ADVENTUS

Proven Soil, Sediment, and Groundwater Remediation Technologies

June 1, 2009

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Subject: **Response to ACEPD Comments on the ISBS Pilot Study Report**
Adventus Project No. AAI6-189

Dear Mr. Brourman:

In their letter dated February 24, 2009 the Alachua County Environmental Protection Department (ACEPD) submitted comments on the ISBS Pilot Study Report, Field Performance Assessment, Cabot-Koppers Superfund Site, Gainesville, Florida (Adventus Americas Inc., January 30, 2009). Our responses to these comments are presented below.

Comment 1. The procedure for generating leachate from the treated soil cores was different than the column procedure used to generate the leachate in the pre-treatment cores. Since the leaching procedure was not the same between the two cores, an experimental bias may have been introduced in the post treatment soil core data. Explanation is needed as to how data from significantly different experimental procedures can generate comparable data.

Response: The different experimental procedures used to generate the leachate for the pre- and post-treatment cores was due to the different methods used to collect the samples in the field. In summary, the pre-treatment cores collected by Rotosonic drilling generated large volumes of soil and sub-samples of these borings were used for the baseline leaching experiment. Whereas these field samples were sufficient for analytical chemical analyses they were not conducive to the geochemical crust analyses described in Appendix B of the original report. Because crust analysis was a critical component of this program, we accommodated the needs of Dr. Tom Al's laboratory at the University of New Brunswick (UNB) and used an alternative sampling method (*i.e.,* GeoProbe Macro-Core direct push sampler with 2-inch diameter acetate sleeves) for the post-treatment cores. The post treatment cores were split in half lengthwise and care was taken to minimize disturbing the soil since preservation of the soil structure was required for the crust analyses. Half of each core was packaged and shipped to UNB while the remaining half of each core was processed at Adventus. This procedure yielded an excellent, intact sample for physical crust analysis but provided a much smaller sample of soil for chemical analyses.

Over the past 4 years, various extraction procedures have been used with soils from this site as part of various ISBS studies. Although the volume of the leachate generated was indeed very different among various extraction processes, pre- and post-ISBS treatment, there did not appear to any differences in the "quality" of the leachates generated (*i.e.*, one extraction process did not tend to produce clean leachate while another extraction process of the same material generated a more impacted product). When viewed in combination with all other

data reported, we are confident that the leachate data reflect the treatment reported, and that these data were reported without bias.

Comment 2. The high variability of the total PAH data within the 2 ft sections of the pre-treatment cores such as observed in TIP-4 (10-12') in Table 7 where the PAH concentration varies from 13.2 mg/Kg to 5,427 mg/Kg within one two foot section, raises questions about the ability to accurately determine the reduction in PAHs from a separate post treatment core TVB-1-A taken from a different depth and from a non-identical location. In other words, we may not know for sure what the "before" concentration was for the treated core if there appears to be such a wide variability in the concentration of COIs contaminants within a few feet of depth. Therefore drawing reliable conclusions about the reduction of COIs between the pre-treated and post-treated samples may not be possible.

Response. The high degree of variability in the PAH data within a two foot section confirms the heterogeneity of the PAH impacts at the Site. Variability is indeed a potentially confounding issue but it is also a most common occurrence. In anticipation of such variability, we collected pre- and post-treatment cores from the same locations - both spatially and vertically - and replicate samples were analyzed. To further minimize the variability observed within selected cores, the data were grouped from multiple locations and depths for each area (TIP & DIP) and average % reductions were presented in Table 7.

Comment 3. Experimental details about the exact weight of soil used and volume of leachate generated in the post treatment soil leaching tests are not available in the report. It appears that 200 grams of soil were used in the pre-treatment column leaching tests and about 2 liters of leachate were collected. Without similar information on the weight of post treatment soil samples and the volume of final leachate, and knowing that these parameters were controlled, it is not possible to evaluate the validity of the COIs concentrations and the leachate reduction data in the post treatment samples. This data and the lab data were not provided in the report.

Response: The mass of soil used for the baseline leaching experiment (200 g) was selected based on the ISBS treatability study procedure for soils from the Gainesville Site where 200 g of impacted soil were treated with ISBS reagents for a given time period and then the treated soil was leached with water. For post-treatment analysis, however, the samples consisted of split cores, 2-ft long (See Response to Comment #1). To minimize disruption of the soil in the half cores available for chemical analyses, Adventus cut each core in half lengthwise yielding two 2-ft long half cores. One half core (2' long) was submitted to UNB and the other half core was cut in half horizontally to form two 1' sections. The two flat sides of the 1' sections were placed together and inserted with the acetate sleeve into a glass column. The soil with the acetate sleeve was inserted into the column to preserve the soil structure. The weight of the empty column and the column with the soil (in the acetate sleeve) were recorded (Table 1). Although a larger mass of soil was used in the post-treatment leachate test, the same volume (2 L) of distilled water was pumped through the column.

Table 1: Mass of soil cores used to create post-treatment leachate

Core ID	Mass (g)		
	Empty column	Column with soil in acetate sleeve	Soil in acetate sleeve
TVB-1-A 12-14'	809.72*	1,586.45	776.73
DVB-2-A 16-18'	805.70	1,481.24	675.54
TVB-3-A 12-14'	811.85	1,546.19	734.34
DVB-2-A 20-22'	832.40	1,577.01	744.61
TVB-1-A 19.5-21.5'	788.91	1,598.10	809.19
TVB-3-A 18-20'	809.72*	1,595.92	786.20

*the empty weight of the column was not recorded thus the average empty weight of the other four columns was calculated and used as the empty weight.

