7428 Rockville Road | Indianapolis, IN 46214 | 317.347.1111 office | 317.347.9326 fax

October 9, 2019

Ms. Carolyn Bury
Corrective Action Section 2
Remediation and Re-use Branch
U.S. Environmental Protection Agency, Region 5
77 West Jackson Boulevard
Chicago, IL 60604-3590

Re: **Off-site Groundwater Treatment Pilot Study**
Franklin Power Products, Inc./Amphenol Corporation
Administrative Order on Consent, Docket # R8H-5-99-002
EPA ID # IND 044 587 848
980 Hurricane Road
Franklin, Indiana 46131

Dear Ms. Bury:

In accordance with the request made by the United States Environmental Protection Agency (USEPA) in a letter dated December 11, 2018, Industrial Waste Management Consulting Group, LLC (IWM Consulting), on behalf of Amphenol Corporation (Amphenol) the "Performing Respondent", submitted an *Off-Site Interim Measure Work Plan* (*OIM Work Plan*) on June 18, 2019. Reports entitled *Off-Site Interim Measure Conceptual Design* (*Conceptual Design*) and *Off-Site Interim Measure Conceptual Design Addendum* (*Conceptual Design Addendum*) were also submitted to the USEPA on May 7, 2019 and May 16, 2019, respectively. The *OIM Work Plan* was conditionally approved by the USEPA on August 8, 2019. In order to address comments outlined in the USEPA's *OIM Work Plan* conditional approval letter, a *Conditionally Approved Off-Site Interim Measure Work Plan – Response to Comments* (*Response to Comments*) was submitted to the USEPA on September 30, 2019.

The *OIM Work Plan* proposed the removal of impacted soil and groundwater surrounding portions of the sanitary sewer system along Hamilton Avenue and North Forsythe Street. This plan incorporated the replacement of approximately 1,285 linear feet of sanitary sewer main during excavation activities and lining of 1,270 feet of sanitary sewer main within the Study Area. The Study Area includes portions of streets and adjacent structures that are near and downgradient of the Former Amphenol facility located at 980 Hurricane Road, Franklin, IN (Site), including Hurricane Road, Hamilton Avenue, Forsythe Street, Glendale Drive, and Ross Court. A map depicting the Study Area has been included as **Figure 1**.

The removal of soil and groundwater surrounding the sanitary sewer system was proposed in order to perform targeted source removal activities along the identified preferential exposure pathway (sanitary sewer line), which in turn will reduce the overall contaminant mass located immediately adjacent to the sanitary sewer line and reduce the dissolved contaminant concentrations post removal activities. In addition, a new sanitary sewer main will be installed in portions of Hamilton Avenue and Forsythe

Street in order to eliminate the potential for any residual soil vapors to enter the sanitary sewer main, thereby minimizing or completely eliminating this preferential potential exposure pathway.

IWM Consulting is submitting this *Off-site Groundwater Treatment Pilot Study* (Pilot Study) in order to evaluate a potential supplemental groundwater remedy within the southern third of the recently completed sanitary sewer main excavation. The Pilot Study will also incorporate one (1) area outside of the recently completed excavation in order to further evaluate this potential groundwater remediation technique in an off-site area that has not been disturbed and thus is more representative of natural sub-surface conditions. Specifically, one (1) undisturbed area will be located south of the 980 Hurricane Road property (Site), near the Hamilton Avenue/Glendale Drive intersection and existing groundwater monitoring well MW-35. This area is outside the proposed sewer replacement excavation area and has historically exhibited a high dissolved trichloroethene (TCE) concentration.

Proposed Pilot Study Remediation Technology

IWM Consulting has evaluated various in-situ groundwater remediation techniques and selected a technology that has been proven to provide quick reductions in dissolved volatile organic compound (VOC) concentrations, including TCE, with minimal production of chlorinated solvent daughter products (i.e. cis-1,2-dichloroethene [cis-1,2-DCE] and vinyl chloride). The proposed in-situ technology includes the application of a mixture of PlumeStop Liquid Activated Carbon® (PlumeStop) and Sulfidated-MicroZVI™ (S-MZVI™).

PlumeStop is a colloidal form of activated carbon with a surface treatment that allows the material to move more readily through the soil pores, increasing the sorption surface of the PlumeStop since it is thoroughly distributed throughout the sub-surface. PlumeStop will result in immediate reductions in the dissolved VOC concentrations since the contaminants will adsorb to the carbon and because the contaminants are now concentrated on the surface of the carbon, the contaminants can now be readily destroyed by supplemental S-MZVI™.

S-MZVI™ is a colloidal, sulfidated zero-valent iron product which is suspended in glycerol using proprietary environmentally acceptable dispersants. This product provides reactivity with chlorinated hydrocarbons [such as TCE and tetrachloroethylene (PCE)] and generates beta-elimination of chlorinated compounds, which bypasses the formation of cis-1,2-DCE and vinyl chloride. Instead, this abiotic degradation process results in the production of ethenes and ethanes. The passivation technique of sulfidation of the zero valent iron will also increase the stability of the S-MZVI™ and provide long-term (up to two to three years) of chlorinated hydrocarbon degradation. The specification sheets regarding PlumeStop and S-MZVI™ have been included in **Attachment A**.

Proposed Pilot Study Injection Methods

Both products are manufactured by Regenesis® and Regenesis Remediation Services (RRS) will supply the injection trailer, personnel, and injection equipment during the implementation phase of this pilot study. IWM Consulting will also be present throughout the work activities in order to provide oversight during implementation of the pilot study and contract with a qualified drilling firm to provide the drilling services which are required for the pilot study.

