Missouri
Department of
Natural Resources

Site Investigation Findings Report
(March 10, 2010 Addendum)
Tannery Sludge Farm Fields Site
Agricultural Farm Fields Pilot Study
Andrew County, MO

Site Information:

ESP LDPR Code: FEPA8 HWP Staff: Michael Stroh
Job Code: NJ10TSFF Investigation Date: October 2, 2009

Introduction:

The Missouri Department of Natural Resources (MDNR) Environmental Services Program (ESP) conducted sampling related to an ongoing investigation of the Tannery Sludge Farm Fields Site on August 12, 2009. The sampling activities were described in a DNR Sampling Report dated November 9, 2009 (MDNR, 2009a). This addendum provides additional information regarding the agricultural fields pilot study, and is intended as an interim measure to document sampling activities. A full project report will be written by the HWP project manager when all sample results have been received and evaluated for the overall project.

Background:

Thirty discrete surface soil samples were collected from 3 farm field plots established in a pilot study field on August 12, 2009. The sampling was conducted to determine how well correlated the variability of total Cr (analyzed by XRF) is to the variability of hexavalent Cr (Cr^{+6}) (analyzed by lab) across different spatial scales in the agricultural field soils, and to aid in preparation of a sampling design for the subsequent full investigation. Those field activities are described in the November 9, 2009 ESP Sampling Report.

The data was evaluated statistically by the EPA Office of Superfund Remediation & Technology Innovation (TIO) using EPA's Visual Sampling Plan software, and used to design a sampling plan for assessing the agricultural farm fields (MDNR, 2009b). The design called for determining sampling density in the field based on total Cr XRF results, but specified a minimum of five 1-acre sampling units per 80-acre farm field decision unit, and collecting a minimum of 10 increments of soil per 1-acre sampling unit.

A residential yard pilot study was also conducted in October 2009 (MDNR, 2010a). As part of that pilot study it was determined that the laboratory method used by Test America Laboratories (TAL) for the farm fields pilot study, while adequate for assessing the farm fields, was not capable of providing the sensitivity needed to assess yards at the lower screening level (2 ppm for yards vs. 86 ppm for fields). Sample matrix interferences and a less specific detection system (spectrophotometric) required the laboratory to dilute the samples such that the reporting levels were too close to the screening level.

An alternative laboratory method was identified with a more sensitive and specific detection system (mass spectrometric) which is generally less susceptible to matrix interferences. This alternative method, available through Applied Speciation and Consulting (ASC), was used for re-analysis of the yard pilot study soil samples, and for the private well sampling conducted in December 2009 (MDNR, 2010b). In order to maintain consistency among results, the sampling team decided that all samples for the overall project should be analyzed for Cr^{+6} using the same analytical method. Since the farm fields sampling design was based on results for the less sensitive analytical method, the planning team needed to confirm that the use of the alternative method would not yield results that would require changes to the farm fields sampling design.

Therefore, two of the farm field pilot samples were submitted to ASC for Cr^{+6} analysis on December 29, 2009. The planning team was aware that the samples had exceeded the holding time limits specified in the sampling and analysis plan by the time they were submitted to ASC. However, the team decided to proceed with analysis due to a number of factors. The results of the analysis would be used primarily to confirm the existing sampling design and would not be used to directly make an environmental decision about the pilot study farm field – the field would be re-sampled later along with the other fields as part of the larger investigation once the sampling design was finalized. Secondly, the team felt that additional reduction of Cr^{6+} to Cr^{3+} was unlikely to occur over time within a containerized, dried and sieved soil matrix. Finally, the sampling design assumptions made based on the results of the reanalysis would be further tested using data obtained during the larger overall sampling event.

Findings:
Results for the two samples were received from ASC on January 21, 2010 (Appendix A). The results for the original TAL analysis and the ASC reanalysis are summarized together with the total Cr XRF results (Appendix B) in Table 1.

Table 1: Results for Reanalysis of Farm Field Pilot Samples

Original DNR Sample Number	TAL Transfer COC Sample Number	ASC Transfer COC Sample Number	Date Collected	Total Cr (XRF) (mg/kg)	TAL Cr^{6+} (mg/kg)	Ratio TAL Cr^{6+}:Cr (%)+	ASC Cr^{6+} (mg/kg)	Ratio ASC Cr^{6+}:Cr (%)	Location Collected & Description
0916260	AB03921	AB14504	08/12/09	192	27.5	14.3	0.40	0.2	Parcel 1 ID 5180 Sample A01
0916270	AB03931	AB14505	08/12/09	268	45.4	16.9	0.32	0.1	Parcel 1 ID 5180 Sample B01

The reanalysis results were approximately two orders of magnitude lower than the original results. All other factors being held the same, the larger the gap between the mean concentration of Cr^{6+} in the farm fields and the screening level, the fewer samples are required to make an environmental decision in the farm fields. Therefore, the ASC results show that the sampling

density in the design created based on the original pilot study samples results would be much greater than actually necessary to make an environmental decision with the stated level of uncertainty. The team elected to take a conservative approach and retain the existing sampling design even though it would likely result in an unnecessarily high sampling density.

However, since the results of the reanalysis were so significantly different, the sampling team wanted to confirm that the differences were due to an improved analytical method (removal of positive interferences) and not a result of reduction of Cr^{6+} to Cr^{3+} in samples stored past holding time limits.

Sample collection for the overall farm fields project began on January 25, 2010. In order to further investigate this issue, six discrete surface soil samples from that event were submitted to ASC for expedited Cr^{6+} analysis on February 2, 2010. Results were received on February 8, 2010 (Appendix A). Table 2 provides a summary of the total Cr XRF and Cr^{6+}results for the six farm field samples.

Table 2: Results for Six Farm Farm Field Samples

Original DNR Sample Number	ASC Transfer COC Sample Number	Date Collected	Total Cr (XRF) (mg/kg)	ASC Cr^{6+} (mg/kg)	Ratio Cr^{6+}:Cr %	Location Collected & Description
1000361	AB14350	1/26/10	206	1.71	0.8	Loc ID 218, SU 102.02
1000362	AB14351	1/26/10	68	1.00	1.5	Loc ID 218, SU 87.04
1000363	AB14352	1/26/10	302	1.76	0.6	Loc ID 202, SU 59.09
1000364	AB14353	1/26/10	616	4.88	0.8	Loc ID 202, SU 59.07
1000365	AB14354	1/26/10	132	2.08	1.6	Loc ID 202, SU 79.03
1000366	AB14355	1/26/10	424	1.59	0.4	Loc ID 218, SU 146.08

These results confirm previous findings, and indicate that the original Cr^{6+} results reported by TAL were most likely elevated do to positive matrix interferences, and not a holding time issue. The planning team will further test these findings by submission of a standard reference material containing a known and certified concentration of Cr^{6+} in a soil matrix as part of the overall project.

REFERENCES:

MDNR, 2009a Site Screening Sampling Report, Tannery Sludge Farm Fields Site, Union Star, Missouri, August 12, 2009, 6 pages with Appendices.

MDNR, 2009b Farm Fields and Residential Yards Sampling and Analysis Plan, Tannery Sludge Farm Fields, Andrew, Buchanan, Clinton, and DeKalb Counties, January 14, 2010, 30 pages with Appendices.

MDNR, 2010a Site Investigation Findings Report, Tannery Sludge Farm Fields Site, Residential Yard Pilot Study, Buchanan County, March 3, 2010, 4 pages with Appendices.

MDNR, 2010b Site Investigation Findings Report, Tannery Sludge Farm Fields Site, Andrew, Buchanan, Clinton, and DeKalb Counties, January 25, 2010, 3 pages with Appendices.

Prepared by: 3-17-10

Michael Stroh (Date)
Environmental Specialist
Site Assessment Unit
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Approved by: Julieann Warren 3-17-10

Julieann Warren (Date)
Chief, Site Assessment Unit
Hazardous Waste Program

MS:cc

c: Ken Hannon, DNR, Environmental Services Program

APPENDIX A

Chain of Custody/Analytical Results

Tannery Sludge Farm Fields Site
Agricultural Fields Pilot Study (March 10, 2010 Addendum)
Andrew County, MO

APPLIED SPECIATION AND CONSULTING, LLC

18804 Northcreek Parkway Bothell, WA, 98011
Tel: (425) 483-3300 Fax: (425) 483-9818
www.appliedspeciation.com

January 21, 2010

Michael Stroh
Missouri Department of Natural Resources
2710 W. Main St.
Jefferson City, MO 65109
(573) 522-9902

Dear Mr. Stroh,

Attached is the report associated with two (2) sediment samples submitted for hexavalent chromium quantitation on December 29, 2009. The samples were received on December 30, 2009 in a sealed cooler at -7.7°C. The submitted samples were extracted using EPA Method 3060A and then analyzed for hexavalent chromium via ion chromatography inductively coupled plasma dynamic reaction cell mass spectrometry (IC-ICP-DRC-MS). Any analytical issues associated with the analysis are addressed in the following report.

If you have any questions, please feel free to contact me at your convenience.

Sincerely,

Ben Wozniak
Project Manager
Applied Speciation and Consulting, LLC

Applied Speciation and Consulting, LLC

Report Prepared for:

Michael Stroh
Missouri Department of Natural Resources
2710 W. Main St.
Jefferson City, MO 65109

January 21, 2010

1. Sample Reception

Two (2) sediment samples were submitted in wide-mouth glass jars (not provided by Applied Speciation and Consulting) for hexavalent chromium quantitation on December 29, 2009. The samples were received in acceptable condition on December 30, 2009 in a sealed cooler at -7.7°C.

All samples were received in a laminar flow clean hood void of trace metals contamination and ultra-violet radiation. Upon reception, all samples were designated discrete sample identifiers and then stored in a secure, monitored refrigerator (maintained at a temperature of $\leq 4^{\circ}C$) until all preparatory and analytical procedures could be performed.

