ASSESSMENT OF QUALITY ASSURANCE/QUALITY CONTROL ASSOCIATED WITH ANALYSIS OF INORGANIC ELEMENTS IN DUST SAMPLES FROM THE FLIN FLON AREA

2008 Final Report

Prepared for

Intrinsik Environmental Sciences Inc.

by

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TABLE OF CONTENTS

I. Introduction 3

II. Methods 4

III. Results and Discussion 6

IV. Conclusions 17

V. Limitations and Use of Report 18

VI. References 19

I. INTRODUCTION

Intrinsik Environmental Sciences Inc. contracted the Environmental Sciences Group (ESG) of the Royal Military College of Canada (RMC) to assess the quality assurance and quality control (QA/QC) associated with the analysis of inorganic elements by two laboratories of dust samples from the Flin Flon, Manitoba, area.

Intrinsik initiated the assessment because of large differences between results of inorganic elements (in particular, lead, which is a contaminant of concern, and tin) in the dust samples from two different laboratories. Specifically, the testing laboratory Bodycote Testing Group (Edmonton, Alberta) reported results that were consistently higher than those reported by Testmark Laboratories Inc. (Garson, Ontario), and in particular two samples were reported by Bodycote with lead concentrations two orders of magnitude higher than the concentrations reported by Testmark.

The assessment of QA/QC associated with the delivery of an analytical report by a testing laboratory consists of two steps. The first step is to assess if the methods and laboratory QA program meets the requirements in a standard (such as ISO/IEC 17025:2005); this usually involves inspecting documentation that the laboratory has written, which gives procedures for testing methods, laboratory management and organization, assessment of data, etc. The second step is to assess if the conduct of the laboratory follows the aforementioned documentation. These two steps were used in the present investigation.

II. METHODS

The first step of the assessment was carried out by examining method documents provided by the two laboratories. The Canadian Association of Laboratory Accreditation (CALA, formerly known as the Canadian Association for Environmental Analytical Laboratories, CAEAL) rating guide (CALA 2007) was consulted for comparison to the standard ISO/IEC 17025:2005, since it is a summary of the requirements of this international standard; only the applicable clauses were selected (Tables 1 and 2). Because only the method documents were available, only the clauses pertaining to method documents and reports could be used[1]. In some cases the method details were not sufficient to assess a clause thoroughly, and in these cases the laboratory was consulted for details if the item was considered to be important for the examination (e.g., sample preparation details, steps to minimize cross contamination).

The second step of the assessment was carried out by examining analytical reports and results files provided by the laboratory, as well as by questioning the laboratories on points that were not apparent from the documents. Additionally, e-mail letters were provided by Intrinsik and their partner in the dust project, Jacques Whitford (abbreviation JW in the e-mail titles), which summarized some of the communications between these groups and the laboratories before the commencement of the present examination. The required proficiency of analysts, adherence to the procedures in the method documents provided, traceability of the reported results and proper record-keeping were assumed (these could not be directly assessed from the provided documentation).

The documents used in the present examination include the following:

Bodycote:

Scope of Accreditation, Bodycote Testing Group, Edmonton lab, Jun 3, 2008.

Bodycote Testing Group, 2008. Method TM METAL 077(10)-10, Metals in soil, sludge, sediment and oily waste by ICP.

Bodycote Testing Group, 2007. Method WI METAL 079(8)-10, Digestion of solid samples for ICP analysis.

[1] Other clauses pertain to aspects such as laboratory management, training and analyst proficiency, method validation, etc.

Bodycote Testing Group, 2008. Analytical Report for Project ID 1032002.02, Report Number 1133033.

Bodycote Testing Group, 2008. Analytical Report for Project ID 1032002.02, Report Number 1154339 (second amendment to Report number 1133033).

E-mail: August 14, 2008, bodycote to JW - sample and qc Q&A.msg.

E-mail: August 19, 2008, Bodycote to JW - initial calc and analysis check.msg.

E-mail: September 23, 2008, JW to ESG confirmation of Q for Bodycote.htm.

E-mail attachment: September 26, 2008, Bodycote response.doc.

E-mail: October 8, 2008, JW to ESG 8 Oct.htm.

E-mail: October 9, 2008, Bodycote to ESG 9 Oct.htm.