IWM Consulting proposes to inject 3,600-lbs of PlumeStop and 200-lbs of S-MZVI into the six (6) 2-inch diameter temporary polyvinyl chloride (PVC) injection wells placed within the backfill of the newly installed sewer main trench. This covers an area approximately 383 linear feet along the southern portion of the newly installed sewer main trench. Each well is constructed with 5-feet of 0.020-inch slot PVC screen and the wells were placed as close as possible to the bottom of the sewer main trench prior to backfilling the trench with No. 8 limestone aggregate. These injection points are temporary in nature and will need to be permanently abandoned immediately after the injection activities in order for the new paved road to be installed. The mixture is anticipated to be pressure injected into the formation using a bottom up injection technique via the above ground pumps placed inside the injection trailer.

The estimated quantity of material injected into each injection point is provided in the Regenesis Design Summary sheets provided in **Attachment A**. However, depending upon site conditions, the actual amount of material injected into each point may be higher or lower than what is proposed and if for some reason the injection points are not providing a good pathway for injection, the material may be applied to the trench via alternative methods (i.e. traditional direct push points).

The objective of this application is to provide additional groundwater treatment for the base of the trench, VOC impacted water groundwater currently within the trench, and to act as a barrier to treat any VOCs that back diffuse out of the surrounding soil which convert into the dissolved phase. For estimating purposes, Regenesis has assumed that the bottom 2.5-feet of the trench will be targeted for treatment since the saturated thickness of the sidewalls and base did not exceed that during the excavation work activities.

IWM Consulting proposes to inject 3,200-lbs of PlumeStop and 100-lbs of S-MZVI™ via five (5) temporary injection points placed around MW-35, treating an area approximately 400-square feet in size. The temporary injection points will be installed with a direct push drilling unit equipped with 1.5-inch diameter drill rods and retractable screens (2-4 feet in length). The mixture is anticipated to be pressure injected into the formation using a bottom up injection technique via the above ground pumps placed inside the injection trailer. The vertical treatment area is anticipated to be from 8-16 feet below land surface (BLS), which will include treatment from the base of Unit B upward 8 feet, which should fully treat the anticipated maximum saturated thickness of Unit B (including any potentially unusually high-water table periods).

The amount of material injected into each injection point and interval, associated injection pressures, the start and end time of the injections, and notations regarding any surfacing of the injected material (if any) will be recorded during the injection activities.

A more detailed description of the proposed work activities, including the Regenesis® application design calculations have been included in **Attachment A**.

Pilot Study Evaluation & Sampling

Immediately prior to and approximately 1-month after the implementation of the pilot study activities, IWM Consulting will obtain low flow groundwater samples from existing monitoring well MW-31 and MW-35. Post pilot study injection activities, groundwater samples will also be obtained from newly installed monitoring well MW-38 approximately 1-month post injection activities. The well locations and installation methods were discussed in the *OIM Work Plan* dated June 18, 2019. As of now, all of the new groundwater monitoring wells (MW-36 through MW-40) proposed as part of the *OIM Work Plan* are scheduled to be installed on November 11 and 12, 2019.

Additionally, in accordance with the *Response to Comments* document that was submitted to the USEPA on September 30, 2019, on-site monitoring well MW-12R and offsite monitoring wells IT-2, and MW-31 through MW-40 will be sampled for VOCs on a monthly basis for twelve (12) months starting within 1-month of substantial completion of the *OIM Work Plan* and installation of the new offsite groundwater monitoring wells (MW-36 through MW-40). Consequently, VOC samples will be obtained from monitoring wells MW-31, MW-35, and MW-38 on a monthly basis beginning in late November 2019.

The pre-injection sampling activities will document the baseline groundwater conditions prior to implementing the pilot study activities and since groundwater samples cannot be obtained from proposed monitoring well MW-38 prior to initiating the sampling activities, the VOC concentrations observed in historical temporary monitoring well TW-13 (March 2019) will be used for the baseline VOC concentrations for monitoring well sampling location MW-38. This temporary well is located within 5-feet of the proposed well location for MW-38.

A portable bladder pump in conjunction with a Horiba® U-52 Multi-Probe Field Meter will be used to collect groundwater samples from the monitoring wells. The pump will be equipped with a disposable bladder sleeve that will be exchanged between wells. Dedicated tubing will be used for each well. The Multi-Probe Field Meter included probes for turbidity, temperature, pH, specific conductance, dissolved oxygen, and oxidation-reduction potential (ORP). Purge rates will be established at a rate that minimizes groundwater drawdown in order to help reduce turbidity. Purge water generated during groundwater sampling activities will be temporarily containerized within a labeled 55-gallon DOT approved steel drum, transported back to the Site, and then treated by the onsite groundwater remediation system, prior to discharge to the on-Site sanitary sewer per the approved municipal discharge permit with the City of Franklin.

Field parameters will be measured during each sampling event, and groundwater samples will be collected after the field parameters have stabilized (for three consecutive readings), after a maximum of 1 hour of purge time, or immediately prior to the wells running dry (if insufficient groundwater recharge occurs). Care will be taken to ensure that the bladder pump discharge tubing and flow through cell have evacuated several volumes of water before the samples are obtained. Groundwater stabilization criteria which will be utilized during the purging activities are listed below:

- pH ± 0.1 pH units
- Specific Conductance ± 3% of reading

- DO ± 10% of reading or ± 0.2 mg/L
- ORP ± 10 millivolts
- Turbidity ± 10%

The groundwater samples will be collected from the wells and placed into the appropriate laboratory provided pre-labeled containers. The groundwater samples will be submitted to Pace Analytical Services, LLC located in Indianapolis, Indiana and analyzed for shortlist VOCs using SW-846 Method 8260 and Level IV QA/QC. The VOC shortlist includes the following compounds: TCE, PCE, vinyl chloride, trans-1,2-dichloroethene (trans-1,2-DCE), 1,1-dichloroethane (1,1-DCA), cis-1,2-DCE, 1,2-DCA, methylene chloride, and 1,1,1-trichloroethane (1,1,1-TCA).