2. Sample Preparation

All sample preparation is performed in laminar flow clean hoods known to be free from trace metals contamination. All applied water for dilutions and sample preservatives are monitored for contamination to account for any biases associated with the sample results.

Hexavalent Chromium Quantification by IC-ICP-DRC-MS Prior to analysis, all samples were extracted using EPA Method 3060A on January 14, 2010. In summary, each sample was first spread into a thin layer onto a clean surface and a known mass of each sample was then weighed into a polypropylene centrifuge tube by taking approximately fifteen random subsamples of the original sample. A buffered alkaline extraction solution, $MgCl_2$, and a phosphate buffer solution were then applied to each sample. All vials were then heated at 90-95°C in a sonicating bath for a minimum of one (1) hour. The resulting extracts were cooled, filtered, and injected directly into sealed autosampler vials prior to analysis for hexavalent chromium.

3. Sample Analysis

All sample analysis is preceded by a minimum of a five-point calibration curve spanning the entire concentration range of interest. Calibration curves are performed

at the beginning of each analytical day. All calibration curves, associated with each species of interest, are standardized by linear regression resulting in a response factor. All sample results are **instrument blank corrected** to account for any operational biases associated with the analytical platform.

Prior to sample analysis, all calibration curves are verified using second source standards which are identified as initial calibration verification standards (ICV).

Ongoing instrument performance is identified by the analysis of continuing calibration verification standards (CCV) and continuing calibration blanks (CCB) at a minimal interval of every ten analytical runs.

Hexavalent Chromium Quantitation by IC-ICP-DRC-MS All sample extracts for hexavalent chromium quantitation were analyzed via a modified version of EPA Method 7199 employing ion chromatography inductively coupled plasma dynamic reaction cell mass spectrometry (IC-ICP-DRC-MS) on January 15 and January 18, 2010. Aliquots of each sample are injected onto an anion exchange column and mobilized by an alkaline (pH > 7) gradient. The eluting chromium species are then introduced into a radio frequency (RF) plasma where energy-transfer processes cause desolvation, atomization, and ionization. The ions are extracted from the plasma through a differentially-pumped vacuum interface and travel through a pressurized chamber (DRC) containing a specific reactive gas which preferentially reacts with interfering ions of the same target mass to charge (m/z) ratios. A solid-state detector detects ions transmitted through the mass analyzer, on the basis of their mass-to-charge ratio (m/z), and the resulting current is processed by a data handling system.

The retention time for hexavalent chromium is compared to known standards for species identification.

4. Analytical Issues

Although the overall analyses went well, significant issues were encountered during the applied extraction procedure, as described below.

Hexavalent Chromium Quantitation - Laboratory Control Samples Three laboratory control samples were extracted with the submitted samples to identify the extraction efficiency and capacity of the extraction procedure to induce conversion of trivalent chromium to hexavalent chromium. The laboratory control samples spiked with an aqueous hexavalent chromium and a solid $PbCrO_4$ standard produced acceptable recoveries (98.6% and 91.5%, respectively), indicating that the applied method effectively extracts and stabilizes the hexavalent chromium species. The third laboratory control sample spiked with an aqueous trivalent chromium standard solution resulted in a hexavalent chromium recovery of 0.4%. The quantity of hexavalent chromium detected in this LCS is near the level present in the preparation blanks, which is attributed to trace levels of hexavalent chromium in the reagents used for the extraction procedure. This low recovery for the trivalent chromium spike

demonstrates that the extraction procedure, under ideal conditions, induces minimal conversion of trivalent to hexavalent chromium.

Hexavalent Chromium Quantitation – Matrix Spike / Matrix Spike Duplicates (MS/MSDs) Similar to the laboratory control samples, three discrete sets of matrix spikes were extracted to identify the interaction of the sample matrix with trivalent and hexavalent chromium. The performance of the matrix spikes can assist in identifying chemical interferences associated with the sample matrix and the applied extraction procedure.

Hexavalent Chromium Quantitation – Cr(III) MS/MSDs The hexavalent chromium recoveries associated with each aqueous trivalent chromium MS and MSD were less than 1%. These low trivalent chromium matrix spike recoveries suggest that the extraction procedure induces minimal oxidation of trivalent chromium to hexavalent chromium in the spiked sample matrix.

The RPD associated with the MSD performed on the sample identified as AB03921 was above the established control limit of 25% (101.9%). This elevated RPD is attributable to the fact that a minimal amount of the trivalent chromium spikes were converted to hexavalent chromium during the applied extraction procedure, as expected, resulting in hexavalent chromium concentrations that represented an increase in Cr(VI) above the ambient sample concentration that was less than the RL. Since greater variability is expected as sample concentrations approach the RL, the elevated RPD is identified as an inherent limitation of any quantitative method and does not impact the validity of the reported results.

Hexavalent Chromium Quantitation – Aqueous Cr(VI) and Solid $PbCrO_4$ MS/MSDs The hexavalent chromium recoveries associated with both the soluble and insoluble hexavalent chromium matrix spikes performed on the sample identified as AB03921 were below the established control limit of 75% for all spiked samples (see attached results). The obtained matrix spike recoveries indicate that significant interference was encountered during the applied extraction procedure. As previously mentioned, the recoveries associated with both the soluble hexavalent chromium LCS and insoluble hexavalent chromium LCS were within control, demonstrating that the applied method both extracts and stabilizes hexavalent chromium. Since the low bias observed for all of the matrix spikes may therefore be attributed to interference from the sample matrices, no further corrective action was deemed necessary. The reported results suggest that the spiked sample matrix favors reduction of hexavalent chromium.

It must be noted that during the analysis of the submitted samples, the instrument sensitivity drifted to approximately seventy percent (70%) of that of the initial calibration, as determined by the CCV recoveries. This instrument drift was noted by the analyst, who analyzed a second calibration curve (on January 18th) after most of the sample batch had already been analyzed (on January 15th). When the second calibration curve was then applied to the sample results immediately preceding this

calibration, the recoveries of the CCVs bracketing these samples improved from approximately 70% to 83.8-90.6%. Since these latter recoveries are within Applied Speciation and Consulting's control limits for CCVs and demonstrate acceptable instrument sensitivity at the time these samples were analyzed, all reported sample results from January 15th have been calculated using the second calibration curve.

It should be noted that the estimated method detection limit (eMDL) for hexavalent chromium for solids is generated using the standard deviation of the associated preparation blanks, in accordance with Applied Speciation and Consulting's SOP.

If you have any questions or concerns regarding this report, please feel free to contact me.

Sincerely,

Ben Wozniak
Project Manager
Applied Speciation and Consulting, LLC

Hexavalent Chromium Results for the Missouri Department of Natural Resources
Contact: Michael Stroh

Date: January 21, 2010
Report Generated by: Ben Wozniak
Applied Speciation and Consulting, LLC

Sample Results

Sample ID	Date & Time Analyzed*	Cr(VI)
AB03921	1/15/2010 16:40	0.399
AB03931	1/15/2010 17:43	0.323

All results are reported in mg/kg (as received)
* Times reported in CST

Hexavalent Chromium Results for the Missouri Department of Natural Resources
Contact: Michael Stroh

Date: January 21, 2010
Report Generated by: Ben Wozniak
Applied Speciation and Consulting, LLC

Quality Control Summary - Preparation Blank Summary

Analyte (mg/kg)	PBS1	PBS2	PBS3	PBS4	Mean	StdDev	eMDL	RL
Cr(VI)	0.015	0.015	0.016	0.015	0.015	0.001	0.002	0.025

eMDL = Estimated Method Detection Limit
RL = Reporting Limit

Quality Control Summary - Laboratory Control Samples

Analyte (mg/kg)	LCS	True Value	Result	Recovery
Cr(VI)	LCS	5.000	4.932	98.6
Cr(III)	LCS	5.000	0.019	0.4
$PbCrO_4$	LCS	3314	3034	91.5

Hexavalent Chromium Results for the Missouri Department of Natural Resources
Contact: Michael Stroh

Date: January 21, 2010
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Applied Speciation and Consulting, LLC

Quality Control Summary - Matrix Duplicate

Analyte (mg/kg)	Sample ID	Rep 1	Rep 2	Mean	RPD
Cr(VI)	AB03921	0.399	0.332	0.365	18.2

Quality Control Summary - Matrix Spike/ Matrix Spike Duplicate

Analyte (mg/kg)	Sample ID	Spike Conc	MS Result	Recovery	Spike Conc	MSD Result	Recovery	RPD
Cr(III)	AB03921	5.114	0.327	-0.8	4.932	0.353	-0.2	101.9**
Cr(VI)	AB03921	4.851	0.347	-0.4*	4.973	0.347	-0.4*	2.4
$PbCrO_4$	AB03921	3601	1945	54.0*	3753	2217	59.0*	8.9

* The recovery is below the established control limit of 75%; please see narrative.
** The RPD is above the established control limit of 25%; please see narrative.

