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National Measurement Institute

Proficiency Test Final Report AQA 21-14 Metals, Nutrients and Anions in Soil

January 2022

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I would like to thank the management and staff of the participating laboratories for supporting the study. It is only through widespread participation that we can provide an effective service to laboratories.

The assistance of the following NMI staff members in the planning, conduct and reporting of the study is acknowledged.

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Accredited for compliance with ISO/IEC 17043

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TABLE OF CONTENTS

1 SUMMARY

This report presents the results of the proficiency test AQA 21-14 Metals, Nutrients and Anions in Soil. The study covers the measurement of acid extractable elements: Ag, Al, As, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cs, Cu, Fe, Ga, Hg, K, La, Li, Mg, Mn, Mo, Na, Ni, P, Pb, Rb, S, Sb, Se, Sn, Sr, Th, Tl, U, V and Zn. Measurement of pH, electrical conductivity (EC), water soluble bromide (Br^-), chloride (Cl^-), fluoride (F^-), iodide (I^-), orthophosphate-P (PO_4^{3-}-P), and sulphate (SO_4^{2-}), total Kjeldahl nitrogen (TKN), 2M KCl extractable ammonium nitrogen (NH_4^+-N) and 2M KCl extractable nitrate nitrogen (NO_3^--N) were also included in the program.

The sample set consisted of one soil sample, one sediment sample and one agricultural soil sample.

Thirty laboratories registered to participate and all submitted results.

The assigned values were the robust average of participants' results. The associated uncertainties were estimated from the robust standard deviation of the participants' results.

The outcomes of the study were assessed against the aims as follows, to:

i. compare the performance of participant laboratories and assess their accuracy;

Laboratory performance was assessed using both z-scores and E_n-scores.

Of 785 z-scores, 711 (91%) were satisfactory with $|z| \leq 2.0$.

Of 785 E_n-scores, 623 (79%) were satisfactory with $|E_n| \leq 1.0$.

ii. evaluate the laboratories 'methods used in determination of inorganic analytes in soil;

Boron, antimony and low level selenium were the tests which presented the most analytical difficulty to participating laboratories.

iii. evaluate within laboratory reproducibility;

Sample S1 of the present study was distributed as Sample S2 of AQA 19-12. Although the assigned values set for the two samples were not significantly different, in some cases, the reported results varied greatly.

iv. compare the performance of participant laboratories with their past performance;

On average participants' performance in the measurement of inorganic analytes in soil over has remained fairly consistent over time.

v. develop the practical application of traceability and measurement uncertainty and provide participants with information that will be useful in assessing their uncertainty estimates;

Of 871 numerical results, 825 (95%) were reported with an expanded measurement uncertainty. An example of estimating measurement uncertainty using the proficiency testing data only is given in Appendix 3.

vi. produce materials that can be used in method validation and as control samples.

The test samples of this study were checked for homogeneity and are well characterised, both by in-house testing and from the results of the proficiency round. Surplus of these test samples is available for purchase from NMI.

2 INTRODUCTION

2.1 NMI Proficiency Testing Program

The National Measurement Institute (NMI) is responsible for Australia's national measurement infrastructure providing a wide range of services, including a chemical proficiency testing program.

Proficiency testing (PT) "is evaluation of participant performance against pre-established criteria by means of inter-laboratory comparison."[1] NMI PT studies target chemical testing in areas of high public significance such as trade, environment and food safety. NMI offers studies in:

- inorganic analytes in soil, water, food and pharmaceuticals;
- pesticide residues in fruit and vegetables, soil and water;
- petroleum hydrocarbons in soil and water;
- PFAS in water, soil, biota and food;
- controlled drug assay; and
- folic acid in flour.

AQA 21-14 is the 29th NMI proficiency study of inorganic analytes in soil.

2.2 Study Aims

The aims of the study were to:

- compare the performance of participant laboratories and assess their accuracy;
- evaluate the laboratories' methods used in determination of inorganic analytes in soil;
- evaluate within-laboratory reproducibility;
- compare the performance of participant laboratories with their past performance;
- develop the practical application of traceability and measurement uncertainty; and
- produce materials that can be used in method validation and as control samples.

2.3 Study Conduct

The conduct of NMI proficiency tests is described in the NMI Chemical Proficiency Testing Study Protocol.[2] The statistical methods used are described in the NMI Chemical Proficiency Statistical Manual.[3] These documents have been prepared with reference to ISO Standard 17043[1] and The International Harmonized Protocol for Proficiency Testing of (Chemical) Analytical Laboratories.[4]

NMI is accredited by National Association of Testing Authorities, Australia (NATA) to ISO/IEC 17043 as a provider of proficiency testing schemes. This proficiency test is within the scope of NMI's accreditation.

The choice of the test method was left to the participating laboratories.

3 STUDY INFORMATION

3.1 Selection of Matrices and Inorganic Analytes

The 54 tests were selected from those for which an investigation level is published in the Guideline on the Investigation Levels for Soil and Groundwater, promulgated by the National Environmental Protection Council (NEPC)[5] and from analytes commonly measured in soil.

3.2 Participation

Thirty laboratories participated and all thirty submitted results.

The timetable of the study was:

Invitation issued:	22 September 2021
Samples dispatched:	12 October 2021
Results due:	17 November 2021
Interim report issued:	18 November 2021

3.3 Test Material Specification

Three samples were provided for analysis:

Sample S1 was 25 g of dried sediment previously distributed as sample S2 of AQA 19-12;

Sample S2 was 25 g of dried soil; and

Sample S3 was 75 g of dried agricultural soil**.**

3.4 Laboratory Code

All participant laboratories were assigned a confidential code number.

3.5 Sample Preparation, Analysis and Homogeneity Testing

Test samples from previous studies have been demonstrated to be sufficiently homogeneous for the evaluation of participants' performance. Therefore, only a partial homogeneity test was conducted for all analytes with the exception of Sb and Rb in S2 and EC, pH, iodide, 2M KCl extractable nitrate-N and S in S3. The results from the partial homogeneity test for these samples are reported in the present study as the homogeneity value.

The preparation, analysis and homogeneity testing of the study samples are described in Appendix 1.

3.6 Stability of Analytes

No stability study was carried out in the present study. Stability studies conducted for the previous proficiency tests of inorganic analytes in soil found no significant changes in any of the analytes' concentration.

3.7 Sample Storage, Dispatch and Receipt

The samples were dispatched by courier on 12 October 2021.

A description of the test samples and instructions for participants, and a form for participants to confirm the receipt of the test samples, were sent with the samples.

An Excel spreadsheet for the electronic reporting of results was e-mailed to participants.

3.8 Instructions to Participants

Participants were instructed as follows:

- Quantitatively analyse the samples using your normal test method.
- For *Sample S3* for 2M KCl Extractable (NO_3^--N) and (NH_4^+-N), participants are asked to follow the extraction procedure described below:

  "Prepare a 1:10 w/v soil/2M KCl extracting solution. For example, weigh 5 g of soil into a suitable bottle or jar and add 50 mL of 2M KCl extracting solution. Mechanically shake (end-over-end preferred), at room temperature for 1 h. Allow around 20-30 min for soil to settle and clarify and then take a known aliquot for the measurement technique employed. Further dilution of the aliquot may be required."

Measure the analytes using a colorimetric method; and report results of 1:10 soil/2M KCl extracting solution on as received basis in units of mg/kg for: 2M KCl extractable ammonium-N (NH_4^+-N) and 2M KCl extractable nitrate-N (NO_3^--N).

- Report on as received basis in units of mg/kg except for EC and pH. EC results are to be reported in units of µS/cm.

SAMPLE S1 (sediment)		SAMPLE S2 (soil)		SAMPLE S3 (agricultural soil)	
Test Acid Extractable	Approximate Conc. Range mg/kg	Test Acid Extractable	Approximate Conc. Range mg/kg	Test	Approximate Conc. Range*mg/kg
Al	250-10000	Ag	0.5-20	Ca (acid extractable)	100-4000
As	5-200	B	20-800	Fe (acid extractable)	1000-40000
Cd	5-200	Ba	20-800	K (acid extractable)	100-4000
Co	5-200	Be	0.5-20	Mg (acid extractable)	100-4000
Cr	5-200	Bi	0.5-20	Na (acid extractable)	100-4000
Cu	5-200	Cd	0.5-20	P (acid extractable)	100-4000
Hg	5-200	Cs	0.5-20	S (acid extractable)	NA
Mn	50-2000	Ga	0.5-20	Sr (acid extractable)	10-400
Mo	0.5-20	Hg	0.2-8	Water soluble Bromide (Br^-) – 1:5 soil/water extract	0.5-20
Ni	0.5-20	La	5-200	Water soluble Chloride (Cl^-) – 1:5 soil/water extract	5-200
Pb	10-400	Li	0.5-20	Water soluble Fluoride (F^-) – 1:5 soil/water extract	0.5-20
Sb	0.5-20	Ni	5-200	Water soluble Iodide (I^-) – 1:5 soil/water extract	5-200
Se	5-200	Rb	0.5-20	Water soluble Orthophosphate-P (PO_4^{3-}-P) – 1:5 soil/water extract	0.5-20
Th	0.5-20	Sb	5-200	Water soluble Sulphate (SO_4^{2-}) – 1:5 soil/water extract	50-2000
U	0.5-20	Se	0.5-20	pH of 1:5 soil/water suspension	<10
V	5-200	Sn	0.5-20	EC of 1:5 soil/water extract	>500µS/cm
Zn	5-200	Tl	0.5-20	Kjeldahl Nitrogen, Total (TKN)	250-10000
		Zn	5-200	2M KCl Extractable (Ammonium-N)	NA
				2M KCl Extractable (Nitrate-N)	NA

NA = Not Available

- Report results using the electronic results sheet emailed to you:
- Report results as you would report to a client. For each analyte, report the expanded measurement uncertainty.
- Please send the requested details regarding the test method and the basis of your uncertainty estimate.

3.9 Interim Report

An interim report was emailed to participants on 18 November 2021.

4 PARTICIPANT LABORATORY INFORMATION

4.1 Test Method Summaries

Summaries of test methods are transcribed in Tables 1 to 10.

Table 1 Methodology for Acid Extractable Elements

Lab. Code	Method Reference	Sample Mass (g)	Temp. (°C)	Time (min)	Vol. HNO_3 (mL)	Vol. HCl (mL)	Vol. HNO_3 (1:1) (mL)	Vol. HCl (1:1) (mL)	Vol. H_2O_2 (mL)	Other (mL)
1	AS4479.2-1997	2	90	90	2	6				
2	USEPA Method 200.2	1	95	60			2	10		
4	USEPA method 200.2 Revision 2.8	1	95	60			2	10	2	
5	In House, US EPA 6020B	2	90-95	60	4	12				4 (H_2O)
6	In House S6 - Referencing APHA 3125	0.4	120	60	2.5	7.5				
7	USEPA 200.2	1	95	60			2		2	10 (HCl 1:4)
8	200.2 Revision 2.8	1	95 ± 5	60	2	10			2	
10*	EPA 200.2, (1:1 Nitric:Hydrochloric Acid)	0.5	96	30	1	1				
11	USEPA Method 3050B and APHA Method 3125	0.5	95	120	3	3				
12	US EPA 3050 B	1.0006	98	100		5.0 mL	10.0 mL			
13	US EPA 3050B	0.5	95	120	7.5	5			1.5	
14	USEPA 3051A (Modification)	1	170	15			8	2		
15	ICPOES/ICPMS/AFS In-house methods referenced to USEPA 6010,6020 and 7474	1	95	90	2	3			2	
16*	Soil Chemical Methods - Australasia (Raymod and Lyons) - Method 17B1	3	95	120	22.5	7.5				
17	USEPA 3050B	1.0000	98	150	5	5				
18	US EPA Methods 3050B, 3051A and 6020B	2	100	60	4	12				
19		1	90	240	4	1				
20	USEPA-6010C (Except Mercury by USEPA-7471B)	ICP=1g, FIMS=0.5g	95		5	5		3		
21*	200.2	1	98	90	3	3				
22		1	95-100	120	3	3				
23*	EPA 200.2	0.5	95	45	1	1				5 (H_2O)

Table 1 Methodology for Acid Extractable Elements (continued)

Lab. Code	Method Reference	Sample Mass (g)	Temp. (°C)	Time (min)	Vol. HNO_3 (mL)	Vol. HCl (mL)	Vol. HNO_3 (1:1) (mL)	Vol. HCl (1:1) (mL)	Vol. H_2O_2 (mL)	Other (mL)
24	EPA 3052	0.50xx	210	30	5	3				0.75 (HF)
25	APHA 3030E	1	40	240	10	1				
26	US-EPA Method 200.2	1	95	50	2	2				10 (H_2O)
27	EPA (Environmental Protection Agency) 1994 Method 200.8		109	60	800	400				1200 (Type 1 Water)
28	USEPA Method 3010	5	95	60	10	10				
29	EPA3050B, 6020B	2	95-105	60	4	12				
30	AS 4479.2-1997, AS4479.4-1999	0.5	95	120	1	3				

*Additional information in Table 10

Table 2 Methodology for Total Kjeldahl Nitrogen

Lab. Code	Method Reference	Digestion	Distillation	Measurement Method	Instrument
2	APHA 4500 Norg, A & D	Yes	No	Colorimetric - salicylate method	DA
4	APHA 4500 - Norg. A & D.	Yes	No	Colorimetric - salicylate method	DA
6*				TKN = TN-NOx (Dumas)	
7	APHA 4500	Yes		Colorimetric - phenate method	DA
8	APHA 22nd edition 4500 Norg A & D with Jirka Modification- Jirka et al. (1976) and the appropriate Discrete Analyser method.	Yes	No	Colorimetric - phenate method	DA
10	APHA (online edition) 4500-N org	Yes		Colorimetric - salicylate method	DA
12	NSW.AES.072: Based on 7A1 Australian Laboratory Handbook of Soil and Water Chemical Methods (By Rayment and Higginson)	Yes	Yes		
14	APHA Method 4500-N Org B and Method 4500-NH3 F	Yes	Yes	Colorimetric - phenate method	DA
15	APHA 4500-Norg D In-house method	Yes		Colorimetric - salicylate method	FIA
16	In-house method based on APHA 23rd edition 4500-Norg B	Yes	Yes	Colorimetric - salicylate method	DA
22		Yes	Yes	Titrimetric method	Manual Analysis
25	APHA 4500-Norg C	Yes	Yes	Titrimetric method	Manual Analysis
28		Yes	No	Colorimetric - salicylate method	FIA

*Additional information in Table 10

Table 3 Methodology for 2M KCl Extractable Ammonium-N and Nitrate-N

Lab. Code	Method Reference		Sample Mass (g)	Extraction Solution 2M KCl Volume (mL)	Shake time (hours)	Measurement Method		Measurement Instrument	
	NH_4^+-N	NO_3^--N				NH_4^+-N	NO_3^--N	NH_4^+-N	NO_3^--N
6	In House S37	In House S37	2	20	1	Colorimetric - Salicylate method	Colorimetric - vanadium III method	FIA	FIA
9	7C2b	7C2b	10	100	1	Colorimetric Salicylate Method	Colorimetric-Sulfanilamide-NEDD hydrazine reduction	FIA	FIA
10	APHA (online edition) 4500-NH3H	NT	5	100	1	Colorimetric - Phenate method	NT	FIA	NT
12	APHA 4500 NH3 B/C		10.0003	100	1				
14*	7C2b	7C2b	3	30	1	Colorimetric - Phenate method	Colorimetric-Sulfanilamide-NEDD Cd reduction	FIA	FIA
15*	APHA 4500-NH3 H	4500-NO3 I	3	30	1	Colorimetric - Phenate method	Colorimetric-Sulfanilamide-NEDD Cd reduction	FIA	FIA
16	Soil Chemical Methods, Rayment & Lyons method 7C2	Soil Chemical Methods, Rayment & Lyons method 7B1	5	50	1	Colorimetric - Salicylate method	Colorimetric - vanadium III method	DA	DA
17	R&L 7C2b	R&L 7C2b	2	20	1			DA	DA
22		apha	10	100	1	Fluorescence is measure at 460	Colorimetric-Sulfanilamide-NEDD Cd reduction	SFA	
28			10	50	16	Colorimetric - Phenate method	Colorimetric-Sulfanilamide-NEDD Cd reduction	FIA	FIA
29	APHA 4500-NH3		5	50	1	Colorimetric - Phenate method		DA	

Additional information in Table 10. NT = Not Tested

Table 4 Methodology for Water Soluble Br^-

Lab. Code	Method Reference	Sample Mass (g)	Water Volume (mL)	Shake Time (hours)	Measurement Method	Measurement Instrument
7	APHA 4110	10	50	1	Ion Chromatographic Method	IC
13		10	50	1	Ion Chromatographic Method	IC
14	APHA 4110B	10	50	1	Ion Chromatographic Method	IC
21	APHA 4110B and C	5	25		Ion Chromatographic Method	IC
22	apha	10	50	1	Ion Chromatographic Method	IC
29	APHA 4110B	10	50	1	Ion Chromatographic Method	IC

Table 5 Methodology for Water Soluble Cl^-

Lab. Code	Method Reference	Sample Mass (g)	Water Volume (mL)	Shake Time (hours)	Measurement Method	Measurement Instrument
2		10	50	1	Mercurric Nitrate Titration	DA
4	APAH 4500-Cl	10	50	1	Ferricyanide Colorimetric Method	DA
7	APHA 4110	10	50	1	Ion Chromatographic Method	IC
9	5	5	40	1	Ferricyanide Colorimetric Method	FIA
10					NT	
12	NSW.AES.030	15.0006	75	1		
13		10	50	1	Ion Chromatographic Method	IC
14	APHA 4110B	10	50	1	Ion Chromatographic Method	IC
15	Inhouse with reference to APHA4110B	4	20	1	Ion Chromatographic Method	IC
16	Soil Chemical Methods, Rayment & Lyons	50	250	1	Potentiometric Method	Titration
17		10	50	1		
21	APHA 4110B and C	5	25		Ion Chromatographic Method	IC
22	apha	10	50	1	Ion Chromatographic Method	IC
28		5	25	16	Mercuric Thiocyanate	DA
29	APHA 4110B	10	50	1	Ion Chromatographic Method	IC

NT = Not Tested

Table 6 Methodology for Water Soluble F^-

Lab. Code	Method Reference	Sample Mass (g)	Water Volume (mL)	Shake Time (hours)	Measurement Method	Measurement Instrument
2		10	50	1	Potenciometric	Fluoride Selective Electrode
4	In house	10	50	1	Ion Selective Electrode Method	Fluoride Selective Electrode
7	APHA 4110	10	50	1	Ion Chromatographic Method	IC
10					NT	
14	APHA 4500-F C	10	50	1	Ion Selective Electrode Method	Fluoride Selective Electrode
16	Soil Chemical Methods, Rayment & Lyons	50	250	1	Ion Selective Electrode Method	Fluoride Selective Electrode
21	APHA 4110B and C	5	25		Ion Chromatographic Method	IC
22	apha	10	50	1	Ion Selective Electrode Method	IC
28		5	25	16	Ion Selective Electrode Method	Fluoride Selective Electrode

NT = Not Tested

Table 7 Methodology for Water Soluble I^-

Lab. Code	Method Reference	Sample Mass (g)	Water Volume (mL)	Shake Time (hours)	Measurement Method	Measurement Instrument
7	APHA 4110	10	50	1	Ion Chromatographic Method	IC
14	APHA 4110B	10	50	1	Ion Chromatographic Method	IC
22	apha	10	50	1	Ion Chromatographic Method	IC
29	APHA 4110B	10	50	1	Ion Chromatographic Method	IC

NT = Not Tested

Table 8 Methodology for Water Soluble Orthophosphate-P

Lab. Code	Method Reference	Sample Mass (g)	Water Volume (mL)	Shake Time (hours)	Measurement Method	Measurement Instrument
2		10	50	1	Ascorbic Acid Colorimetric	DA
4	APHA 4500-P	10	50	1	Vanadomolybdophosphoric Colorimetric Method	DA
6		2	10	1	Vanadomolybdophosphoric Colorimetric Method	FIA
7	APHA 4110	10	50	1	Ion Chromatographic Method	FIA
10					NT	
14	APHA 4500-P G	10	50	1	Ascorbic Acid Colorimetric Method	FIA
16	Soil Chemical Methods, R&L	50	250	1	Ascorbic Acid Colorimetric Method	DA
17		10	50	1		DA
21	APHA 4110B and C	5	25		Ion Chromatographic Method	IC
22	apha	10	50	1	Ion Chromatographic Method	IC
28		5	25	16	Ascorbic Acid Colorimetric Method	DA
29	APHA 4500-PE, 4500-P B	10	50	1	Ascorbic Acid Colorimetric Method	DA

NT = Not Tested

Table 9 Methodology for Water Soluble SO_4^{2-}

Lab. Code	Method Reference	Sample Mass (g)	Water Volume (mL)	Shake Time (hours)	Measurement Method	Measurement Instrument
2		10	50	1	Turbidimetric Method	DA
4	In house	10	50	1	ICP-Method	ICP-OES
6		2	10	1	ICP-Method	ICP-OES
7	APHA 4110	10	50	1	Ion Chromatographic Method	IC
12	NSW.AES.032	15.0006	75	1		
14	APHA 4110B	10	50	1	Ion Chromatographic Method	IC
16	Soil Chemical Methods R&L	50	250	1	Turbidimetric Method	Turbidemeter
17		10	50	1		ICP-OES
21	APHA 4110B and C	5	25		Ion Chromatographic Method	IC
22	apha	10	50	1	Ion Chromatographic Method	IC
28		5	25	16	Turbidimetric Method	DA
29	APHA 4110B	10	50	1	Ion Chromatographic Method	IC

4.2 Instruments Used for Measurements

The instruments and settings used by participants for acid extractable elements are presented in Appendix 4.