The samples obtained from MW-31, MW-35, and MW-38 will also be analyzed for the following parameters during the baseline and monthly after the injection activities for a period of six (6) months:

Analyte	Method	Container	Preservative	Hold Time
Total Iron	SW846-6010	250 mL plastic	Nitric acid	6 months
Dissolved Iron	SW846-6010	250 mL plastic	None*	6 months
Total Manganese	SW846-6010	250 mL plastic	Nitric acid	6 months
Dissolved Manganese	SW846-6010	250 mL plastic	None*	6 months
Sulfate	SW846-9038	250 mL plastic	None	28 days
Sulfide	EPA Method 376.1	250 mL plastic	NaOH/ZnOAC	7 days
Nitrate	EPA Method 353.1	250 mL plastic	None	48 hours
Ethene/Ethane/Methane	RSK 175	40 mL vials (3)	Hydrochloric acid	14 days

*Laboratory filtered and preserved after filtering at the laboratory.

For Quality Assurance/Quality Control (QA/QC) purposes, one (1) field duplicate sample will be collected at a rate of one (1) sample per every ten (10) groundwater samples and will be analyzed for the same analytical parameters. Additionally, one (1) matrix spike/matrix spike duplicate (MS/MSD) sample will be collected at a rate of one (1) sample per every twenty (20) groundwater samples and will be analyzed for the same analytical parameters. One (1) trip blank for volatile organic compound (VOC) analysis will accompany each cooler shipment that contains samples for select VOC analyses. One (1) equipment blank per sampling media per day will be obtained.

Ultimately, the success of this pilot study will be based on the observed decrease in dissolved chlorinated VOC concentrations in groundwater. However, the generation of ethenes and ethanes will also demonstrate that chlorinated VOCs are being destroyed via the beta-elimination pathway, in lieu of the reductive dichlorination pathway which would generate cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride.

TIMELINE

Based on the *OIM Work Plan* implementation schedule, these pilot study activities will need to be completed before the end of October 2019 and the **anticipated start date is October 21, 2019**. The pilot study injection activities should be completed before October 24, 2019. The baseline

groundwater sampling event is anticipated to occur on October 18, 2019 or early morning on October 21, 2019 (prior to initiating the injection activities). The implementation contractor anticipates installation of the asphalt surface in early November 2019 and must finish prepping the road subgrade beginning the week of October 21, 2019. Consequently, the injection points in the trench will need to be permanently abandoned prior to the contractor completing the final prepping of the road subgrade and completion of subsequent asphalt placement activities. Additionally, after the asphalt surface is installed, the City of Franklin will not allow any additional injection work within the new pavement surface. Therefore, it is imperative that this pilot study work plan be reviewed as soon as possible in order to meet the deadlines associated with the pavement installation.

Following completion of groundwater verification sampling, a Pilot Study Evaluation Report will be prepared and submitted to the USEPA for review. It is estimated that the evaluation report will be submitted by July 1, 2020.

Please contact the undersigned if you have any questions regarding this submittal.

Sincerely,

IWM CONSULTING GROUP, LLC

Christopher D. Parks, LPG #2169
Senior Project Manager

Bradley E. Gentry, LPG #2165
Vice President/Brownfield Coordinator

cc: Mr. Joseph Bianchi, Amphenol (electronic only)
Bhooma Sundar, U.S. EPA Region 5, RRB CAS2 (electronic only)

Attachments

Attachment A

Regenesis® S-MicroZVI™/Plumestop Pilot Study Scope of Work

REGENESIS
REMEDIATION SERVICES
Technology-Based Solutions for the Environment

October 4, 2019

To:	Bradley E. Gentry, LPG , IWM Consulting Group, LLC, Indianapolis, IN 46214
Project #:	DoD64667
Subject:	Proposal Pilot Study Remedial Application Services using PlumeStop Liquid Activated Carbon® and MicroZVI™ at the Franklin-Amphenol site in Franklin, Indiana

REGENESIS Remediation Services (RRS) appreciates the opportunity to evaluate this project and provide IWM Consulting Group, LLC (IWM) with this proposal. We have provided information related to the design and application of PlumeStop Liquid Activated Carbon® (PlumeStop) and Sulfidated-MicroZVI (S-MicroZVI)®. This remediation plan is proposed to rapidly reduce the chlorinated solvent concentrations within the defined treatment areas at this site located in Franklin, Indiana.

Remedial Approach

We are proposing application of PlumeStop and S-MicroZVI® to treat residual chlorinated solvents. PlumeStop is a colloidal form of activated carbon with a surface treatment which reduces its interactions with the soil matrix. This allows it to move through soil pores leaving a coating on the soil matrix as it distributes from the injection point. This provides a very large sorption surface which will result in immediate reduction of these contaminants while concentrating contaminants to allow for more efficient and controlled remediation through destructive technologies like S-MZVI.