Hexavalent Chromium Results for the Missouri Department of Natural Resources
Contact: Michael Stroh

Date: January 21, 2010
Report Generated by: Ben Wozniak
Applied Speciation and Consulting, LLC

Quality Control Summary - Historical Calibration Standards

Cr(VI) True Value	Cr(VI) Measured Result	Percent Recovery
0.050	0.065	130.8
0.050	0.055	110.7
0.050	0.062	124.5
0.050	0.062	124.8
0.500	0.502	100.4
5.000	5.020	100.4
50.00	49.99	100.0
0.050	0.060	120.0
0.050	0.060	120.9
0.050	0.056	111.4
0.050	0.060	120.1
0.500	0.442	88.5
5.000	5.062	101.2
50.00	49.98	100.0
0.050	0.058	116.4
0.050	0.052	103.4
0.050	0.059	117.7
0.050	0.056	111.0
0.500	0.496	99.3
5.000	5.117	102.3
25.00	24.96	99.8

All results are reported in µg/L

Hexavalent Chromium Results for the Missouri Department of Natural Resources
Contact: Michael Stroh

Date: January 21, 2010
Report Generated by: Ben Wozniak
Applied Speciation and Consulting, LLC

Quality Control Summary - Historical CCV Standards

Cr(VI) True Value	Cr(VI) Measured Result	Percent Recovery
5.000	5.328	106.6
5.000	5.385	107.7
5.000	5.390	107.8
5.000	5.533	110.7
5.000	5.559	111.2
5.000	5.377	107.5
5.000	4.531	90.6
5.000	4.294	85.9
5.000	4.483	89.7
5.000	4.372	87.4
5.000	4.192	83.8
5.000	4.180	83.6
5.000	5.157	103.1
5.000	5.119	102.4
5.000	5.150	103.0
5.000	4.990	99.8
5.000	4.728	94.6
5.000	4.824	96.5
5.000	4.904	98.1
5.000	5.045	100.9

CCV = Continuing Calibration Verification
All results are reported in µg/L

Hexavalent Chromium Results for the Missouri Department of Natural Resources
Contact: Michael Stroh

Date: January 21, 2010
Report Generated by: Ben Wozniak
Applied Speciation and Consulting, LLC

Quality Control Summary - Historical Second Source Standards

Cr(VI) True Value	Cr(VI) Measured Result	Percent Recovery
5.000	4.932	98.6
200.0	218.7	109.4
4.000	3.795	94.9
200.0	204.6	102.3
20.00	20.04	100.2
100.0	95.38	95.4
20.00	19.73	98.7
40.00	39.83	99.6
20.00	18.90	94.5
1010	1054	104.3
505.0	513.7	101.7
505.0	472.3	93.5
505.0	478.0	94.7
505.0	474.2	93.9
202.0	214.0	105.9
5.000	5.107	102.1
10.00	12.09	120.9
5.000	5.495	109.9

Second source standard = Cr(VI) Blank Spike (from 3060A Extraction)
All results are reported in mg/kg

Hexavalent Chromium Results for the Missouri Department of Natural Resources
Contact: Michael Stroh

Date: January 21, 2010
Report Generated by: Ben Wozniak
Applied Speciation and Consulting, LLC

Quality Control Summary - Historical Matrix Spikes

Ambient Cr(VI) Conc.	MS Spike Conc.	MS Measured Result	MS Recovery	MSD Spike Conc.	MSD Measured Result	MSD Recovery	RPD
2.961	221.2	257.4	115.0	209.2	216.7	102.1	11.9
2.853	150.2	167.7	109.8	226.2	243.7	106.4	3.1
3.647	4.009	6.202	63.7	4.061	6.469	69.5	8.7
1.351	163.9	162.5	98.3	266.7	282.0	105.2	6.8
131.4	40.07	179.8	120.9	38.99	164.2	84.1	35.9
0.889	208.7	148.3	70.6	208.7	139.2	66.3	6.3
1.219	184.0	160.6	86.6	205.3	181.5	87.8	1.4
0.003	18.72	0.126	0.7	19.48	0.125	0.6	5.1
151.2	935.2	1081	99.4	795.3	926.5	97.5	2.0
132.8	506.8	534.0	79.2	483.5	527.1	81.6	3.0
126.8	867.7	947.6	94.6	765.2	834.1	92.4	2.3
0.187	4.046	3.095	71.9	3.775	2.961	73.5	2.2
0.160	4.017	4.214	100.9	4.078	4.038	95.1	5.9
0.080	3.906	3.657	91.6	3.959	3.600	88.9	2.9
0.101	5.052	3.646	70.2	4.694	3.300	68.2	2.9
0.224	4.910	2.551	47.4	4.893	2.361	43.7	8.2
0.342	4.885	3.534	65.4	4.820	3.424	63.9	2.2
0.070	18.83	0.214	0.8	18.42	1.851	9.7	170.7
0.118	43.67	44.23	101.0	54.70	53.27	97.2	3.9
0.077	4.976	3.343	65.6	5.124	3.790	72.5	9.9

All results are reported in mg/kg

MISSOURI DEPARTMENT OF NATURAL RESOURCES

FIELD SHEET AND CHAIN-OF-CUSTODY RECORD

LABORATORY ORDER ID: _____

Collector's Name: (Please Print) Transfer COC to Applied Speciation and Consulting, LLC

Affiliation: (circle one) ESP KCRO NERO SERO SLRO SWRO WPP DGLS HWP Other:

Description of Shipment

x Shipped-Carrier: Next Day Air

x Tape sealed and initialed

Hand Delivered

No. Of Containers: 2

Sample Number	Sample Collected	Analyses						Sample Type	For Lab Use Only: Matrix	Container		Preserved
AB03921 AB14504 (Sample A)	Date: 08/12/09	Hexavalent Cr						x Grab / Composite / Modified	Water / 1 Soil / Organic / Sludge / Other:	1L amber / Cubitainer / 2 oz glass / 1 8 oz glass / VOA vial / Encore / Other:	120 mL / Nalgene / 1L / 500mL / 250mL	H_2SO_4 / HNO_3 / NAOH / HCL / 1 4° C(None) / Disinfected / Other
For Lab Use Only	Time: 1132	D.O	Flow	pH	Spec. Cond.	Temp.	Other:	Other:				
AB03931 AB14505 (Sample B)	Date: 08/12/09	Hexavalent Cr						x Grab / Composite / Modified	Water / 1 Soil / Organic / Sludge / Other:	1L amber / Cubitainer / 1 2 oz glass / 8 oz glass / VOA vial / Encore / Other:	120 mL / Nalgene / 1L / 500mL / 250mL	H_2SO_4 / HNO_3 / NAOH / HCL / 1 4° C(None) / Disinfected / Other
For Lab Use Only	Time: 1245	D.O	Flow	pH	Spec. Cond.	Temp.	Other:	Other:				
(Sample C)	Date:							Grab / Composite / Modified	Water / Soil / Organic / Sludge / Other:	1L amber / Cubitainer / 2 oz glass / 8 oz glass / VOA vial / Encore / Other:	120 mL / Nalgene / 1L / 500mL / 250mL	H_2SO_4 / HNO_3 / NAOH / HCL / 4° C(None) / Disinfected / Other
For Lab Use Only	Time:	D.O	Flow	pH	Spec. Cond.	Temp.	Other:	Other:				
(Sample D)	Date:							Grab / Composite / Modified	Water / Soil / Organic / Sludge / Other:	1L amber / Cubitainer / 2 oz glass / 8 oz glass / VOA vial / Encore / Other:	120 mL / Nalgene / 1L / 500mL / 250mL	H_2SO_4 / HNO_3 / NAOH / HCL / 4° C(None) / Disinfected / Other
For Lab Use Only	Time:	D.O	Flow	pH	Spec. Cond.	Temp.	Other:	Other:				

Relinquished By: [signature] 12/29/09	Received By: [signature] Stefanie Keller	Date: 12/30/09 -7.7°C	Time: 1002
Relinquished By:	Received By:	Date:	Time:
Relinquished By:	Received By:	Date:	Time:

60
75

Sample I.D. Letter	Site Description						
Sample A	**Facility ID:**	**Site/Study Name:**	**County:**			**LDPR Code:**	**Job Code:**
	Sample Comment (briefly describe where and how the sample was collected, station number, sample type, etc.):						
	GPS Coordinates (Record Coordinates in UTM Zone 15 NAD 83 Only):		**Accuracy**	(check one)		**Sample Reference ID:**	
	X Easting	**Y Northing**		**EPE (meters)**			
				PDOP			
Sample B	**Facility ID:**	**Site/Study Name:**	**County:**			**LDPR Code:**	**Job Code:**
	Sample Comment (briefly describe where and how the sample was collected, station number, sample type, etc.):						
	GPS Coordinates (Record Coordinates in UTM Zone 15 NAD 83 Only):		**Accuracy**	(check one)		**Sample Reference ID:**	
	X Easting	**Y Northing**		**EPE (meters)**			
				PDOP			
Sample C	**Facility ID:**	**Site/Study Name:**	**County:**			**LDPR Code:**	**Job Code:**
	Sample Comment (briefly describe where and how the sample was collected, station number, sample type, etc.):						
	GPS Coordinates (Record Coordinates in UTM Zone 15 NAD 83 Only):		**Accuracy**	(check one)		**Sample Reference ID:**	
	X Easting	**Y Northing**		**EPE (meters)**			
				PDOP			
Sample D	**Facility ID:**	**Site/Study Name:**	**County:**			**LDPR Code:**	**Job Code:**
	Sample Comment (briefly describe where and how the sample was collected, station number, sample type, etc.):						
	GPS Coordinates (Record Coordinates in UTM Zone 15 NAD 83 Only):		**Accuracy**	(check one)		**Sample Reference ID:**	
	X Easting	**Y Northing**		**EPE (meters)**			
				PDOP			

REMARKS:

Missouri Department of Natural Resources
Environmental Services Program

RECEIVED
FEB 22 2010
Hazardous Waste Program
MO Dept. of Natural Resources

Order ID 100217007 **Program, Contact:** HWP Julieann Warren

Report Date: 02/18/2010 **LDPR/JobCode:** FEPA8 / NJ097SFA

Sample: AB14504

Customer #: AB03921

Facility ID:
County: Andrew
Collector: SEAN COUNIHAN
Sample Comment: Soil Grab A01

Site: Tannery Sludge Farm Fields
Sample Reference ID: 5180
Affiliation: ESP
Collect Date: 8/12/2009 11:32:00AM

Test	Parameter	Result	Qualifier	Units	QC Batch ID	Method
Hexavalent Chromium	Hexavalent Chromium	0.40		mg/Kg		Contract Lab Dep

The analysis of this sample was performed in accordance with procedures approved or recognized by the U.S Environmental Protection Agency.

