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September 13, 2022

Ms. Megan Kuczka
Environmental Program Specialist 1
Division of Environmental Remediation
New York State Department of Environmental Conservation
700 Delaware Avenue
Buffalo, New York 14209

Re: Notification of Planned Intrusive Activities (Corrective Measures Work Plan)
Former Roblin Steel Site – 320 South Roberts Road, Dunkirk, New York
NYSDEC Site No. B00173-9

Dr. Ms. Kuczka:

Pursuant to the notification requirements set forth in the Excavation Work Plan (EWP) contained in the Site Management Plan (SMP) for the above referenced Site, the purpose of this letter is to notify the New York State Department of Environmental Conservation (NYSDEC) of planned corrective measures at this Site. According to NYSDEC correspondence, dated April 1, 2022, a scope of work for corrective measures is being requested associated with the December 2021 and March 2022 groundwater laboratory analytical results, for the increases in total volatile organic compound (VOC) concentrations for groundwater monitoring wells MW-07R and EX-MW-11R. These two wells are part of the larger groundwater monitoring well network sampled annually as part of the overall Site Management Periodic Review process for the Roblin property. The following section addresses the notification requirements established in the following document:

☐ Former Roblin Steel SMP/EWP (November 2010, revised June 2021)

Description of Work to be Performed

1. Mobilize to the Site to install one, 2-inch permanent groundwater monitoring well, north of MW-07R and immediately south of the north Site Boundary. The NYSDEC has requested installation of this new permanent well to establish groundwater conditions on-site proximate the Site boundary and to evaluate if any contaminants previously identified on-site may be migrating off-site to the north.
    - A *Dig Safely New York* stakeout will be conducted at the Site to locate subsurface utilities in the area where planned intrusive activities will take place. A figure (1) depicting the proposed location of the new well has been amended to this scope of work.
    - The 2-inch PVC well will be installed to an approximate depth of 20 feet below the ground surface (ft bgs). It is anticipated that shale bedrock will be encountered between approximately 10 and 15 ft bgs. An appropriate length of riser and well screen will be determined in the field during installation of the well. The well will be completed at the surface with a stick-up protective casing.
    - Well installation will be continuously assessed in the field for visible impairment, olfactory indications of impairment and total VOCs using a photoionization detector. LaBella will provide a qualified scientist or engineer to supervise and document well installation, and prepare logs describing the overburden stratigraphy, field measurements, and visual and olfactory observations. Upon completion of well installation activities, the removed materials will be drummed for proper off-site disposal at an approved facility. Laboratory analysis for disposal purposes will be included as part of the scope and fee associated with this task. The well position will be located with a global positioning system. It is assumed that the cover soil will be manually removed to the top of the demarcation layer, staged next to the work area, and put back in place once the drilling work is complete to accomplish the cover system repair; and that no additional clean soil will need to be imported to the site.
    - Return to the Site no less than 48 hours post-installation, to purge and collect one sample (and one field duplicate) from the new well for Target Compound List (TCL) VOCs via United States Environmental Protection Agency Method 8260. Field parameters will also be collected at the time of purge/sample. Purge, sample and collection of field parameter procedures will be followed as laid out in the SMP.
    - Complete a Letter report for the new well. The letter report will briefly summarize the services completed including a comparison of analytical data to the appropriate NYSDEC Water Quality Standards. The report will also contain mapping that depicts the location of the new well, relative to the overall Site and include a soil boring log and well construction diagram. The analytical results for the new well may affect the overall approach to #4 below. Analytical results associated with the new well will be validated by a qualified validator.

- Mobilize to the Site for an approximately 6-day period to perform injections proximate both MW-07R and EX-MW-11R. More specifically, 16 injection points will be advanced proximate each well, over an approximately 1,600 square foot area, with an approximately 23% slurry of water and Provectus-IR. Due to the shallow injection interval (e.g., 5 to 10 ft bgs) and tight soil matrix, an injection point spacing of 8 to 10 ft will be applied. Provectus-IR will be injected to address the chlorinated VOCs (CVOCs) proximate MW-07R and MW-11R. Provectus-IR is a unique mixture of reagents, including zero valent iron (ZVI) and organic carbon substrate, combined into a single technology that optimizes in-situ reductive dechlorination. Approximately three liters of *Dehalococcoides* (DHC) will also be injected, as a bioaugmentation process, to assist in overall CVOC destruction. The DHC will be spread out over approximately four injection points proximate each well area. *Chemical Mixing will be done in approved containers located inside a berm containment able to hold 110% of the maximum volume of the largest container. If daylighting is noticed during injection activities, the injection pressure will be lowered until daylighting stops. The surfaced material will be contained and disposed of into 55-gallon waste drums for proper off-site disposal.* (Given the recommended processing time of the applied materials, it is anticipated that sampling of MW-07R and EX-MW-11R will not take place until the annual Period Review Report (PRR) sampling event in December 2022). A figure (2) depicting the proposed injection point locations proximate MW-07R and MW-11R has been amended to this scope of work. During the injection process, LaBella will provide a qualified scientist or engineer to supervise and document activities, and prepare logs describing the field measurements, and visual and olfactory observations. It is assumed that the cover soil will be manually removed to the top of the demarcation layer, staged next to the work area, and put back in place once the injection work is complete to accomplish the cover system repair; and that no additional clean soil will need to be imported to the Site. Complete a Corrective Measures Summary (CMS) Report for the groundwater treatment injection event. The CMS report will summarize the services completed. The report will also contain mapping that depicts the location of the injection points relative to MW-07R and EX-MW-11R. Literature associated with the Provectus-IR and DHC has been amended to this scope of work. *Thirty days prior to any subsurface injection work commencing, form 7520-16-Underground Injection Control permit, will be submitted to the United States Environmental Protection Agency (USEPA) for approval.*

During corrective measure activities at the Site, decontamination of equipment and management of purged fluids will be handled according to procedures outlined in the EWP.