S-MZVI is a concentrated aqueous suspension of sulfidated, colloidal zero valent iron formulated for compatibility with PlumeStop. When applied to the subsurface it imparts an in-situ chemical reduction (ISCR) mechanism that allows for the destruction of chlorinated ethenes (i.e. TCE) via abiotic degradation pathways. This unique mechanism allows for the traditional reduction pathway to be circumvented, minimizing the formation of daughter species such as vinyl chloride. Sulfidation blocks the effects of water on the ZVI particles, allowing the reagent to be effectively focused on the chemical reduction of chlorinated ethenes. As contaminants are degraded to non-toxic and non-sorptive end products, the PlumeStop sorption surface will be regenerated. This allows for further sorption and treatment of contaminants that may diffuse back into the groundwater from the soil matrix over time.

We propose treatment and present design information for the following three treatment components explained as follows.

1) Design Verification (Pilot) Test #1- The initial phase will include a design verification (i.e., pilot) test including a small-scale application of PlumeStop and S-Micro ZVI. The purpose of the test is to assess feasibility and effectiveness of this approach for larger-scale treatment in other areas of the plume. This application will consist of injecting these reagents at five (5) direct-push rig-installed injection points in the vicinity of monitoring well MW-35. The injection interval will extend from the bottom of the sand unit to the top of the water table (estimated to be 8 feet vertical thickness total). Assessment of the injection radius and potential for material surfacing will be performed. Two soil cores will be collected pre-application to assess soil grain size, color and degree of saturation. MW-35 will be used to assess PlumeStop influence and to complete injection radius testing. Samples will be collected from MW-35 and/or the

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piezometer during injection to assess PlumeStop influence.

2) Trench Barrier Application (Pilot) Test - As part of sewer line refurbishment along Forsythe Street, IWM has installed six 2-inch injection wells along an approximate 300 feet section of Forsythe Road in the area of highest potential for residual contaminants in the soil beneath the trench. PlumeStop and S-Micro ZVI will be injected into these wells, each forming a barrier within the saturated zone of approximate 10 ft width across the trench. Based on a review of the geologic cross section for this area, we have designed for a vertical treatment interval of approximately 2.5 feet to extend from the base of the sand unit to the top of the water table. The purpose of these barriers is to arrest any contaminants that diffuse out of soil and into the dissolved phase (i.e., back-diffusion). Once sorbed onto the PlumeStop matrix, these contaminants will be degraded abiotically by S-Micro ZVI as explained above.

Summary of Relevant Design Information

A summary of design parameters for the areas described above is presented as follows.

Design Verification Pilot Test Area #1

- Surficial Treatment – 400 square feet
- Vertical Treatment Interval –from 8 to 16 ft. bgs
- Remediation Technologies:
  - PlumeStop – 3,200 lbs.
  - S-MicroZVI – 100 lbs.
- Injection Points: 5DPT
- Bottom-Up Approach

Trench Barriers Pilot Test

- Surficial Treatment – 383 linear feet
- Vertical Treatment Interval – ~2.5 feet
- Remediation Technologies:
  - PlumeStop – 3,600 lbs.
  - S-MicroZVI – 200 lbs.
- Injection Wells: Six (6) 2'' PVC wells

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RRS has allotted 4 on-site working days (9.5-hr days, Monday through Friday) to apply the remediation technologies for the Trench Barriers Pilot and Pilot Area #1. RRS estimates a daily average production rate during the application of ~1,500 gallons per day based on the current design parameters.

Scope of Work

RRS will work under the direction of IWM to implement the field work associated with the application of the selected remediation technologies. Responsibilities for the implementation of this scope of work will be shared between RRS and IWM. Responsibilities for each are listed below and further under the Assumptions/Qualification section:

RRS Responsibilities

- **RRS** will provide and ship the specified quantities of PlumeStop and MicroZVI to the site prior to personnel mobilization. Additional shipping locations or phases could result in an increase in total costs. RRS will work with you to the best of our ability to avoid shipping overages. The first shipping event will take place prior to mobilization for the application event and should be onsite ready for application upon arrival of the RRS application team.
- **RRS** will provide qualified personnel and support equipment to handle, prepare, and apply the remediation technologies during application. The following tasks are included:
    - Mix and prepare PlumeStop and MicroZVI for application
    - Injection equipment (pumps, mixing tanks, delivery manifold, injection heads with flow & pressure gauges, safety bypass valves, first aid station, etc.)
    - PPE and safety equipment for RRS personnel
    - 300 linear feet of 1.5-inch National Standard Fire Hose
- **RRS** will prepare and implement a site-specific health and safety plan.
- Budget crew to work up to 9.5 hours per weekday on site.
- **RRS** will water rinse empty PlumeStop and MicroZVI containers daily (totes/buckets).
- **RRS** will provide a means to maneuver product around the site as needed during the application activities.
- **RRS** will perform real time reagent distribution monitoring for optimization of the injection design during the application activities.
- **RRS** will provide a 500-gallon water storage tank.
- **RRS** will provide the means to further maneuver product around the site (forklift or equivalent) as needed during the duration of the application activities. Cost for this work has been included.
- Application Summary Report including injection depths, material quantities, elapsed time, injection pressures, surfacing of material and other noteworthy field observations.

IWM Responsibilities

- **IWM** will receive all product delivery at the site based on the delivery schedule. **IWM** will unload product from delivery trucks utilizing a forklift or equivalent and arrange for secure storage near the work

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area during product application. The PlumeStop and MicroZVI will be delivered in 2,000 lbs. totes and 400 lbs. drums. S-MicroZVI will be delivered in 50 lbs. buckets.