Chris Boldt

Chris Boldt, Laboratory Manager
Environmental Services Program
Field Services Division

Qualifier Descriptions

01 Improper collection method
02 Improper preservation
03 Exceeded holding time
04 Analyzed by Contract Laboratory
05 Estimated value, detected below PQL
06 Estimated value, QC data outside limits
07 Estimated value, analyte outside calibration range
08 Analyte present in blank at > 1/2 reported value
09 Sample was diluted during analysis
10 Laboratory error
11 Estimated value, matrix interference
12 Insufficient quantity
13 Estimated value, true result is > reported value
14 Estimated value, non-homogeneous sample
15 No Result - Failed Quality Controls Requirements
16 Not analyzed - related analyte not detected
17 Results in dry weight
18 Sample pH is outside the acceptable range
19 Estimated value
20 Not analyzed - Instrument failure
21 No result - spectral interference
22 pH was performed at the Laboratory
ND Not detected at reported value
23 Contract Lab specific qualifier - see sample comments

Missouri Department of Natural Resources
Environmental Services Program

Order ID 100217007 **Program, Contact:** HWP Julieann Warren

Report Date: 02/18/2010 **LDPR/JobCode:** FEPA8 / NJ097SFA

Sample: AB14505

Customer #: AB03931

Facility ID:
County: Andrew
Collector: SEAN COUNIHAN
Sample Comment: Soil grab B01

Site: Tannery Sludge Farm Fields
Sample Reference ID: 5180
Affiliation: ESP
Collect Date: 8/12/2009 12:45:00PM

Test	Parameter	Result	Qualifier	Units	QC Batch ID	Method
Hexavalent Chromium	Hexavalent Chromium	0.32		mg/Kg		Contract Lab Dep

The analysis of this sample was performed in accordance with procedures approved or recognized by the U.S Environmental Protection Agency.

Chris Boldt, Laboratory Manager
Environmental Services Program
Field Services Division

Qualifier Descriptions

01 Improper collection method
02 Improper preservation
03 Exceeded holding time
04 Analyzed by Contract Laboratory
05 Estimated value, detected below PQL
06 Estimated value, QC data outside limits
07 Estimated value, analyte outside calibration range
08 Analyte present in blank at > 1/2 reported value
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11 Estimated value, matrix interference
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14 Estimated value, non-homogeneous sample
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16 Not analyzed - related analyte not detected
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18 Sample pH is outside the acceptable range
19 Estimated value
20 Not analyzed - Instrument failure
21 No result - spectral interference
22 pH was performed at the Laboratory
ND Not detected at reported value
23 Contract Lab specific qualifier - see sample comments

Preliminary Results for the Six Sediments Submitted on February 3, 2010 for Expedited Cr(VI) Analysis

Ben Wozniak to Julieann Warren, Michael Stroh, Ron Heckman 02/08/2010 06:55 PM

Please respond to ben

Attached are the preliminary sample results associated with the six (6) sediment samples submitted for expedited Cr(VI) quantitation on February 3rd.

I apologize for the delay in the final report, but we are performing an additional total solids analysis on the sample identified as AB14355 to confirm that the obtained result (87.5% solids) was not biased due to a preparatory error. All other reported Cr(VI) results should not change in the final report, however.

Once we have completed the analyses we will ship these 6 samples back to the attention on Ken Hannon, as you requested Michael. If you have any questions or concerns about these samples in the meantime, please contact me at your convenience.

Best regards,
Ben

Ben Wozniak
Project Manager
Applied Speciation and Consulting, LLC
www.appliedspeciation.com
email: ben@appliedspeciation.com
Phone: (425) 483-3300
Fax: (425) 483-9818

Important announcement!! Applied Speciation and Consulting has moved. Our new address is 18804 Northcreek Parkway Bothell, WA 98011. Our new phone number is (425) 483-3300 and fax number (425) 483-9818. All communication and samples should be directed to the new contact information provided in this notification. Please update your records.

or other nondisclosure protection. If you believe that it has been sent to you in error you may not read, disclose, print, copy, store or disseminate the e-mail, any attachments, or the information in them. Please reply to the sender that you have received the message in error and then delete it. Thank you.

Missouri DNR 02.04.09 Fast TAT Samples Preliminary Results.pdf

APPLIED SPECIATION AND CONSULTING, LLC

18804 Northcreek Parkway Bothell, WA, 98011
Tel: (425) 483-3300 Fax: (425) 483-9818
www.appliedspeciation.com

February 15, 2010

Michael Stroh
Missouri Department of Natural Resources
2710 W. Main St.
Jefferson City, MO 65109
(573) 522-9902

Dear Mr. Stroh,

Attached is the report associated with six (6) sediment samples submitted for hexavalent chromium quantitation on February 3, 2010. The samples were received on February 4, 2010 in a sealed cooler at -0.2°C. The submitted samples were extracted using EPA Method 3060A and then analyzed for hexavalent chromium via ion chromatography inductively coupled plasma dynamic reaction cell mass spectrometry (IC-ICP-DRC-MS). Any analytical issues associated with the analysis are addressed in the following report.

If you have any questions, please feel free to contact me at your convenience.

Sincerely,

Ben Wozniak
Project Manager
Applied Speciation and Consulting, LLC

Applied Speciation and Consulting, LLC

Report Prepared for:

Michael Stroh
Missouri Department of Natural Resources
2710 W. Main St.
Jefferson City, MO 65109

February 15, 2010

1. Sample Reception

Six (6) sediment samples were submitted in wide-mouth glass jars (not provided by Applied Speciation and Consulting) for hexavalent chromium quantitation on February 3, 2010. The samples were received in acceptable condition on February 4, 2010 in a sealed cooler at -0.2°C.

All samples were received in a laminar flow clean hood void of trace metals contamination and ultra-violet radiation. Upon reception, all samples were designated discrete sample identifiers and then stored in a secure, monitored refrigerator (maintained at a temperature of $\leq 4^{\circ}C$) until all preparatory and analytical procedures could be performed.

2. Sample Preparation

All sample preparation is performed in laminar flow clean hoods known to be free from trace metals contamination. All applied water for dilutions and sample preservatives are monitored for contamination to account for any biases associated with the sample results.

Hexavalent Chromium Quantification by IC-ICP-DRC-MS Prior to analysis, all samples were extracted using EPA Method 3060A on February 5, 2010. In summary, each sample was first spread into a thin layer onto a clean surface and a known mass of each sample was then weighed into a polypropylene centrifuge tube by taking approximately fifteen random subsamples of the original sample. A buffered alkaline extraction solution, $MgCl_2$, and a phosphate buffer solution were then applied to each sample. All vials were then heated at 90-95°C in a sonicating bath for a minimum of one (1) hour. The resulting extracts were cooled, filtered, and injected directly into sealed autosampler vials prior to analysis for hexavalent chromium.

3. Sample Analysis

All sample analysis is preceded by a minimum of a five-point calibration curve spanning the entire concentration range of interest. Calibration curves are performed

at the beginning of each analytical day. All calibration curves, associated with each species of interest, are standardized by linear regression resulting in a response factor. All sample results are **instrument blank corrected** to account for any operational biases associated with the analytical platform. All sample results have also been **dry-weight corrected** using the measured total solids (percent moisture) values.

Prior to sample analysis, all calibration curves are verified using second source standards which are identified as initial calibration verification standards (ICV).

Ongoing instrument performance is identified by the analysis of continuing calibration verification standards (CCV) and continuing calibration blanks (CCB) at a minimal interval of every ten analytical runs.

Hexavalent Chromium Quantitation by IC-ICP-DRC-MS All sample extracts for hexavalent chromium quantitation were analyzed via a modified version of EPA Method 7199 employing ion chromatography inductively coupled plasma dynamic reaction cell mass spectrometry (IC-ICP-DRC-MS) on February 5, 2010. Aliquots of each sample are injected onto an anion exchange column and mobilized by an alkaline (pH > 7) gradient. The eluting chromium species are then introduced into a radio frequency (RF) plasma where energy-transfer processes cause desolvation, atomization, and ionization. The ions are extracted from the plasma through a differentially-pumped vacuum interface and travel through a pressurized chamber (DRC) containing a specific reactive gas which preferentially reacts with interfering ions of the same target mass to charge (m/z) ratios. A solid-state detector detects ions transmitted through the mass analyzer, on the basis of their mass-to-charge ratio (m/z), and the resulting current is processed by a data handling system.

The retention time for hexavalent chromium is compared to known standards for species identification.

Total Solids Analysis Approximately 1-2 grams of each sample was placed into a pre-weighed pan, and the combined mass of the sample and pan was recorded. All samples were then placed into a convection oven maintained at a temperature of 65-70°C. After drying for a minimum of eight (8) hours, all samples were briefly cooled and reweighed. The total solids percentage of each sample was calculated by dividing the weight of the dried sample by the weight of the original sample.

4. Analytical Issues

Although the overall analyses went well, significant issues were encountered during the applied extraction procedure, as described below.

Hexavalent Chromium Quantitation - Laboratory Control Samples Three laboratory control samples were extracted with the submitted samples to identify the extraction efficiency and capacity of the extraction procedure to induce conversion of trivalent chromium to hexavalent chromium. The laboratory control samples spiked with an aqueous hexavalent chromium and a solid $PbCrO_4$ standard produced acceptable

recoveries (101.5% and 97.8%, respectively), indicating that the applied method effectively extracts and stabilizes the hexavalent chromium species. The third laboratory control sample spiked with an aqueous trivalent chromium standard solution resulted in a hexavalent chromium recovery of 0.2%. The quantity of hexavalent chromium detected in this LCS is near the level present in the preparation blanks, which is attributed to trace levels of hexavalent chromium in the reagents used for the extraction procedure. This low recovery for the trivalent chromium spike demonstrates that the extraction procedure, under ideal conditions, induces minimal conversion of trivalent to hexavalent chromium.