4.3 Additional Information

Participants had the option to report additional information for each sample analysed. These are transcribed in Table 10.

Table 10 Additional information

Lab Code	Additional Information
6	Methodology for Total Kjeldahl Nitrogen: TKN - TN done by LECO, NOx by FIA
10	Instrument Techniques for Acid Extractable Elements: APHA (online edition) 3125B by ICPMS
14	Methodology for 2M KCl Extractable Ammonium-N and Nitrate-N: Method reference from Rayment & Lyons, 2011.
15	Methodology for 2M KCl Extractable Ammonium-N and Nitrate-N: Rayment and Lyons(for 2M KCL Extraxtable Ammonium-N and Nitrate-N) 7C2b
16	Methodology for Acid Extractable Elements: Once digested the sample is made up to 100 mL with DI Water Instrument Techniques for Acid Extractable Elements: Mercury is analysed by in-house method based on USEPA method 245.7 using FIMS Total Phosphorus was analysed by Ascorbic Acid colorimetric using DA
21	Sample S2: Se not detected for this sample (<LOR)
23	Methodology for Acid Extractable Elements: After acid addition, samples are left for 5-10 minutes before water added & heated.

4.4 Basis of Participants' Measurement Uncertainty Estimates

Participants were requested to provide information about the basis of their uncertainty estimates (Tables 11 and 12).

Table 11 Basis of Uncertainty Estimate

Lab. Code	Approach to Estimating MU	Information Sources for MU Estimation[a]		Guide Document for Estimating MU
		Precision	Method Bias	
1	Bottom Up (ISO/GUM, fish bone/ cause and effect diagram)	Control Samples - CRM Duplicate Analysis Instrument Calibration	CRM Instrument Calibration	
2	Bottom Up (ISO/GUM, fish bone/ cause and effect diagram)	Standard deviation from PT studies only		Eurachem/CITAC Guide
		Control Samples - CRM Duplicate Analysis Instrument Calibration	CRM Instrument Calibration Recoveries of SS	
3	Standard deviation of replicate analyses multiplied by 2 or 3	Control Samples - CRM	CRM Laboratory Bias from PT Studies Recoveries of SS	Eurachem/CITAC Guide
4	Top Down - precision and estimates of the method and laboratory bias	Control Samples - CRM	CRM Recoveries of SS	Eurachem/CITAC Guide
5	Top Down - precision and estimates of the method and laboratory bias	Control Samples - SS	Recoveries of SS	ISO/GUM
6	Top Down - precision and estimates of the method and laboratory bias	Control Samples - RM Duplicate Analysis	Instrument Calibration Standard Purity	Eurachem/CITAC Guide
7	Top Down - precision and estimates of the method and laboratory bias	Control Samples - RM Duplicate Analysis Instrument Calibration		Eurachem/CITAC Guide
8	Top Down - precision and estimates of the method and laboratory bias	Control Samples - CRM Duplicate Analysis	CRM	Eurachem/CITAC Guide
9	Top Down - reproducibility (standard deviation) from PT studies used directly	Control Samples - CRM Duplicate Analysis Instrument Calibration		Nordtest Report TR537
10	Top Down - precision and estimates of the method and laboratory bias	Control Samples - SS Duplicate Analysis Instrument Calibration	CRM Instrument Calibration Recoveries of SS Standard Purity	IANZ Technical Guide
11	SD of replicate analyses x 2 x 100/85 x 100/mean	Control Samples	CRM Instrument Calibration	
12		Control Samples - CRM Duplicate Analysis Instrument Calibration	CRM Instrument Calibration Recoveries of SS Standard Purity	Eurachem/CITAC Guide
13	Top Down - precision and estimates of the method and laboratory bias	Control Samples - CRM Duplicate Analysis	CRM Recoveries of SS	Top Down approach, John Eames
14	Top Down - precision and estimates of the method and laboratory bias	Control Samples - CRM Duplicate Analysis	CRM	NMI Uncertainty Course
15	Bottom Up (ISO/GUM, fish bone/ cause and effect diagram)	Control Samples - SS Duplicate Analysis Instrument Calibration	CRM Instrument Calibration Recoveries of SS	Eurachem/CITAC Guide
16	Top Down - precision and estimates of the method and laboratory bias	Control Samples - SS Duplicate Analysis Instrument Calibration	Recoveries of SS	NATA Estimating and Reporting measurement

Lab. Code	Approach to Estimating MU	Information Sources for MU Estimation[a]		Guide Document for Estimating MU
		Precision	Method Bias	
				uncertainty of chemical test results - Jan 2018
17	Top Down - reproducibility (standard deviation) from PT studies used directly	Standard deviation from PT studies only		Eurolab Technical Report No1/2007
		Control Samples	CRM Laboratory Bias from PT Studies	
18*	Top Down - precision and estimates of the method and laboratory bias	Control Samples - CRM Duplicate Analysis Instrument Calibration	CRM Instrument Calibration Laboratory Bias from PT Studies	ASTM E2554-13
19	Top Down - precision and estimates of the method and laboratory bias	Control Samples - RM Duplicate Analysis	CRM	NATA General Accreditation, Guidance, Estimating and Reporting MU
20	Top Down - precision and estimates of the method and laboratory bias	Control Samples - CRM Duplicate Analysis	CRM Instrument Calibration Recoveries of SS	NMI Uncertainty Course
21	Top Down - precision and estimates of the method and laboratory bias	Standard deviation from PT studies only		Nordtest Report TR537
		Control Samples - RM Duplicate Analysis Instrument Calibration	CRM Instrument Calibration Recoveries of SS	
22	Top Down - precision and estimates of the method and laboratory bias	Control Samples Duplicate Analysis	CRM Variation in Sample Moisture Content Recoveries of SS	Nordtest Report TR537
23	Top Down - precision and estimates of the method and laboratory bias	Control Samples Duplicate Analysis	CRM Recoveries of SS	ISO/GUM
24		Duplicate Analysis	Instrument Calibration Standard Purity	
25	Standard deviation of replicate analyses multiplied by 2 or 3	Standard deviation from PT studies only		ISO/GUM
		Duplicate Analysis Instrument Calibration	CRM	
26	Standard deviation of replicate analyses multiplied by 2 or 3	Control Samples Duplicate Analysis	CRM Instrument Calibration Laboratory Bias from PT Studies	Eurachem/CITAC Guide
27	Standard deviation of replicate analyses multiplied by 2 or 3	Control Samples - RM	Recoveries of SS	
28	Top Down - precision and estimates of the method and laboratory bias	Control Samples - CRM	CRM	ISO/GUM
29	Estimation of MU from within-laboratory data on bias and precision has been calculated by using the procedures outlined in ASTM E2554-13 Standard Practice for Estimating and Monitoring the Uncertainty of Test Results of a Test Method Using Control Chart Techniques	Control Samples Duplicate Analysis Instrument Calibration	CRM	ASTM E2554-13

Lab. Code	Approach to Estimating MU	Information Sources for MU Estimation[a]		Guide Document for Estimating MU
		Precision	Method Bias	
30	Calculated from Standard deviation and concentration of long term in house QC samples	Control Samples - RM Duplicate Analysis	Instrument Calibration Laboratory Bias from PT Studies	NATA General Accreditation, Guidance, Estimating and Reporting MU (Replace TN 33)

*Additional information in Table 12. [a]RM = Reference Material, CRM = Certified Reference Material, SS =Spiked samples

Table 12 Additional Information for Basis of Uncertainty Estimate

Lab Code	Additional Information
18	Estimation of MU from within-laboratory data on bias and precision has been calculated by using the procedures outlined in ASTM E2554-13 Standard Practice for Estimating and Monitoring the Uncertainty of Test Results of a Test Method Using Control Chart Techniques

4.5 Participant Comments on this PT Study or Suggestions for Future Studies

The study co-ordinator welcomes comments or suggestions from participants about this study or possible future studies. Such feedback may be useful in improving future studies. Participants' comments are reproduced in Table 13.

Table 13 Participants' Comments

Lab Code	Participants' Comments	Study Co-ordinator's Response
3	These work well for us. Maybe provide larger sample size for ongoing us as quality control samples.	The test samples of this study were checked for homogeneity and are well characterised, both by in-house testing and from the results of the proficiency round. Surplus of these test samples is available for purchase from NMI.

5 PRESENTATION OF RESULTS AND STATISTICAL ANALYSIS

5.1 Results Summary

Participant results are listed in Tables 14 to 67 with resultant summary statistics: robust average, median, maximum, minimum, robust standard deviation (SD_{rob}) and robust coefficient of variation (CV_{rob}). Bar charts of results and performance scores are presented in Figures 2 to 55. An example chart with interpretation guide is shown in Figure 1.

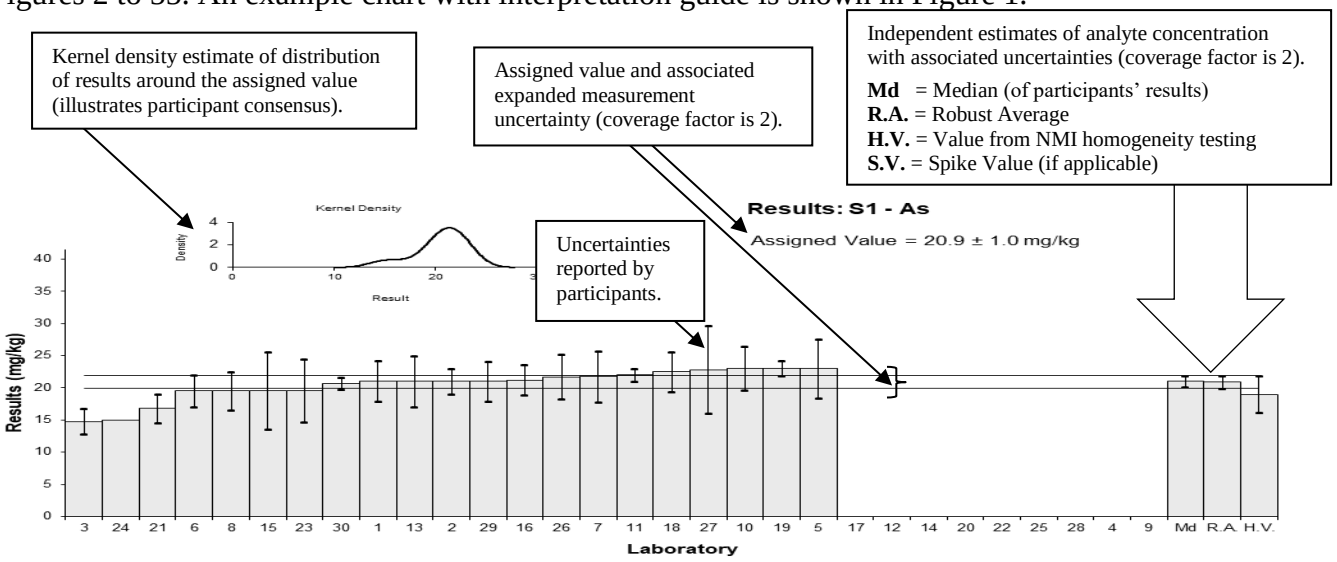


Figure 1 Guide to Presentation of Results

5.2 Outliers and Extreme Outliers

Outliers were results less than 50% and greater than 150% of the robust average and were removed before assigned value calculation. Extreme outliers were obvious blunders, such as those with incorrect units, decimal errors, or results from a different proficiency test item (gross errors) and were removed for calculation of summary statistics.[3, 4]

5.3 Assigned Value

An example of an assigned value calculation using data from the present study is given in Appendix 2. The assigned value is defined as: 'the value attributed to a particular property of a proficiency test item.'[1] In this study the property is the mass fraction of analyte. Assigned values were the robust average of participants' results; the expanded uncertainties were estimated from the associated robust standard deviations.[4, 6]

5.4 Robust Average

The robust averages and associated expanded measurement uncertainties were calculated using the procedure described in 'Statistical methods for use in proficiency testing by inter-laboratory comparisons, ISO13528:2015(E)'.[6]

5.5 Robust Between-Laboratory Coefficient of Variation

The robust between-laboratory coefficient of variation (robust CV) is a measure of the variability of participants' results and was calculated using the procedure described in ISO13528:2015(E).[6]

5.6 Target Standard Deviation for Proficiency Assessment

The target standard deviation for proficiency assessment (σ) is the product of the assigned value *(X)* and the performance coefficient of variation (PCV). This value is used for calculation of participant z-score and provides scaling for laboratory deviation from the assigned value.

$\sigma = (X) * PCV$ Equation 1

It is important to note that the PCV is a fixed value and is not the standard deviation of participants' results. The fixed value set for PCV is based on the existing regulation, the acceptance criteria indicated by the methods, the matrix, the concentration level of analyte and on experience from previous studies. It is backed up by mathematical models such as Thompson Horwitz equation.[7]

5.7 z-Score

An example of z-score calculation using data from the present study is given in Appendix 2.

For each participant's result a z-score is calculated according to Equation 2 below:

$$z = \frac{(\chi - X)}{\sigma}$$ Equation 2

where:

z is z-score;
χ is a participant's result;
X is the assigned value;
σ is the target standard deviation.

A z-score with absolute value (|z|):

- $|z| \leq 2.0$ is satisfactory;
- $2.0 < |z| < 3.0$ is questionable;
- $|z| \geq 3.0$ is unsatisfactory.

5.8 E_n-Score

An example of E_n-score calculation using data from the present study is given in Appendix 2.

The E_n-score is complementary to the z-score in assessment of laboratory performance. E_n-score includes measurement uncertainty and is calculated according to Equation 3 below:

$$E_n = \frac{(\chi - X)}{\sqrt{U_\chi^2 + U_X^2}}$$ Equation 3

where:

E_n is E_n-score;
χ is a participant's result;
X is the assigned value;
U_χ is the expanded uncertainty of the participant's result;
U_X is the expanded uncertainty of the assigned value.

An E_n-score with absolute value ($|E_n|$):

- $|E_n| \leq 1.0$ is satisfactory;
- $|E_n| > 1.0$ is unsatisfactory.