- Pilot Test Area: (1) 2,000 lbs tote of Plumestop and (3) 400 lbs drums, (2) 50 lbs pails of S-MZVI.
- Trench Barriers: (1) 2,000 lbs tote of Plumestop and (4) 400 lbs drums, (4) 50 lbs pails of S-MZVI.

- **IWM** will take delivery of the remediation technologies and arrange for secure storage and protect form inclement weather (i.e., freezing, etc.). The product will be shipped all at once. If additional deliveries are requested, changes to the price will be incorporated as necessary. If material is stored off-site, **IWM** will coordinate the delivery of the material to the site.
- **IWM** will provide a water source (e.g. hydrant) capable of producing at least 30 gpm for the duration of the project within 300 ft. of the project staging area, at no cost to RRS. **IWM** will coordinate and provide a backflow preventer for on-site hydrants utilization.
- **IWM** will provide a direct push contractor with the following equipment:
  - Direct push rig with an operator and driller helper/laborer capable of accessing all the work areas of the site where injection points will be placed
  - Direct push rods will be 1.5" Geoprobe® threaded rods and have a minimum of 120 linear feet of said rods in good working order at the site for injection activities
  - Other supplies needed for injection work includes Teflon or PVC tape for rod joints, 35 feet of quick link extension rods (or equivalent), granular bentonite, bentonite chips, and hole patch to close borings at ground surface (where needed)
- All empty product containers will be the responsibility of **IWM** for proper disposal/recycling. General refuse will be collected and disposed of in an **IWM** provided refuse container on-site.
- Any traffic control requirement beyond providing cones and caution tape is the responsibility of **IWM** (including permits, street signs, etc.…).
- **IWM** will provide a field water quality meter similar to a YSI 556 with a down-hole sensor capable of reaching the water table and well screen interval while on-site for injection activities. **IWM** will provide bailors to check for influence in monitoring wells.

Assumption/Qualifications

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

- The above cost outlined will be valid for 60 days from date or proposal. If beyond 60 days, REGENESIS reserves the right to update cost.
- All work is assumed to be completed in above freezing temperatures and within daylight hours. If freezing temperature are encountered during work activities, RRS is not responsible for the potential loss in production and will utilize the daily rate mentioned above if work is completed beyond the anticipated numbers of days.

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- RRS will have access to the site for equipment operation and secure storage of materials and equipment. All access to each work area location will be clear and free of obstructions. RRS also assumes the injection trailer will be staged within 80 ft. of the furthest injection point location.
- **IWM** will provide access to a restroom during on-site hours. RRS has not included costs to provide a portable restroom onsite.
- Pricing and work schedule assumes prevailing wages are not necessary.
- **IWM** is responsible for securing any permits prior to mobilizing to the site, including traffic control and management.
- **IWM** is responsible for all soil, air and groundwater sampling and analysis.
- **IWM** is responsible for transportation and disposal of any contaminated waste generated on-site during injection activities, though we do not anticipate generating any such waste during injection activities.
- **IWM** will call in a public utility locate for the area in or near the direct push injection zones. All private, on-site underground utilities and any known subsurface features (e.g., piping, storage tanks, septic systems, etc.) will be clearly marked/cleared by **IWM** prior to RRS mobilization to the site. RRS is not responsible for damage to any unmarked utilities or subsurface features. If as-built drawings are available for any on-site subsurface features, RRS request the right to review these drawing with the Wilcox to confirm clearance for the advancement of DPT injection points.
- For safety reasons, access to the treatment area will be limited to RRS and IWM personnel. RRS will provide delineators and cones to section off working areas. IWM will provide traffic control and coordinate with local authorities to shut down any section of the work area in the right-of-way.
- The proposed quantity of reagents can be delivered to the treatment area without significant surfacing/short-circuiting via the prescribed number of injection points. RRS will not be responsible for any treatment chemistry infiltration into undesired locations.
- RRS personnel can have access to site for work up to 12 hours per day Sunday-Saturday, though, in generating the costs, a 9.5-hour, Monday through Friday, work day was assumed. Additional charges may apply for Saturday and/or Sunday work schedules.
- This proposal assumes probing and drilling will begin at the ground surface. If hand auger, concrete/asphalt coring, or air knife services are required, additional charges, including surface restoration charges could apply.