Hexavalent Chromium Quantitation – Matrix Spike / Matrix Spike Duplicates (MS/MSDs) Similar to the laboratory control samples, three discrete sets of matrix spikes were extracted to identify the interaction of the sample matrix with trivalent and hexavalent chromium. The performance of the matrix spikes can assist in identifying chemical interferences associated with the sample matrix and the applied extraction procedure.

Hexavalent Chromium Quantitation – Cr(III) MS/MSDs The hexavalent chromium recoveries associated with each aqueous trivalent chromium MS and MSD were less than 3%. The increase in the Cr(VI) concentration for each trivalent chromium matrix spike was less than the ambient Cr(VI) sample concentration. These low trivalent chromium matrix spike recoveries confirm that the extraction procedure induces minimal oxidation of trivalent chromium to hexavalent chromium in the spiked sample matrices.

The RPD associated with the MSD performed on the sample identified as AB14350 was above the established control limit of 25% (322.1%). This elevated RPD is attributable to the fact that a minimal amount of the trivalent chromium spikes were converted to hexavalent chromium during the applied extraction procedure, as expected, resulting in sample concentrations that reflected an increase in Cr(VI) that was less than the ambient concentration. Since greater variability is expected when the increase in Cr(VI) attributable to the spike is less than the ambient concentration, no corrective action was required.

Hexavalent Chromium Quantitation – Solid $PbCrO_4$ MS/MSDs The hexavalent chromium recoveries associated with the insoluble hexavalent chromium MS and MSD performed on the sample identified as AB14350 were within acceptance limits (86.2% and 85.2%, respectively). These acceptable recoveries suggest that the applied method effectively extracts hexavalent chromium in this particular sample matrix.

Hexavalent Chromium Quantitation – Aqueous Cr(VI) MS/MSDs The hexavalent chromium recoveries associated with the soluble hexavalent chromium MS and MSD performed on the sample identified as AB14350 were below the established control limit of 75% (23.8% and 19.7%, respectively). As previously mentioned, the recovery of the aqueous hexavalent chromium LCS was within acceptance limits,

demonstrating that the applied extraction procedure stabilizes this species in solution. Since the biased low recoveries observed for these matrix spikes may therefore be attributed to interference from the sample matrix, no further corrective action was deemed necessary. These MS/MSD results suggest that the matrix of AB14350 favors reduction of hexavalent chromium.

It should be noted that the estimated method detection limit (eMDL) for hexavalent chromium for solids is generated using the standard deviation of the associated preparation blanks, in accordance with Applied Speciation and Consulting's SOP.

During the analyses for hexavalent chromium, the mean of the preparation blanks (0.039mg/kg) extracted concurrently with the submitted samples was above the reporting limit (RL) of 0.025mg/kg. Similarly, the eMDL (0.029mg/kg) was elevated above the RL. Since the concentration of hexavalent chromium in each submitted sample is greater than twenty times both the elevated blank mean and the eMDL, the impact of these elevated parameters on the measured sample concentrations is minimal. No corrective action was deemed necessary and the reported results are deemed representative of the submitted samples.

If you have any questions or concerns regarding this report, please feel free to contact me.

Sincerely,

Ben Wozniak
Project Manager
Applied Speciation and Consulting, LLC

Hexavalent Chromium Results for the Missouri Department of Natural Resources
Contact: Michael Stroh

Date: February 15, 2010
Report Generated by: Ben Wozniak
Applied Speciation and Consulting, LLC

Sample Results

Sample ID	Date & Time Analyzed for Cr(VI)*	Cr(VI) in mg/kg (dw)	% Solids
AB14350	2/5/2010 15:38	1.71	99.3
AB14351	2/5/2010 16:31	1.00	99.1
AB14352	2/5/2010 16:36	1.76	97.3
AB14353	2/5/2010 17:08	4.88	96.9
AB14354	2/5/2010 17:13	2.08	99.5
AB14355	2/5/2010 17:18	1.59	87.5

dw = dry weight
* Times reported in CST

Hexavalent Chromium Results for the Missouri Department of Natural Resources
Contact: Michael Stroh

Date: February 15, 2010
Report Generated by: Ben Wozniak
Applied Speciation and Consulting, LLC

Quality Control Summary - Preparation Blank Summary

Analyte	Units	PBS1	PBS2	PBS3	PBS4	Mean	StdDev	eMDL	RL
Cr(VI)	mg/kg (dw)	0.050	0.042	0.032	0.030	0.039	0.009	0.028	0.025

eMDL = Estimated Method Detection Limit
RL = Reporting Limit

Quality Control Summary - Laboratory Control Samples

Analyte	Units	LCS	True Value	Result	Recovery
Cr(VI)	mg/kg (dw)	LCS	20.00	20.30	101.5
Cr(III)	mg/kg (dw)	LCS	20.00	0.034	0.2
$PbCrO_4$	mg/kg (dw)	LCS	5566	5447	97.8

Hexavalent Chromium Results for the Missouri Department of Natural Resources
Contact: Michael Stroh

Date: February 15, 2010
Report Generated by: Ben Wozniak
Applied Speciation and Consulting, LLC

Quality Control Summary - Matrix Duplicate

Analyte	Units	Sample ID	Rep 1	Rep 2	Mean	RPD
% Solids	%	AB14350	99.3	99.3	99.3	0.0
Cr(VI)	mg/kg (dw)	AB14350	1.708	1.923	1.816	11.8

Quality Control Summary - Matrix Spike/ Matrix Spike Duplicate

Analyte	Units	Sample ID	Spike Conc	MS Result	Recovery	Spike Conc	MSD Result	Recovery	RPD
Cr(III)	mg/kg (dw)	AB14350	20.54	1.717	-0.5*	19.88	2.227	2.1*	322.1**
Cr(VI)	mg/kg (dw)	AB14350	20.46	6.685	23.8*	20.39	5.832	19.7*	18.8
$PbCrO_4$	mg/kg (dw)	AB14350	7384	6367	86.2	7255	6183	85.2	1.2

* The recovery is below the established control limit of 75%; please see narrative.
** The RPD is above the established control limit of 25%; please see narrative.

Hexavalent Chromium Results for the Missouri Department of Natural Resources
Contact: Michael Stroh

Date: February 15, 2010
Report Generated by: Ben Wozniak
Applied Speciation and Consulting, LLC

Quality Control Summary - Historical Calibration Standards

Cr(VI) True Value	Cr(VI) Measured Result	Percent Recovery
0.050	0.053	106.7
0.050	0.056	112.3
0.050	0.067	134.5
0.050	0.052	103.6
0.500	0.501	100.2
5.000	4.929	98.6
25.00	24.24	96.9
0.050	0.049	98.9
0.050	0.052	103.6
0.050	0.053	105.4
0.050	0.050	100.6
0.500	0.491	98.1
5.000	4.944	98.9
25.00	25.00	100.0
0.050	0.060	120.0
0.050	0.060	120.9
0.050	0.056	111.4
0.050	0.060	120.1
0.500	0.442	88.5
5.000	5.062	101.2
50.00	49.98	100.0

All results are reported in µg/L

Hexavalent Chromium Results for the Missouri Department of Natural Resources
Contact: Michael Stroh

Date: February 15, 2010
Report Generated by: Ben Wozniak
Applied Speciation and Consulting, LLC

Quality Control Summary - Historical CCV Standards

Cr(VI) True Value	Cr(VI) Measured Result	Percent Recovery
5.000	5.043	100.9
5.000	5.181	103.6
5.000	5.013	100.3
5.000	5.063	101.3
5.000	5.055	101.1
5.000	5.179	103.6
5.000	5.177	103.5
5.000	5.458	109.2
5.000	5.673	113.5
5.000	5.220	104.4
5.000	5.560	111.2
5.000	4.301	86.0
5.000	5.018	100.4
5.000	4.981	99.6
5.000	5.127	102.5
5.000	4.998	100.0
5.000	5.002	100.0
5.000	5.149	103.0
5.000	5.050	101.0
5.000	4.992	99.8

CCV = Continuing Calibration Verification
All results are reported in µg/L

Hexavalent Chromium Results for the Missouri Department of Natural Resources
Contact: Michael Stroh

Date: February 15, 2010
Report Generated by: Ben Wozniak
Applied Speciation and Consulting, LLC

Quality Control Summary - Historical Second Source Standards

Cr(VI) True Value	Cr(VI) Measured Result	Percent Recovery
505.0	478.0	94.7
505.0	474.2	93.9
1010	1054	104.3
20.00	18.90	94.5
40.00	39.83	99.6
20.00	19.73	98.7
20.00	20.04	100.2
200.0	204.6	102.3
4.000	3.795	94.9
200.0	218.7	109.4
202.0	214.0	105.9
10.00	12.09	120.9
5.000	5.495	109.9
5.000	5.107	102.1
100.0	95.38	95.4
5.000	4.932	98.6
5.000	4.706	94.1
20.00	20.30	101.5

Second source standard = Cr(VI) Blank Spike (from 3060A Extraction)
All results are reported in mg/kg

Hexavalent Chromium Results for the Missouri Department of Natural Resources
Contact: Michael Stroh

Date: February 15, 2010
Report Generated by: Ben Wozniak
Applied Speciation and Consulting, LLC