5.9 Traceability and Measurement Uncertainty

Laboratories accredited to ISO/IEC Standard 17025:2018[8] must establish and demonstrate the traceability and measurement uncertainty associated with their test results. Guidelines for quantifying uncertainty in analytical measurement are described in the Eurachem/CITAC Guide.[9]

6 TABLES AND FIGURES

Table 14

Sample Details

Sample No.	S1
Matrix.	Sediment
Analyte.	Al
Units	mg/kg

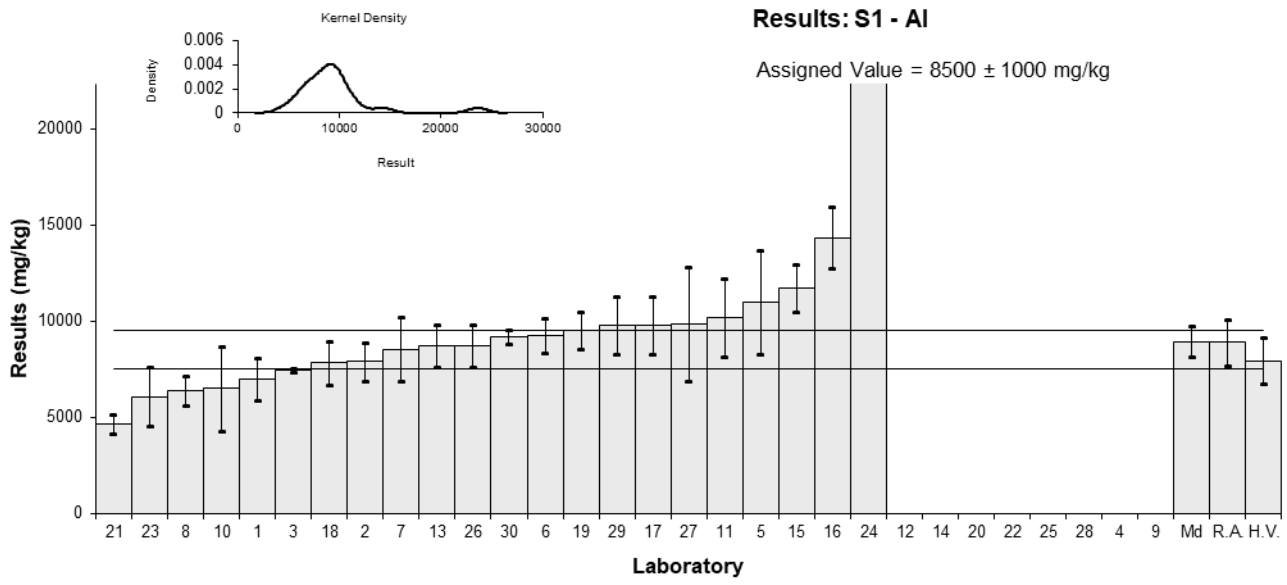
Participant Results

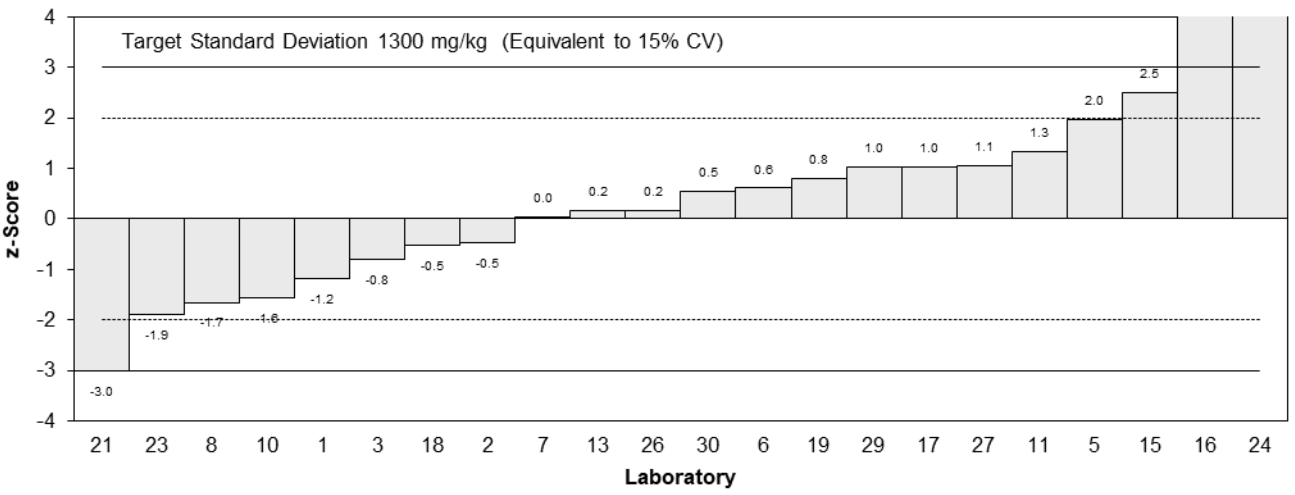
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	7000	1100	-1.18	-1.01
2	7900	1000	-0.47	-0.42
3	7463.05	100	-0.81	-1.03
4	NT	NT		
5	11000	2700	1.96	0.87
6	9280	900	0.61	0.58
7	8546	1680	0.04	0.02
8	6390	736	-1.65	-1.70
9	NT	NT		
10	6500	2200	-1.57	-0.83
11	10200	2040	1.33	0.75
12	NT	NT		
13	8700	1100	0.16	0.13
14	NT	NT		
15	11700	1230	2.51	2.02
16	14349	1578	4.59	3.13
17	9820	1500	1.04	0.73
18	7830	1140	-0.53	-0.44
19	9530	953	0.81	0.75
20	NT	NT		
21	4660	490	-3.01	-3.45
22	NT	NT		
23	6080	1520	-1.90	-1.33
24	23607.181	NR	11.85	15.11
25	NT	NT		
26	8700	1100	0.16	0.13
27	9841	2952	1.05	0.43
28	NT	NT		
29	9800	1500	1.02	0.72
30	9200	370	0.55	0.66

Statistics

Assigned Value*	8500	1000
Spike	Not Spiked	
Homogeneity Value	8000	1200
Robust Average	8900	1200
Median	8950	780
Mean	9460	
N	22	
Max.	23607.181	
Min.	4660	
Robust SD	2200	
Robust CV	24%	

*Robust Average excluding laboratories 16 and 24.


Kernel Density
Density
0.006
0.004
0.002
0
0
10000
20000
30000
Result
Results: S1 - Al
Assigned Value = 8500 ± 1000 mg/kg
Results (mg/kg)
20000
15000
10000
5000
0
21 23 8 10 1 3 18 2 7 13 26 30 6 19 29 17 27 11 5 15 16 24 12 14 20 22 25 28 4 9 Md R.A. H.V.
Laboratory


z-Scores: S1 - Al
Target Standard Deviation 1300 mg/kg (Equivalent to 15% CV)
z-Score
4
3
2
1
0
-1
-2
-3
-4
-3.0
-1.9
-1.7
-1.6
-1.2
-0.8
-0.5
-0.5
0.0
0.2
0.2
0.5
0.6
0.8
1.0
1.0
1.1
1.3
2.0
2.5
21 23 8 10 1 3 18 2 7 13 26 30 6 19 29 17 27 11 5 15 16 24
Laboratory

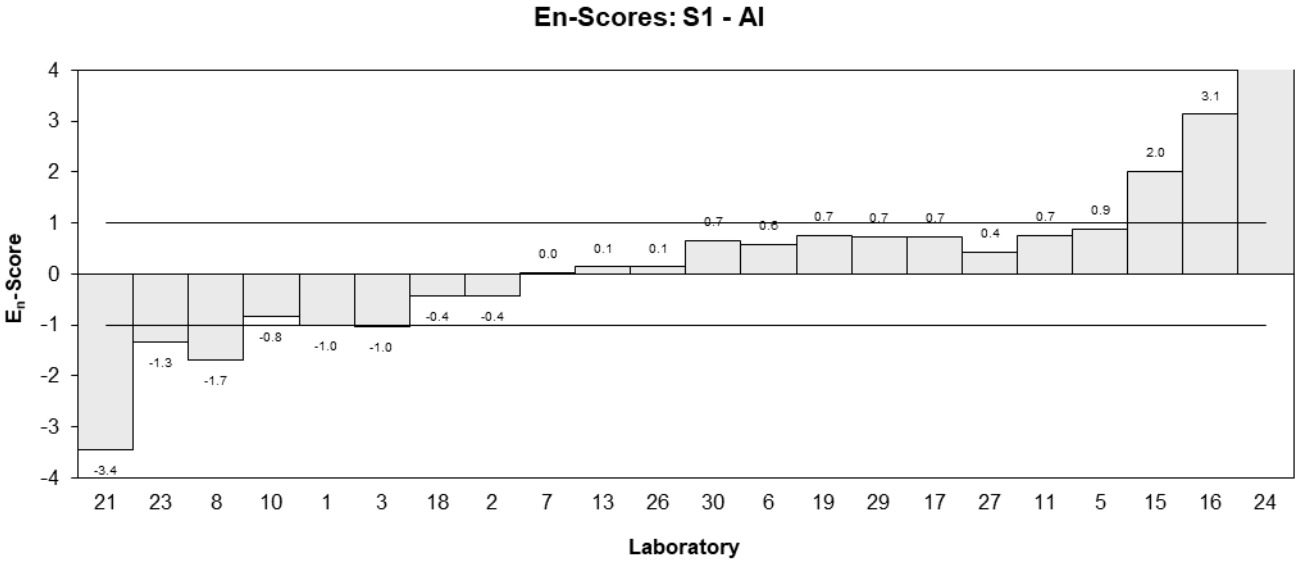

En-Scores: S1 - Al
En-Score
4
3
2
1
0
-1
-2
-3
-4
-3.4
-1.3
-1.7
-0.8
-1.0
-1.0
-0.4
-0.4
0.0
0.1
0.1
0.7
0.6
0.7
0.7
0.7
0.4
0.7
0.9
2.0
3.1
21 23 8 10 1 3 18 2 7 13 26 30 6 19 29 17 27 11 5 15 16 24
Laboratory

Figure 2

Table 15

Sample Details

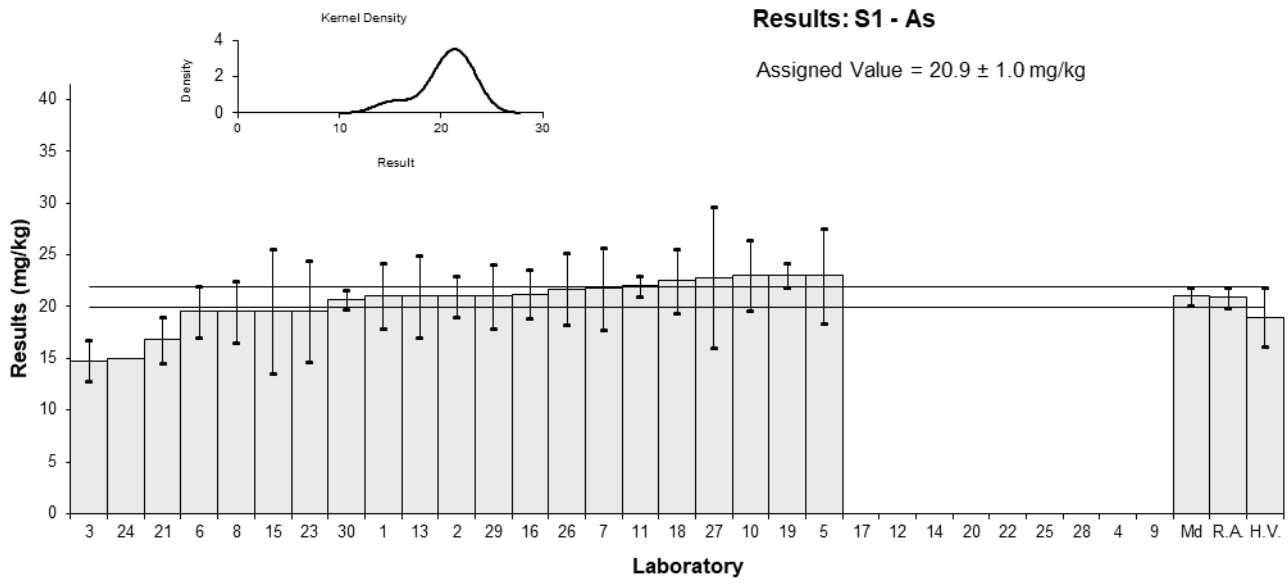
Sample No.	S1
Matrix.	Sediment
Analyte.	As
Units	mg/kg

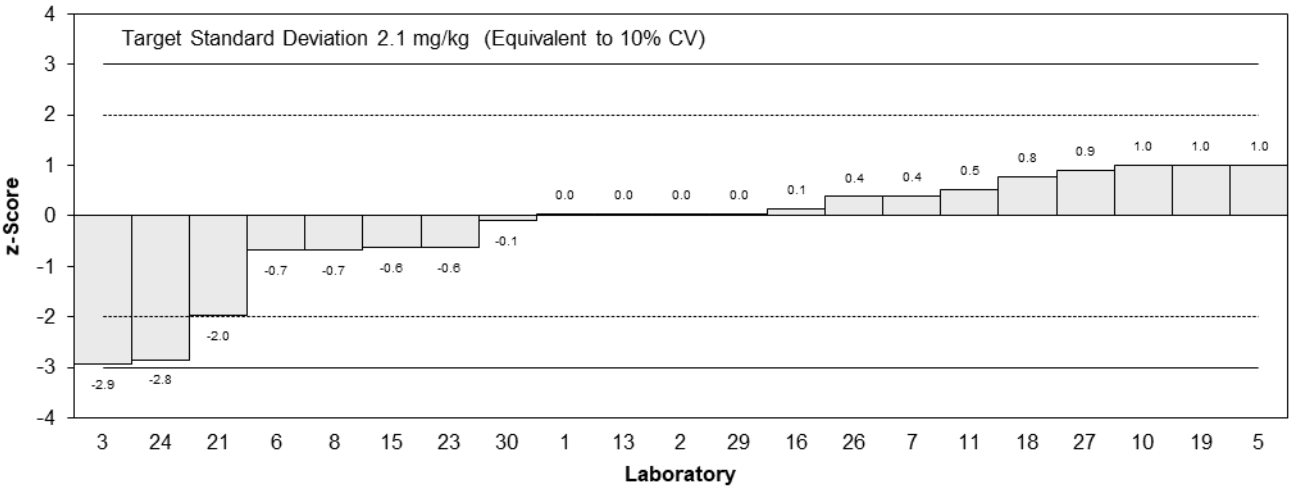
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	21	3.15	0.05	0.03
2	21	2	0.05	0.04
3	14.75	2	-2.94	-2.75
4	NT	NT		
5	23	4.6	1.00	0.45
6	19.5	2.5	-0.67	-0.52
7	21.74	4	0.40	0.20
8	19.5	3.0	-0.67	-0.44
9	NT	NT		
10	23	3.4	1.00	0.59
11	22	1	0.53	0.78
12	NT	NT		
13	21	4	0.05	0.02
14	NT	NT		
15	19.6	6.0	-0.62	-0.21
16	21.2	2.33	0.14	0.12
17	<25	NR		
18	22.5	3.1	0.77	0.49
19	23	1.15	1.00	1.38
20	NT	NT		
21	16.8	2.2	-1.96	-1.70
22	NT	NT		
23	19.6	4.9	-0.62	-0.26
24	14.949	NR	-2.85	-5.95
25	NT	NT		
26	21.7	3.5	0.38	0.22
27	22.8	6.8	0.91	0.28
28	NT	NT		
29	21	3.1	0.05	0.03
30	20.7	0.9	-0.10	-0.15

Statistics

Assigned Value	20.9	1.0
Spike	Not Spiked	
Homogeneity Value	19.0	2.9
Robust Average	20.9	1.0
Median	21.0	0.9
Mean	20.5	
N	21	
Max.	23	
Min.	14.75	
Robust SD	1.9	
Robust CV	8.9%	


Kernel Density
Density
Result
Results: S1 - As
Assigned Value = 20.9 ± 1.0 mg/kg
Results (mg/kg)
Laboratory
3 24 21 6 8 15 23 30 1 13 2 29 16 26 7 11 18 27 10 19 5 17 12 14 20 22 25 28 4 9 Md R.A. H.V.


z-Scores: S1 - As
Target Standard Deviation 2.1 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
3 24 21 6 8 15 23 30 1 13 2 29 16 26 7 11 18 27 10 19 5

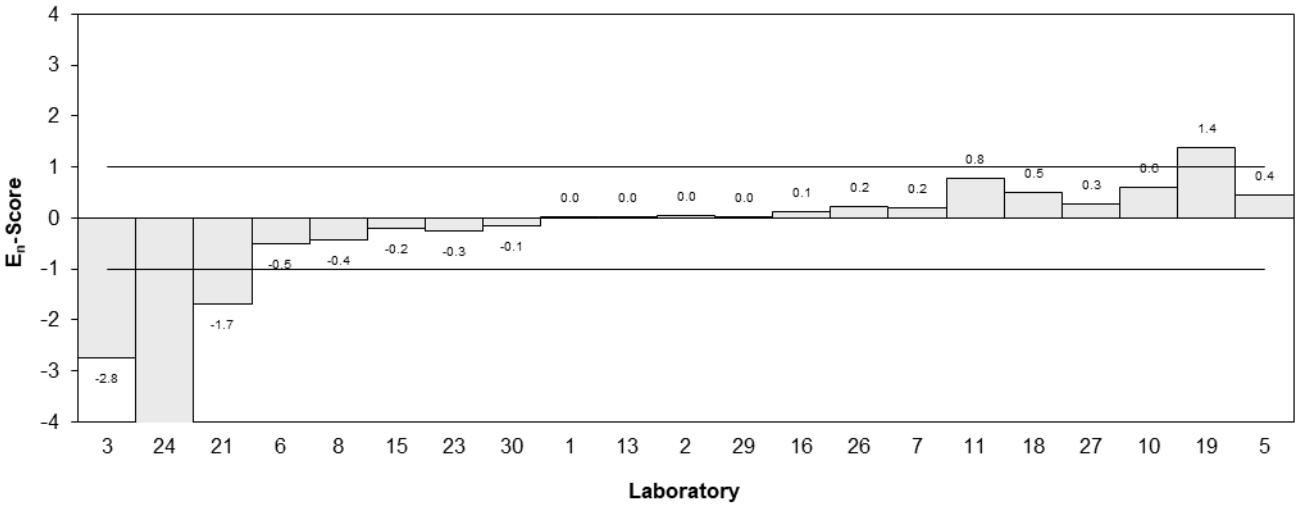

En-Scores: S1 - As
En-Score
Laboratory
3 24 21 6 8 15 23 30 1 13 2 29 16 26 7 11 18 27 10 19 5

Figure 3

Table 16

Sample Details

Sample No.	S1
Matrix.	Sediment
Analyte.	Cd
Units	mg/kg

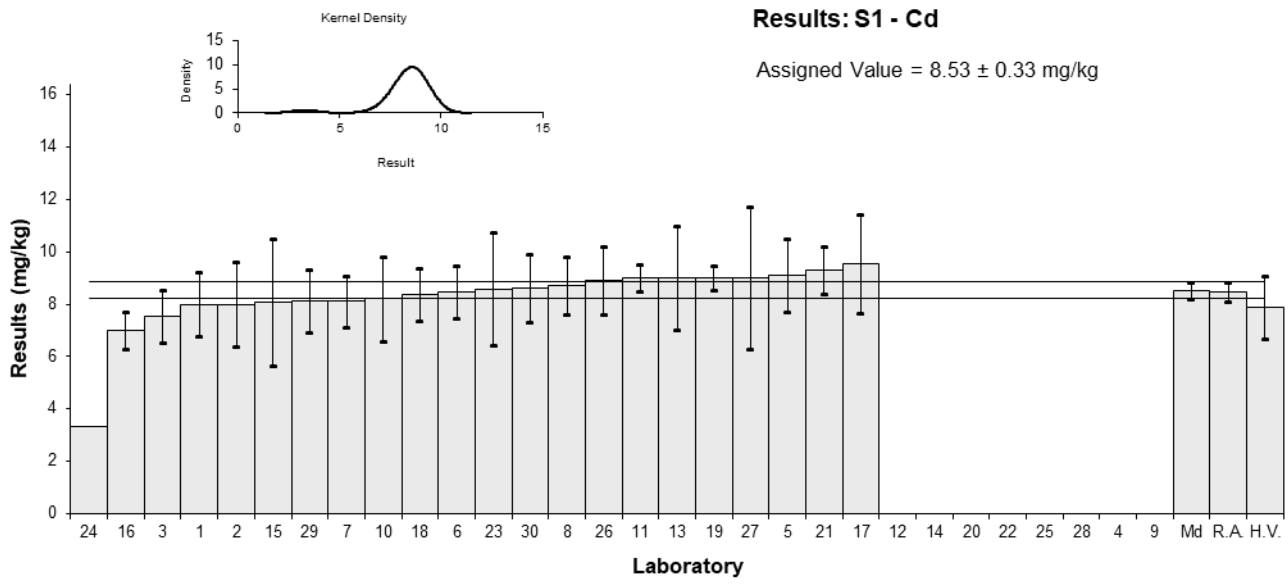
Participant Results

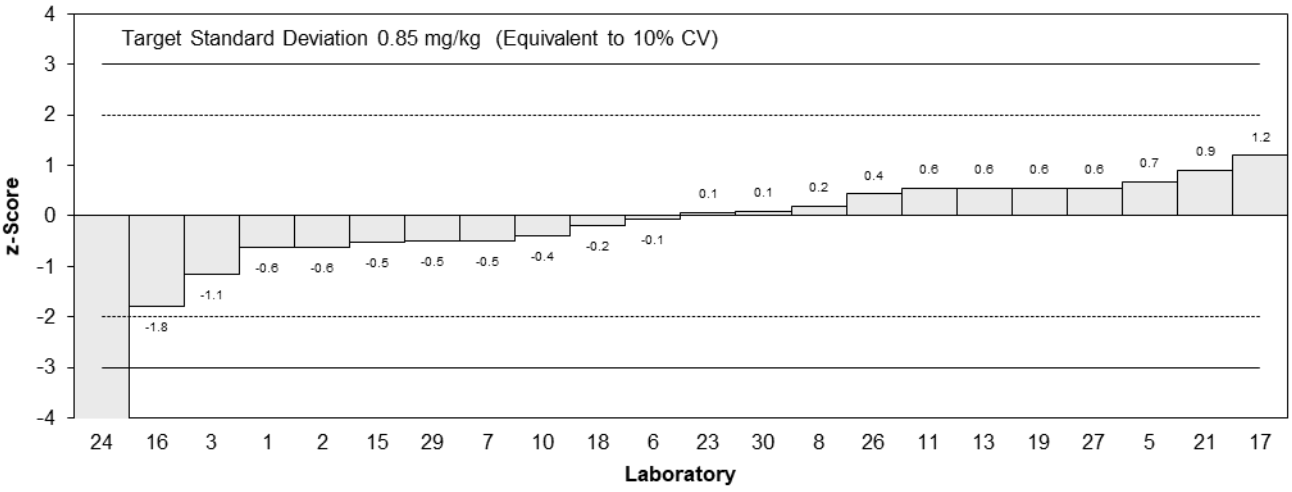
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	8.0	1.2	-0.62	-0.43
2	8	1.6	-0.62	-0.32
3	7.55	1	-1.15	-0.93
4	NT	NT		
5	9.1	1.4	0.67	0.40
6	8.48	1.0	-0.06	-0.05
7	8.1	1	-0.50	-0.41
8	8.7	1.1	0.20	0.15
9	NT	NT		
10	8.2	1.6	-0.39	-0.20
11	9	0.5	0.55	0.78
12	NT	NT		
13	9.0	2.0	0.55	0.23
14	NT	NT		
15	8.09	2.43	-0.52	-0.18
16	6.99	0.70	-1.81	-1.99
17	9.55	1.9	1.20	0.53
18	8.36	1.0	-0.20	-0.16
19	9	0.45	0.55	0.84
20	NT	NT		
21	9.3	0.9	0.90	0.80
22	NT	NT		
23	8.58	2.15	0.06	0.02
24	3.326	NR	-6.10	-15.77
25	NT	NT		
26	8.9	1.3	0.43	0.28
27	9.0	2.7	0.55	0.17
28	NT	NT		
29	8.1	1.2	-0.50	-0.35
30	8.61	1.3	0.09	0.06

Statistics

Assigned Value*	8.53	0.33
Spike	Not Spiked	
Homogeneity Value	7.9	1.2
Robust Average	8.48	0.36
Median	8.53	0.31
Mean	8.27	
N	22	
Max.	9.55	
Min.	3.326	
Robust SD	0.67	
Robust CV	7.9%	

*Robust Average excluding laboratory 24.