E-mail: October 15, 2008, Intrinsik to ESG 15 Oct.htm.

E-mail: October 20, 2008, Bodycote to ESG 20 Oct.htm

E-mail: October 20, 2008, Bodycote to ESG 20b Oct.htm

Results file: July 21, 2008, Bodycote report results 1133033.xls.

Results file: Sept 20, 2008, Bodycote 2nd QC Blank and standard for Jacques Whitford AXYS Ltd.xls.

Testmark:

CAEAL Directory of Laboratories Scope of Accreditation, Testmark Laboratories Ltd., Aug 27, 2008

Proficiency Testing Registered tests. Accessed Oct 3, 2008. http://209.90.159.196/lab_info.php?mId=3066&wId=p

Testmark Laboratories Ltd, 2005. Method Used for Dust Sample Analysis- Metals

Testmark Laboratories Ltd, 2008. Analytical Report, WO# 61648

E-mail: Sept 25, 2008, Intrinsik to ESG elements in SRM.htm

E-mail: Sept 25, 2008, testmark to ESG Q&A.htm

E-mail: October 8, 2008, JW to ESG 8 Oct.htm.

E-mail: October 8, 2008, Testmark to ESG final questions Oct 08.txt.

E-mail: October 15, 2008, Intrinsik to ESG 15 Oct.htm.

E-mail: October 21, 2008, Testmark to ESG final questions Oct 21 08.txt

III. RESULTS AND DISCUSSION

When a preliminary statistical analysis was carried out, significant differences were observed between the Bodycote and Testmark laboratories for all elements (paired t-test, $p<0.05$) except for nickel, phosphorus, titanium, beryllium, manganese, molybdenum, selenium, and thallium. Therefore of the contaminants of concern (mercury, arsenic, cadmium, copper, lead, selenium, and zinc) significant differences were observed for all except selenium. Elements for which the Bodycote results were, on average, more than twice the Testmark results are mercury, antimony, lead and tin.

The examination of the documents provided by the laboratories revealed that, with a few exceptions, the requirements of the standard ISO/IEC 17025:2005 were met (Tables 1 and 2).

Table 1. Assessment checklist for Bodycote Testing Group Project ID 1032002.02. Italicized text signifies deviations from the standard, or between the conduct of testing and the documented method.

Reference to Standard	Item Assessed	Assessment	Document Reference
5.4.1	Scope of Accreditation	Edmonton laboratory, SCC, includes TM Metals 077-10	Scope of Accreditation, Bodycote Testing Group, Edmonton lab, 2008-06-03
5.4.1, 5.9.1	Proficiency Testing	Information not available on SCC website	http://palcan.scc.ca/SpecsSearch/GLSearchForm.do
Method (1st step of assessment)			
4.2, 5.4, 5.4.1	Method Document, Deviations	Provided, including strong acid extraction (called strong acid leach in the method). Deviation consisted of analyzing dust sample instead of dried and ground sample, included in the report, but not in written method. Could not assess if deviations were documented, but they were approved by client.	TM METAL 077(10)-10, Metals in soil, sludge, sediment and oily waste by ICP; WI METAL 079(8)-10, Digestion of solid samples for ICP analysis; Bodycote to ESG 9 Oct.htm Environmental Sample Information Sheet of Bodycote Project ID 1032002.02, Report Number 1133033