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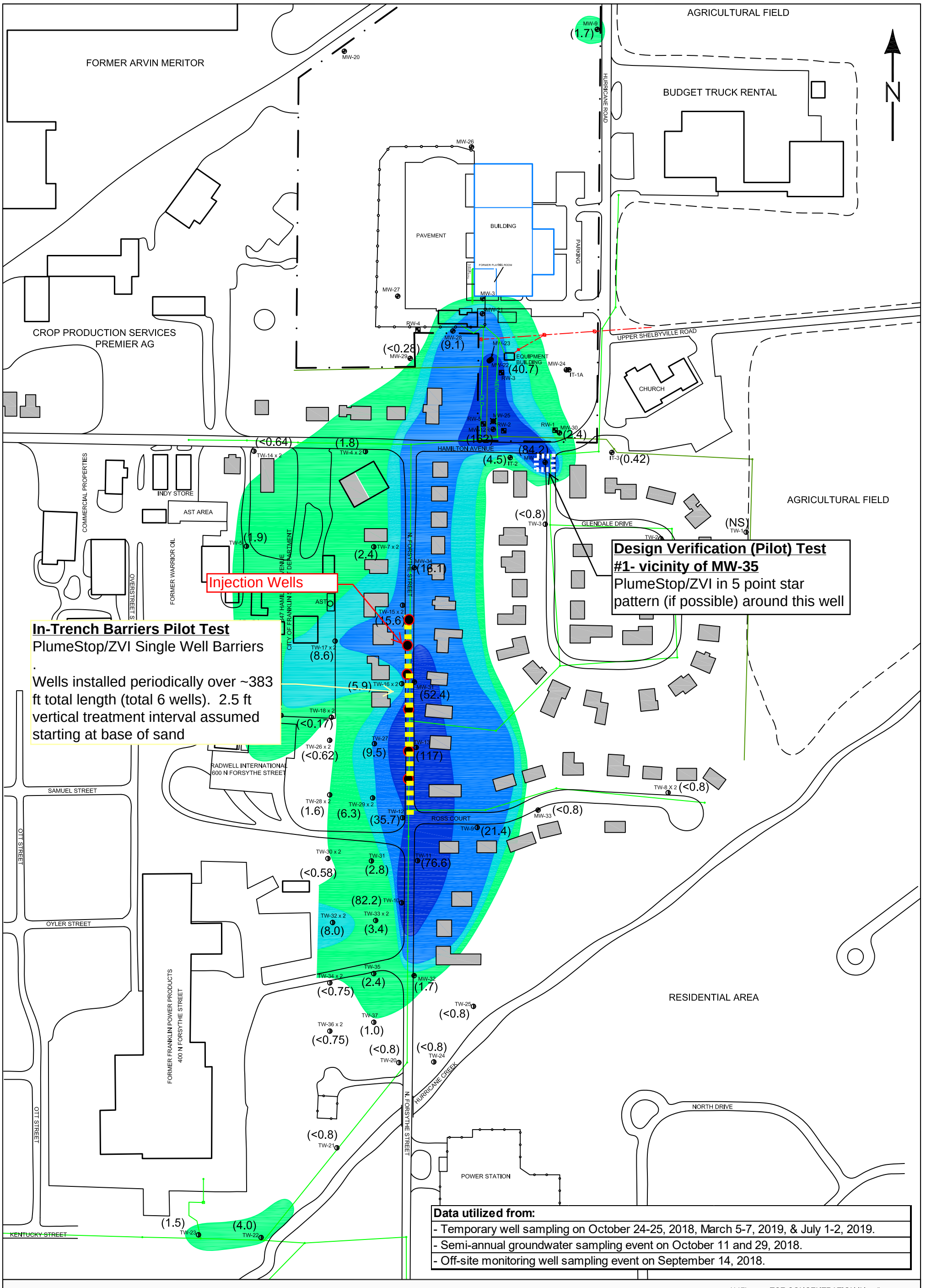
FORMER ARVIN MERITOR
AGRICULTURAL FIELD
BUDGET TRUCK RENTAL
HURRICANE ROAD
N
MW-9
(1.7)
MW-20
MW-26
PAVEMENT
BUILDING
PARKING
FORMER PLATING ROOM
MW-27
MW-3
MW-21
RW-4
MW-28
(9.1)
(<0.28)
MW-29
MW-23
EQUIPMENT BUILDING
MW-22
(40.7)
MW-24
IT-1A
RW-3
CROP PRODUCTION SERVICES
PREMIER AG
UPPER SHELBYVILLE ROAD
CHURCH
RW-5
MW-25
RW-2
RW-1
MW-30
(2.4)
(<0.64)
(1.8)
TW-14 x 2
TW-4 x 2
HAMILTON AVENUE
(84.2)
(4.5)
IT-2
IT-3
(0.42)
COMMERCIAL PROPERTIES
INDY STORE
AST AREA
(<0.8)
TW-3
GLENDALE DRIVE
(NS)
TW-1
AGRICULTURAL FIELD
(1.9)
TW-5
TW-7 x 2
(2.4)
MW-34
(16.1)
FORMER WARRIOR OIL
OVERSTREETS
Injection Wells
TW-15 x 2
(15.6)
N. FORSYTHE STREET
Design Verification (Pilot) Test
#1- vicinity of MW-35
PlumeStop/ZVI in 5 point star pattern (if possible) around this well
In-Trench Barriers Pilot Test
PlumeStop/ZVI Single Well Barriers
.
Wells installed periodically over ~383 ft total length (total 6 wells). 2.5 ft vertical treatment interval assumed starting at base of sand
TW-17 x 2
(8.6)
TW-16 x 2
(5.9)
MW-31
(52.4)
TW-18 x 2
(<0.17)
TW-27
(9.5)
TW-13
(117)
TW-26 x 2
(<0.62)
RADWELL INTERNATIONAL
600 N FORSYTHE STREET
SAMUEL STREET
TW-8 X 2
(<0.8)
TW-28 x 2
(1.6)
TW-29 x 2
(6.3)
TW-12
(35.7)
ROSS COURT
MW-33
(<0.8)
TW-9
(21.4)
OTT STREET
TW-30 x 2
(<0.58)
TW-31
(2.8)
TW-11
(76.6)
(82.2)
TW-10
TW-32 x 2
(8.0)
TW-33 x 2
(3.4)
OYLER STREET
TW-34 x 2
(<0.75)
TW-35
(2.4)
MW-32
(1.7)
RESIDENTIAL AREA
TW-25
(<0.8)
TW-36 x 2
(<0.75)
TW-37
(1.0)
(<0.8)
TW-20
(<0.8)
TW-24
HURRICANE CREEK
NORTH DRIVE
(<0.8)
TW-21
POWER STATION
FORMER FRANKLIN POWER PRODUCTS
400 N FORSYTHE STREET
(1.5)
TW-23
(4.0)
TW-22
KENTUCKY STREET
Data utilized from:
- Temporary well sampling on October 24-25, 2018, March 5-7, 2019, & July 1-2, 2019.
- Semi-annual groundwater sampling event on October 11 and 29, 2018.
- Off-site monitoring well sampling event on September 14, 2018.
LEGEND
ABANDONED MONITORING WELL
MONITORING WELL
RECOVERY WELL
TEMPORARY WELLS
PROPERTY LINE (APPROXIMATE)
STORM SEWER
SANITARY SEWER
O/H POWER
RESIDENTIAL HOME
* DETACHED GARAGES & SHEDS NOT SHOWN
NON-RESIDENTIAL STRUCTURE
PRIMARY BUILDING WALLS
(117) TCE CONCENTRATION IN ug/L
TCE CONCENTRATION >1.2 ug/L
TCE CONCENTRATION >5 ug/L
TCE CONCENTRATION >9.1 ug/L
TCE CONCENTRATION >38 ug/L
0'
200'
SCALE IN FEET
DRAWN BY: L. STRUM
DATE: 9/27/99
REVISED: 08/05/2019
HWPA #111291-01
DWG. NO. 111291S1
FIGURE 1
TCE GROUNDWATER
ISOCONCENTRATION MAP
FORMER AMPHENOL RFI/CMS
980 HURRICANE ROAD
FRANKLIN, INDIANA
IWM
CONSULTING GROUP

