February 9, 2004

Mr. Dan Powell
U.S. Environmental Protection Agency
Office of Superfund Remediation and Technology Innovation (5102G)
1200 Pennsylvania Avenue NW
Washington, DC 20460

Subject: Statistical Data Assessment for the Ross Incinerator Site
U.S. Environmental Protection Agency Region 8
Work Authorization 013

Dear Mr. Powell:

This letter provides a statistical evaluation of analytical data performed by the Brownfields Technology Support Center (BTSC) for the Office of Superfund Remediation and Technology Innovation (OSRTI). The evaluation was performed on data collected by the U.S. Environmental Protection Agency (EPA) Region 8 at the Ross Incinerator site (the Site) in Colman, South Dakota. In the Spring of 2003, EPA Region 8 requested BTSC assistance in refining the technical approach for a focused Site Inspection (SI) planned at the Site. The BTSC provided recommendations regarding the sampling strategy and the use of field test kits that were incorporated into the final work plan for the SI. When data from the SI became available in December 2003, EPA Region 8 requested additional assistance from the BTSC in the statistical assessment and interpretation of the analytical results.

The BTSC's statistical assessment focused on 31 surface soil samples that were collected at the Site (Table 1). A judgmental (biased) sampling approach was used, wherein samples were collected near potential sources and from disturbed or stained areas. In areas of the Site where sources or disturbed areas were not observed, a random grid sampling approach was applied. The soil samples were analyzed for total polychlorinated biphenyls (PCBs) using RaPID Assay® immunoassay test kits provided by Strategic Diagnostics, Inc (SDI). Five of the samples were sent for further PCB analyses at an off-site laboratory by EPA Contract Laboratory Program (CLP) analytical methods. Additional test kit and CLP data were collected for off-site soil, background soil, sediment, and surface water samples. Although these off-site data were not statistically evaluated, they are provided in Table 2 for your information.

Figure 1 is correlation plot for the on-site surface soil data, showing the correlation line (with 95% confidence intervals) between the test kit and the CLP lab data. Also attached (Figure 2) is a set of statistical plots, including normal probability plots, box-and-whisker plots, and histograms, that can be used to assess the distribution of the on-site data. Discussions of each figure are provided below.

Figure 1: Correlation Plot

Although only five on-site samples were collected for both test kit and CLP analyses, a clear correlation is obtained ($r = 0.989$). The kits consistently display a significantly high, conservative bias (on the order of 10X, or more) over the CLP results. This level of bias is greater than the

bias found in the EPA Environmental Technology Verification study for the RaPID Assay® test kits that was completed in 1998 (http://www.epa.gov/etv/verifications/vcenter1-7.html). The CLP data reported Aroclor 1260 as the predominant PCB mixture in each of the five samples submitted. Because the test kits were calibrated based on Aroclor 1254, the test kit data were divided by a correction factor of 1.56 to report Aroclor 1260 per SDI's recommendations.

The main purpose of the correlation plot is to generate a field-based action level for the kit that is tied to the actual risk-based concentration of interest for the Site. Establishment of such an action level is necessary if the test kit results are to be used for decision-making. EPA Region 8 is currently favoring the EPA Region 3 preliminary remedial goal (PRG) for industrial soil (2.9 parts per million [ppm] for Aroclor 1260) in the screening of risk for on-site workers (the envisioned future land use scenario). As illustrated on the plot, a conservative estimate of the kit result that corresponds to a lab concentration of 2.9 ppm can be found by using the 95% upper confidence limit of the regression line rather than the line itself, and then estimating the corresponding test kit result. Accordingly, the red arrows on Figure 1 indicate that 2.9 ppm correlates with a field result of approximately 26 ppm Aroclor 1260. Through multiplying by 1.56, this field result can be further adjusted to the equivalent the Aroclor 1254 result actually reported by the kits. This adjustment yields a field-based action level of 40 ppm.

The implication of the correlation plot is that because the highest test kit result found at the Site (18.9 ppm, as shown in Table 1) is well below the field-based action level of 40 ppm, no action is necessary to protect workers at the site using the EPA Region 3 industrial PRG as a risk screening criterion.