Reference to Standard	Item Assessed	Assessment	Document Reference
4.2, 5.4, 5.4.1	Fitness for use	Meets requirements; detection limits and high limits in ug/g provided, using ICP-MS: As (0.2-500), Cd (0.01-250), Cu (1-500), Pb (0.1-250), Se (0.3-500), Zn (1-2500), OK for limits used by clients (confirmed ahead of time).	TM METAL 077(10)-10, Metals in soil, sludge, sediment and oily waste by ICP; JW to ESG 8 Oct.htm
5.7	Sample History	Some sample requirements in method not applicable to the analysis used i.e. of dust samples: 200 g wet sample in method but dust samples much less; dried and ground in method but dust samples required sieving; description of sieving in e-mail response (Bodycote to ESG 9 Oct.htm). However this was not considered to be a deviation since the client had requested the dust analysis, thus approving changes to the standard method.	TM METAL 077(10)-10, Metals in soil, sludge, sediment and oily waste by ICP; bodycote to JW - sample and qc Q&A.msg; JW to ESG confirmation of Q for Bodycote.htm; Bodycote response.doc; Bodycote to ESG 9 Oct.htm
5.7	Sampling and Sub-sampling	From the method could not assess the following but some details for these given in e-mail response Bodycote to ESG 9 Oct.htm: (i) Sampling/sub-sampling methods – sieving (ii) Sampling plans are statistically based – not applicable; (iii) Dust loss and cross-contamination are minimized – unlikely since special procedure used (sieving); (iv) Sample size reduction generates a representative portion for subsequent work – not applicable because of limited sample size. Duplicates incorporated into method (every 16 samples)	TM METAL 077(10)-10, Metals in soil, sludge, sediment and oily waste by ICP; Bodycote to ESG 9 Oct.htm
5.6.2	Calibration	Method calibration is appropriate, referenced in the test method, and matrix matching of standards to samples (i.e. all analysis in 1%	TM METAL 077(10)-10, Metals in soil, sludge, sediment and oily waste by ICP;

Reference to Standard	Item Assessed	Assessment	Document Reference
		acid matrix) is specified.	Bodycote to ESG 9 Oct.htm:
5.9	Quality Control	Quality control consists of digestion reference material (SS-2 soil) and a digestion blank (no soil) every batch, or every 33 samples, duplicates digested every batch, or every 16 samples[2], and water QC samples every 20 samples during analysis.	TM METAL 077(10)-10, Metals in soil, sludge, sediment and oily waste by ICP
Report/Conduct of Testing (2nd step of assessment)			
5.8.1, 5.8.2, 5.8.3	Report – Sample history	On first page of report, dust samples specified, <63 um fraction specified, small sample size noted, request for maintenance of detection limits	Environmental Sample Information Sheet of Bodycote Project ID 1032002.02, Report Number 1133033
5.8.1, 5.8.2, 5.8.3	Report - Sample reception	Small sample size noted on first page	Environmental Sample Information Sheet of Bodycote Project ID 1032002.02, Report Number 1133033
5.8.2	Report - Chain of custody	Included on first page of report	Environmental Sample Information Sheet of Bodycote Project ID 1032002.02, Report Number 1133033
5.9, 5.4.1, 5.10.2, 5.10.3	Report – Quality control	Quality control in report: *One sample duplicate, instead of 3, which would have been expected based on method (48 samples).* *One reference material and digestion blank, instead of 2 (1 batch of 33 samples, 1 batch for remaining samples).* Data for a 2nd digestion blank and reference material were provided during the course of this investigation. All QC data were acceptable	Bodycote Project ID 1032002.02, Report Number 1133033; Bodycote 2nd QC Blank and standard for Jacques Whitford AXYS Ltd.xls

[2] Whichever is smaller; e.g., a batch size is a maximum of 33 samples for digestion reference material and blanks, but these tests are included in a batch even if the batch size is less than 33 samples.

Reference to Standard	Item Assessed	Assessment	Document Reference
		based on limits given in report but could not be checked against method (limits not in the method).	
5.10.2 5.10.3	Report – Deviations or Flags	No deviations or flags in report, except sample notes on first page. *List of samples not analyzed for Hg might have been useful, as well as flag regarding lack of duplicates*	Bodycote Project ID 1032002.02, Report Number 1133033
5.9.2, 5.4.1, 5.10.2, 5.10.3	Report - Data validation	Assume transcription and calculation errors were checked (e-mail communication); comparison with expected ranges given in the report. Reanalysis of samples extracts (but not a redigestion) requested by the client gave results consistent with initial values.	Bodycote Project ID 1032002.02, Report Number 1133033; Bodycote to JW - initial calc and analysis check.msg; Report 1135978 referenced within Report 1154339
5.10.2j	Test Report Authorization	Laboratory Operations Manager's signature	Bodycote Project ID 1032002.02, Report Number 1133033 and 1154339
5.4.1, 5.7	Conduct of testing – sample particle size	Sample that passed through 63 um sieve was analyzed for metals and for mercury where sample mass sufficed	Bodycote response.doc
4.2, 5.4, 5.4.1	Conduct of testing – samples and elements analyzed	Metals and mercury in 28 out of 48 samples; metals in all 48 samples	Bodycote Project ID 1032002.02, Report Number 1133033 and 1154339
5.9, 5.4.1	Conduct of testing – method quality control - frequency	4.2% (1 in 24) for digestion blanks and reference samples, which was consistent with frequency in method; *2% (1 in 48) for duplicates, which was less than frequency in method (1 in 16).* Lower frequency was recorded as a non-conformance in lab's non-conformance log.	Bodycote response.doc; Bodycote 2nd QC Blank and standard for Jacques Whitford AXYS Ltd.xls; Bodycote to ESG 9 Oct.htm
5.9, 5.4.1	Conduct of testing –	Meets requirements.	Bodycote Project ID 1032002.02, Report;