Kernel Density
Density
Result
Results: S1 - Cd
Assigned Value = 8.53 ± 0.33 mg/kg
Results (mg/kg)
Laboratory
24 16 3 1 2 15 29 7 10 18 6 23 30 8 26 11 13 19 27 5 21 17 12 14 20 22 25 28 4 9 Md R.A. H.V.


z-Scores: S1 - Cd
Target Standard Deviation 0.85 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
24 16 3 1 2 15 29 7 10 18 6 23 30 8 26 11 13 19 27 5 21 17

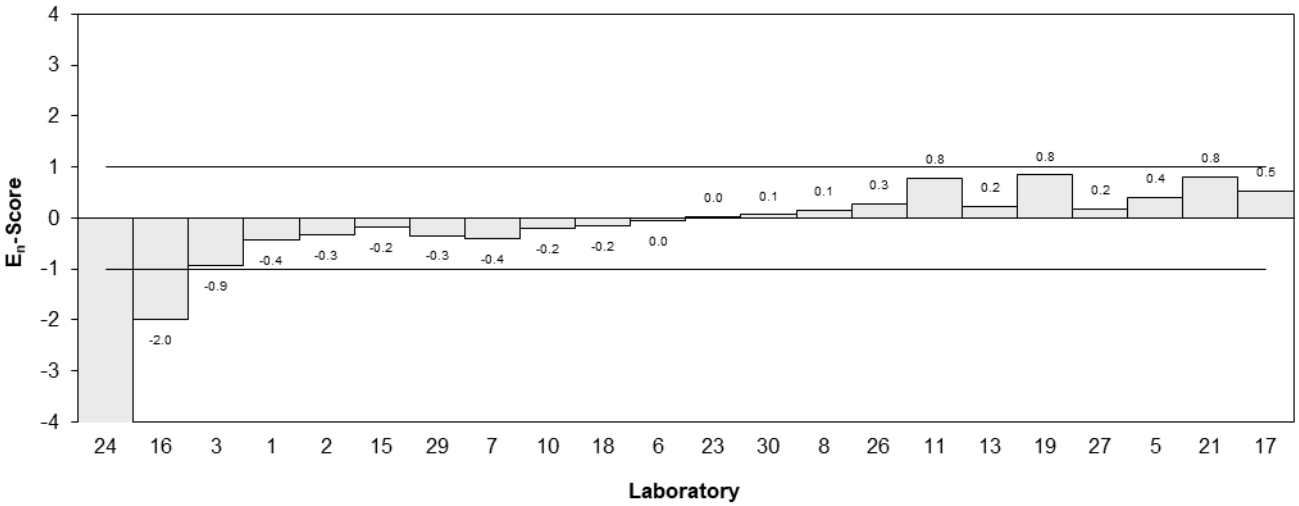

En-Scores: S1 - Cd
En-Score
Laboratory
24 16 3 1 2 15 29 7 10 18 6 23 30 8 26 11 13 19 27 5 21 17

Figure 4

Table 17

Sample Details

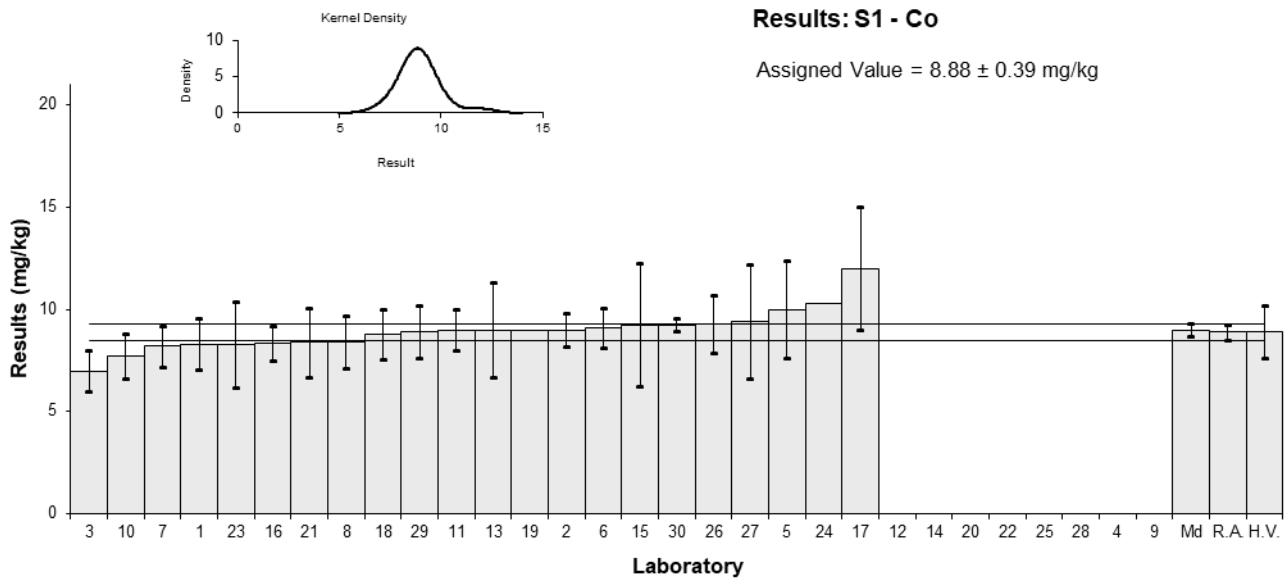
Sample No.	S1
Matrix.	Sediment
Analyte.	Co
Units	mg/kg

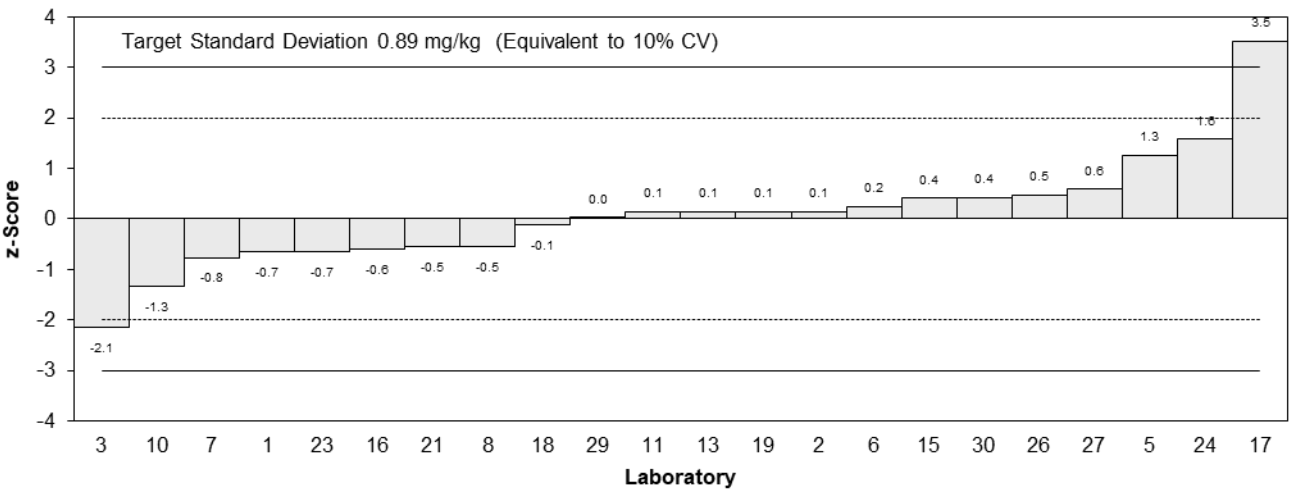
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	8.3	1.245	-0.65	-0.44
2	9	0.8	0.14	0.13
3	6.98	1	-2.14	-1.77
4	NT	NT		
5	10	2.4	1.26	0.46
6	9.10	1.0	0.25	0.20
7	8.2	1	-0.77	-0.63
8	8.4	1.3	-0.54	-0.35
9	NT	NT		
10	7.7	1.1	-1.33	-1.01
11	9	1	0.14	0.11
12	NT	NT		
13	9.0	2.3	0.14	0.05
14	NT	NT		
15	9.24	3.00	0.41	0.12
16	8.35	0.84	-0.60	-0.57
17	12.0	3	3.51	1.03
18	8.78	1.2	-0.11	-0.08
19	9	NR	0.14	0.31
20	NT	NT		
21	8.4	1.7	-0.54	-0.28
22	NT	NT		
23	8.3	2.1	-0.65	-0.27
24	10.278	NR	1.57	3.58
25	NT	NT		
26	9.3	1.4	0.47	0.29
27	9.4	2.8	0.59	0.18
28	NT	NT		
29	8.9	1.3	0.02	0.01
30	9.25	0.3	0.42	0.75

Statistics

Assigned Value	8.88	0.39
Spike	Not Spiked	
Homogeneity Value	8.9	1.3
Robust Average	8.88	0.39
Median	9.00	0.33
Mean	8.95	
N	22	
Max.	12	
Min.	6.98	
Robust SD	0.73	
Robust CV	8.2%	


Kernel Density
Density
Result
Results: S1 - Co
Assigned Value = 8.88 ± 0.39 mg/kg
Results (mg/kg)
Laboratory
3 10 7 1 23 16 21 8 18 29 11 13 19 2 6 15 30 26 27 5 24 17 12 14 20 22 25 28 4 9 Md R.A. H.V.


z-Scores: S1 - Co
Target Standard Deviation 0.89 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
3 10 7 1 23 16 21 8 18 29 11 13 19 2 6 15 30 26 27 5 24 17

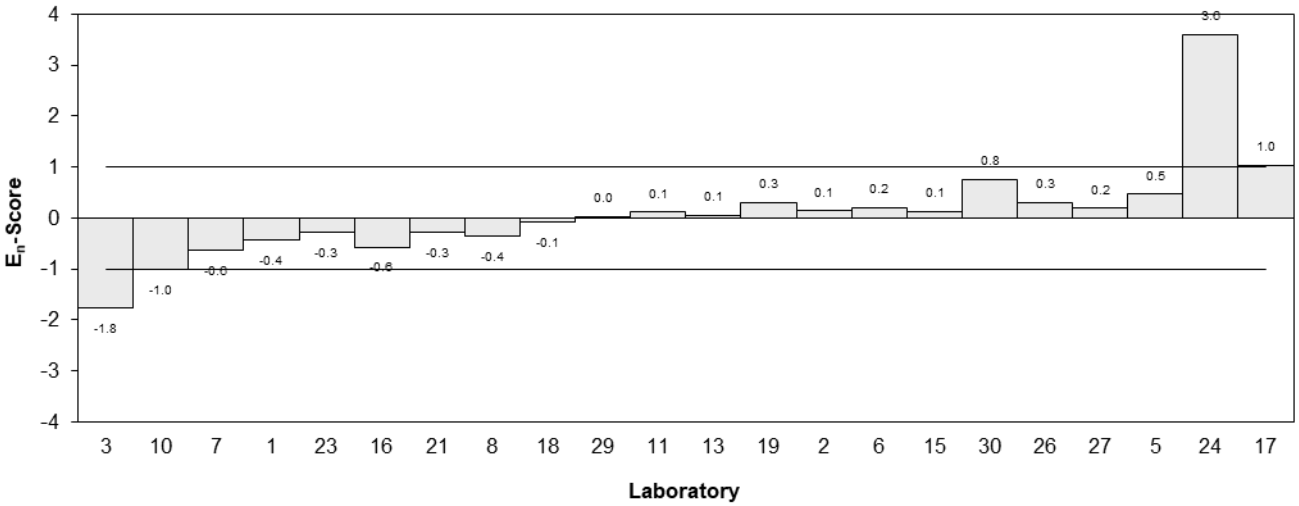

En-Scores: S1 - Co
En-Score
Laboratory
3 10 7 1 23 16 21 8 18 29 11 13 19 2 6 15 30 26 27 5 24 17

Figure 5

Table 18

Sample Details

Sample No.	S1
Matrix.	Sediment
Analyte.	Cr
Units	mg/kg

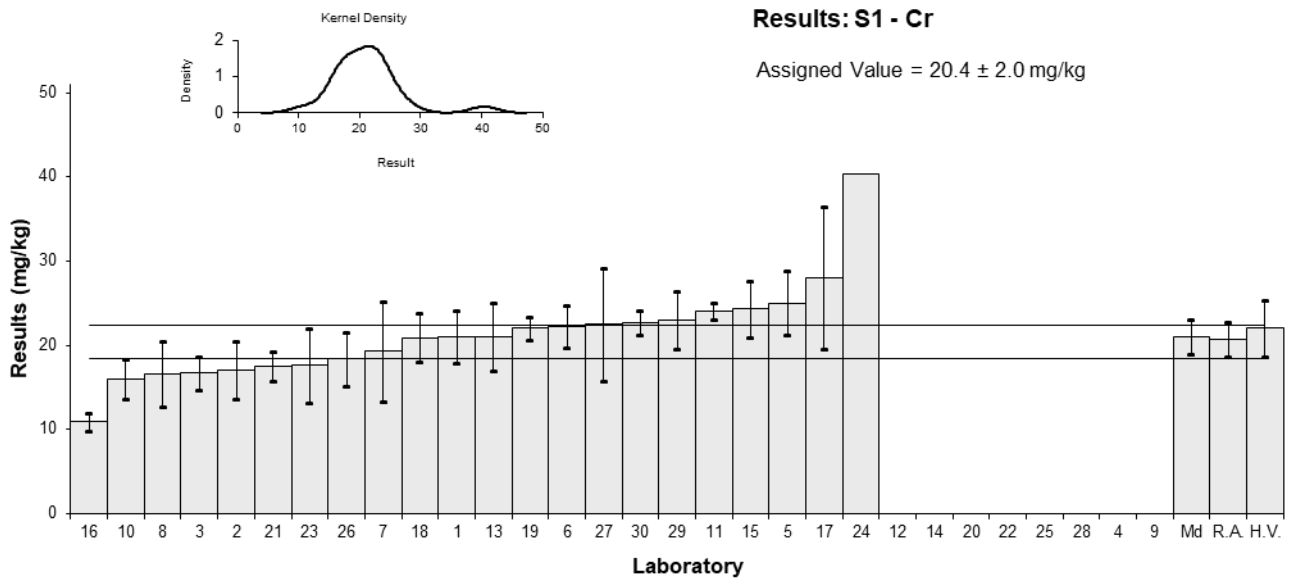
Participant Results

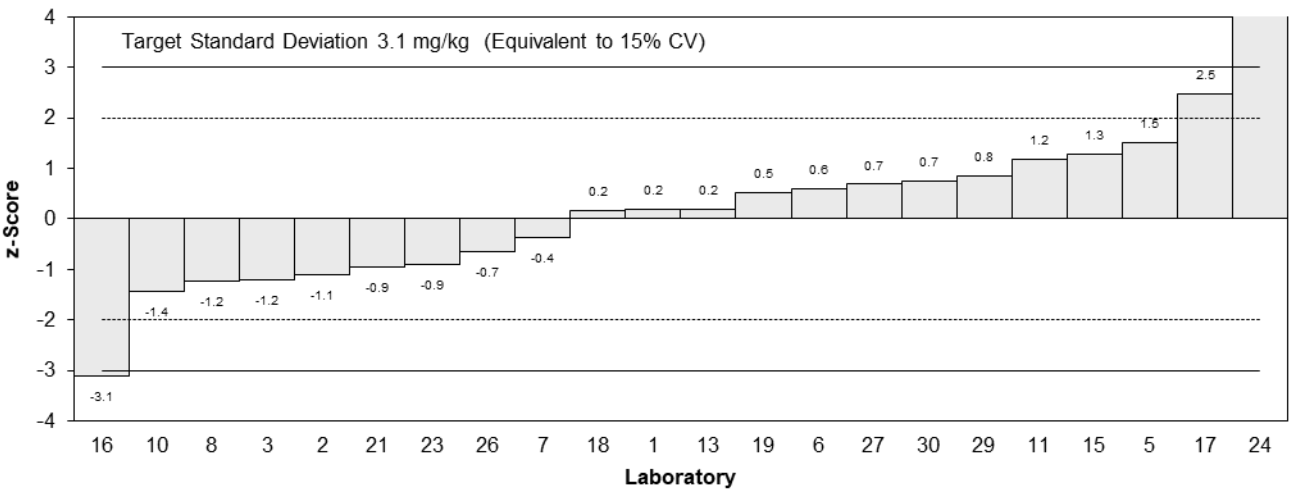
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	21	3.15	0.20	0.16
2	17	3.4	-1.11	-0.86
3	16.7	2	-1.21	-1.31
4	NT	NT		
5	25	3.8	1.50	1.07
6	22.2	2.5	0.59	0.56
7	19.26	6	-0.37	-0.18
8	16.6	3.9	-1.24	-0.87
9	NT	NT		
10	16	2.4	-1.44	-1.41
11	24	1	1.18	1.61
12	NT	NT		
13	21	4	0.20	0.13
14	NT	NT		
15	24.3	3.3	1.27	1.01
16	10.9	1.09	-3.10	-4.17
17	28.0	8.4	2.48	0.88
18	20.9	2.9	0.16	0.14
19	22	1.32	0.52	0.67
20	NT	NT		
21	17.5	1.8	-0.95	-1.08
22	NT	NT		
23	17.6	4.4	-0.92	-0.58
24	40.385	NR	6.53	9.99
25	NT	NT		
26	18.4	3.2	-0.65	-0.53
27	22.5	6.7	0.69	0.30
28	NT	NT		
29	23	3.4	0.85	0.66
30	22.68	1.4	0.75	0.93

Statistics

Assigned Value*	20.4	2.0
Spike	Not Spiked	
Homogeneity Value	22.0	3.3
Robust Average	20.7	2.1
Median	21.0	2.1
Mean	21.2	
N	22	
Max.	40.385	
Min.	10.9	
Robust SD	4.0	
Robust CV	19%	

*Robust Average excluding laboratory 24.


