreased, e.g., using a thinner slurry. Conversely, for situations where less volume is required (for example to minimize surfacing issues), thicker slurry with higher solids can be applied. A slurry containing ca .29% solids will have the following general characteristics:

- Wet Density = 0.9 to 1.1 g/cm<sup>3</sup>
- Dry Density = 0.3 to 0.4 g/cm<sup>3</sup>
- Viscosity = 500 to 1,500 cP

TABLE 1. FIELD GUIDE FOR MAKING SLURRY			
per 50 pound bag		per 25 kg bag	
Target weight %	USG water required	Target weight %	Liters water required
15	34	15	142
20	24	20	100
22	21	22	89
24	19	24	79
26	17	26	71
28	15	28	64
30	14	30	58
32	13	32	53
34	12	34	49
36	11	36	44

## APPLICATION TECHNIQUES

Provect-IR has been employed for source area treatment, plume treatment and/or plume management using permeable reactive barrier (PRBs). The choice of installation method will depend on the site-specific conditions, including treatment depth and geology. The most commonly practiced *in situ* application method has been direct injection of aqueous slurry.

Provect-IR slurry containing 10 to 35% solids has been added to numerous aquifers using a variety of injection methods, including hydraulic fracturing, pneumatic fracturing and direct injection. It can also be added via direct soil mixing using deep soil mixing equipment, or it can be placed directly into an open excavation or trench. ABC-CH4 is a liquid formulation of our antimethanogenic ERD reagent which has been added to existing well screens.

## GENERAL GUIDELINES FOR DIRECT PUSH INJECTION OF AQUEOUS SLURRY

Mixing Equipment. Reagent slurry has been prepared in various ways, ranging from in-line automated mixing systems, to manual mixing using a hand-held drill with a mixing attachment, to more creative processes. Particularly for larger projects, experienced drillers will have some form of mechanical mixing system on site that includes a tank with a paddle-type mixer at the bottom. The slurry is then transferred to a feed tank connected to an injection pump so that slurry can be prepared continuously while injections are being performed (see example, ChemGrout mixing system [www.chemgrout.com/500hp.htm](http://www.chemgrout.com/500hp.htm)). Slurry mixes quickly in these systems (<1 minute), and injections can proceed without interruption.



Pumps. Experienced drillers will have a variety of pumping equipment on site. For injecting slurries, an injection pump capable of generating at least 300 psi of pressure at a flow rate of >5 gpm is desired. Obviously, the pump needs to be able to handle solids, such as piston pumps, grout pumps, and progressing cavity pumps - with a preference towards the piston and grout pumps. Slurry is typically injected at pressures of 100 to 200 psi; however, higher pressures are sometimes required to initiate the injection. It is recommended to have a higher pressure pump available on site that can generate over 500 psi and ca. >10 gpm, as deeper installations often require higher injection pressures.



Tooling. Experienced drillers will have sufficient rod length on site to allow 3 to 5 injection points to be capped overnight to allow pressure to dissipate. This can help prevent backflow and surfacing of slurry as the injection rods are retracted. Likewise, experienced drillers will have on hand a variety of injection tips, some that direct the slurry horizontally (see for example GeoProbe's pressure activated tip at [geoprobe.com](http://geoprobe.com)).

In a "top-down" injection approach, the rods are initially advanced to the top of the targeted depth interval, and a specified volume of slurry is injected while recording flow rate, injection pressure, and slurry volume delivered. The injection rods are then further advanced a distance ranging 2 to 4 feet and the process is repeated to help ensure even distribution of slurry over the targeted depth interval. At the end of each injection point, a small volume of water (15 USG) is often used to clear the rods and the injection tip of any slurry.



**CONTACT US FOR A COMPLIMENTARY SITE EVALUATION**

**PROVECTUS ENVIRONMENTAL PRODUCTS, INC.**

**2871 West Forest Road, Suite 2 | Freeport, IL 61032**

**Tel: (815) 650-2230 | Fax: (815) 650-2232 | Email: [info@ProvectusEnv.com](mailto:info@ProvectusEnv.com)**

**Multiple remedial contracting options available via strategic providers**

**Turn-Key, Risk-Reward, Pay-for Performance, Remedial Guarantees/Warranties**

### **Attachment 3**

#### Dosing Calculations



**Site Name:** Metro Park, New York  
**Date of Evaluation:** 10/1/2015  
**Personnel:** Arcadis

**Area of Interest**  
**Chemical of Potential Concern**  
**Target Interval**

**Test Area 1**  
**CVOC**  
**10 to 14 ft**

**Test Area 2**  
**CVOC**  
**10 to 14 ft**

Parameter	Abbreviation	Formula	Units	Value	Value	Notes
<u>Input Parameters</u>						
Target Injection Radius	A		ft	5	5	design
Saturated Thickness	B		ft	4	4	design
Mobile Porosity	C		%	5.0%	5.0%	professional judgement
Total Porosity	D		%	30%	30%	literature value
Soil Straining Factor	E		lbs/lbs	1.3	1.3	professional judgement
Soil Bulk Density	F		lbs/cf	120.0	120.0	literature value
EVO 'As Sold' Density	G		lbs/gal	8.20	8.20	vendor
EVO 'As Sold' Organic Carbon Percent	H		%	45%	45%	vendor
Oil to Soil Loading Rate	I		--	0.014	0.014	literature value
No. of Injection Points	J		ea	3	3	design
Target Injection Rate	K		gpm	0.5	0.5	professional judgement