Pursuant to the EWP, air monitoring for particulates and VOCs as prescribed in the Community Air Monitoring Plan (CAMP) for the Site will be performed by LaBella during the prescribed intrusive activities. Additionally, the auger spoils generated during construction of the 2-inch permanent groundwater monitoring well, north of MW-07R and immediately south of the north Site Boundary will be screened by LaBella for VOCs.

<u>Anticipated Environmental Conditions</u>

Industrial fill material containing residual contamination consisting primarily of semi-volatile organic compounds (SVOCs) and metals, and low level groundwater contamination consisting of VOCs is expected to be encountered at the location of the new well installation at the Site.

Drilling Schedule

LaBella understands that the EWP specifies that 15-day notification shall be given to the NYSDEC prior to conducting intrusive activities on this Site. It is anticipated that the field activities associated with the scope of work described above will occur over an approximately two week period. Once a tentative field schedule is confirmed, such notification procedures will be followed in kind.

Compliance with EWP

The work will be completed in accordance with the aforementioned EWP and with applicable provisions of 29 CFR Part 1910.120. Components of the EWP that apply to this corrective measures scope of work include:

☐ Notification
☐ Soil Screening
☐ Materials Management, Transport & Disposal
☐ Fluids Management
☐ Cover System Restoration
☐ Community Air Monitoring Plan
☐ Odor Control
☐ Dust Control

Health & Safety Plan

A copy of the Health & Safety Plan (HASP) is included in the SMP.

Identification of Disposal Facilities

Disposal facilities for potential waste streams are identified below:

- Auger Spoils, Decontamination Solids: Chautauqua County Landfill, Ellery, New York
- Decontamination Fluids Exhibiting Indications of Impact: American Recyclers Company, Tonawanda, New York

Please let me know if you have any questions or concerns relative to this notification.