Kernel Density
Density
Result
Results: S1 - Cr
Assigned Value = 20.4 ± 2.0 mg/kg
Results (mg/kg)
Laboratory
16 10 8 3 2 21 23 26 7 18 1 13 19 6 27 30 29 11 15 5 17 24 12 14 20 22 25 28 4 9 Md R.A. H.V.


z-Scores: S1 - Cr
Target Standard Deviation 3.1 mg/kg (Equivalent to 15% CV)
z-Score
Laboratory
16 10 8 3 2 21 23 26 7 18 1 13 19 6 27 30 29 11 15 5 17 24

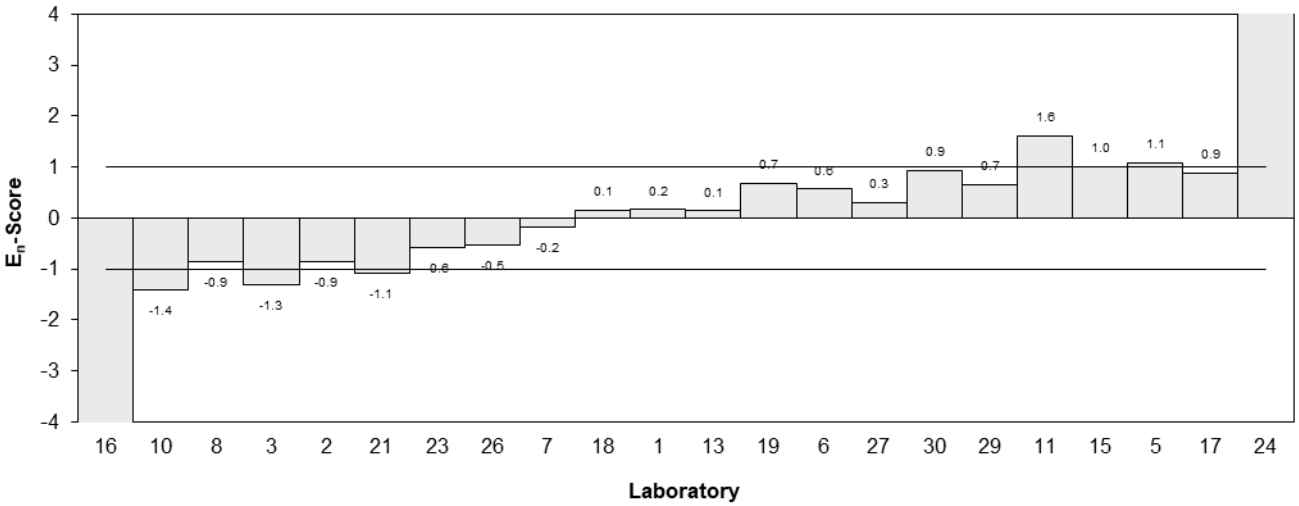

En-Scores: S1 - Cr
En-Score
Laboratory
16 10 8 3 2 21 23 26 7 18 1 13 19 6 27 30 29 11 15 5 17 24

Figure 6

Table 19

Sample Details

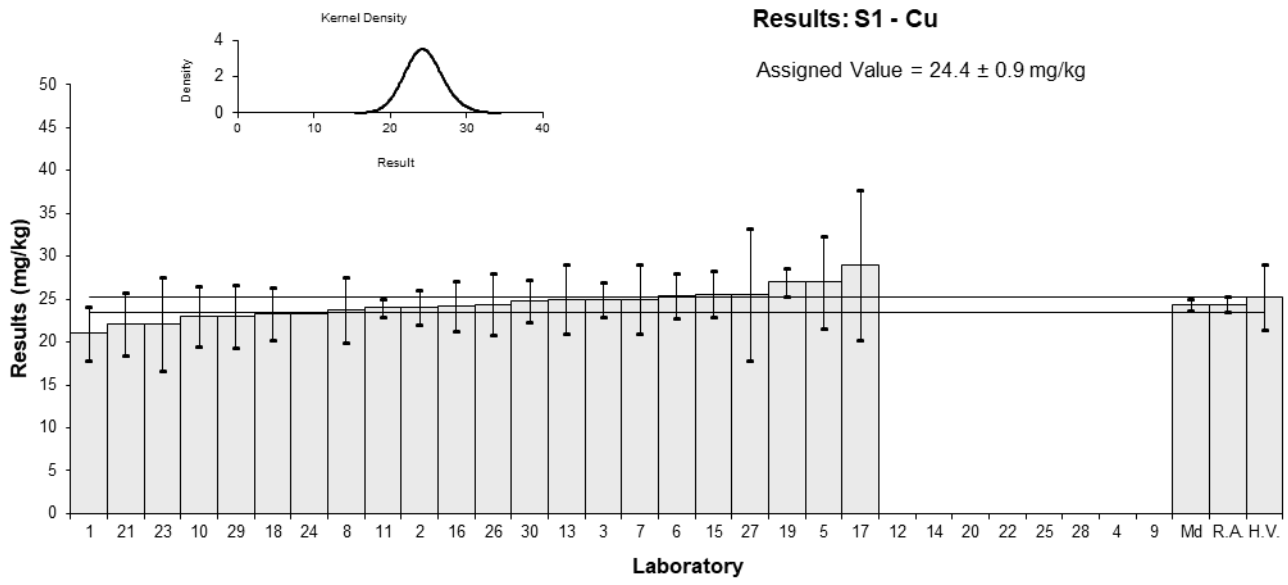
Sample No.	S1
Matrix.	Sediment
Analyte.	Cu
Units	mg/kg

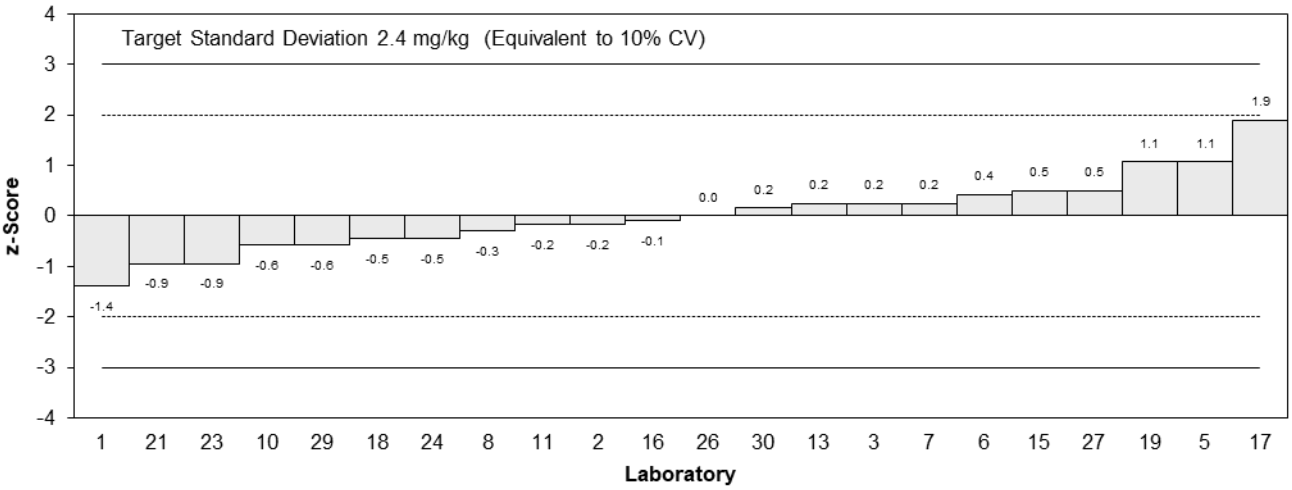
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	21	3.15	-1.39	-1.04
2	24	2	-0.16	-0.18
3	25	2	0.25	0.27
4	NT	NT		
5	27	5.4	1.07	0.47
6	25.4	2.6	0.41	0.36
7	25	4	0.25	0.15
8	23.7	3.8	-0.29	-0.18
9	NT	NT		
10	23	3.5	-0.57	-0.39
11	24	1	-0.16	-0.30
12	NT	NT		
13	25	4	0.25	0.15
14	NT	NT		
15	25.6	2.7	0.49	0.42
16	24.2	2.9	-0.08	-0.07
17	29.0	8.7	1.89	0.53
18	23.3	3.1	-0.45	-0.34
19	27	1.62	1.07	1.40
20	NT	NT		
21	22.1	3.7	-0.94	-0.60
22	NT	NT		
23	22.1	5.5	-0.94	-0.41
24	23.302	NR	-0.45	-1.22
25	NT	NT		
26	24.4	3.6	0.00	0.00
27	25.6	7.7	0.49	0.15
28	NT	NT		
29	23	3.7	-0.57	-0.37
30	24.77	2.5	0.15	0.14

Statistics

Assigned Value	24.4	0.9
Spike	Not Spiked	
Homogeneity Value	25.3	3.8
Robust Average	24.4	0.9
Median	24.3	0.7
Mean	24.4	
N	22	
Max.	29	
Min.	21	
Robust SD	1.7	
Robust CV	7.2%	


Kernel Density
Density
Result
Results: S1 - Cu
Assigned Value = 24.4 ± 0.9 mg/kg
Results (mg/kg)
Laboratory
1 21 23 10 29 18 24 8 11 2 16 26 30 13 3 7 6 15 27 19 5 17 12 14 20 22 25 28 4 9 Md R.A. H.V.


z-Scores: S1 - Cu
Target Standard Deviation 2.4 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
1 21 23 10 29 18 24 8 11 2 16 26 30 13 3 7 6 15 27 19 5 17

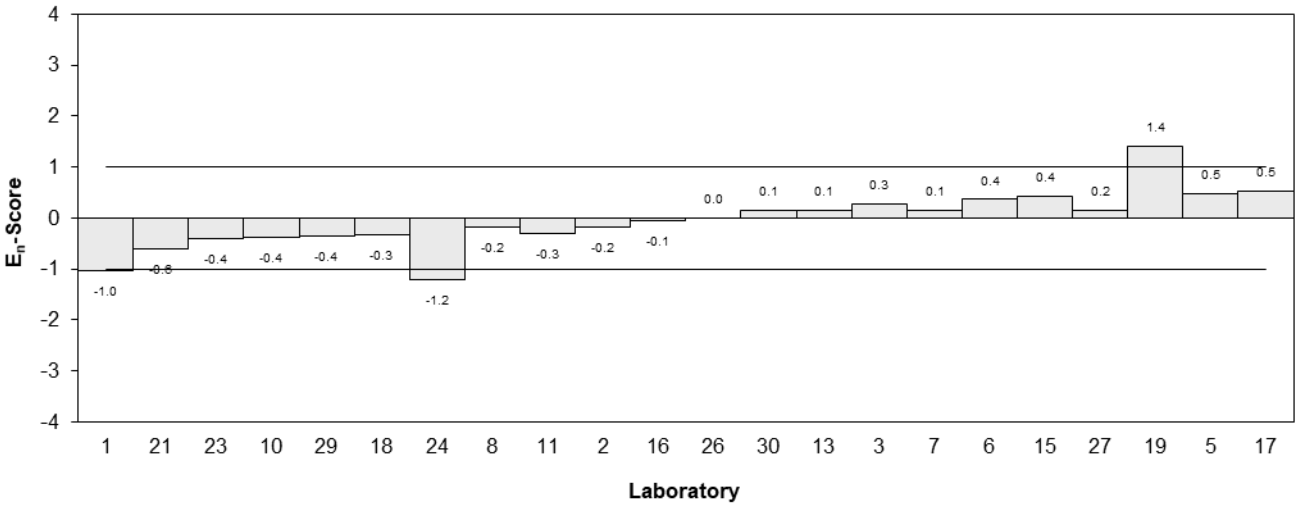

En-Scores: S1 - Cu
En-Score
Laboratory
1 21 23 10 29 18 24 8 11 2 16 26 30 13 3 7 6 15 27 19 5 17

Figure 7

Table 20

Sample Details

Sample No.	S1
Matrix.	Sediment
Analyte.	Hg
Units	mg/kg

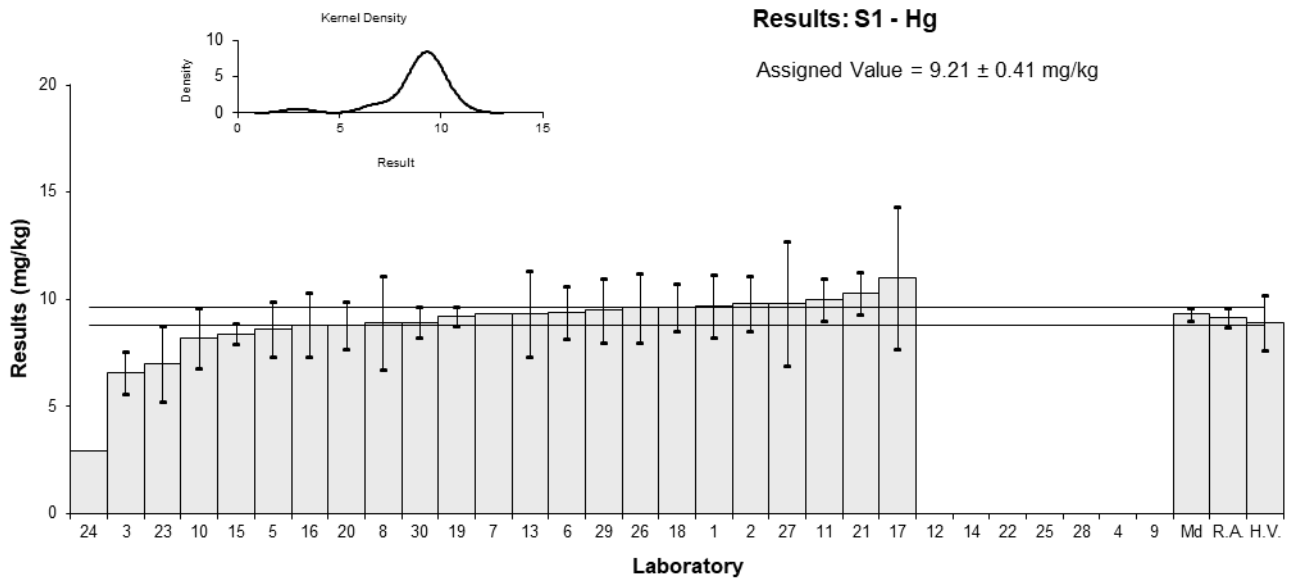
Participant Results

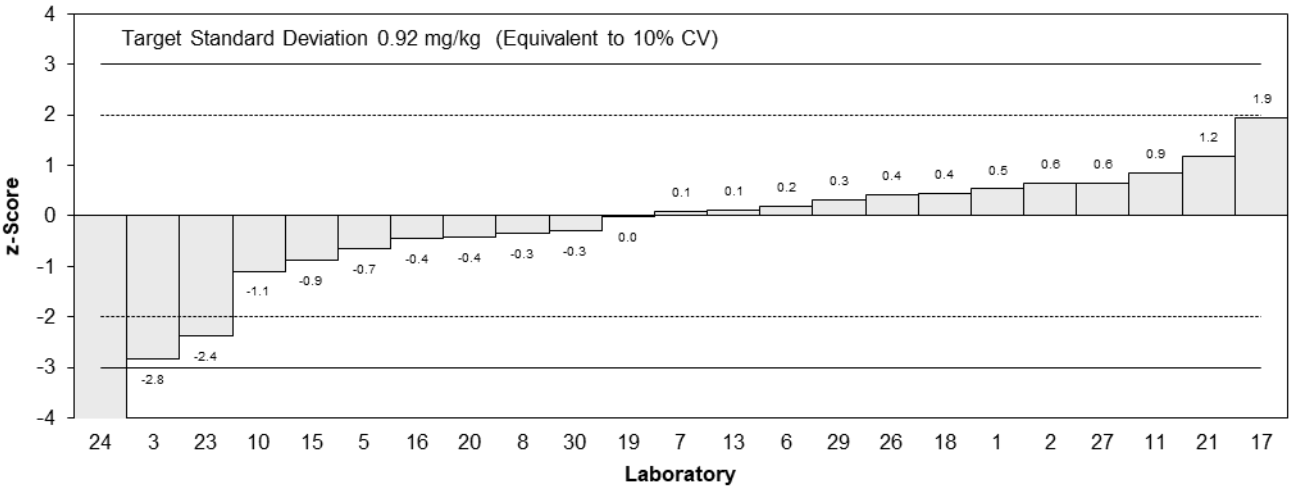
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	9.7	1.455	0.53	0.32
2	9.8	1.3	0.64	0.43
3	6.59	1	-2.84	-2.42
4	NT	NT		
5	8.6	1.3	-0.66	-0.45
6	9.39	1.2	0.20	0.14
7	9.3	NR	0.10	0.22
8	8.9	2.2	-0.34	-0.14
9	NT	NT		
10	8.2	1.4	-1.10	-0.69
11	10	1	0.86	0.73
12	NT	NT		
13	9.31	2	0.11	0.05
14	NT	NT		
15	8.39	0.48	-0.89	-1.30
16	8.8	1.5	-0.45	-0.26
17	11.0	3.3	1.94	0.54
18	9.61	1.1	0.43	0.34
19	9.2	0.46	-0.01	-0.02
20	8.81075	1.101	-0.43	-0.34
21	10.3	1.0	1.18	1.01
22	NT	NT		
23	7.01	1.75	-2.39	-1.22
24	2.950	NR	-6.80	-15.27
25	NT	NT		
26	9.6	1.6	0.42	0.24
27	9.8	2.9	0.64	0.20
28	NT	NT		
29	9.5	1.5	0.31	0.19
30	8.93	0.7	-0.30	-0.35

Statistics

Assigned Value*	9.21	0.41
Spike	Not Spiked	
Homogeneity Value	8.9	1.3
Robust Average	9.13	0.45
Median	9.30	0.32
Mean	8.86	
N	23	
Max.	11	
Min.	2.95	
Robust SD	0.86	
Robust CV	9.5%	

*Robust Average excluding Laboratory 24.