Calculations

						<u>Total</u>
Radial Pore Volume	L	= PI()*(A*E)^2*B*C*7.48	gal	199	199	<b>397</b>
	M	= PI()*(A*E)^2*B*C	cf	27	27	<b>53</b>
Soil Mass in Treatment Area	N	= M * F	lbs	3186	3186	<b>6371</b>
EVO 'As Sold' Mass - Per Location	O	= N * I	lbs	45	45	<b>89</b>
EVO 'As Sold' Mass - Total	P	= O * J	lbs	134	134	<b>268</b>
EVO Solution Strength	Q	= N / (L *G)	%	2.0	2.0	<b>2</b>
Organic Carbon Mass - Total	R	= O * H	lbs	60.2	60.2	<b>120</b>
Injection Time	S	= L / K / 60	Hrs	6.6	6.6	<b>13</b>

	enter value
	calculation

**Site Name:** Metro Park, New York  
**Date of Evaluation:** 10/1/2015  
**Personnel:** Arcadis

**Area of Interest**

**Chemical of Potential Concern**

**Tool Depth**

**Target Interval**

**Test Area 3**      **Test Area 3**  
**TCE**              **TCE**  
**10 ft**              **12 ft**  
**8 to 10 ft**      **10 to 12 ft**

Parameter	Abbreviation	Formula	Units	Value	Value	Notes
<u>Input Parameters</u>						
Target Radius	A		ft	10	10	design
Treatment Area	B		sf	100	100	design
Saturated Thickness	C		ft	2	2	design
Soil Bulk Density	D		lbs/cf	120.0	120.0	literature value
Soil to ZVI Mass Ratio	E		%	0.40%	0.40%	vendor
Percent Solids in Injection Solution	F		%	29%	29%	vendor
ZVI 'As Sold' Density	G		lbs/gal	6.67	6.67	vendor
Water Density	H		lbs/gal	8.34	8.34	literature value

Calculations

						<u>Total</u>
Soil Volume in Treatment Area	I	= B * C	cf	200	200	<b>400</b>
Soil Mass in Treatment Area	J	= I * D	lbs	24000	24000	<b>48000</b>
ZVI Mass in Treatment Area	K	= J * E	lbs	96	96	<b>192</b>
Number of Injection Points	L	= B / (PI()*A^2)	ea	1	1	<b>1</b>
ZVI Mass Per Injection Point	M	= K / L	lbs	96	96	<b>192</b>
Water Mixing Volume	N	= M / (H * F)	gal	40	40	<b>79</b>
ZVI/Water Mixing Ratio	O	= N / M	gal/lbs	0.4	0.4	

	enter value
	calculation

## Provectus Environmental Products Modified RYR Antimethanogen Supplement

<b>English (1) or Metric (2) Units</b>	<input type="text" value="1"/>
<b>Customer:</b>	<input type="text"/>
<b>Contact:</b>	<input type="text"/>
<b>Site Location:</b>	<input type="text"/>
<b>Targeted Dosage (ppm)</b>	<input type="text" value="75"/>
<b>Proposal Number:</b>	<input type="text"/>

### Site Information

#### Treatment Zone Dimensions

or enter Area

Width of targeted zone (perpendicular to gw flow)	<input type="text" value="10"/>	ft
Length of targeted zone (parallel to gw flow)	<input type="text" value="10"/>	ft
Depth to top of treatment zone	<input type="text" value="10"/>	ft
Depth to bottom of treatment zone	<input type="text" value="14"/>	ft
Treatment zone thickness	<input type="text" value="4"/>	ft
Calculated Volume	<input type="text" value="400"/>	ft3