Figure 2: Other Statistical Plots

This set of plots was generated largely for informational purposes to assess the on-site test kit data set as a whole. The probability plots and histograms show that the data set can be more accurately described as lognormal than normal. Along with the box and whisker plots, the histograms also show that the lognormality of the data set is largely due to the presence of a few extreme (high) values. Review of the statistical plots further indicate that the random and judgmental samples can be considered a single population; both the random and judgmental results are broadly distributed in the data set such that there are no obvious inflections or discontinuities in the probability plots (Table 1 identifies the random and judgmental samples).

Despite the appearance of the lognormal plots, the results of the Shapiro-Wilk normality test, presented with the histograms, show that neither the logtransformed data set nor the untransformed data set can be said to fit a normal distribution at a probability level of 95% ($p > 0.05$). Thus, any statistical comparisons of the data to action levels or other data sets should not use parametric tests such as the t-test, which assume normality. Rather, non-parametric tests such as the Wilcoxon Signed Rank test, the Chen test, or a test of proportions should be considered. The observed high bias in the test kit results would complicate the interpretation of the results of such statistical tests, however. Thus, the BTSC maintains that the correlation plot is the best way to apply the test kit results. This approach has been successfully applied in the Cos Cob case study, and was also demonstrated in an appendix to the aforementioned ETV report for the test kits.

Conclusions

Overall, the statistical analyses indicate that the field test kit results and correlating CLP results comprise a data set of sufficient quality for decision-making at the Site. One or two additional CLP samples collected on-site could have better defined the degree of correlation. In addition, the Region 8 project team noted that while blanks and calibrations were performed as quality control (QC) measures for the field test kits and indicated no problems, other QC checks such as field duplicates or spike samples were not performed due to limited test kit materials. The BTSC recommends that the project team identify what other QC data may be available (such as duplicates and spikes for the CLP samples) to further assess sampling and analytical precision for the SI before a final determination is made for the Site.

Based on the initial evaluation performed by the BTSC, however, the test kits appear to have cost-effectively produced a high data density at the Site, and indicate that no further action is necessary at the Site if an industrial risk-screening level of 2.9 ppm is applied. As an added note, the lack of detections in the off-site samples, again with corroborating CLP data, further indicate that PCBs have not significantly impacted other environmental media surrounding the Site.

If you have any questions concerning this letter or the attachments, please call me at 303-313-8284.

Sincerely,

Mark R. Colsman, Ph.D.
Environmental Chemist

Enclosures

Cc: Robert Howe, Tetra Tech EM Inc.
Richard Weisman, Tetra Tech EM Inc.
Project File

Table 1: Summary of On-site Soil Sample Results for Aroclors
Ross Incinerator Focused Site Inspection, July 2003

Sample No.	Test Kit Result 1254 (PPM) *	Test Kit Result 1260 (PPM) **	Comment	CLP Lab 1260 (PPB) ***	Comment	Random/ Judgmental
RI-SO-01	2.46	1.58				judg
RI-SO-02	1.98	1.27				judg
RI-SO-03	2.42	1.55		76		judg
RI-SO-04	0.1	0.06	nd			judg
RI-SO-05	0.1	0.06	nd	92		judg
RI-SO-06	4.23	2.71				judg
RI-SO-07	18.89	12.11		1153		judg
RI-SO-08	0.1	0.06	nd			random
RI-SO-09	0.53	0.34				random
RI-SO-10	0.52	0.33				random
RI-SO-11	1.52	0.97				judg
RI-SO-12	0.1	0.06	nd			random
RI-SO-13	0.22	0.14	J			random
RI-SO-14	1.95	1.25				random
RI-SO-15	1.83	1.17				random
RI-SO-16	0.6	0.38				random
RI-SO-17	4.59	2.94				random
RI-SO-18	0.29	0.19	J			random
RI-SO-19	4.85	3.11		267		judg
RI-SO-20	0.1	0.06	nd			random
RI-SO-21	5.93	3.80				judg
RI-SO-22	0.42	0.27	J			random
RI-SO-23	0.89	0.57				judg
RI-SO-24	1.95	1.25				judg
RI-SO-25	0.1	0.06	nd			random
RI-SO-26	0.1	0.06	nd			random
RI-SO-27	0.88	0.56				random
RI-SO-28	1.23	0.79		153		judg
RI-SO-49	1.37	0.88				judg
RI-SO-50	3.63	2.33				judg
RI-SO-52	2.9	1.86				judg

Notes:

* From discussions with SDI and the field team, the field-based operational method detection limit (MDL) of the test kits was assessed to be approximately 0.2 ppm. One-half of this value (0.1) was used as a replacement value for nondetections in the statistical evaluations of on-site data.