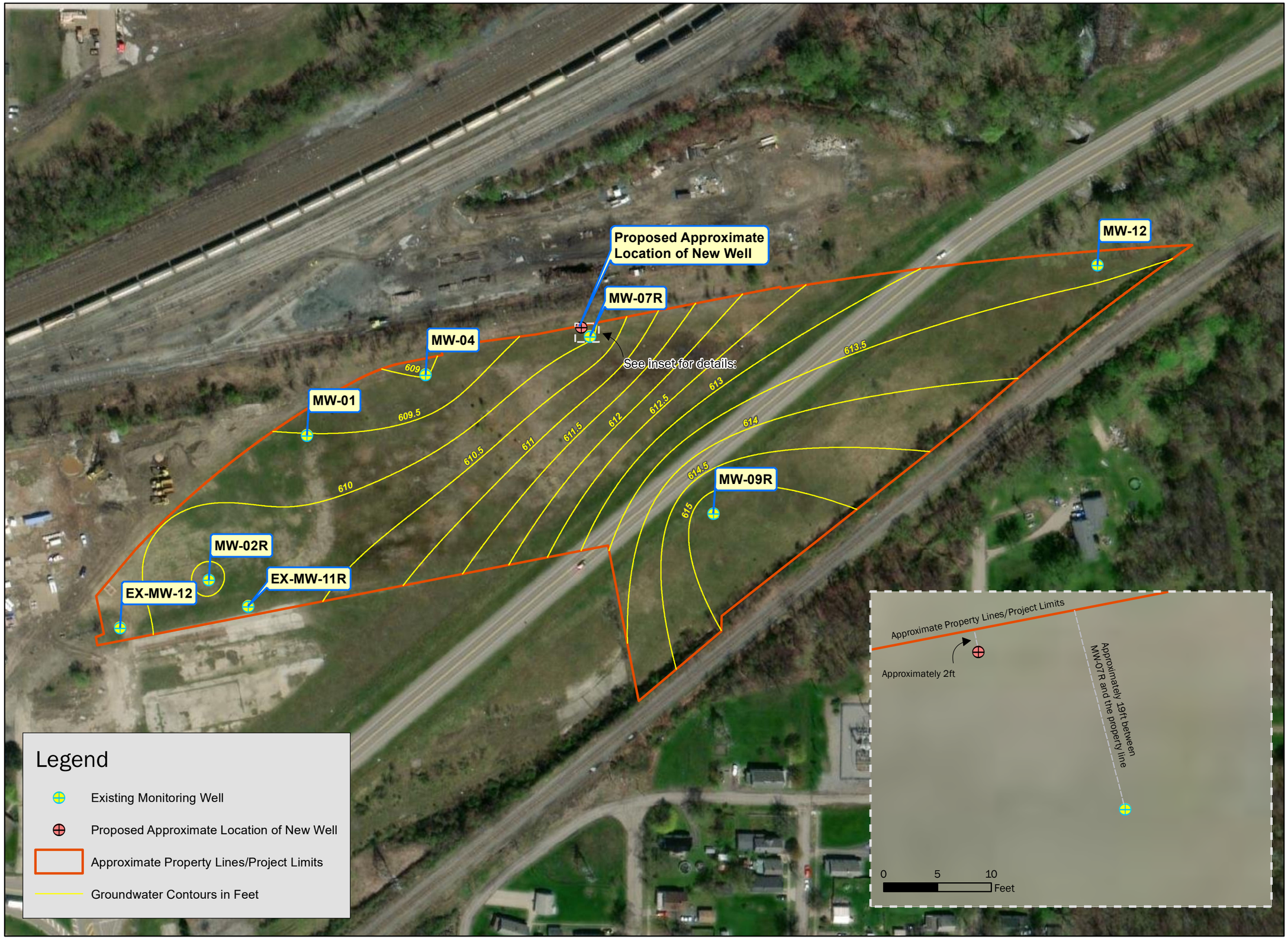
Respectfully submitted,

LaBella Associates

Chris Kibler
Project Manager
Environmental Professional

Attachments

cc: Andrea Caprio (NYSDEC)
Megan Kuczka (NYSDEC)



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Feet

1 inch = 142 feet

INTENDED TO PRINT AS: 11" X 17"

PROJECT:

FORMER ROBLIN STEEL SITE

DRAWING NAME:

PROPOSED APPROXIMATE LOCATION OF NEW WELL

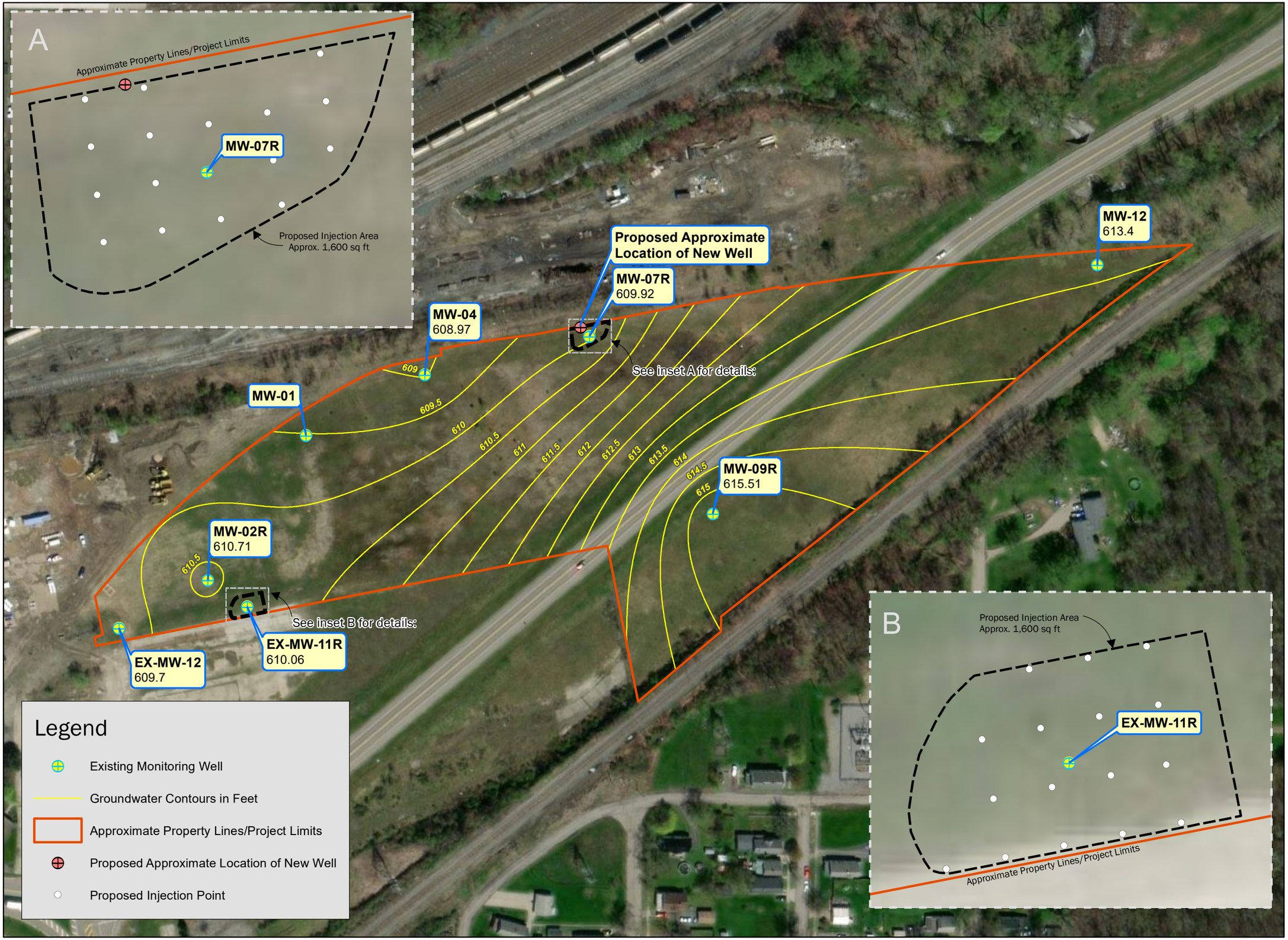
PROJECT #/DRAWING #/ DATE

2200014

FIGURE 1

8/10/2022

I:\Chautauqua County\2200014 - Dunkirk Brownfield Monitoring\Reports\CMWP-N of IA\Maps\Fig 1 Proposed Approx Well Location DP.mxd