Quality Control Summary - Historical Matrix Spikes

Ambient Cr(VI) Conc.	MS Spike Conc.	MS Measured Result	MS Recovery	MSD Spike Conc.	MSD Measured Result	MSD Recovery	RPD
1.816	20.46	6.685	23.8	20.39	5.832	19.7	18.8
0.088	5.064	3.253	62.5	5.134	3.254	61.7	1.3
0.889	208.7	148.3	70.6	208.7	139.2	66.3	6.3
1.219	184.0	160.6	86.6	205.3	181.5	87.8	1.4
0.003	18.72	0.126	0.7	19.48	0.125	0.6	5.1
131.4	40.07	179.8	120.9	38.99	164.2	84.1	35.9
0.070	18.83	0.214	0.8	18.42	1.851	9.7	170.7
1.351	163.9	162.5	98.3	266.7	282.0	105.2	6.8
3.647	4.009	6.202	63.7	4.061	6.469	69.5	8.7
2.961	221.2	257.4	115.0	209.2	216.7	102.1	11.9
2.853	150.2	167.7	109.8	226.2	243.7	106.4	3.1
0.118	43.67	44.23	101.0	54.70	53.27	97.2	3.9
0.077	4.976	3.343	65.6	5.124	3.790	72.5	9.9
126.8	867.7	947.6	94.6	765.2	834.1	92.4	2.3
0.187	4.046	3.095	71.9	3.775	2.961	73.5	2.2
0.160	4.017	4.214	100.9	4.078	4.038	95.1	5.9
0.080	3.906	3.657	91.6	3.959	3.600	88.9	2.9
0.101	5.052	3.646	70.2	4.694	3.300	68.2	2.9
0.224	4.910	2.551	47.4	4.893	2.361	43.7	8.2
0.342	4.885	3.534	65.4	4.820	3.424	63.9	2.2

All results are reported in mg/kg

MISSOURI DEPARTMENT OF NATURAL RESOURCES

FIELD SHEET AND CHAIN-OF-CUSTODY RECORD

LABORATORY ORDER ID: _____

Collector's Name: *(Please Print)*	Transfer COC to Applied Speciation and Consulting, LLC	**Description of Shipment**
Affiliation: *(circle one)*	ESP KCRO NERO SERO SLRO SWRO WPP DGLS HWP Other:	x Shipped-Carrier: Next Day Air x Tape sealed and initialed Hand Delivered No. Of Containers: 4

Sample Number	Sample Collected	Analyses						Sample Type	For Lab Use Only: Matrix	Container		Preserved
AB14350 (Sample A)	Date: 01/26/10	Hexavalent Chromium, Percent Moisture **EXPEDITED 48 HR TURNAROUND**						X Grab Composite Modified	Water Soil Organic Sludge Other:	1L amber Cubitainer 2 oz glass 8 oz glass VOA vial Encore Other:	120 mL Nalgene 1L 500mL 250mL	H_2SO_4 HNO_3 NAOH HCL 4° C(None) Disinfected Other
For Lab Use Only	Time: 10:57	D.O	Flow	pH	Spec. Cond.	Temp.	Other:	Other:				
AB14351 (Sample B)	Date: 01/26/10	Hexavalent Chromium, Percent Moisture **EXPEDITED 48 HR TURNAROUND**						X Grab Composite Modified	Water Soil Organic Sludge Other:	1L amber Cubitainer 2 oz glass 8 oz glass VOA vial Encore Other:	120 mL Nalgene 1L 500mL 250mL	H_2SO_4 HNO_3 NAOH HCL 4° C(None) Disinfected Other
For Lab Use Only	Time: 9:46	D.O	Flow	pH	Spec. Cond.	Temp.	Other:	Other:				
AB14352 (Sample C)	Date: 01/26/10	Hexavalent Chromium, Percent Moisture **EXPEDITED 48 HR TURNAROUND**						X Grab Composite Modified	Water Soil Organic Sludge Other:	1L amber Cubitainer 2 oz glass 8 oz glass VOA vial Encore Other:	120 mL Nalgene 1L 500mL 250mL	H_2SO_4 HNO_3 NAOH HCL 4° C(None) Disinfected Other
For Lab Use Only	Time: 12:00	D.O	Flow	pH	Spec. Cond.	Temp.	Other:	Other:				
AB14353 (Sample D)	Date: 01/26/10	Hexavalent Chromium, Percent Moisture **EXPEDITED 48 HR TURNAROUND**						X Grab Composite Modified	Water Soil Organic Sludge Other:	1L amber Cubitainer 2 oz glass 8 oz glass VOA vial Encore Other:	120 mL Nalgene 1L 500mL 250mL	H_2SO_4 HNO_3 NAOH HCL 4° C(None) Disinfected Other
For Lab Use Only	Time: 11:50	D.O	Flow	pH	Spec. Cond.	Temp.	Other:	Other:				

Relinquished By:	Received By:	Date:	Time:
Richard Kivoch 2-3-10	, Temp = -0.2°C	2/4/2010	1010
Relinquished By:	Received By:	Date:	Time:
Relinquished By:	Received By:	Date:	Time:

MISSOURI DEPARTMENT OF NATURAL RESOURCES

FIELD SHEET AND CHAIN-OF-CUSTODY RECORD

LABORATORY ORDER ID: _____

Collector's Name: (Please Print) Transfer COC to Applied Speciation and Consulting, LLC	**Description of Shipment**
Affiliation: (circle one) ESP KCRO NERO SERO SLRO SWRO WPP DGLS HWP Other:	x Shipped-Carrier: Next Day Air
	x Tape sealed and initialed
	Hand Delivered — No. Of Containers: 4

Sample Number	Sample Collected	Analyses						Sample Type	For Lab Use Only: Matrix	Container		Preserved
AB14354 (Sample A)	Date: 01/26/10	Hexavalent Chromium, Percent Moisture **EXPEDITED 48 HR TURNAROUND**						X Grab / Composite / Modified	Water / Soil / Organic / Sludge / Other:	1L amber / Cubitainer / 2 oz glass / 8 oz glass / VOA vial / Encore / Other:	120 mL / Nalgene 1L / 500mL / 250mL	H_2SO_4 / HNO_3 / NAOH / HCL / 4° C(None) / Disinfected / Other
For Lab Use Only	Time: 13:10	D.O	Flow	pH	Spec. Cond.	Temp.	Other:	Other:				
AB14355 (Sample B)	Date: 01/26/10	Hexavalent Chromium, Percent Moisture **EXPEDITED 48 HR TURNAROUND**						X Grab / Composite / Modified	Water / Soil / Organic / Sludge / Other:	1L amber / Cubitainer / 2 oz glass / 8 oz glass / VOA vial / Encore / Other:	120 mL / Nalgene 1L / 500mL / 250mL	H_2SO_4 / HNO_3 / NAOH / HCL / 4° C(None) / Disinfected / Other
For Lab Use Only	Time: 13:30	D.O	Flow	pH	Spec. Cond.	Temp.	Other:	Other:				
(Sample C)	Date:							Grab / Composite / Modified	Water / Soil / Organic / Sludge / Other:	1L amber / Cubitainer / 2 oz glass / 8 oz glass / VOA vial / Encore / Other:	120 mL / Nalgene 1L / 500mL / 250mL	H_2SO_4 / HNO_3 / NAOH / HCL / 4° C(None) / Disinfected / Other
For Lab Use Only	Time:	D.O	Flow	pH	Spec. Cond.	Temp.	Other:	Other:				
(Sample D)	Date:							Grab / Composite / Modified	Water / Soil / Organic / Sludge / Other:	1L amber / Cubitainer / 2 oz glass / 8 oz glass / VOA vial / Encore / Other:	120 mL / Nalgene 1L / 500mL / 250mL	H_2SO_4 / HNO_3 / NAOH / HCL / 4° C(None) / Disinfected / Other
For Lab Use Only	Time:	D.O	Flow	pH	Spec. Cond.	Temp.	Other:	Other:				

Relinquished By:	Received By:	Date:	Time:
Richard Kinock 2-3-10	, Temp = -0.2°C	2/4/2010	1010
Relinquished By:	Received By:	Date:	Time:
Relinquished By:	Received By:	Date:	Time:

Missouri Department of Natural Resources
Environmental Services Program

Order ID 100203001 **Program, Contact:** HWP Julieann Warren

Report Date: 02/19/2010 **LDPR/JobCode:** FEPA8 / NJ10TSFF

Sample: AB14350
Customer #: 1000361

Facility ID:
County: (Multiple)
Site: Tannery Sludge Farm Fields
Sample Reference ID: 218
Collector: PAM HACKLER
Affiliation: ESP
Collect Date: 1/26/2010 10:57:00AM
Sample Comment: SU 102.02. Expedited 48 hour turnaround.

Test	Parameter	Result	Qualifier	Units	QC Batch ID	Method
Hexavalent Chromium	Hexavalent Chromium	1.71	04	mg/Kg		Contract Lab Dep
Percent Moisture	Percent Moisture	0.7	04	%		Infrared Drying

Sample: AB14351
Customer #: 1000362

Facility ID:
County: (Multiple)
Site: Tannery Sludge Farm Fields
Sample Reference ID: 218
Collector: PAM HACKLER
Affiliation: ESP
Collect Date: 1/26/2010 9:46:00AM
Sample Comment: SU 87.04. Expedited 48 hour turnaround.

Test	Parameter	Result	Qualifier	Units	QC Batch ID	Method
Hexavalent Chromium	Hexavalent Chromium	1.00	04	mg/Kg		Contract Lab Dep
Percent Moisture	Percent Moisture	0.9	04	%		Infrared Drying

Sample: AB14352
Customer #: 1000363

Facility ID:
County: (Multiple)
Site: Tannery Sludge Farm Fields
Sample Reference ID: 202
Collector: PAM HACKLER
Affiliation: ESP
Collect Date: 1/26/2010 12:00:00PM
Sample Comment: SU 59.09. Expedited 48 hour turnaround.