** The CLP data indicated that the major Aroclor detected was Aroclor 1260. Because the kits are calibrated based on Aroclor 1254, a correction factor of 1.56 was applied to the test kit data set to convert the reported concentrations from Aroclor 1254 to Aroclor 1260.

*** CLP reporting limit for Aroclors is 33 ppb

nd	Not detected
J	Estimated concentration between the lowest calibration standard (0.5 ppm) and the method detection limit (0.2 ppm)
PPM	Parts per million (milligrams per kilogram)
PPB	Parts per billion (micrograms per kilogram)

Table 2: Summary of Off-Site Sample Results for Aroclors
Ross Incinerator Focused Site Inspection, July 2003

Sample No.	Test Kit Result 1254 (PPM) *	Test Kit Result 1260 (PPM) **	Comment	CLP 1260 (PPB) ***	Comment
Background Soil					
RI-BG-01	0.2	0.13	nd		
RI-BG-02	0.2	0.13	nd	33	nd
RI-BG-03	0.2	0.13	nd		
RI-BG-04	0.2	0.13	nd		
RI-BG-05	0.2	0.13	nd	33	nd
Off-site Sediment					
RI-SE-02	0.2	0.13	nd	33	nd
RI-SE-05	0.2	0.13	nd	33	nd
RI-SE-42	0.43	0.28	J		
RI-SE-43	0.2	0.13	nd		
RI-SE-44	0.2	0.13	nd		
Off-site Soil (Town)					
RI-SO-29	0.2	0.13	nd	15	
RI-SO-30	0.2	0.13	nd	21	
RI-SO-31	0.2	0.13	nd		
RI-SO-32	0.2	0.13	nd		
RI-SO-34	0.2	0.13	nd		
RI-SO-35	0.2	0.13	nd		
RI-SO-36	0.2	0.13	nd		
RI-SO-37	0.2	0.13	nd		
RI-SO-38	0.2	0.13	nd	33	nd
RI-SO-39	0.2	0.13	nd		
RI-SO-40	0.2	0.13	nd		
RI-SO-41	0.2	0.13	nd	33	nd
RI-SO-45	0.2	0.13	nd		
Off-site Surface Water					
RI-SW-02	0.2	0.13	nd	33	nd
RI-SW-05	0.2	0.13	nd	33	nd

* From discussions with SDI and the field team, the field-based operational method detection limit (MDL) of the test kits was assessed to be approximately 0.2 ppm.