Kernel Density
Density
Result
Results: S1 - Hg
Assigned Value = 9.21 ± 0.41 mg/kg
Results (mg/kg)
Laboratory
24 3 23 10 15 5 16 20 8 30 19 7 13 6 29 26 18 1 2 27 11 21 17 12 14 22 25 28 4 9 Md R.A. H.V.


z-Scores: S1 - Hg
Target Standard Deviation 0.92 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
24 3 23 10 15 5 16 20 8 30 19 7 13 6 29 26 18 1 2 27 11 21 17

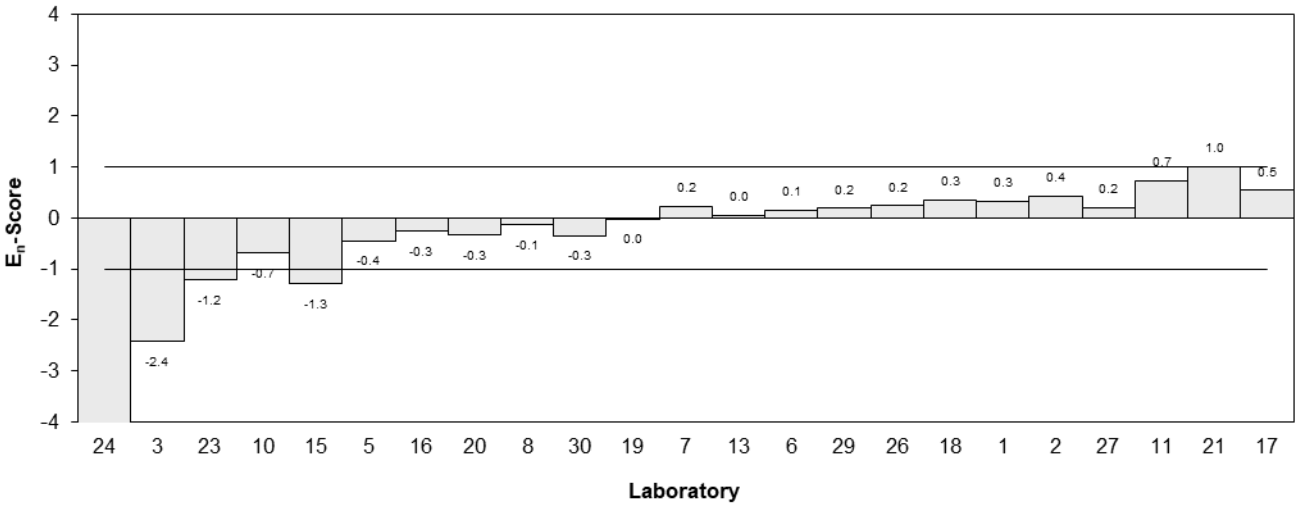

En-Scores: S1 - Hg
En-Score
Laboratory
24 3 23 10 15 5 16 20 8 30 19 7 13 6 29 26 18 1 2 27 11 21 17

Figure 8

Table 21

Sample Details

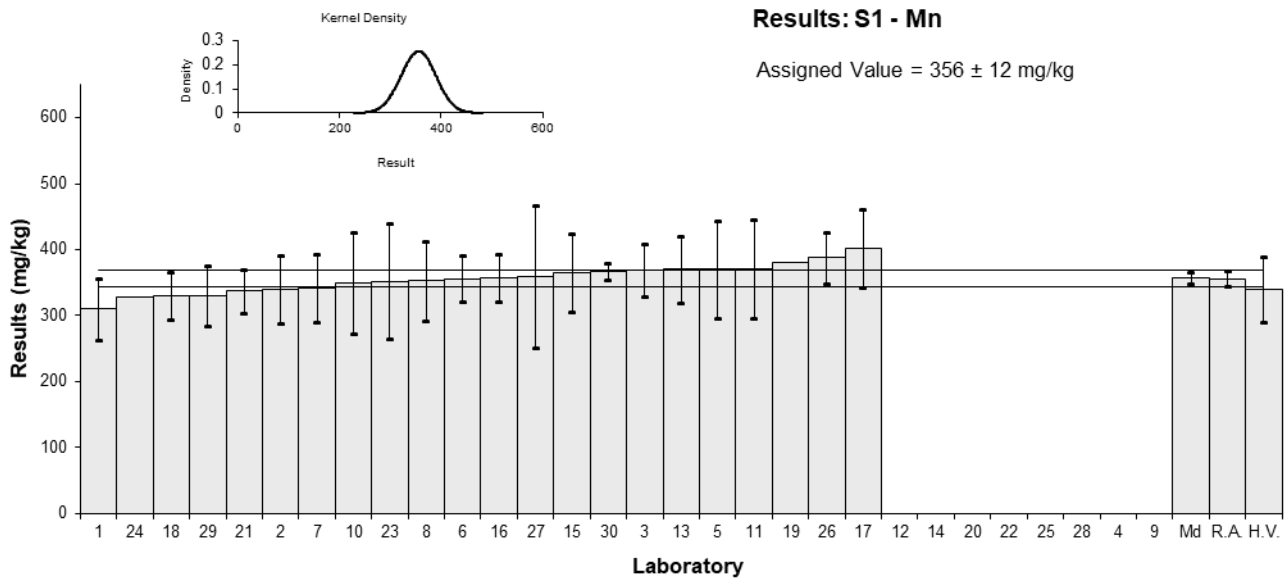
Sample No.	S1
Matrix.	Sediment
Analyte.	Mn
Units	mg/kg

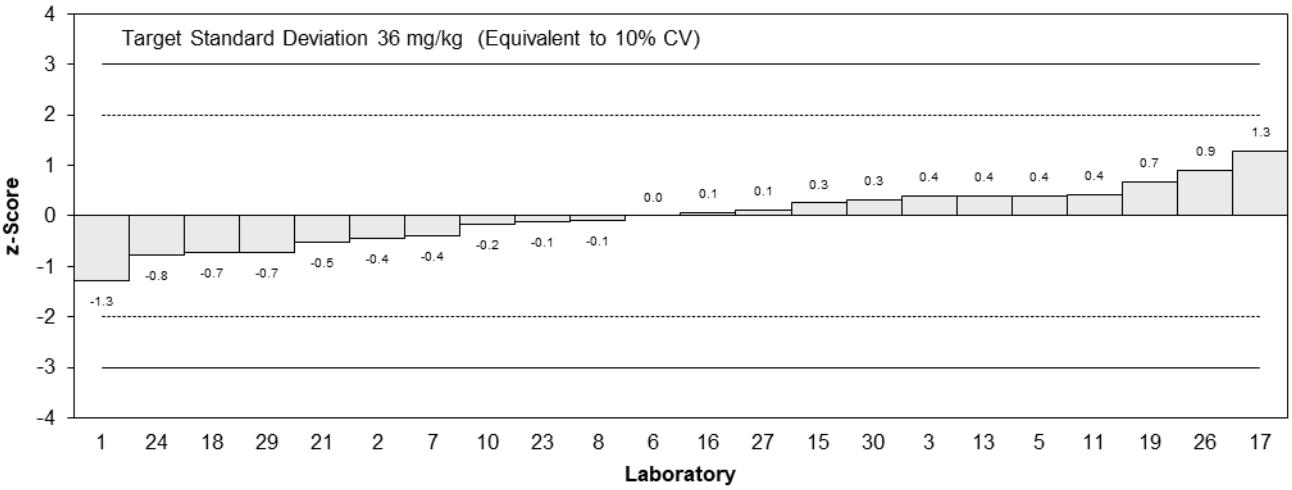
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	310	46.5	-1.29	-0.96
2	340	52	-0.45	-0.30
3	369.75	40	0.39	0.33
4	NT	NT		
5	370	74	0.39	0.19
6	356	35	0.00	0.00
7	342	52	-0.39	-0.26
8	353	60	-0.08	-0.05
9	NT	NT		
10	350	77	-0.17	-0.08
11	371	74	0.42	0.20
12	NT	NT		
13	370	50	0.39	0.27
14	NT	NT		
15	365	60	0.25	0.15
16	358	35.8	0.06	0.05
17	402	60	1.29	0.75
18	330	35.9	-0.73	-0.69
19	380	NR	0.67	2.00
20	NT	NT		
21	337	33	-0.53	-0.54
22	NT	NT		
23	352	87.9	-0.11	-0.05
24	328.349	NR	-0.78	-2.30
25	NT	NT		
26	388	39	0.90	0.78
27	360	108	0.11	0.04
28	NT	NT		
29	330	45	-0.73	-0.56
30	367.1	12	0.31	0.65

Statistics

Assigned Value	356	12
Spike	Not Spiked	
Homogeneity Value	340	50
Robust Average	356	12
Median	357	9
Mean	356	
N	22	
Max.	402	
Min.	310	
Robust SD	22	
Robust CV	6.1%	


Kernel Density
Density
Result
Results: S1 - Mn
Assigned Value = 356 ± 12 mg/kg
Results (mg/kg)
Laboratory
1 24 18 29 21 2 7 10 23 8 6 16 27 15 30 3 13 5 11 19 26 17 12 14 20 22 25 28 4 9 Md R.A. H.V.


z-Scores: S1 - Mn
Target Standard Deviation 36 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
1 24 18 29 21 2 7 10 23 8 6 16 27 15 30 3 13 5 11 19 26 17

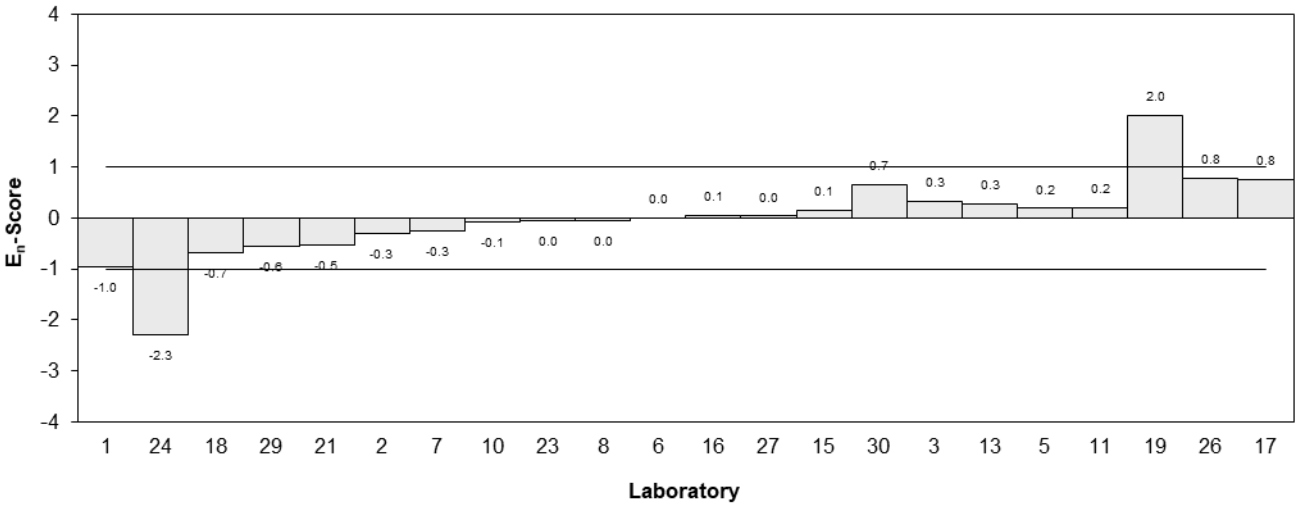

En-Scores: S1 - Mn
En-Score
Laboratory
1 24 18 29 21 2 7 10 23 8 6 16 27 15 30 3 13 5 11 19 26 17

Figure 9

Table 22

Sample Details

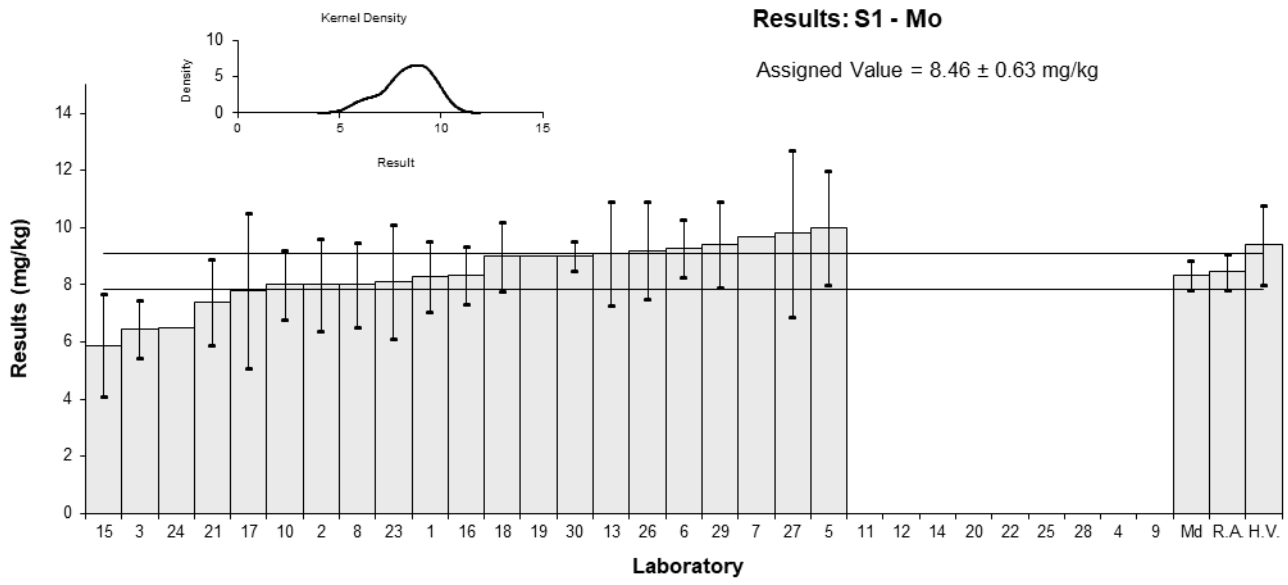
Sample No.	S1
Matrix.	Sediment
Analyte.	Mo
Units	mg/kg

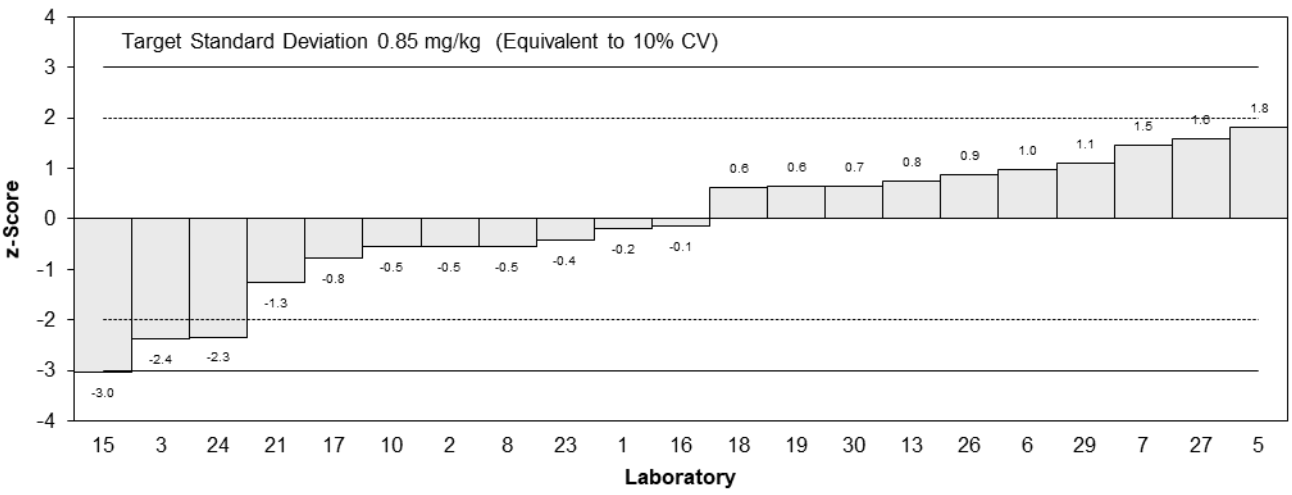
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	8.3	1.245	-0.19	-0.11
2	8	1.6	-0.54	-0.27
3	6.45	1	-2.38	-1.70
4	NT	NT		
5	10	2.0	1.82	0.73
6	9.28	1.0	0.97	0.69
7	9.7	NR	1.47	1.97
8	8.0	1.5	-0.54	-0.28
9	NT	NT		
10	8.0	1.20	-0.54	-0.34
11	NT	NT		
12	NT	NT		
13	9.1	1.8	0.76	0.34
14	NT	NT		
15	5.89	1.80	-3.04	-1.35
16	8.34	1.0	-0.14	-0.10
17	7.80	2.7	-0.78	-0.24
18	8.99	1.2	0.63	0.39
19	9	NR	0.64	0.86
20	NT	NT		
21	7.4	1.5	-1.25	-0.65
22	NT	NT		
23	8.1	2.0	-0.43	-0.17
24	6.480	NR	-2.34	-3.14
25	NT	NT		
26	9.2	1.7	0.87	0.41
27	9.8	2.9	1.58	0.45
28	NT	NT		
29	9.4	1.5	1.11	0.58
30	9.01	0.5	0.65	0.68

Statistics

Assigned Value	8.46	0.63
Spike	Not Spiked	
Homogeneity Value	9.4	1.4
Robust Average	8.46	0.63
Median	8.34	0.51
Mean	8.39	
N	21	
Max.	10	
Min.	5.89	
Robust SD	1.1	
Robust CV	14%	


Kernel Density
Density
Result
Results: S1 - Mo
Assigned Value = 8.46 ± 0.63 mg/kg
Results (mg/kg)
Laboratory
15 3 24 21 17 10 2 8 23 1 16 18 19 30 13 26 6 29 7 27 5 11 12 14 20 22 25 28 4 9 Md R.A. H.V.


z-Scores: S1 - Mo
Target Standard Deviation 0.85 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
15 3 24 21 17 10 2 8 23 1 16 18 19 30 13 26 6 29 7 27 5
-3.0 -2.4 -2.3 -1.3 -0.8 -0.5 -0.5 -0.5 -0.4 -0.2 -0.1 0.6 0.6 0.7 0.8 0.9 1.0 1.1 1.5 1.6 1.8