Comment 4. It would be expected that if a column leaching test is performed and the pre-leached soil and post-leached soil and leachate are analyzed for total PAHs, that there should be an approximate mass balance of PAH mass. It is assumed here that analyzing the "leached soil" would have included analysis of pore volume water in the leached soil. However, in Table 8 of the report that presents leaching test results from the pre-treatment core TIP4 –C (10-12'), there does not appear to be a close mass balance for the PAHs (see calculation below). This lack of a reasonably close mass balance appears to impact other samples in Table 8 (See table below). This may indicate problems in the experimental or lab data. ACEPD has reviewed the data in Table 7 for all DIP and TIP area soil cores and finds the greatest discrepancy in mass balance and the widest variability in mass balance occurs in the TIP Area sample data.

Response. Due to the heterogeneity of the PAH impacts in this soil, replicate samples would need to be collected from both the pre- and post-leached soils to more accurately determine PAH concentrations.

Comment 5. It is unclear from the report why more post treatment samples from the DIP area were not submitted for laboratory analysis. Having more data in this area would have provided a better representation of field conditions in this area especially as the data from the DVB-2A and DB-1 pair show only a slight reduction in COI concentration post treatment.

Response. The selection of the post-treatment cores was made based on the location of the cores and results of the neutralization test. Cores TVB-1-A 12-14'; DVB-2-A 16-18'; and TVB-3-A 12-14' were selected since these cores are from locations close to those of the original baseline cores that were collected in October 2007. Cores DVB-2-A 20-22'; TVB-1-A 19.5-21.5'; and TVB-3-A 18-20' were selected since these cores showed the presence of permanganate and had positive reactions to the neutralization test. Additional archived cores can be analyzed; alternatively new cores can be recovered from the treated area.

Comment 6. Based on the review of the boring logs for the verification borings, it appears that DNAPL free product still remains in the areas after treatment with excess reagent (DVB-2 in the DIP area). This observation suggests that the ISBS technique may not be effective for reduction of total COIs.

Response. There was no attempt to delineate or identify DNAPL free product as part of this study. However, the entire concept of the ISBS technology is to manage such residuals in soil; it is disconcerting that this fundamental concept is still not understood.

Comment 7. Based on the microscopic data from the core crust analysis presented in the report it appears that the ISBS treatment does have some potential to be useful in reducing the porosity of the soils tested at least for lesser contaminated soils such as those from the TIP area. However, since DIP area data were not presented in the report, it is not possible to evaluate whether the ISBS treatment would have similar results in soils from more contaminated areas such as the DIP area. Perhaps more information can be provided here.

Response. The conclusions provided in Section 4.3 are valid for both TIP and DIP areas. Further information on the crust analyses for cores from both the TIP and DIP areas are available in Appendix B.

Comment 8. The slow rate of leachate collection observed from the treated soil samples in the column tests, could be interpreted to indicate the ISBS treatment can significantly reduce permeability in the soils. However, the report states that a greater amount of silty and clayey soils were observed in the post treatment samples than in the pre-treatment samples, which were described as predominantly sandy soil. Could an alternate explanation of the reduced apparent permeability be attributable to the greater clay content of the post treatment cores? Also could the difference in soil clay content between the pre-treatment and post-treatment cores have affected the starting amount of COIs contained in the post treatment cores and therefore make them not comparable as similarly contaminated samples? The impact of the difference should be explained.

Response. Page 24 of the Report contains an error in that the pre-treatment cores produced leachate more slowly, not the post-treatment cores. However, the point regarding variability in soil texture however is noted. The post-treatment leachates were generated from the entire core and would therefore be most representative of the sample. Other differences can again be attributed to environmental heterogeneity despite efforts to collect uniform and representative samples (i.e., post-treatment cores were collected 6 to 12 inches away and from the same vertical depth as their the pre-treatment counterparts).

General Comment. Based on our questions above, ACEPD has concerns about the reliability of some of the data in this report and the conclusions about the ISBS effectiveness to reduce DNAPL concentrations. However, the report does show more reliably based on the microscopy work that there is potential to reduce porosity and perhaps reduce leaching. Perhaps answers to our questions can provide more confidence in the technique. Currently, ACEPD is not fully convinced that the ISBS technique can be relied upon solely as an effective treatment for reducing concentrations of DNAPL constituents and reducing leaching potential in the surficial aquifer

Response: We appreciate ACEPD's thorough review and their efforts associated with issuing comments. However, we disagree with their stated concerns over "data reliability", "experimental bias" and "reliability of conclusions". We respectfully note that over the past 4 years we have conducted numerous related studies at this Site, and we have always reported the results in fair and honest manner. In so doing, we have recognized the inherent limitations of the technologies and their various evaluations. At no time has the ISBS technology been presented as the sole solution to the complicated issues often found at large, complex sites. However, when considering all data in a combined manner, the weight of evidence approach indicates that the ISBS technology can contribute to a safe, effective and cost-efficient remedial strategy.

Please feel free to contact me at jim.mueller@adventusgroup.com or (815) 235-3503 with any questions or comments.

Respectfully,

ADVENTUS AMERICAS INC.

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