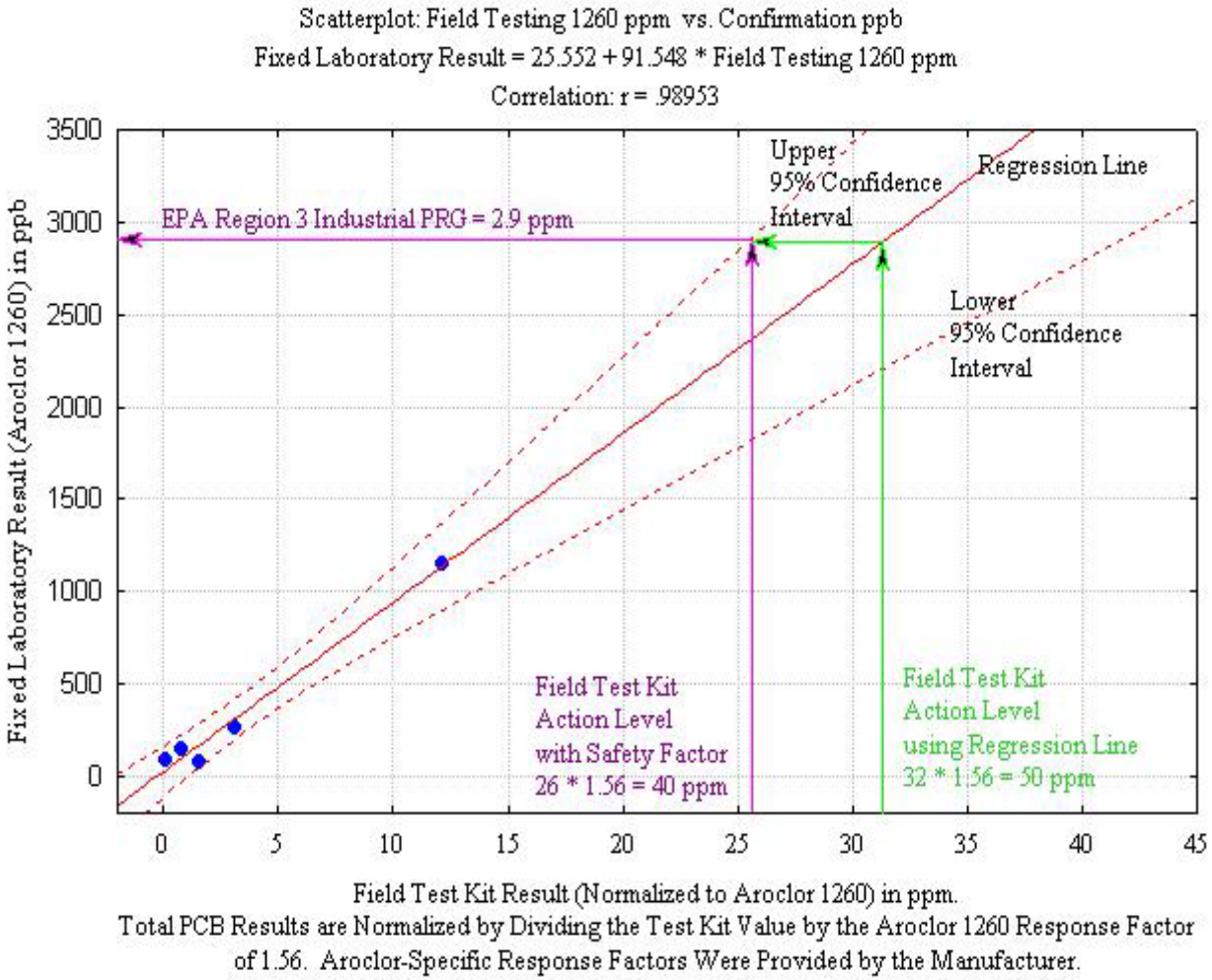
** The CLP data indicated that the major Aroclor detected was Aroclor 1260. Because the kits are calibrated based on Aroclor 1254, a correction factor of 1.56 was applied to the test kit data set to convert the reported concentrations from Aroclor 1254 to Aroclor 1260.

*** CLP reporting limit for Aroclors is 33 ppb.

nd	Not detected
J	Estimated concentration between the lowest calibration standard (0.5 ppm) and the method detection limit (0.2 ppm)
PPM	Parts per million (milligrams per kilogram)
PPB	Parts per billion (micrograms per kilogram)

Figure 1: Correlation Analysis for Field Test Kit and Fixed Laboratory Aroclor Data

Ross Incinerator Focused Site Inspection, July 2003



Confident Decision that True Concentration < Action Level

Final Field-based Action Level = 26 ppm Aroclor 1260 (including Safety Factor). Field-based Equivalent Result (Aroclor 1254) = 40 ppm

Confident Decision that True Concentration > Action Level

Initial Field-based Action Level = 32 ppm Aroclor 1260 (using Regression Line). Field-based Equivalent Result (Aroclor 1254) = 50 ppm

Add Safety Factor by using 95% Upper Confidence Limit of Regression Line

Figure 2: Statistical Plots for On-site Field Test Kit Data for Aroclors
Ross Incinerator Focused Site Assessment, July 2003