Reference to Standard	Item Assessed	Assessment	Document Reference
	method quality control - duplicates		Number 1133033
5.9, 5.4.1	Conduct of testing – method quality control – reference sample	Meets requirements.	Bodycote Project ID 1032002.02, Report Number 1133033; Bodycote 2nd QC Blank and standard for Jacques Whitford AXYS Ltd.xls
5.9, 5.4.1	Conduct of testing – method quality control – blanks	Meets requirements (accepted data include measurable Sn concentrations).	Bodycote Project ID 1032002.02, Report Number 1133033; Bodycote 2nd QC Blank and standard for Jacques Whitford AXYS Ltd.xls
5.9, 5.6.2, 5.4.1	Conduct of testing – calibration curves	Could not assess, except that calibration curves for Sn and Pb consisted of 4 points (including zero).	Bodycote response.doc bodycote to JW - sample and qc Q&A.msg
5.8.1	Sample disposal, if applicable	Returned to client (July 31, 2008)	JW to ESG 8 Oct.htm

For the work carried out by Bodycote, the areas where deviations were observed between the method document and the standard, and between the conduct of testing and the method document are as follows:

1. Deviation between the conduct of testing and the documented method – one sample duplicate, instead of the three that would have been expected based on method (48 samples, one in 16). This was equivalent to a 2% (1 in 48) frequency, which was less than 6.25% frequency specified in the method (1 in 16). This deviation was recorded by Bodycote as a QC non-conformance according to information given in an e-mail response from Bodycote (Bodycote to ESG 9 Oct.htm).

2. Deviation from the standard (clauses 5.10.2 and 5.10.3) – no deviations or flags were noted in the report, except sample notes on first page. The following flags would have been useful and might have prevented some confusion in communications that followed the delivery of the report: a list of

samples not analyzed for Hg, together with reason given, as well as a flag regarding lack of duplicates.

Some inconsistency in communications was apparent; in the e-mail from Bodycote to David Whetter of Jacques Whitford on August 19, 2008, the following statement suggests that sieving did not take place: "…these samples were not dried and ground through a sieve prior to analysis. The volume was too small to go through our grinder effectively so we sub-sampled from the [containers] that you provided to us". However, in the e-mail attachment from Bodycote to David Whetter and ESG on September 26, 2008, the statement "For these particular samples, prior to analysis, the dust was sieved through a 63 um sieve and the portion that passed through the sieve was analyzed" states the opposite. We assume that the results reported were those for sieved (to <63 um) samples as originally requested.

One step that was not controlled for by the blank was the sieving step, and therefore it is possible that contamination was introduced during this step that was not detected using the normal laboratory QC procedures. Decontamination of the sieves consisted of cleaning with a "Duster" canister, a small pressurized spray bottle typically used to clean dust from electronic equipment, and the sieve was then visually inspected for particles prior to preparing the next sample (Bodycote to ESG 9 Oct.htm). The duster material likely consisted of difluoroethane, trifluoroethane, or tetrafluoroethane and sometimes contains a bittering agent (wikipedia, accessed October 20, 2008). This agent may be denatonium benzoate, or denatonium saccharide (http://www.aversiontech.com, accessed October 20, 2008); some plant-based bittering agents (which may contain metals, www.aversiontech.com) are commercially available but it is unknown whether such agents are used in this application. If contamination were introduced in this step, it would likely have been systematic (introducing a consistently higher concentration of some elements overall), and thus it is unlikely that this step was the cause of the very high concentrations of lead observed in some samples.