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Feet

1 inch = 142 feet

INTENDED TO PRINT AS: 11" X 17"

PROJECT:

FORMER ROBLIN STEEL SITE

DRAWING NAME:

PROPOSED INJECTION POINTS AROUND WELLS MW-07R AND EX-MW-11R

PROJECT #/DRAWING #/ DATE

2200014

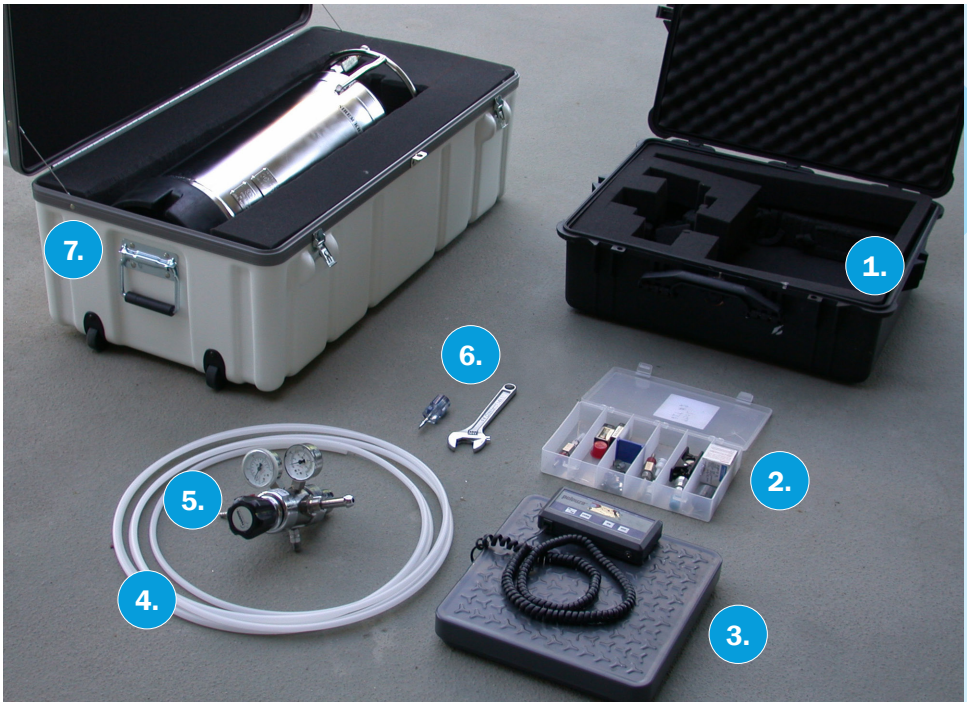
FIGURE 2

8/10/2022

I:\Chautauqua County\2200014 - Dunkirk Brownfield Monitoring\Reports\CMWP-N of IA\Maps\Fig 2 Proposed Injection Points and GW Elevations DP.mxd

SiREM

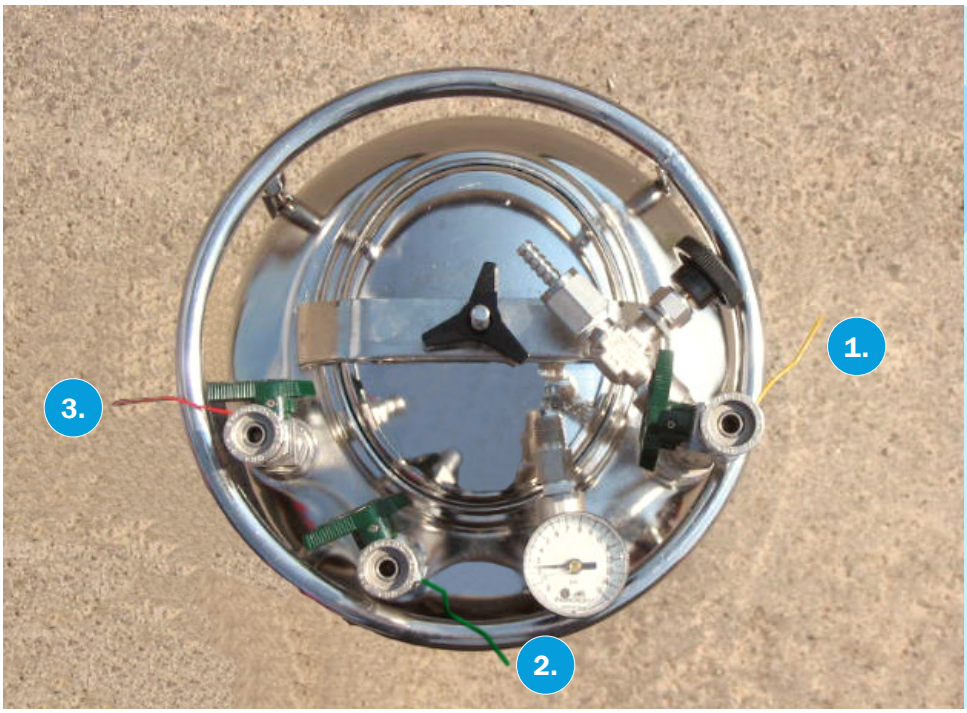
KB-1® Injection Summary



TOOL KIT CONTENTS

1. Toolkit Case
2. Quick Connect Fittings
3. Scale
4. Tubing
5. Regulator
6. Tools
7. KB-1® Vessel in Overpack Case

*Please note that the nitrogen/argon gas cylinder is not included with the culture shipment. Gas can be obtained from a local gas supplier.