<input type="text"/>	ft2
----------------------	-----

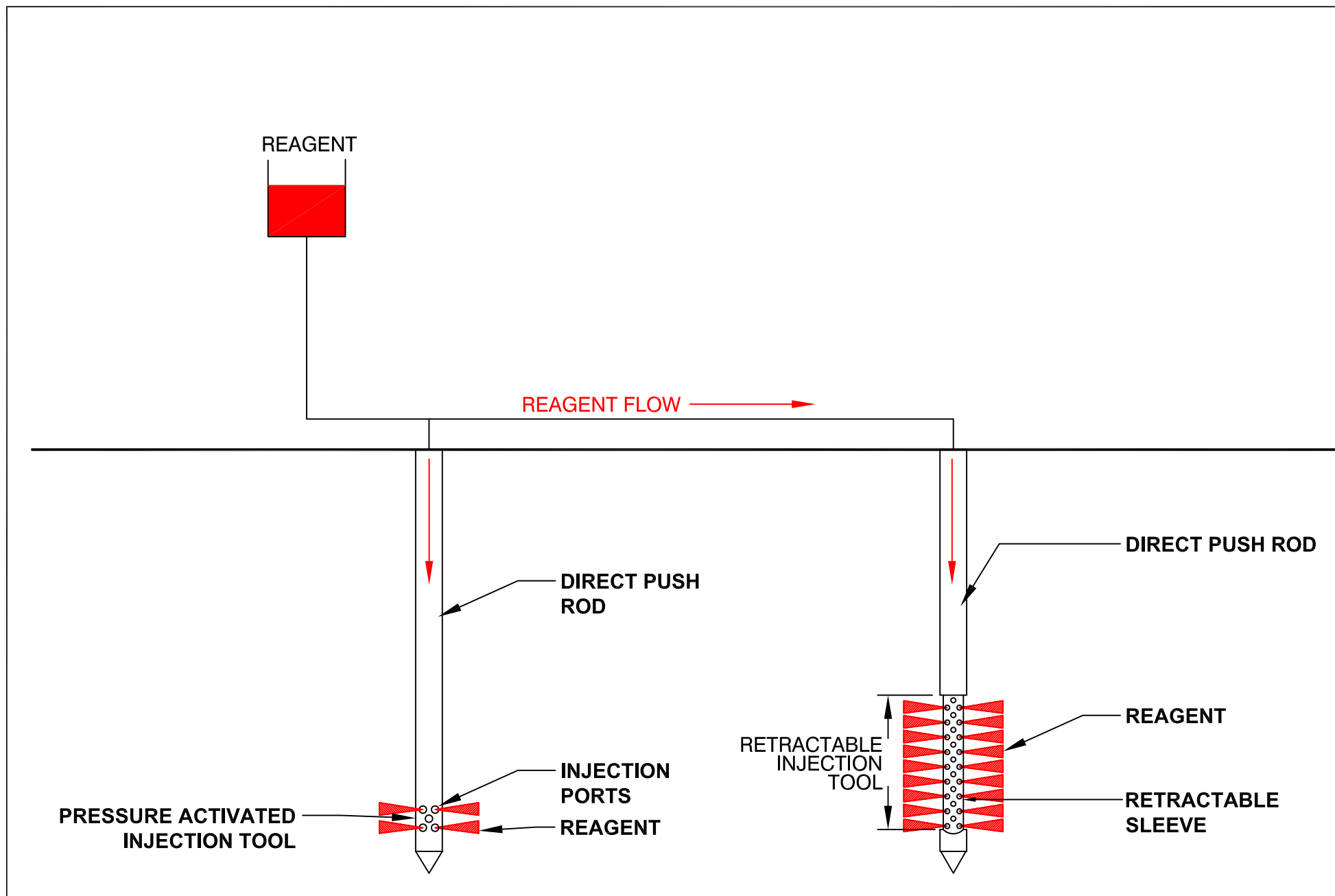
#### Methane Inhibitor Calculations

Estimated Porosity	<input type="text" value="30"/>	%
Calculated impacted liquid	<input type="text" value="120"/>	ft3
Targeted RYR Conc in GW	<input type="text" value="75"/>	ppm
Methane Inhibitor for Project	<input type="text" value="0.6"/>	lbs
ROUND TO 55 lb units	<input type="text" value="0"/>	

**PLEASE CONTACT US FOR PRICING INFORMATION AND DELIVERY QUOTES**  
[info@provectus.com](mailto:info@provectus.com)

#### **Attachment 4**

Injection Tooling Schematics



INSITU REMEDIAL REAGENTS WORKING GROUP

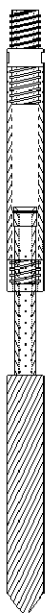
CONCEPTUAL INJECTION  
SHOWING HORIZONTAL  
INJECTION METHODS

FIGURE 3

SCALE:  
N.T.S



**RETRACTABLE SLEEVE INJECTION TOOL DIAGRAM - OPEN**



**RETRACTABLE SLEEVE INJECTION  
TOOL DIAGRAM**



**RETRACTABLE SLEEVE INJECTION  
TOOL DIAGRAM - CLOSED**

**INSITU REMEDIAL REAGENTS WORKING GROUP**

**HORIZONTAL INJECTION:  
RETRACTABLE SLEEVE  
INJECTION TOOL**

**FIGURE 4**

SCALE:  
N.T.S



**PRESSURE ACTIVATED INJECTION TOOL PROBE**



**PRESSURE ACTIVATED INJECTION TOOL PROBE  
SHOWING FLUID INJECTION PATTERN/ORIENTATION**

**INSITU REMEDIAL REAGENTS WORKING GROUP**

**HORIZONTAL INJECTION:  
PRESSURE ACTIVATED  
INJECTION TOOL**

**FIGURE 5**

SCALE:  
N.T.S