Another source of contamination in a laboratory is if samples that are very high in some elements are weighed out, prepared or digested at the same time as the samples of interest. Bodycote checked their records to determine if any samples that were high in lead or tin were digested and analyzed concurrently with the dust samples being discussed. One batch of samples was digested at the same time as the dust samples; all tin samples in that batch were below 5 mg/kg and all lead samples were below 250 mg/kg, suggesting that cross-contamination from other samples was not likely (Bodycote to ESG 20b Oct.htm).

Table 2. Assessment checklist for Testmark Laboratories Ltd., Work Order # 61648. Italicized text signifies deviations from the standard, or between the conduct of testing and the documented method.

Reference to Standard	Item Assessed	Assessment	Document Reference
5.4.1	Scope of Accreditation	Garson laboratory, CAEAL, includes metals in soil by ICPMS-digestion	CAEAL Directory of Laboratories Scope of Accreditation, Testmark Laboratories Ltd., Aug 27, 2008
5.4.1, 5.9.1	Proficiency Testing	Registered tests include As, Cd, Cu, Pb, Zn, but not Se, in soils/sediments by ICPMS-digestion.[3]	http://209.90.159.196/lab_info.php?mId=3066&wId=p
Method (1st step of assessment)			
4.2, 5.4, 5.4.1	Method Document	Provided by Testmark to ESG, which had been provided by Intrinsik to Testmark	Method Used for Dust Sample Analysis- Metals; Testmark to ESG final questions Oct 08.txt
4.2, 5.4, 5.4.1	Fitness for use	Meets requirements.	Method Used for Dust Sample Analysis- Metals
5.7	Sample History	Meets requirements; provided method addresses treatment specific to dust analysis, so no procedures pertaining to sample history.	Method Used for Dust Sample Analysis- Metals
5.7	Sampling and Sub-sampling	Subsampling and sieving is mentioned. All or some of the sieved sample was used for analysis; sample was assumed to be homogenous and therefore no need for consideration of statistically based sampling. No drying is mentioned (not necessary for dust). Procedures to minimize dust loss and cross-contamination given in e-mail response (Testmark to ESG	Method Used for Dust Sample Analysis- Metals; Testmark to ESG final questions Oct 08.txt

[3] Other elements include Sb, Ba, Be, Cr, Co, Fe, Mn, Hg (by ICPMS-digestion), Ni, Sr, Sn, Ti, U, and V.

Reference to Standard	Item Assessed	Assessment	Document Reference
		final questions Oct 08.txt). Sample size reduction consisted of sieving. Duplicates incorporated into method (every 8 samples)	
5.6.2	Calibration	Method calibration is appropriate, and described in the method. No matrix matching of standards but internal standards used – no need for matrix matching because sample "matrix is very similar to calibration standards" (Testmark to ESG final questions Oct 08.txt).	Method Used for Dust Sample Analysis- Metals; Testmark to ESG final questions Oct 08.txt
5.9	Quality Control	Quality control consists of standard reference material (NIST 2711 soil), a digestion blank (no soil) and a sample duplicate every batch of 8 samples or less. Every 10 samples or less during analysis a blank and control standard are run, and every 20 samples or less a sample is analyzed twice. High frequency (with each microwave batch) ensures good control. Elements in SRM do not include all elements reported but the 6 reported elements were considered acceptable by client.	Method Used for Dust Sample Analysis- Metals Intrinsik to ESG elements in SRM.htm testmark to ESG Q&A.htm
Report/Conduct of Testing (2nd step of assessment)			
5.8.1, 5.8.2, 5.8.3	Report – Sample history, sample reception	No mention in report	Testmark Laboratories Ltd Analytical Report, WO# 61648
5.8.2	Report - Chain of custody	Included on first page of report	Testmark Laboratories Ltd Analytical Report, WO# 61648
5.9, 5.4.1, 5.10.2, 5.10.3	Report – Quality control	Quality control in report: meets requirements in the method; calibration checks (control standard) were included as well. Very convenient labelling of batches allows QC tests to be matched to samples. All QC data	Testmark Laboratories Ltd Analytical Report, WO# 61648