VESSEL PORT FUNCTIONS

1. **Inoculation Port (YELLOW)**
   To allow KB-1® to flow out of the vessel.
2. **Purge Port (GREEN)**
   To purge tubing with inert gas.
3. **Pressurization Port (RED)**
   To pressurize KB-1® vessel.

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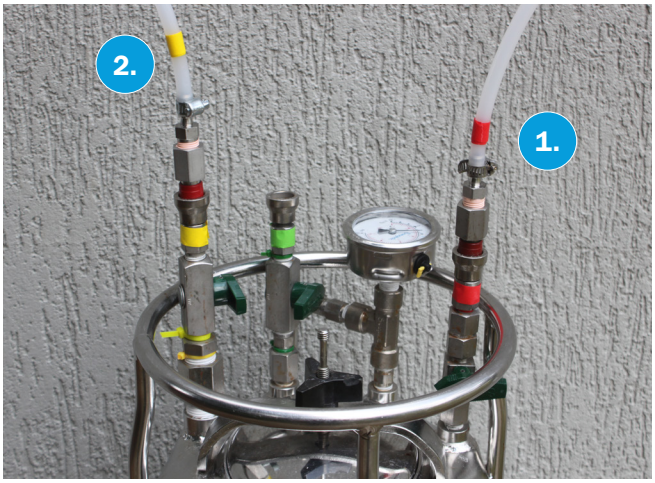
KB-1® Injection Summary

SETUP TO PURGE INJECTION TUBING

1. Gas In: The inert gas tubing remains in the pressurization port **(RED)** for the duration of the injection.

2. Gas Out: Initially the tubing used to inject the KB-1® will be connected to the purge port **(GREEN).**

SETUP TO INJECT KB-1®



1. Gas In: The pressurization port **(RED)** remains in the open position for the duration of the injection.

2. KB-1® Out: The KB-1® injection tubing is moved from the purge port **(GREEN)** to the KB-1® inoculation port **(YELLOW)**.

USING THE SCALE

Turn scale on by pressing the lbs/kg button and ON buttons simultaneously

Change the units to kg by pressing lbs/kg button

Press Zero/Hold to tare scale

Place KB-1® vessel on scale and record the weight

Weight will decrease with each injection of KB-1®

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KB-1® Injection Summary

ANAEROBIC WATER DRIVEN KB-1® INJECTION SETUP

1. Gas Tubing
2. KB-1® Injection Tubing
3. Female Quick Connect (1/4" Male NPT)
4. Ball Valve with ¼" Female NPT Fitting*
5. T-Fitting*
6. Ball Valve*
7. Anaerobic water line

*not included with shipment

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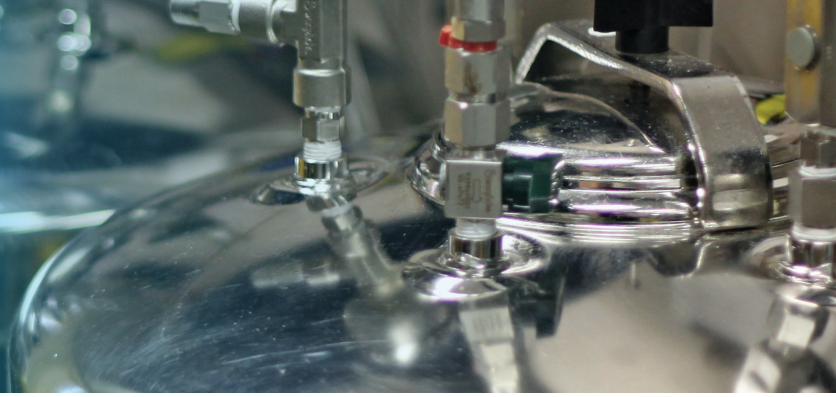
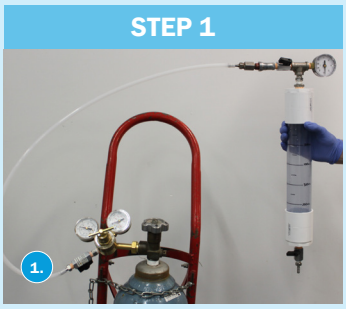
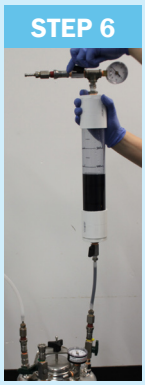
KB-1® Injection Summary



KB-1® INJECTION DISPENSER OPERATION

1. **Gas Line**
2. **Female Quick Connect**
   (item #3 as shown in anaerobic water driven KB-1 injection set-up)





Step 1: Cut the length of tubing that will span from the gas cylinder to the culture vessel (5-10' should be sufficient). Attach one end to the hosebarb on the regulator and the other to the hosebarb on a quick connect. Connect the quick connect to the top port of the injection dispenser.