REGENESIS

Project Info

Franklin Amphenol
Franklin, IN
Design Verification (Pilot) Test-MW-35

Prepared For:
Brad Gentry - IWM Consultants, Inc.

Target Treatment Zone (TTZ) Info	Unit	Value
Grid Treatment Areal Extent	sq ft	400
Top Treat Depth	ft	8.0
Bot Treat Depth	ft	16.0
Vertical Treatment Interval	ft	8.0
Treatment Zone Volume	ft^3	3,200
Treatment Zone Volume	cy	119
Soil Type	---	Sand
Porosity	cm^3/cm^3	0.33
Effective Porosity	cm^3/cm^3	0.20
Treatment Zone Pore Volume	gals	7,899
Treatment Zone Effective Pore Volume	gals	4,788
Treatment Zone Pore Volume	liters	29,902
Treatment Zone Effective Pore Volume	liters	18,123
Fraction Organic Carbon (foc)	g/g	0.002
Soil Density	g/cm^3	1.7
Soil Density	lb/ft^3	108
Soil Weight	lbs	3.5E+05
Hydraulic Conductivity	ft/day	25.0
Hydraulic Conductivity	cm/sec	8.82E-03
Hydraulic Gradient	ft/ft	0.003
GW Velocity	ft/day	0.38
GW Velocity	ft/yr	137

Sources of Hydrogen Demand	Unit	Value
Dissolved Phase Contaminant Mass	lbs	0.01
Sorbed Phase Contaminant Mass	lbs	0.07
Competing Electron Acceptor Mass	lbs	6
Total Mass Contributing to H2 Demand	**lbs**	**6**

Mass Flux and HRC Demand	Unit	Value
Groundwater Mass Flux through TTZ	L/day	340
Stoichiometric HRC Demand	lbs	35
Mass Flux HRC Demand	lbs	144
Toral HRC Demand	**lbs**	**179**

Application Dosing	Unit	Value
PlumeStop to be Applied	**lbs**	**3,200**
S-MZVI to be Applied	**lbs**	**100**

PlumeStop® Application Design Summary

Design Verification (Pilot) Test-MW-35

PlumeStop + S-MZVI	
Treatment Type	**Grid**
Treatment Areal Extent (sq ft)	400
Spacing Within Rows (ft)	8
Spacing Between Rows (ft)	8
DPT Injection Points	**5**
Top Application Depth (ft bgs)	8
Bottom Application Depth (ft bgs)	16
PlumeStop to be Applied (lbs)	**3,200**
PlumeStop to be Applied (gals)	383
In Situ Chemical Reduction - S-MZVI	
S-MZVI to be added to PlumeStop (lbs)	**100**
S-MZVI to be added to PlumeStop (gals)	7
PlumeStop + S-MZVI Volume Totals	
Mixing Water (gal)	2,684
Total Application Volume (gals)	**3,075**
Injection Volume per Point (gals)	615

Technical Notes

Injection Radius for Soil Coverage (ft-est.avg.)

5.2

PlumeStop Injection Concentration (mg/L)

5,000

Special Instructions:
Injection interval is estimated an may change based on water level at time of injection.

Assumptions/Qualifications

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

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

Prepared by: Keith Gaskill, LPG, Sr. Design Specialist and D. Davis-Sr. Design Specialist
Date: 9/26/2019

REGENESIS

Project Info

Franklin Amphenol
Franklin, IN
In-Trench Barriers (6)

Prepared For:
Brad Gentry - IWM Consultants, Inc.