Test	Parameter	Result	Qualifier	Units	QC Batch ID	Method
Hexavalent Chromium	Hexavalent Chromium	1.76	04	mg/Kg		Contract Lab Dep
Percent Moisture	Percent Moisture	2.7	04	%		Infrared Drying

Sample: AB14353
Customer #: 1000364

Facility ID:
County: (Multiple)
Site: Tannery Sludge Farm Fields
Sample Reference ID: 202
Collector: PAM HACKLER
Affiliation: ESP
Collect Date: 1/26/2010 11:50:00AM
Sample Comment: SU 59.07. Expedited 48 hour turnaround.

Test	Parameter	Result	Qualifier	Units	QC Batch ID	Method
Hexavalent Chromium	Hexavalent Chromium	4.88	04	mg/Kg		Contract Lab Dep
Percent Moisture	Percent Moisture	3.1	04	%		Infrared Drying

Sample: AB14354
Customer #: 1000365

Facility ID:
County: (Multiple)
Site: Tannery Sludge Farm Fields
Sample Reference ID: 202
Collector: PAM HACKLER
Affiliation: ESP
Collect Date: 1/26/2010 1:10:00PM
Sample Comment: SU 79.03. Expedited 48 hour turnaround.

Test	Parameter	Result	Qualifier	Units	QC Batch ID	Method
Hexavalent Chromium	Hexavalent Chromium	2.08	04	mg/Kg		Contract Lab Dep
Percent Moisture	Percent Moisture	0.5	04	%		Infrared Drying

Sample: AB14355
Customer #: 1000366

Facility ID:
County: (Multiple)
Site: Tannery Sludge Farm Fields
Sample Reference ID: 218
Collector: PAM HACKLER
Affiliation: ESP
Collect Date: 1/26/2010 1:30:00PM
Sample Comment: SU 146.08. Expedited 48 hour turnaround.

Test	Parameter	Result	Qualifier	Units	QC Batch ID	Method
Hexavalent Chromium	Hexavalent Chromium	1.59	04	mg/Kg		Contract Lab Dep
Percent Moisture	Percent Moisture	12.5	04	%		Infrared Drying

The analysis of this sample was performed in accordance with procedures approved or recognized by the U.S Environmental Protection Agency.

Ch- Boldt

Chris Boldt, Laboratory Manager
Environmental Services Program
Field Services Division

Qualifier Descriptions

01 Improper collection method
02 Improper preservation
03 Exceeded holding time
04 Analyzed by Contract Laboratory
05 Estimated value, detected below PQL
06 Estimated value, QC data outside limits
07 Estimated value, analyte outside calibration range
08 Analyte present in blank at > 1/2 reported value
09 Sample was diluted during analysis
10 Laboratory error
11 Estimated value, matrix interference
12 Insufficient quantity
13 Estimated value, true result is >= reported value
14 Estimated value, non-homogeneous sample
15 No Result - Failed Quality Controls Requirements
16 Not analyzed - related analyte not detected
17 Results in dry weight
18 Sample pH is outside the acceptable range
19 Estimated value
20 Not analyzed - Instrument failure
21 No result - spectral interference
22 pH was performed at the Laboratory
ND Not detected at reported value
23 Contract Lab specific qualifier - see sample comments

100203001

APPENDIX B

XRF Data

Tannery Sludge Farm Fields Site
Agricultural Fields Pilot Study (March 10, 2010 Addendum)
Andrew County, MO

Project: Missouri Tannery Sludge Farm Fields XRF Analyzer Ser Num 5444

This spreadsheet records 4 results per bag; calculates the mean & SD & 2-sided confidence limits on the bag

Property ID: 5180 & 8940

Date: Samples Collected 8/12/09, XRF analyses 8/17&18, 2009

B02, B07, & B10 reshot due to poor SD on 1st 4 replicates

* C01,C02,C03, &C04 not initially ground in mortar prior to sieve

Information: C01

Sample ID & Bagged Replicate Readings	Time	Reading No	Run Time (sec)	Instrmt Result (ppm Cr)	Instrmt Error (as 2SD)	Flag?
					grind	
Bag reading 1				69	51	
2				46	58	
3				57	57	
4				65		
			Mean	59.3	55.3	
			SD	10.1	3.8	
			n =	4	3	
2-sided CLs			Section 95%LCL =	43	46	
			Section 95%UCL =	75	65	

Information: C02

Sample ID & Bagged Replicate Readings	Time	Reading No	Run Time (sec)	Instrmt Result (ppm Cr)	Instrmt Error (as 2SD)	Flag?
					grind	reshoot
Bag reading 1				351	321	233
2				405	261	245
3				363	248	247
4				307	261	235
			Mean	356.5	272.8	240.0
			SD	40.3	32.7	7.0
			n =	4	4	4
2-sided CLs			Section 95%LCL =	292	221	229
			Section 95%UCL =	421	325	251

Information: C03

Sample ID & Bagged Replicate Readings	Time	Reading No	Run Time (sec)	Instrmt Result (ppm Cr)	Instrmt Error (as 2SD)	Flag?
					Grind	
Bag reading 1				80	65	
2				78	65	
3				93	90	
4				91		
			Mean	85.5	66.7	
			SD	7.6	2.9	
			n =	4	3	
2-sided CLs			Section 95%LCL =	73	79	
			Section 95%UCL =	98	94	

Information: C04

					Grind	
Bag reading 1				236	236	
2				271	225	
3				256	193	
4				221		
			Mean	246.0	218.0	
			SD	22.0	22.3	
			n =	4	3	
			Section 95%LCL =	211	163	
			Section 95%UCL =	281	273	

Information: C05

Bag reading 1				181		
2				147		
3				174		
4				178		
			Mean	170.0		
			SD	15.6		
			n =	4		
			Section 95%LCL =	145		
			Section 95%UCL =	195		

Information: C06

Bag reading 1				87		
2				93		
3				86		
4				96		
			Mean	90.5		
			SD	4.8		
			n =	4		
			Section 95%LCL =	83		
			Section 95%UCL =	98		

Information: C07

Bag reading 1				73		
2				64		
3				67		
4				72		
			Mean	69.0		
			SD	4.2		
			n =	4		
			Section 95%LCL =	62		
			Section 95%UCL =	76		

Information: C08

Bag reading 1				61		
2				75		
3				76		
4				61		
			Mean	68.3		
			SD	8.4		
			n =	4		
			Section 95%LCL =	55		
			Section 95%UCL =	82		

Information: C09

Bag reading 1				67		
2				61		
3				62		
4				53		
			Mean	60.8		
			SD	5.8		
			n =	4		
			Section 95%LCL =	52		
			Section 95%UCL =	70		

Information: C10

Bag reading 1				66		
2				45		
3				54		
4				43		
			Mean	52.0		
			SD	10.5		
			n =	4		
			Section 95%LCL =	35		
			Section 95%UCL =	69		

Information: B01

Bag reading 1				273		
2				283		
3				243		
4				271		
			Mean	267.5		
			SD	17.2		
			n =	4		
			Section 95%LCL =	240		
			Section 95%UCL =	295		

Information: B02

					189	reshoot
Bag reading 1				192	228	
2				241	225	
3				273	224	
4				158	223	
				180.0		
			Mean	205.5	225.0	
			SD	42.8	2.2	
			n =	4	3	
			Section 95%LCL =	137	220	
			Section 95%UCL =	274	230	

Information: B03

Bag reading 1				179		
2				198		
3				176		
4				178		
			Mean	182.8		
			SD	10.2		
			n =	4		
			Section 95%LCL =	166		
			Section 95%UCL =	199		

Information: B04

Bag reading 1				282		
2				293		
3				263		
4				295		
			Mean	283.3		
			SD	14.7		
			n =	4		
			Section 95%LCL =	260		
			Section 95%UCL =	307		

Information: B05

Bag reading 1				305		
2				304		
3				280		
4				291		
			Mean	295.0		
			SD	11.9		
			n =	4		
			Section 95%LCL =	276		
			Section 95%UCL =	314		

Information: B06

Bag reading 1				283		
2				308		
3				289		
4				313		
			Mean	298.3		
			SD	14.5		
			n =	4		
			Section 95%LCL =	275		
			Section 95%UCL =	321		

Information: B07

					reshoot	
Bag reading 1				516	525	
2				499	497	
3				553	538	
4				449	491	
			Mean	504.3	512.8	
			SD	43.2	22.4	65
			n =	4	4	
			Section 95%LCL =	436	477	
			Section 95%UCL =	573	548	

Information: B08

Bag reading 1				336		
2				346		
3				317		
4				350		
			Mean	337.3		
			SD	14.7		
			n =	4		
			Section 95%LCL =	314		
			Section 95%UCL =	361		

Information: B09

Bag reading 1				206		
2				200		
3				189		
4				208		
			Mean	200.8		
			SD	8.5		
			n =	4		
			Section 95%LCL =	187		
			Section 95%UCL =	214		

Information: B10

					reshoot	
Bag reading 1				423	404	
2				459	383	
3				324	408	
4				477	376	
			Mean	428.3	392.8	
			SD	75.2	15.6	
			n =	4	4	
			Section 95%LCL =	309	368	
			Section 95%UCL =	548	418	

Information: A01

Bag reading 1				204		
2				213		
3				180		
4				169		
			Mean	191.5		
			SD	20.5		
			n =	4		
			Section 95%LCL =	159		
			Section 95%UCL =	224		

Information: A02

Bag reading 1				205		
2				181		
3				206		
4				208		
			Mean	200.0		
			SD	12.7		
			n =	4		
			Section 95%LCL =	180		
			Section 95%UCL =	220		

Information: A03

Bag reading 1				243		
2				238		
3				235		
4				247		
			Mean	240.8		
			SD	5.3		
			n =	4		
			Section 95%LCL =	232		
			Section 95%UCL =	249		

