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LETTER DISCUSSING REGULATORY COMMITTEE CORRECT PROTOCOLS FOR SOIL AND GROUNDWATER SAMPLE COLLECTION FOR MICROCOSM STUDIES ABL ROCKET CENTER WV
6/30/2000
GEOSYNTEC CONSULTANTS

GEOSYNTEC CONSULTANTS
160 Research Lane, Suite 206
Guelph, Ontario, Canada N1G 5B2
Tel. (519) 822-2230 • Fax (519) 822-3151

30 June 2000

Dawn Hayes
LANTNAVFACENGCOM
Code 18234, Installation Restoration
1510 Gilbert Street
Norfolk, Virginia
23511-2699

Reference: Approach & Protocols for Soil and Groundwater Collection to Evaluate the Applicability of In Situ Bioremediation at the Allegany Ballistics Laboratory, West Virginia

Dear Ms. Hayes:

Thank you for your interest and decision to participate in our Strategic Environmental Research & Development Program (SERDP) to determine the ubiquity of perchlorate biodegrading bacteria in subsurface environments and to assess the applicability of in situ bioremediation at United States Department of Defense (DoD) sites. In followup to our discussions, this letter presents: i) a summary of our understanding of site conditions at the Allegany Ballistics Laboratory (ABL) in West Virginia (the Site); ii) the approach for soil and groundwater collection and microcosm testing; and iii) protocols to assist CH_2MHill for soil and groundwater sample collection for the microcosm studies.

1. Understanding of Site Conditions

Based on our brief discussions, it is my understanding that the Site has been used for research and development of ballistic missiles and/or perchlorate-based explosive materials. As a result of historic testing activities, perchlorate is present in alluvial soils and groundwater at the Site, particularly in former open burn and detonation areas. Perchlorate is also suspected to be present in groundwater in fractured bedrock at the Site. The thickness of the alluvium is approximately 20 feet, with the groundwater table generally located at 10 to 15 feet below ground surface (bgs). Perchlorate concentrations in alluvial groundwater range up to 26 mg/L. A groundwater extraction and treatment system is currently operating to treat chlorinated VOCs in extracted groundwater; perchlorate is not being treated.

2. Approach and Methodology for Soil and Groundwater Collection and Microcosm Studies

For the purposes of the SERDP study, we recommend constructing microcosms using alluvial soil and groundwater (Set 1) and fractured bedrock groundwater (Set 2) to assess the perchlorate biodegradation potential in both the alluvium and the fractured bedrock. It is our understanding that perchlorate-impacted alluvial soils can be collected during an upcoming well installation event (at Site 10) scheduled for July 2000. Perchlorate-impacted groundwater from the alluvium and fractured bedrock can be collected from existing monitoring and/or extraction wells. Subsurface materials should be collected as follows:

- Approximately 5 kg (about 11 lbs) of saturated aquifer material should be collected from the alluvium. Samples should be collected using either a 2 foot long, 2-inch diameter split spoon sampler containing sterile 6-inch brass liners or an appropriate core barrel. About 5 linear feet of 2-inch core is required for the microcosm studies (e.g., depth interval of 15 to 20 feet bgs). Core liners should be immediately capped with plastic end caps upon retrieval from the borehole, labeled with the sample location and depth, and the sample date. Soil samples should be shipped under chain-of-custody to GeoSyntec's Guelph office. Detailed sample collection and handling procedures are provided in Protocol 1 of Appendix A.

- Approximately 4 L (1 gallon) of groundwater should be collected from an existing perchlorate-impacted alluvium well and from a bedrock well (4L from each well). Samples should be collected after well purging using standard protocols (i.e., three purge volumes or until field parameter measurements stabilize). Groundwater should be collected directly into sterile plastic carboys (to be provided by GeoSyntec), minimizing aeration and headspace to the extent possible. Dissolved oxygen and oxidation-reduction potential of the groundwater should be measured during well purging to assess baseline redox conditions. The groundwater samples should be express-shipped on blue ice under chain-of-custody to GeoSyntec's Guelph office. Detailed sample collection and handling procedures are provided in Protocol 2 of Appendix A.

Microcosms will be constructed to represent both the alluvial and bedrock aquifers. The alluvial microcosms will be constructed by filling 100 mL (nominal volume) glass bottles with 60 g of saturated soil and 60 mL of alluvial groundwater, leaving a nominal headspace (i.e., 5 mL) for gas production (e.g., CO_2). The bedrock microcosms will be constructed by filling 100 mL (nominal volume) glass bottles with bedrock groundwater, leaving a nominal headspace (i.e., 5 mL) for gas production (e.g., CO_2). Controls and treatments will consist of a sterile control (autoclaved and inhibited with mercuric chloride), an un-amended active control (to measure any intrinsic perchlorate degradation activity), and two electron donor-amended treatments, including acetate and a slow-release electron donor such as HRC, oleate or chitin. All treatments and controls will be

constructed in triplicate. Microcosms will be incubated at room temperature in an anaerobic chamber for a period of up to 8 weeks. Samples will be collected from all microcosms on a weekly basis for analysis of perchlorate and degradation products such as chlorate and chloride. Sample intervals for individual microcosms may be modified (either shorter or longer interval) during the study depending on observed microbial activity and perchlorate degradation rates.

3. Implementation

To meet the project schedule of the SERDP program, GeoSyntec would greatly appreciate if sample collection could be implemented by the end of July 2000. We anticipate that the microcosm study will require approximately 8 weeks; results will be available to ABL thereafter.