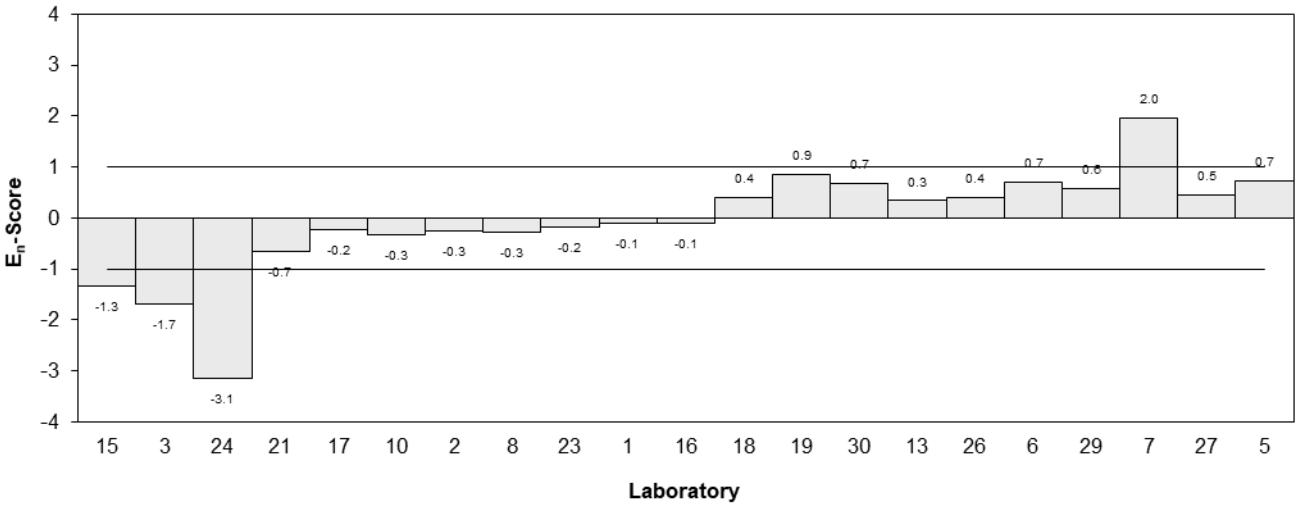

En-Scores: S1 - Mo
En-Score
Laboratory
15 3 24 21 17 10 2 8 23 1 16 18 19 30 13 26 6 29 7 27 5
-1.3 -1.7 -3.1 -0.7 -0.2 -0.3 -0.3 -0.3 -0.2 -0.1 -0.1 0.4 0.9 0.7 0.3 0.4 0.7 0.6 2.0 0.5 0.7

Figure 10

Table 23

Sample Details

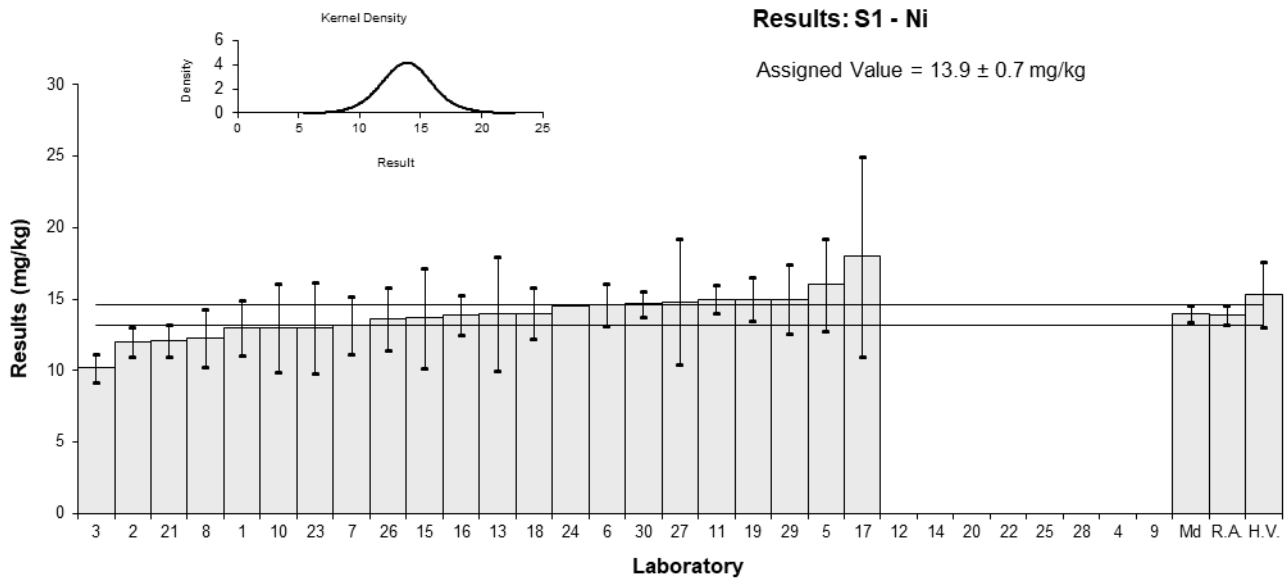
Sample No.	S1
Matrix.	Sediment
Analyte.	Ni
Units	mg/kg

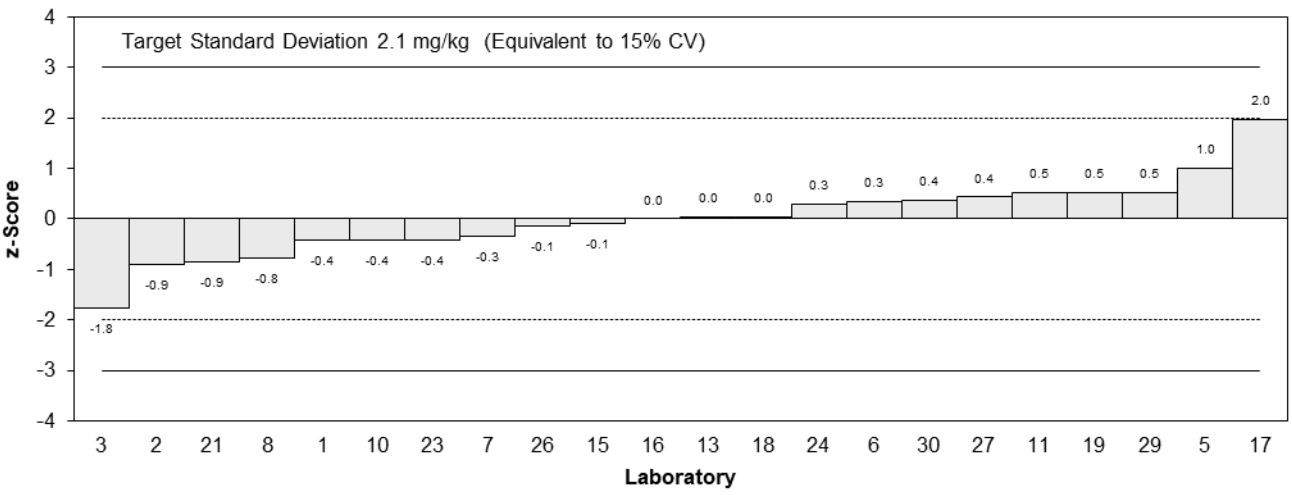
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	13	1.95	-0.43	-0.43
2	12	1	-0.91	-1.56
3	10.2	1	-1.77	-3.03
4	NT	NT		
5	16	3.2	1.01	0.64
6	14.6	1.5	0.34	0.42
7	13.2	2	-0.34	-0.33
8	12.3	2.0	-0.77	-0.76
9	NT	NT		
10	13	3.1	-0.43	-0.28
11	15	1	0.53	0.90
12	NT	NT		
13	14	4	0.05	0.02
14	NT	NT		
15	13.7	3.5	-0.10	-0.06
16	13.9	1.39	0.00	0.00
17	18.0	7	1.97	0.58
18	14.0	1.8	0.05	0.05
19	15	1.5	0.53	0.66
20	NT	NT		
21	12.1	1.1	-0.86	-1.38
22	NT	NT		
23	13.0	3.2	-0.43	-0.27
24	14.495	NR	0.29	0.85
25	NT	NT		
26	13.6	2.2	-0.14	-0.13
27	14.8	4.4	0.43	0.20
28	NT	NT		
29	15	2.4	0.53	0.44
30	14.67	0.9	0.37	0.68

Statistics

Assigned Value	13.9	0.7
Spike	Not Spiked	
Homogeneity Value	15.3	2.3
Robust Average	13.9	0.7
Median	14.0	0.6
Mean	13.9	
N	22	
Max.	18	
Min.	10.2	
Robust SD	1.4	
Robust CV	10%	


Kernel Density
Density
Result
Results: S1 - Ni
Assigned Value = 13.9 ± 0.7 mg/kg
Results (mg/kg)
Laboratory
3 2 21 8 1 10 23 7 26 15 16 13 18 24 6 30 27 11 19 29 5 17 12 14 20 22 25 28 4 9 Md R.A. H.V.


z-Scores: S1 - Ni
Target Standard Deviation 2.1 mg/kg (Equivalent to 15% CV)
z-Score
Laboratory
3 2 21 8 1 10 23 7 26 15 16 13 18 24 6 30 27 11 19 29 5 17

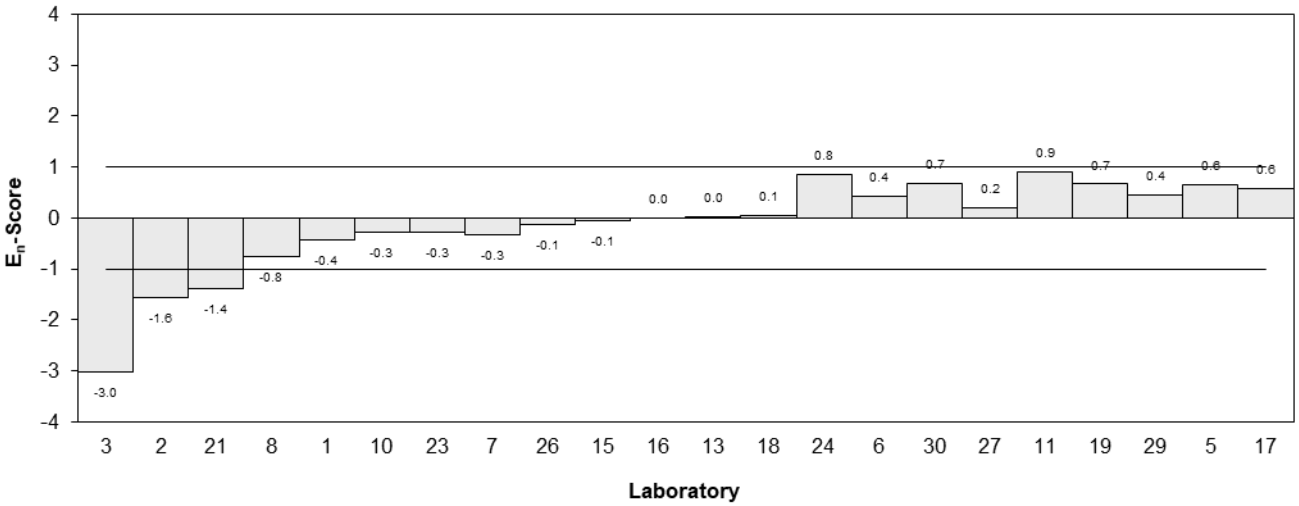

En-Scores: S1 - Ni
En-Score
Laboratory
3 2 21 8 1 10 23 7 26 15 16 13 18 24 6 30 27 11 19 29 5 17

Figure 11

Table 24

Sample Details

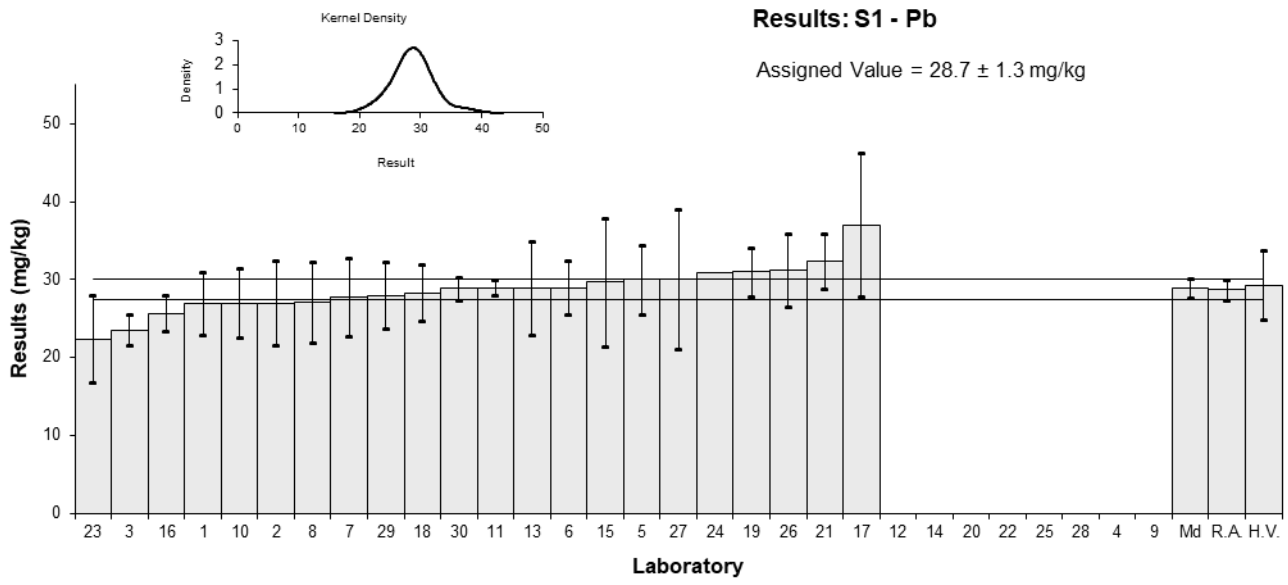
Sample No.	S1
Matrix.	Sediment
Analyte.	Pb
Units	mg/kg

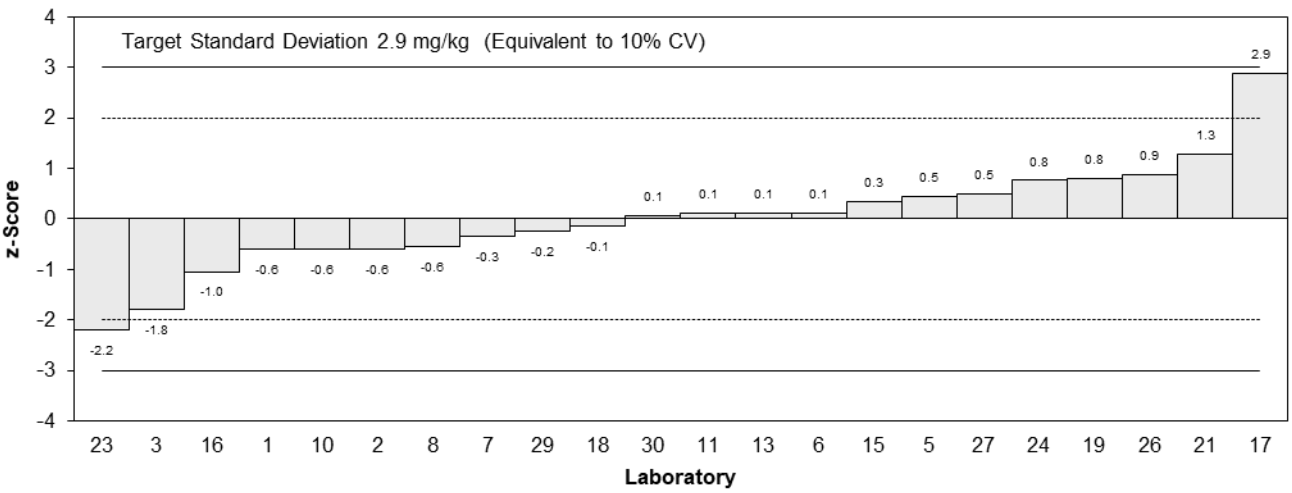
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	27	4.05	-0.59	-0.40
2	27	5.4	-0.59	-0.31
3	23.55	2	-1.79	-2.16
4	NT	NT		
5	30	4.5	0.45	0.28
6	29.0	3.5	0.10	0.08
7	27.7	5	-0.35	-0.19
8	27.1	5.2	-0.56	-0.30
9	NT	NT		
10	27	4.4	-0.59	-0.37
11	29	1	0.10	0.18
12	NT	NT		
13	29	6	0.10	0.05
14	NT	NT		
15	29.7	8.2	0.35	0.12
16	25.7	2.31	-1.05	-1.13
17	37.0	9.2	2.89	0.89
18	28.3	3.6	-0.14	-0.10
19	31	3.1	0.80	0.68
20	NT	NT		
21	32.4	3.5	1.29	0.99
22	NT	NT		
23	22.4	5.6	-2.20	-1.10
24	30.892	NR	0.76	1.69
25	NT	NT		
26	31.2	4.7	0.87	0.51
27	30.1	9.0	0.49	0.15
28	NT	NT		
29	28	4.3	-0.24	-0.16
30	28.87	1.5	0.06	0.09

Statistics

Assigned Value	28.7	1.3
Spike	Not Spiked	
Homogeneity Value	29.3	4.4
Robust Average	28.7	1.3
Median	28.9	1.2
Mean	28.7	
N	22	
Max.	37	
Min.	22.4	
Robust SD	2.4	
Robust CV	8.5%	


Kernel Density
Density
Result
Results: S1 - Pb
Assigned Value = 28.7 ± 1.3 mg/kg
Results (mg/kg)
Laboratory
23 3 16 1 10 2 8 7 29 18 30 11 13 6 15 5 27 24 19 26 21 17 12 14 20 22 25 28 4 9 Md R.A. H.V.


z-Scores: S1 - Pb
Target Standard Deviation 2.9 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
23 3 16 1 10 2 8 7 29 18 30 11 13 6 15 5 27 24 19 26 21 17

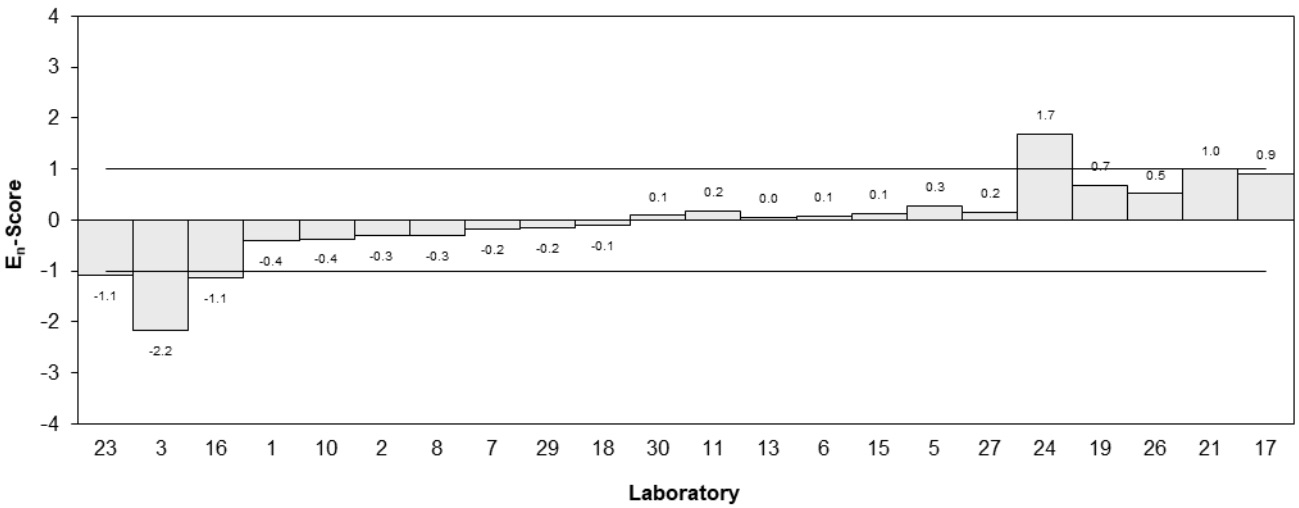

En-Scores: S1 - Pb
En-Score
Laboratory
23 3 16 1 10 2 8 7 29 18 30 11 13 6 15 5 27 24 19 26 21 17