Step 2: Cut the length of tubing that will span from the injection dispenser to the injection location (5-10' should be sufficient). Attach one end to the hosebarb on the injection dispenser and the other to the hosebarb on a quick connect. Open the valve on the gas cylinder, followed by the regulator, the top of the injection dispenser and finally the bottom of the injection dispenser. Push on the bottom of the quick connect to allow gas to flow through the injection equipment.

Step 3: Close the bottom port on the injection dispenser and allow pressure to build to 5 psi in the dispenser. Close the top port of the injection dispenser.

Step 4: Connect the bottom quick connect into the inoculation port **(YELLOW)**. Move the gas line from the top of the injection dispenser to the pressurization port **(RED)** on the culture vessel. Connect a quick connect into the top port of the injection dispenser.

Step 5: Open the inoculation port **(YELLOW)** and allow KB-1® to flow into the injection dispenser to the desired volume.

Step 6: Pressure will increase as the injection dispenser fills. Release the pressure by opening the top port. Close the top port before the target volume is reached, this will ensure that there is always pressure in the dispenser.

Step 7: Once the target volume is reached close the bottom port and remove the quick connect from the top port.

Step 8: Move the injection dispenser from the inoculation port **(YELLOW)** to the port on the anaerobic water line set up. Connect the gas line to the top of the injection dispenser. Open the top port followed by the bottom port of the injection dispenser. Once the culture has been injected, close the bottom port followed by the top port to keep pressure in the injection dispenser.

Step 9: Repeat steps 4-8 until all injections are complete.

Step 10: Once the injections are complete, pack the vessel(s) in the white over pack(s) & place all tools into the tool kit. Contact Corey Scales at 519-515-0848 for return shipping instructions and paperwork.

For additional information refer to the Culture safety data sheet (SDS)
Contact SiREM for Customer Support
Toll free: 1-866-251-1747
Bioaugmentation Coordinator, Corey Scales: (519) 515-0848

OVERVIEW

Provect-IR® *In Situ* Chemical Reduction (ISCR) reagent is designed to treat persistent organic and/or inorganic contaminants present in the subsurface environment. As developers of the conventional ISCR amendments, scientists now at Provectus know that Provect-IR is a more efficient, and safer amendment. It is unique in its composition:

- Zero Valent Iron: Up to 85% (weight basis), site-specific particle sizes
- 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
- Natural, food-grade 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 40% 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 hats. Dust mask may be desired when working with the material under certain conditions. The SDS is posted on our web site.

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 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.* 30% solids will have the following general characteristics:

- Wet Density = 0.9 to 1.1 g/cm^3
- Dry Density = 0.3 to 0.4 g/cm^3
- Viscosity = 500 to 1,500 c P

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 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 a wide range of equipment, or it can be placed directly into an open excavation or trench.

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). 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).

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 SITE EVALUATION

PROVECTUS ENVIRONMENTAL PRODUCTS, INC.

PO BOX 358 | Freeport, IL 61032

Tel: (815) 650-2230 | Email: info@ProvectusEnv.com

Provect-IR® ISCR Reagent

Provect-IR® is a unique mixture of reagents combined into a single product that optimizes the *in situ* reductive dechlorination of chemicals present in soil, sediment, and groundwater. It acts by promoting synergistic interactions between:

- Natural antimethanogenic compounds
- Hydrophilic, nutrient rich organic carbon sources
- Zero-Valent Iron (ZVI)
- Chemical oxygen scavengers
- Vitamin and mineral sources

This distinctive, patented combination of natural and food-grade chemicals promotes *in situ* chemical reduction (ISCR) conditions for fast and effective destruction of targeted constituents of interest (COIs) such as chlorinated solvents, organochlorine pesticides, and other halogenated compounds (Brown *et al.*, 2009; Dolfing *et al.*, 2008; US Patent Office Scalzi *et al* 2012). Notably, Provect-IR® is the only ISCR reagent to simultaneously inhibit the production of methane during the requisite carbon fermentation processes (US Patent Office Scalzi *et al*, 2013, 2014). This promotes more efficient use of the hydrogen donor while avoiding negative issues associated with elevated methane (CH4) in groundwater, soil gas, and indoor air.

Current regulations for methane in groundwater vary from ca. 10 to 28 mg CH4/L (Indiana Department of Environmental Management, 2014). More State regulations are pending, with several enhanced reductive dechlorination (ERD) projects which intended to use liquid carbon (emulsified oils) sources failing 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). Many remedial practitioners have subsequently been required to establish contingencies for conventional ERD/ISCR implementation if methane exceeds a threshold level ranging from 1 ppm to 10 ppm groundwater. These contingencies often entail expensive and extensive systems for capturing and treating methane in soil gas/vapor captured via SVE systems.

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 is a widely known, potent statin used for decades to lower cholesterol in human blood by inhibiting 3-hydro-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.