Reference to Standard	Item Assessed	Assessment	Document Reference
		were acceptable based on limits given in report. *Limits in report were same as those in method except for Be in control standard (acceptable range in report > 20% specified in method) and Cu in SRM (acceptable range in report wider than that in method). In both cases, all control standards and SRM results were within method specified limits.*	
5.10.2 5.10.3	Report – Deviations or Flags	No deviations or flags in report.	Testmark Laboratories Ltd Analytical Report, WO# 61648
5.9.2, 5.4.1, 5.10.2, 5.10.3	Report - Data validation	Comparison with expected ranges given in the report. Assumed data transcription/ calculations were checked by lab as part of routine analysis.	Testmark Laboratories Ltd Analytical Report, WO# 61648
5.10.2j	Test Report Authorization	By Chief Chemist and Inorganic Section Head	Testmark Laboratories Ltd Analytical Report, WO# 61648
5.4.1, 5.7	Conduct of testing – sample particle size	Sample that passed through 75 um sieve was analyzed for metals (including mercury).	testmark to ESG Q&A.htm
5.9.2, 5.4.1, 5.10.2, 5.10.3	Conduct of testing – samples and elements analyzed	Meets requirements.	Testmark Laboratories Ltd Analytical Report, WO# 61648 testmark to ESG Q&A.htm
5.9, 5.4.1	Conduct of testing – method quality control - frequency	Meets requirements.	Testmark Laboratories Ltd Analytical Report, WO# 61648
5.9, 5.4.1	Conduct of testing – method quality control - duplicates	Meets requirements.	Testmark Laboratories Ltd Analytical Report, WO# 61648
5.9, 5.4.1	Conduct of testing –	Meets requirements.	Testmark Laboratories Ltd Analytical Report, WO#

Reference to Standard	Item Assessed	Assessment	Document Reference
	method quality control – reference sample		61648
5.9, 5.4.1	Conduct of testing – method quality control – blanks	Meets requirements	Testmark Laboratories Ltd Analytical Report, WO# 61648
5.9, 5.6.2, 5.4.1	Conduct of testing – calibration curves	Could not assess, except for results for 5 ppm calibration check which were included; met requirements.	Testmark Laboratories Ltd Analytical Report, WO# 61648
5.8.1	Sample disposal, if applicable	Returned to client (September 10, 2008)	Intrinsik to ESG 15 Oct.htm

For the work carried out by Testmark, only one minor deviation was identified between the conduct of testing and the method document. This deviation occurred when the limits in the report differed for beryllium in the control standard (acceptable range in report was greater than the 20% specified in the method) and copper in the standard reference material (acceptable range in report was wider than that in method). In spite of the wider limits allowed (as given in the report), the results for these two elements were nevertheless within the method specified limits. Therefore this deviation did not impact the results.

The sieving step was also not controlled for by the Testmark laboratory (the blank was not taken through this step). It was noted that the decontamination of sieves by Testmark differed from that carried out by Bodycote, consisting of washing the sieves thoroughly with DI water, and drying in an oven, before using for each sample (Testmark to ESG final questions Oct 08.txt, Testmark to ESG final questions Oct 21 08.txt). This decontamination step is unlikely to introduce any cross contamination, provided the sieves were rinsed thoroughly. The good agreement between the Testmark results and those from a third laboratory (Analytical Services Unit, Queen's University; results provided by Intrinsik), where no sieving was carried out, suggests that the Testmark sieving procedure likely did not introduce any contamination.

The dust samples analyzed at Bodycote and Testmark were slightly different, since Bodycote analyzed the <63 um fraction, and Testmark analyzed the <75 um fraction that was obtained from the remainder of the sample analyzed at Bodycote. This <75 um fraction probably contained some <63 um particles for some samples, since Bodycote stated that only as much was sieved as was necessary for the analysis (0.5 g each for mercury and metals), with the remaining sample (which may have contained <63 um particles) returned to the sample container, and returned to the client (Bodycote to ESG 20 Oct.htm). There was no way of recording how many <63 um particles could have remained, but Bodycote stated that the samples that most likely would not have had any <63 um particles remaining would have been those for which mercury analysis could not be carried out (Bodycote to ESG 20 Oct.htm), as listed below in Table 3.