4. Potential Applicability of In Situ Bioremediation at ABL

Based on our limited understanding of Site conditions and remedial requirements/drivers at ABL, we are currently unable to comment on the potential to integrate in situ bioremediation into current or planned remedial activities at the Site. However, experience at multiple DoD and defense contractor facilities suggests that bioremediation is likely to be beneficial at ABL in the following ways:

- Rapid remediation of perchlorate that may remain in low permeability unsaturated soils in former burn or detonation areas (i.e., perchlorate source areas). Experience has shown that perchlorate retained in these unsaturated soils can serve as long-term sources of perchlorate to groundwater. While soil concentrations at many sites are less than the Preliminary Remedial Goals (37 to 890 mg/Kg), soil remediation is required or highly beneficial to prevent continuing impacts to groundwater in excess of the Provisional Action Level (PAL) of 18 μg/L.

- Bioremediation of the perchlorate source areas in the alluvial groundwater that are driving the perchlorate plumes, in order to reduce the duration and cost of groundwater remediation. This can be accomplished through a variety of passive and/or semi-passive nutrient delivery approaches, using electron donors that will be evaluated in the SERDP microcosm study.

- Control of perchlorate migration using passive or semi-passive in situ bio-barriers. This may be possible for both the alluvial groundwater and the fractured bedrock groundwater, depending on Site-specific factors (e.g., degree of biological activity in the bedrock and fracturing).

I have attached a copy of a recent chapter that we published in a book entitled "Perchlorate in the Environment". The paper presents highlights from work conducted at several perchlorate sites, and provides several bioremediation concepts. Following successful completion of the microcosm studies, we would be pleased to work with you and CH_2MHill to evaluate whether/how in situ bioremediation can be integrated into remedial activities at ABL, and to develop appropriate in situ bioremediation design concepts.

We look forward to working with you and CH_2MHill on this interesting project. Please feel free to contact me if you have any questions or if we can provide additional information.

Sincerely,
GeoSyntec Consultants

Evan Cox, M.Sc.
Associate, Project Director

cc: Jeff Morrison - CH_2MHill

Attch: Protocols

APPENDIX A

SOIL AND GROUNDWATER COLLECTION PROTOCOLS

PROTOCOL NO. 1
SUBSURFACE SOIL COLLECTION AND HANDLING

Approximately 5 kg (about 10 lbs) of saturated aquifer material will be collected from the alluvium in a perchlorate-impacted area. Samples will be collected using a 2 foot long, 2-inch diameter split spoon sampler containing clean 6-inch brass/aluminum liners or an equivalent core sampler. About 5 linear feet of 2-inch core is required to provide sufficient aquifer material for the microcosm studies. The following protocols are provided to assist the sample collection and handling processes.

1. Clean all sampling equipment (auger and core tubes) with Alconox (or equivalent) and rinse well with distilled water to remove any soap residue. Allow equipment to air dry. Handle all sampling equipment and soil samples with clean latex gloves.

2. Advance the soil boring to the desired sampling depth, lower the clean sampler containing the liners to the bottom of the borehole, and advance the sampler into the aquifer material in advance of the auger. Clean out the hole if the sampler in the borehole is more than 6 inches above the desired sampling depth.

3. Retrieve the sampler from the borehole and remove the brass liners from the sampler. Immediately cap both ends of each brass liner containing soil with clean plastic end caps to prevent contamination or oxygenation of the soil cores. If shelby tubes are used in place of the brass liners, cut the tubes into 12 to 15-inch lengths using a pipe cutter or hack-saw and secure clean plastic end caps to each section end.

4. Label the outside of each core liner section with the sampling location, depth, date and time of sampling. Place each core liner section in a sealable plastic bag.

5. Place the soil cores in a cooler and express-ship the cores (accompanied by a chain-of-custody) to GeoSyntec's Guelph office. Do not ship with ice as it may melt and infiltrate into the cores, affecting core chemistry. Complete the FedEx waybill as per the attached sample copy to prevent delay at Customs. Write the Agriculture Canada permit number provided below on the FedEx waybill and the outside of the cooler.

6. Avoid shipping on Fridays to prevent improper storage of samples (by Fedex) on weekends. On the day of shipment, please fax (519-822-3151) or email the waybill number and shipment info to the attention of Evan Cox/Jamey Rosen at GeoSyntec's Guelph office to allow tracking.

NOTE: For this shipment, use the following Agriculture Canada Permit Number: **to be provided**

PROTOCOL NO. 2
GROUNDWATER COLLECTION

Approximately 4 L (1 gallon) of groundwater is required from each of perchlorate-impacted wells screened in the alluvium and in the fractured bedrock. The following protocols are provided to assist the sample collection and handling process.

1. Record activities in an appropriate monitoring well purging and sampling record log. Note observations on the physical appearance and odor (if any) of the purge water (e.g., organic or sulfide odors, black precipitates).

2. Purge three well volumes, as per standard well sampling procedures for the site. Measure dissolved oxygen (DO), oxidation-reduction potential (ORP), pH and temperature and specific conductance after each purge volume. Pump a continuous flow of groundwater across the electrodes and record readings when they stabilize. Record instrument calibration information on the logs.

3. Collect groundwater from each well directly into independent 4L plastic carboys (to be provided by GeoSyntec), allowing overflow. Cap the carboys allowing no or minimal headspace.

4. Label each water sample container with the well number and geologic interval (alluvium/bedrock), place them on blue ice in a cooler, and express-ship the samples, accompanied by a chain-of-custody form, to GeoSyntec's Guelph office.

5. Avoid shipping on Fridays to prevent improper storage of samples (by Fedex) on weekends. On the day of shipment, please fax (519-822-3151) or email the waybill number and shipment info to the attention of Evan Cox/Jamey Rosen at GeoSyntec' Guelph office to allow tracking.

An Agriculture Canada Permit Number is not required for groundwater shipments, unless accompanied by soil.