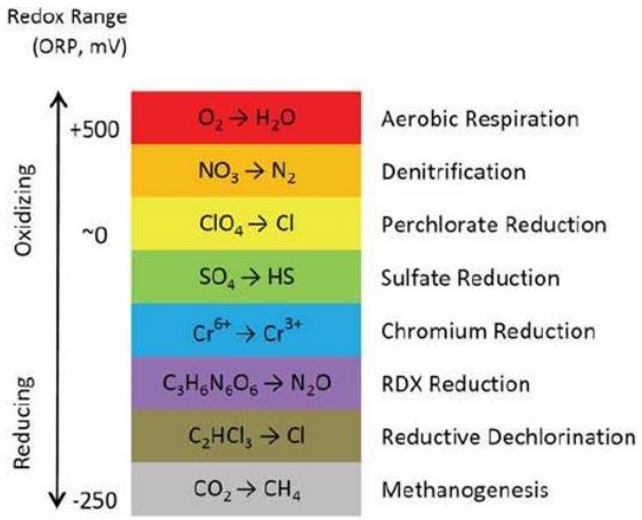
What is Red Yeast (Rice) Extract? The red yeast rice (RYR) extract that is component of Provect-IR® is a substance extracted from rice that has been fermented with a type of yeast called Monascus purpureus. Red yeast extract is used as a food coloring, food additive/preservative, and is widely consumed by humans. The RYR 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, RYR extract also contains mono-unsaturated fatty acids and other vitamins that will effectively stimulate anaerobic bacteria in the subsurface.

So - How Does a Statin Inhibit a Methanogen? Interestingly, Monacolin K is a potent inhibitor of methanogenic archaea because cell membrane production in archaea shares a similar pathway with cholesterol biosynthesis (Miller and Wolin, 2001). And since methanogens are so uniquely different than bacteria, the inhibitory effect 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). RYR has been used in the cattle industry for decades in efforts to manage rumen microbiology and control methane production in cows.

ATTENUATION PROCESSES – SAFER, MORE EFFICIENT ISCR TREATMENT

In situ chemical reduction as defined by Dolfing et al (2008) describes the combined effect of stimulated biological oxygen consumption (via fermentation of an organic carbon source), direct chemical reduction with ZVI or other reduced metals. The corresponding enhanced thermodynamic decomposition reactions that are realized at the lowered redox (Eh) conditions allow for more effective mineralization of many COIs.

Several 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 purportedly offer similar responses. However, the Provect-IR® antimethanogenic ISCR substrate is unique in its ability to yield Eh values most conducive to reductive dechlorination while simultaneously preventing methane production - which is a waste of the H being generated and potentially a safety issue under field conditions.



Provect-IR® uniquely combines RYR extract with of 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. As outlined below, it can be used to manage environments impacted by chlorinated solvents, pesticides, heavy metals and other COIs.

Specially Selected Organic Hydrogen Donors: A variety of hydrophilic, nutrient rich organic carbon sources are incorporated in Provect-IR® that assist in promoting the ISCR process. The Provect-IR bioremediation amendments consist of slow, medium and long-term release carbon sources. Such a formulation is desirable because it provides both a rapidly utilized electron donor (calcium propionate), slow-release long-term electron donors (kelp meal and yeast extract) and long-term release carbon sources (other cellulose and hemi-cellulose carbon such as soy meal). More specifically,

- Calcium propionate and other readily biodegradable carbon sources: Following the addition of simple carbon sources such as lactate, formate, ethanol or glucose to an aquifer setting these compounds are often converted rapidly to hydrogen and acetate. Although this is the desired response, the process is sometimes too rapid, and this can result in aquifer acidification (due to rapid VFA production) and the liberation of too much hydrogen (which allows methanogens and sulfate reducers to compete effectively with dehalogenators, which tend to grow more slowly). Hence, calcium propionate is used as a readily biodegradable carbon source.
- Yeast extract: This supplement provides a variety of organic hydrogen donors that have slower release profiles (i.e., they are not fermented as rapidly as proprionate). Yeast extract also contains biological components that are very useful to anaerobes, but are not available through other carbon-only media. In particular, yeast extract provides an abundant source of priming ATPase along with trace nutrients and vitamin B complexes.

- Kelp meal/Cellulose based carbon: These hydrogen sources are composed of a hydrophilic, solid and complex carbon that ferment more slowly and inherently generate less methane. The hydrophilic organic component of the kelp meal, for example, is composed of cellulose and hemicellulose and it may be treated during the manufacturing process so that some of the components more easily undergo hydrolysis to glucose while maintaining an overall longevity of 3 to 5+ years.

Chemical Oxygen Scavengers: The presence of chemical oxygen scavengers such as sodium sulfite helps minimize performance lag phases that are often observed following the injection of remedial amendments. This is due, in part, to the presence of oxygen that is introduced as a result of the field mixing and blending operations. It takes a certain amount of time and reagent consumption to remove that introduced oxygen and allow the ISCR reactions to proceed. Provect-IR is unique it that manages this impact chemically, which is a more effective, reliable manner thus allowing the ISCR process to be more effective.