Table 3. List of samples that were not analyzed for mercury, and therefore had all the <63 um sample used up for metals analysis. These samples were possibly a sample size between 63 and 75 um when they were analyzed at Testmark. Bodycote reported % concentrations of lead for the bolded samples. Sample masses were provided by Jacques Whitford (JW to ESG 8 Oct.htm)

Sample ID	Approximate Sample Mass (g) after Bodycote analysis
AC-DS-1	1.7
AG-DS-1	0.8
AJZ-DS-1*	8.1
AK-DS-1	10.3
AL-DS-1	7
AN-DS-1	8.4
AR-DS-1	4.1
BC-DS-1	4
BD-DS-1	1.6
C-DS-1	1.3
D-DS-1	7.4
E-DS-1	4.8
J-DS-1	3.4
O-DS-1	6
P-DS-1	7.2
QZ-DS-1	8.2
R-DS-1	6.2
S-DS-1	9.4
T-DS-1	5.4
W-DS-1	3.9

IV. CONCLUSIONS

The project commissioned by Intrinsik Environmental to examine the quality assurance and quality control of dust analyses by two testing laboratories was carried out in two steps. The first step consisted of checking the documents provided by the laboratories against the standard to which they, as accredited laboratories, must perform (ISO/IEC 17025:2005). The second step consisted of checking that the conduct of testing was consistent with the laboratories' documented methods (and therefore with the standard).

No major problems were identified in either laboratory with the quality assurance program (as far as it could be assessed) or quality control measures undertaken. A minor non-conformance was identified for the Bodycote Testing Group when the duplicate frequency in the dust analyses was only one third that of the frequency stated in the method; the laboratory explained that this frequency was lower because the available sample sizes were too small. A flag in the report (not found) would have clarified this issue. For Testmark Laboratories Ltd, no non-conformances that could have impacted the results were found.

Two differences were noted in the analyses carried out by the two laboratories that may have impacted the results but would not have been detectable using the laboratory QC procedures. The first is that different decontamination procedures of sieves (which could have introduced contamination to the samples that would not have been monitored by blanks) were used: at Bodycote a "Duster" container was used, for which no information is available regarding the metals contents in its aerosol, and at Testmark the sieves were rinsed with water and dried in an oven. If any contamination had been introduced during the use of the Duster cleaner, it would have been systematic and at a consistent level. The second difference was that possibly different samples were analyzed at the two laboratories. For some samples it is quite likely that the Bodycote results are for the <63 um fraction, whereas the results reported by Testmark are for the size fraction between 63 and 75 um. Nevertheless the agreement of results provided by a third laboratory with those from Testmark indicates that the samples analyzed at Testmark do not appear to be remarkably heterogeneous. Thus the large differences seen between the Bodycote and Testmark results for some samples (e.g., AC-DS-1 and C-DS-1) may not be explainable at the current time.

V. LIMITATIONS AND USE OF REPORT

The present report was prepared for the exclusive use of Intrinsik Environmental. The report and other materials, which specifically include method documents, reports, and e-mail communications, were sent by Intrinsik or the partner group for this project, Jacques Whitford Environmental, or were provided by the two testing laboratories Bodycote Testing Group and Testmark Laboratories Ltd. The documentation provided by the two testing laboratories is to be used for the present investigation only and is confidential to Intrinsik, Jacques Whitford Environmental, and the Environmental Sciences Group (RMC).

The content of the present report is based on information collected during our investigation, our present understanding of the methods, and our professional judgement in light of such information available in this report. This report provides a professional opinion and does not provide a legal opinion regarding compliance with applicable laws. Although methods were followed that are used by assessors carrying out site assessments for CALA (formerly known as CAEAL), this report does not provide an opinion on the assessment, for the purposes of accreditation, of any testing laboratory.

The services performed as described in this report were conducted in a manner consistent with that level of care and skill normally exercised by other members of the science and engineering professions currently practising under similar conditions.

The findings and conclusions of this report are valid only as of the date of this report.

We trust that this report provides you with the information you require at this time. If you have any questions, please do not hesitate to contact us.

Dr. Ken Reimer, Director, ESG

Dr. Iris Koch, Senior Analytical Manger, ESG

VI. REFERENCES

The following document is available from www.cala.ca.

Canadian Association for Laboratory Accreditation (CALA) Inc. 2007. A02 – Assessment Rating Guide Revision 2.4 – January 2007. For use with ISO/IEC 17025:2005, General requirements for the competence of testing and calibration laboratories.