Information: A04

Bag reading 1				204		
2				192		
3				216		
4				206		
			Mean	204.5		
			SD	9.8		
			n =	4		
			Section 95%LCL =	189		
			Section 95%UCL =	220		

Project: Missouri Tannery Sludge Farm Fields XRF Analyzer Ser Num 5444

This spreadsheet records 4 results per bag; calculates the mean & SD & 2-sided confidence limits on the bag

Property ID: 5180 & 8940

B02, B07, & B10 reshot due to poor SD on 1st 4 replicates

Date: Samples Collected 8/12/09, XRF analyses 8/17&18, 2009

* C01,C02,C03, &C04 not initially ground in mortar prior to sieve

Information: A05	
Bag reading 1	253
2	281
3	281
4	273
Mean	272.0
SD	13.2
n =	4
Section 95%LCL =	251
Section 95%UCL =	293

Information: A06	
Bag reading 1	207
2	223
3	210
4	210
Mean	212.5
SD	7.1
n =	4
Section 95%LCL =	201
Section 95%UCL =	224

Information: A07	
Bag reading 1	162
2	207
3	179
4	180
Mean	182.0
SD	18.6
n =	4
Section 95%LCL =	152
Section 95%UCL =	212

Information: A08	
Bag reading 1	177
2	179
3	183
4	177
Mean	179.0
SD	2.8
n =	4
Section 95%LCL =	174
Section 95%UCL =	184

Information: A09	
Bag reading 1	152
2	161
3	151
4	158
Mean	155.5
SD	4.8
n =	3
Section 95%LCL =	144
Section 95%UCL =	167

Information: A10	
Bag reading 1	154
2	188
3	187
4	184
Mean	178.3
SD	16.3
n =	4
Section 95%LCL =	152
Section 95%UCL =	204

Project: Missouri Tannery Sludge Farm Fields

XRF Analyzer Ser Num 5434

This spreadsheet records 4 results per bag; calculates the mean & SD & 2-sided confidence limits on the bag

Property ID: 5180 & 8940

Date: Samples Collected 8/12/09, XRF analyses 8/17&18, 2009

B10 reshot due to poor SD on 1st 4 replicates

* C01,C02, & C03 not initially ground in mortar prior to sieve

Information: C01

Sample ID & Bagged Replicate Readings	Time	Reading No	Run Time (sec)	Instrmnt Result (ppm Cr)	Instrmnt Error (as 2SD)	Flag?
					grind	
Bag reading 1				27	43	
2				33	34	
3				30	33	
4				32	23	
			Mean	30.5	33.3	
			SD	2.6	8.2	
			n =	4	4	
2-sided CLs			Section 95%LCL =	26	20	
			Section 95%UCL =	35	46	

Information: C02

Sample ID & Bagged Replicate Readings	Time	Reading No	Run Time (sec)	Instrmnt Result (ppm Cr)	Instrmnt Error (as 2SD)	Flag?
					grind	
Bag reading 1				227	183	
2				252	199	
3				242	183	
4				235		
			Mean	239.0	188.3	
			SD	10.6	9.2	
			n =	4	3	
2-sided CLs			Section 95%LCL =	222	165	
			Section 95%UCL =	256	211	

Information: C03

Sample ID & Bagged Replicate Readings	Time	Reading No	Run Time (sec)	Instrmnt Result (ppm Cr)	Instrmnt Error (as 2SD)	Flag?
					grind	
Bag reading 1				59	57	
2				74	47	
3				55	54	
4				65		
			Mean	63.3	52.7	
			SD	8.3	5.1	
			n =	4	3	
2-sided CLs			Section 95%LCL =	50	40	
			Section 95%UCL =	76	65	

Information: C04

Bag reading 1				159		
2				160		
3				164		
4				153		
			Mean	159.0		
			SD	4.5		
			n =	4		
			Section 95%LCL =	152		
			Section 95%UCL =	166		

Information: C05

Bag reading 1				157		
2				127		
3				120		
4				127		
			Mean	132.8		
			SD	16.5		
			n =	4		
			Section 95%LCL =	106		
			Section 95%UCL =	159		

Information: C06

Bag reading 1				68		
2				67		
3				60		
4				65		
			Mean	65.0		
			SD	3.6		
			n =	4		
			Section 95%LCL =	59		
			Section 95%UCL =	71		

Information: C07

Bag reading 1				65		
2				44		
3				63		
4				51		
			Mean	55.8		
			SD	10.0		
			n =	4		
			Section 95%LCL =	40		
			Section 95%UCL =	72		

Information: C08

Bag reading 1				41		
2				47		
3				45		
4				50		
			Mean	45.8		
			SD	3.8		
			n =	4		
			Section 95%LCL =	40		
			Section 95%UCL =	52		

Information: C09

Bag reading 1				44		
2				33		
3				28		
4				36		
			Mean	34.8		
			SD	7.5		
			n =	4		
			Section 95%LCL =	23		
			Section 95%UCL =	47		

Information: C10

Bag reading 1				47		
2				30		
3				36		
4				42		
			Mean	38.8		
			SD	7.4		
			n =	4		
			Section 95%LCL =	27		
			Section 95%UCL =	50		

Information: B01

Bag reading 1				175		
2				198		
3				228		
4				202		
			Mean	200.8		
			SD	21.7		
			n =	4		
			Section 95%LCL =	166		
			Section 95%UCL =	235		

Information: B02

				138		
Bag reading 1				168		
2				137		
3				136		
4				145		
			Mean	144.8		
			SD	13.4		
			n =	4		
			Section 95%LCL =	123		
			Section 95%UCL =	166		

Information: B03

Bag reading 1				116		
2				135		
3				123		
4				124		
			Mean	124.5		
			SD	7.9		
			n =	4		
			Section 95%LCL =	112		
			Section 95%UCL =	137		

Information: B04

Bag reading 1				220		
2				186		
3				202		
4				194		
			Mean	200.5		
			SD	14.5		
			n =	4		
			Section 95%LCL =	177		
			Section 95%UCL =	224		

Information: B05

				216		
Bag reading 1				265		
2				261		
3				240		
4				207		
			Mean	237.8		
			SD	26.0		
			n =	4		
			Section 95%LCL =	196		
			Section 95%UCL =	279		

Information: B06

Bag reading 1				217		
2				228		
3				232		
4				247		
			Mean	231.0		
			SD	12.4		
			n =	4		
			Section 95%LCL =	211		
			Section 95%UCL =	251		

Information: B07

Bag reading 1				327		
2				318		
3				369		
4				338		
			Mean	338.0		
			SD	22.2		
			n =	4		
			Section 95%LCL =	303		
			Section 95%UCL =	373		

Information: B08

Bag reading 1				267		
2				278		
3				257		
4				241		
			Mean	260.8		
			SD	15.7		
			n =	4		
			Section 95%LCL =	236		
			Section 95%UCL =	286		

Information: B09

Bag reading 1				142		
2				160		
3				161		
4				163		
			Mean	156.5		
			SD	9.7		
			n =	4		
			Section 95%LCL =	141		
			Section 95%UCL =	172		

Information: B10

				reshoot		
Bag reading 1				272	334	
2				250	248	
3				261	265	
4				260	282	
			Mean	260.8	282.3	
			SD	9.0	37.2	
			n =	4	4	
			Section 95%LCL =	246	223	
			Section 95%UCL =	275	341	

Information: A01

Bag reading 1				120		
2				113		
3				125		
4				118		
			Mean	119.0		
			SD	5.0		
			n =	4		
			Section 95%LCL =	111		
			Section 95%UCL =	127		

Information: A02

Bag reading 1				130		
2				149		
3				153		
4				139		
			Mean	142.8		
			SD	10.3		
			n =	4		
			Section 95%LCL =	126		
			Section 95%UCL =	159		

Information: A03

Bag reading 1				168		
2				182		
3				165		
4				165		
			Mean	170.0		
			SD	8.1		
			n =	4		
			Section 95%LCL =	157		
			Section 95%UCL =	183		

Information: A04

Bag reading 1				141		
2				151		
3				147		
4				143		
			Mean	145.5		
			SD	4.4		
			n =	4		
			Section 95%LCL =	138		
			Section 95%UCL =	153		

Project: Missouri Tannery Sludge Farm Fields XRF Analyzer Ser Num 5434

This spreadsheet records 4 results per bag; calculates the mean & SD & 2-sided confidence limits on the bag

Property ID: 5180 & 8940

B10 reshot due to poor SD on 1st 4 replicates

Date: Samples Collected 8/12/09, XRF analyses 8/17&18, 2009

* C01,C02, & C03 not initially ground in mortar prior to sieve

Information: A05

Bag reading 1	211
2	187
3	186
4	207
Mean	197.8
SD	13.1
n =	4
Section 95%LCL =	177
Section 95%UCL =	219

Information: A06

Bag reading 1	161
2	161
3	153
4	166
Mean	160.3
SD	5.4
n =	4
Section 95%LCL =	152
Section 95%UCL =	169

Information: A07

Bag reading 1	125
2	123
3	122
4	120
Mean	122.5
SD	2.1
n =	4
Section 95%LCL =	119
Section 95%UCL =	126

Information: A08

Bag reading 1	122
2	107
3	117
4	130
Mean	119.0
SD	9.6
n =	4
Section 95%LCL =	104
Section 95%UCL =	134

Information: A09

Bag reading 1	110
2	103
3	112
4	101
Mean	106.5
SD	5.3
n =	4
Section 95%LCL =	98
Section 95%UCL =	115

Information: A10

Bag reading 1	128
2	133
3	126
4	121
Mean	127.0
SD	5.0
n =	4
Section 95%LCL =	119
Section 95%UCL =	135