Zero-Valent Iron: The presence of ZVI in Provect-IR® is critical to ISCR reactions. The ZVI is added as a reduced material that is oxidized during the reductive dechlorination reactions which use ZVI as the reducing agent. The beta-elimination reaction mainly produces (chloro)acetylene, ethane/ethane and chloride ions, without the accumulation of potentially problematic catabolites typical of microbiologically mediated sequential reductive dehalogenation processes (e.g., DCE "stall"). As the ZVI reacts, hydroxyl ions are released and pH increases which is useful in neutralizing the acidity generated during the fermentation of carbon, where acids are generated. Oxidized iron species are also produced, where are useful in alpha-elimination reactions and iron cycling. One limitation to ZVI reactions is that they are surface mediated which means that direct contact is required for direct COI destruction.

RYR Extract: Provect-IR® is the only ISCR amendment that will rapidly induce ISCR conditions while simultaneously preventing or significantly minimizing the production of methane. The benefits are notable:

- 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.
- 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.

PRIMARY FEATURES

- Effective: No accumulation of dead-end catabolic intermediates as a function of substrate addition (as is common with [emulsified] oils and sources of carbon only).
  - Does not rely on physical sorption/sequestration as a major "removal" mechanism (as is common with oils).
  - Inherently buffered for pH control – will not acidify an aquifer and liberate heavy metals as potential secondary COIs.
- Efficient: Significantly lower costs as a result more efficient amendment utilization and avoidance of contingencies for methane management. No need for additional buffers.
- Safe: Fewer health and safety concerns as compared with use of traditional ERD or ISCR reagents; Avoid issues associated with new and emerging methane regulations.
- Ease of Use: Green and sustainable. All components integrated in a single package. Logistics with no surprises.
- Longevity: Engineered profile of carbon sources for multi-year longevity estimated at 3 to 7 years based on site-specific hydrogeology. Reagent will stay in place and remain active which prevents rebound.
- Improved Performance: More efficient use of hydrogen donors (does not get wasted as methane).
- Adaptable Formulations for Heavy Metals: Will not mobilize arsenic or other heavy metals yielding secondary contaminants (as is common with [emulsified] oils and sources of carbon only). Can be formulated to manage environments that are co-impacted by various inorganic contaminants while simultaneously mineralizing the organic compounds.
- Patented Technologies: Technology end users and their clients are fully protected from all Patent and other legal issues

PHYSICAL PROPERTIES

Particle Size: ranges from ca. <5 to >100 micron (can be manufactured to specifications).

Dry Density: ranges from 0.4 to 0.5 g/cm3

29% Aqueous Slurry Density: ranges from 0.9 to 1.0 g/cm3

29% Aqueous Slurry Viscosity: ranges from 500 to 1,500 cP

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Kibler, Christopher

From: Will Moody <will.moody@provectusenv.com>
Sent: Wednesday, August 31, 2022 12:02 PM
To: Kibler, Christopher
Subject: RE: [Ext] RE: Quote for a project site in Dunkirk, NY???

Hi Chris,

Thank you for the update. Yes, I can provide dosage details. We typically do not provide our full calculation sheets, but I can outline how we develop our recommended reagent mass. For our Provect-IR remedial programs, we develop and compare two different design calculations. The first calculation is based on the site contaminant concentrations, competing electron acceptors (e.g., nitrate, sulfate, etc.), and desired lifespan of the reagent in the subsurface. The second calculation is based on ensuring sufficient distribution of the reagent in the subsurface. Typically the larger calculated reagent mass is recommended to ensure we overcome the contaminant/electron acceptor demands while achieving good subsurface reagent distribution. For your site, the distribution demand was larger than the contaminant/electron acceptor demand (i.e., the site contaminant concentrations aren't very high).

Please see below for details:

MW-07
1,600 sq ft treatment area with a 5-ft vertical target interval
Contaminant/Electron Acceptor Demand
Used TCE, DCE, and VC concentrations of 120 ug/L, 3,600 ug/L, and 740 ug/L, respectively, for contaminant demands. Data is from 12/2/2021 sample event.
Assumed nitrate and sulfate concentrations of 5 mg/L and 40 mg/L, respectively.
Used a 3 year treatment area lifespan ; the same CVOC and electron acceptor concentrations will be entering the treatment zone over this time period.
Total calculated Provect-IR required is approximately 515 lbs.
Reagent Distribution Calculation
Used a 115 lbs/ft3 soil density to calculate approximate total mass within treatment area (460 US tons).
Recommend an approximate 0.35% by soil mass reagent demand to ensure distribution or **3,250 lbs of Provect-IR** or greater than 6X the contaminant/electron acceptor demand

EX-MW-11R
1,600 sq ft treatment area with a 5-ft vertical target interval
Contaminant/Electron Acceptor Demand
Used TCE, DCE, and VC concentrations of 1,400 ug/L, 7,450 ug/L, and 1,300 ug/L, respectively, for contaminant demands. Data is from 12/2/2021 sample event.
Assumed nitrate and sulfate concentrations of 5 mg/L and 40 mg/L, respectively.
Used a 3 year treatment area lifespan ; the same CVOC and electron acceptor concentrations will be entering the treatment zone over this time period.
Total calculated Provect-IR required is approximately 525 lbs.
Reagent Distribution Calculation
Used a 115 lbs/ft3 soil density to calculate approximate total mass within treatment area (460 US tons)
Recommend an approximate 0.35% by soil mass reagent demand to ensure distribution or 3**,250 lbs of Provect-IR** or greater than 6X the contaminant/electron acceptor demand

Please contact me with questions or if you need any additional information.