Target Treatment Zone (TTZ) Info	Unit	Value
Barrier Length	ft	10
Top Treat Depth	ft	9.5
Bot Treat Depth	ft	15.5
Vertical Treatment Interval	ft	6.0
Treatment Zone Volume	ft^3	3,600
Treatment Zone Volume	cy	133
Soil Type	---	Sand
Porosity	cm^3/cm^3	0.33
Effective Porosity	cm^3/cm^3	0.20
Treatment Zone Pore Volume	gals	8,887
Treatment Zone Effective Pore Volume	gals	5,386
Treatment Zone Pore Volume	liters	33,640
Treatment Zone Effective Pore Volume	liters	20,388
Fraction Organic Carbon (foc)	g/g	0.002
Soil Density	g/cm^3	1.7
Soil Density	lb/ft^3	108
Soil Weight	lbs	3.9E+05
Hydraulic Conductivity	ft/day	25.0
Hydraulic Conductivity	cm/sec	8.82E-03
Hydraulic Gradient	ft/ft	0.003
GW Velocity	ft/day	0.38
GW Velocity	ft/yr	137

Sources of Hydrogen Demand	Unit	Value
Dissolved Phase Contaminant Mass	lbs	0.01
Sorbed Phase Contaminant Mass	lbs	0.08
Competing Electron Acceptor Mass	lbs	7
Total Mass Contributing to H2 Demand	**lbs**	**7**

Mass Flux and HRC Demand	Unit	Value
Groundwater Mass Flux through TTZ	L/day	127
Stoichiometric HRC Demand	lbs	39
Mass Flux HRC Demand	lbs	54
Toral HRC Demand	**lbs**	**93**

Application Dosing	Unit	Value
PlumeStop to be Applied	**lbs**	**3,600**
S-MZVI to be Applied	**lbs**	**200**

PlumeStop® Application Design Summary

In-Trench Barriers (6)

PlumeStop + S-MZVI	
Treatment Type	**Barrier**
Distance Perpendicular to Flow (ft)	10
Spacing Within Rows (ft)	10
Number of Rows	6
Injection Wells	**6**
Top Application Depth (ft bgs)	9.5
Bottom Application Depth (ft bgs)	15.5
PlumeStop to be Applied (lbs)	**3,600**
PlumeStop to be Applied (gals)	431
In Situ Chemical Reduction - S-MZVI	
S-MZVI to be added to PlumeStop (lbs)	**200**
S-MZVI to be added to PlumeStop (gals)	13.2
PlumeStop + S-MZVI Volume Totals	
Mixing Water (gal)	2,445
Total Application Volume (gals)	**2,891**
Injection Volume per Point (gals)	482

Technical Notes

Injection Radius for Soil Coverage (ft-est.avg.)

5.3

PlumeStop Injection Concentration (mg/L)

6,000

Special Instructions:
Injection depths are estimated averages for this area.

Assumptions/Qualifications

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

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

Prepared by: Keith Gaskill, LPG, Sr. Design Specialist and D. Davis-Sr. Design Specialist
Date: 9/26/2019

PlumeStop® Liquid Activated Carbon™ Technical Description

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

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

Distribution of PlumeStop in water

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

Chemical Composition

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

Properties

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

Storage and Handling Guidelines

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

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

PlumeStop® Liquid Activated Carbon™ Technical Description

Applications

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

Health and Safety

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

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

S-MicroZVI Specification Sheet

S-MicroZVI Technical Description

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

S-MicroZVI is Best in Class For

- ☑ Longevity
- ☑ Kinetics
- ☑ Transport

Sulfidated ZVI

S-MicroZVI is composed of colloidal, sulfidated zero-valent iron particles suspended in glycerol using proprietary environmentally acceptable dispersants. The passivation technique of sulfidation, completed using proprietary processing methods, provides unparalleled reactivity with chlorinated hydrocarbons like PCE and TCE and increases its stability and longevity by minimizing undesirable side reactions. In addition to superior reactivity, S-MicroZVI is designed for easy handling that is unmatched by any ZVI product on the market. Shipped as a liquid suspension, S-MicroZVI requires no powder feeders, no thickening with guar, and pneumatic or hydraulic fracturing is not mandatory. When diluted with water prior to application, the resulting suspension is easy to inject using either direct push or permanent injection wells.

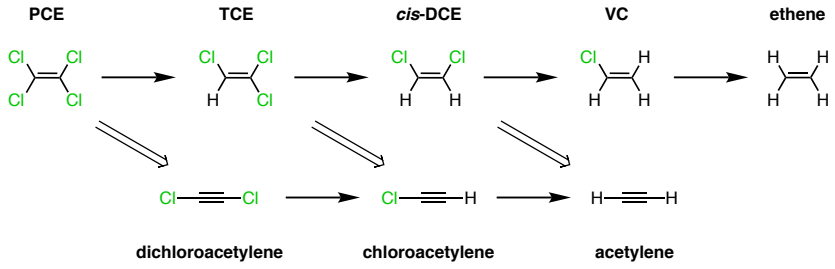

Figure 1: *Chlorinated ethene degradation pathways and products. The top pathway with single line arrows represent the reductive dechlorination (hydrogenolysis) pathway. The lower pathway with downward facing double line arrows represent the beta-elimination pathway.*

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

S-MicroZVI
Sulfidated Zero-Valent Iron

S-MicroZVI Specification Sheet

Chemical Composition

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

Properties

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

Storage and Handling Guidelines

Storage:

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

Handling:

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

Applications

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

Health and Safety

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

REGENESIS®

www.regenesis.com

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

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

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Suggested Performance Monitoring Parameters

Analytical Parameter	Method
Contaminants of Concern (COC's)	Varies
pH	Meter reading taken in flow-through cell (DO can also be measured with a Hach kit)
Dissolved Oxygen (DO)	
Oxidation Reduction Potential (ORP)	
Total Fe	Colorimetric Hach Method or EPA 6000 series with filtered and unfiltered samples
Total Mn	
Dissolved Fe	
Dissolved Mn	
Sulfate	EPA 375.3 or EPA 9056
Sulfide	EPA 376.1
Nitrate	EPA 353.1 or EPA 9056