Figure 12

Table 25

Sample Details

Sample No.	S1
Matrix.	Sediment
Analyte.	Sb
Units	mg/kg

Participant Results

Lab Code	Result	Uncertainty
1	7	1.1
2	4.5	0.9
3	7.6	1
4	NT	NT
5	<10	NR
6	11.4	1.2
7	5.9	NR
8	4.3	1.1
9	NT	NT
10	5.1	1.7
11	NT	NT
12	NT	NT
13	NT	NT
14	NT	NT
15	4.94	1.40
16	3.35	0.37
17	<100	NR
18	8.50	1.2
19	NT	NT
20	NT	NT
21	4.1	0.4
22	NT	NT
23	9.8	2.4
24	7.762	NR
25	NT	NT
26	5.22	0.98
27	8.5	2.5
28	NT	NT
29	<10	NR
30	9.08	0.8

Statistics

Assigned Value	Not Set	
Spike	Not Spiked	
Homogeneity Value	5.40	0.80
Robust Average	6.6	1.6
Median	6.5	1.6
Mean	6.7	
N	16	
Max.	11.4	
Min.	3.35	
Robust SD	2.5	
Robust CV	38%	

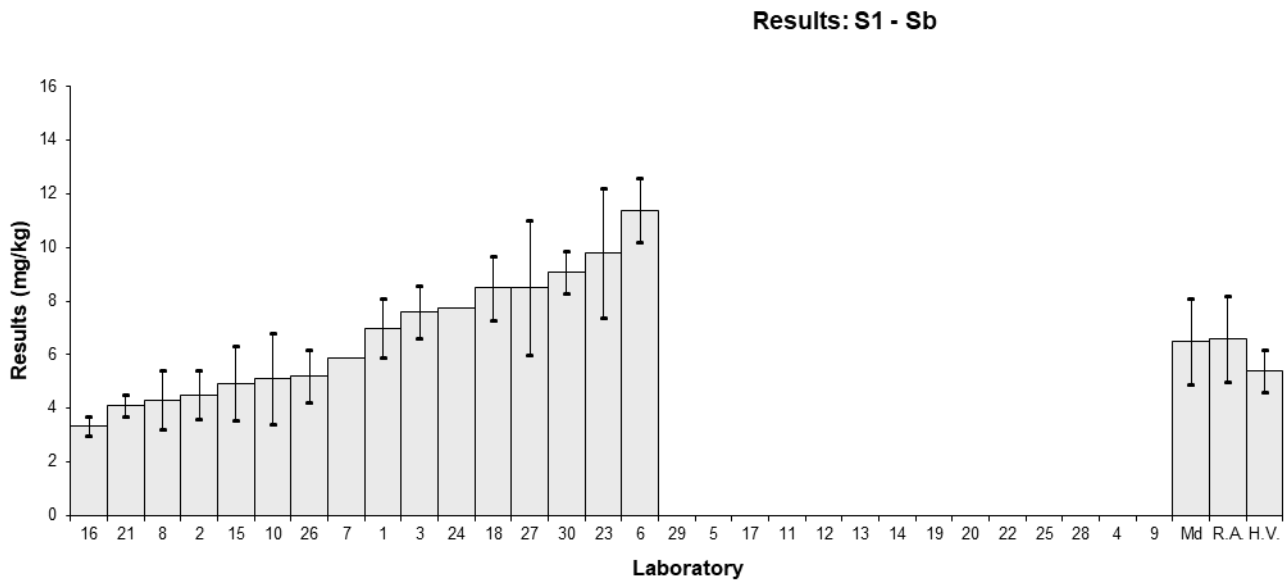

Results: S1 - Sb
Results (mg/kg)
0
2
4
6
8
10
12
14
16
16 21 8 2 15 10 26 7 1 3 24 18 27 30 23 6 29 5 17 11 12 13 14 19 20 22 25 28 4 9 Md R.A. H.V.
Laboratory

Figure 13

Table 26

Sample Details

Sample No.	S1
Matrix.	Sediment
Analyte.	Se
Units	mg/kg

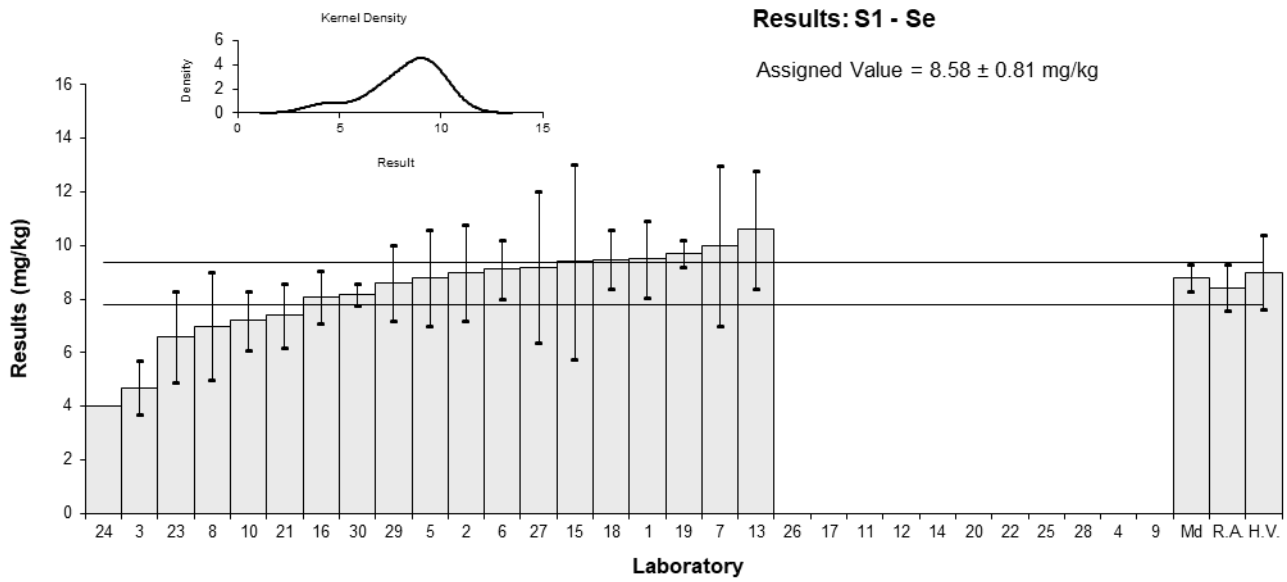
Participant Results

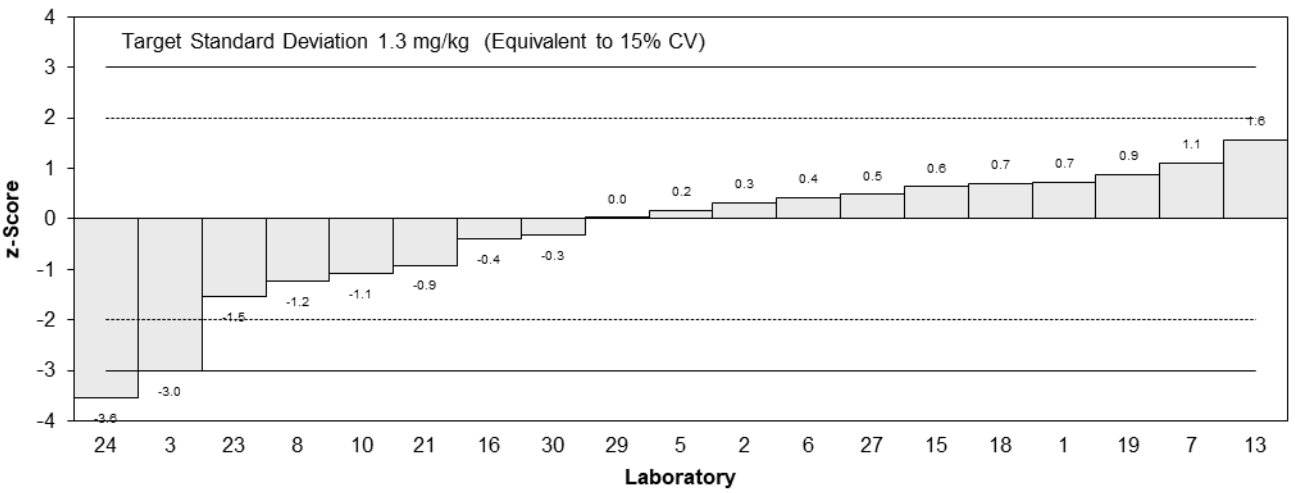
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	9.5	1.43	0.71	0.56
2	9	1.8	0.33	0.21
3	4.7	1	-3.01	-3.02
4	NT	NT		
5	8.8	1.8	0.17	0.11
6	9.12	1.1	0.42	0.40
7	10	3	1.10	0.46
8	7	2	-1.23	-0.73
9	NT	NT		
10	7.2	1.1	-1.07	-1.01
11	NT	NT		
12	NT	NT		
13	10.6	2.2	1.57	0.86
14	NT	NT		
15	9.40	3.62	0.64	0.22
16	8.08	0.97	-0.39	-0.40
17	<100	NR		
18	9.47	1.1	0.69	0.65
19	9.7	0.485	0.87	1.19
20	NT	NT		
21	7.4	1.2	-0.92	-0.82
22	NT	NT		
23	6.6	1.7	-1.54	-1.05
24	4.006	NR	-3.55	-5.65
25	NT	NT		
26	< 20	14		
27	9.2	2.8	0.48	0.21
28	NT	NT		
29	8.6	1.4	0.02	0.01
30	8.17	0.4	-0.32	-0.45

Statistics

Assigned Value*	8.58	0.81
Spike	Not Spiked	
Homogeneity Value	9.0	1.4
Robust Average	8.43	0.87
Median	8.80	0.51
Mean	8.24	
N	19	
Max.	10.6	
Min.	4.006	
Robust SD	1.5	
Robust CV	18%	

*Robust Average excluding laboratory 24.


Kernel Density
Density
Result
Results: S1 - Se
Assigned Value = 8.58 ± 0.81 mg/kg
Results (mg/kg)
Laboratory
24 3 23 8 10 21 16 30 29 5 2 6 27 15 18 1 19 7 13 26 17 11 12 14 20 22 25 28 4 9 Md R.A. H.V.


z-Scores: S1 - Se
Target Standard Deviation 1.3 mg/kg (Equivalent to 15% CV)
z-Score
Laboratory
24 3 23 8 10 21 16 30 29 5 2 6 27 15 18 1 19 7 13
-3.6 -3.0 -1.5 -1.2 -1.1 -0.9 -0.4 -0.3 0.0 0.2 0.3 0.4 0.5 0.6 0.7 0.7 0.9 1.1 1.6

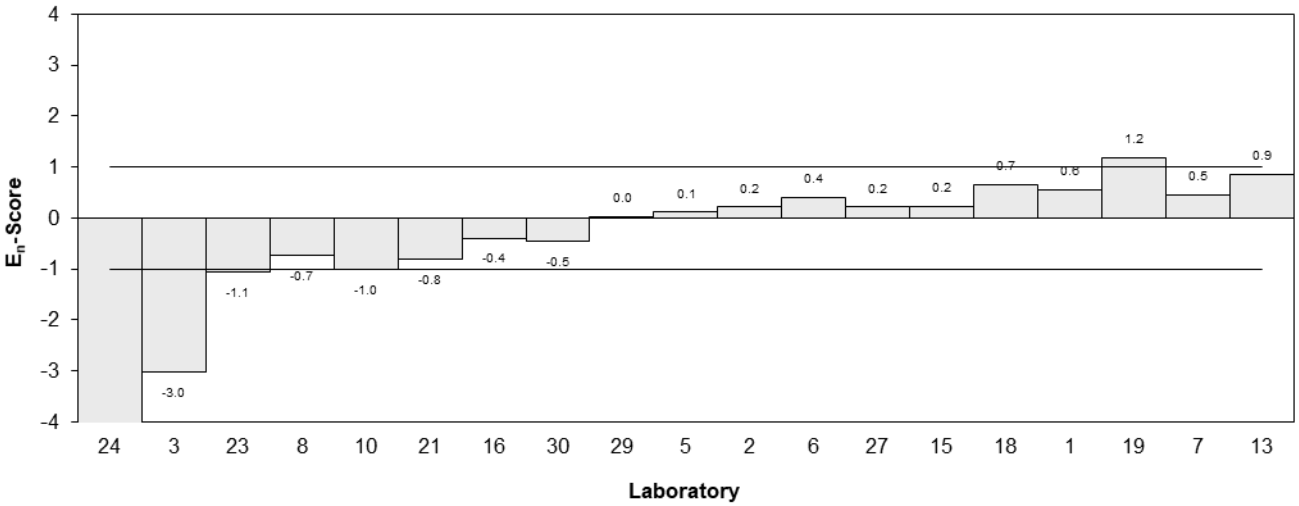

En-Scores: S1 - Se
En-Score
Laboratory
24 3 23 8 10 21 16 30 29 5 2 6 27 15 18 1 19 7 13
-3.0 -1.1 -0.7 -1.0 -0.8 -0.4 -0.5 0.0 0.1 0.2 0.4 0.2 0.2 0.7 0.6 1.2 0.5 0.9

Figure 14

Table 27

Sample Details

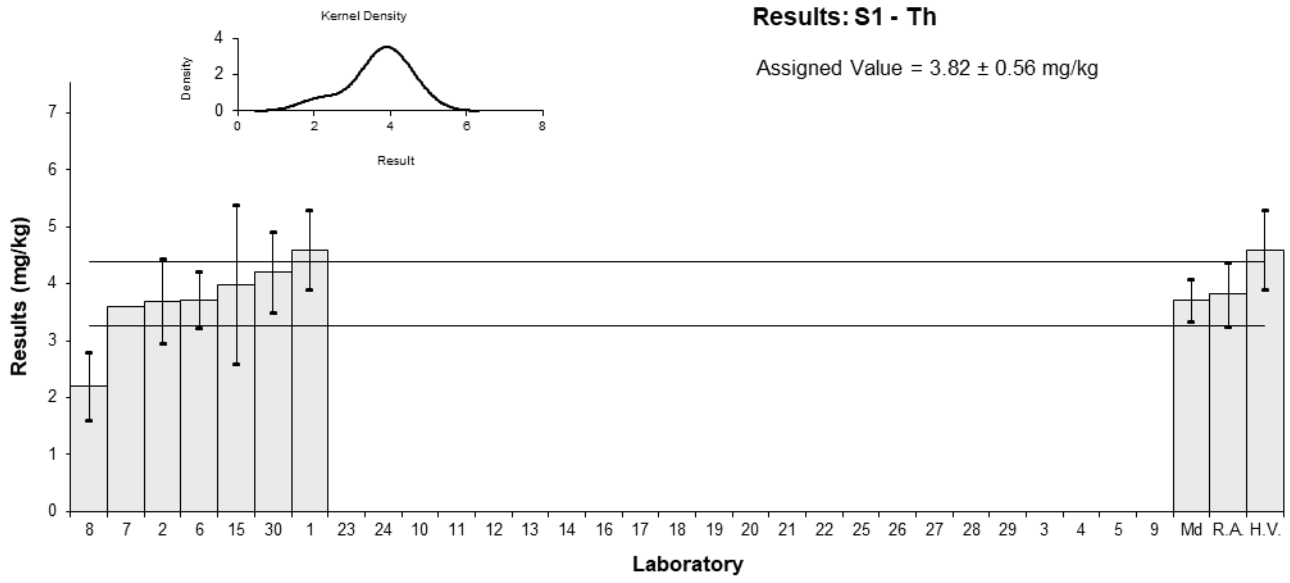
Sample No.	S1
Matrix.	Sediment
Analyte.	Th
Units	mg/kg

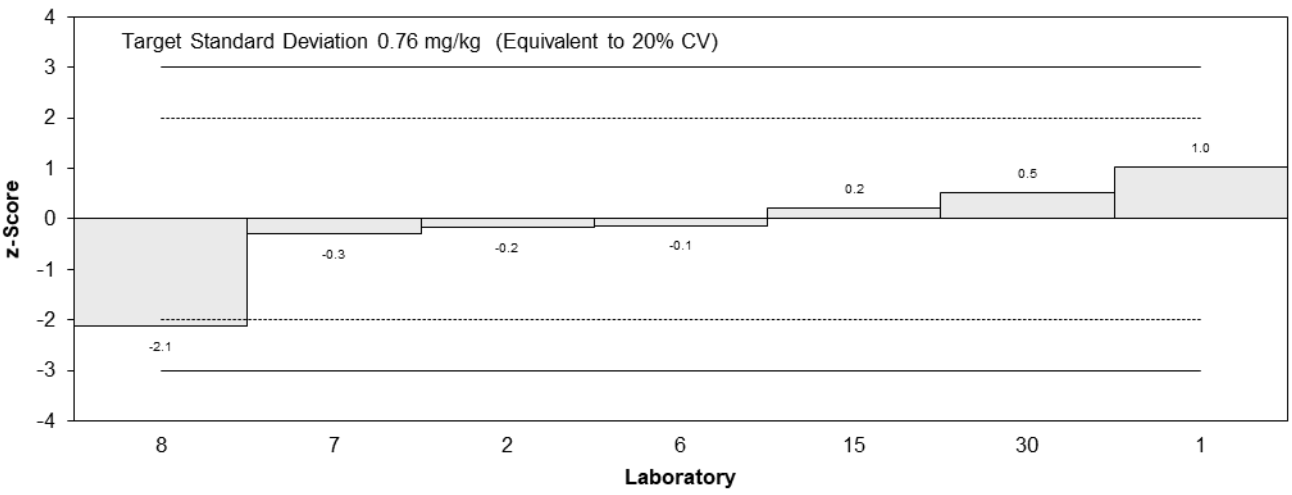
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	4.6	0.69	1.02	0.88
2	3.7	0.74	-0.16	-0.13
3	NT	NT		
4	NT	NT		
5	NT	NT		
6	3.72	0.5	-0.13	-0.13
7	3.6	NR	-0.29	-0.39
8	2.2	0.6	-2.12	-1.97
9	NT	NT		
10	NT	NT		
11	NT	NT		
12	NT	NT		
13	NT	NT		
14	NT	NT		
15	3.99	1.39	0.22	0.11
16	NT	NT		
17	NT	NT		
18	NT	NT		
19	NT	NT		
20	NT	NT		
21	NT	NT		
22	NT	NT		
23	NR	NR		
24	NR	NR		
25	NT	NT		
26	NT	NT		
27	NT	NT		
28	NT	NT		
29	NT	NT		
30	4.21	0.7	0.51	0.44

Statistics

Assigned Value	3.82	0.56
Spike	Not Spiked	
Homogeneity Value	4.60	0.70
Robust Average	3.82	0.56
Median	3.72	0.37
Mean	3.72	
N	7	
Max.	4.6	
Min.	2.2	
Robust SD	0.60	
Robust CV	16%	


Kernel Density
Density
Result
Results: S1 - Th
Assigned Value = 3.82 ± 0.56 mg/kg
Results (mg/kg)
Laboratory
8 7 2 6 15 30 1 23 24 10 11 12 13 14 16 17 18 19 20 21 22 25 26 27 28 29 3 4 5 9 Md R.A. H.V.


z-Scores: S1 - Th
Target Standard Deviation 0.76 mg/kg (Equivalent to 20% CV)
z-Score
Laboratory
8 7 2 6 15 30 1
-2.1
-0.3
-0.2
-0.1
0.2
0.5
1.0

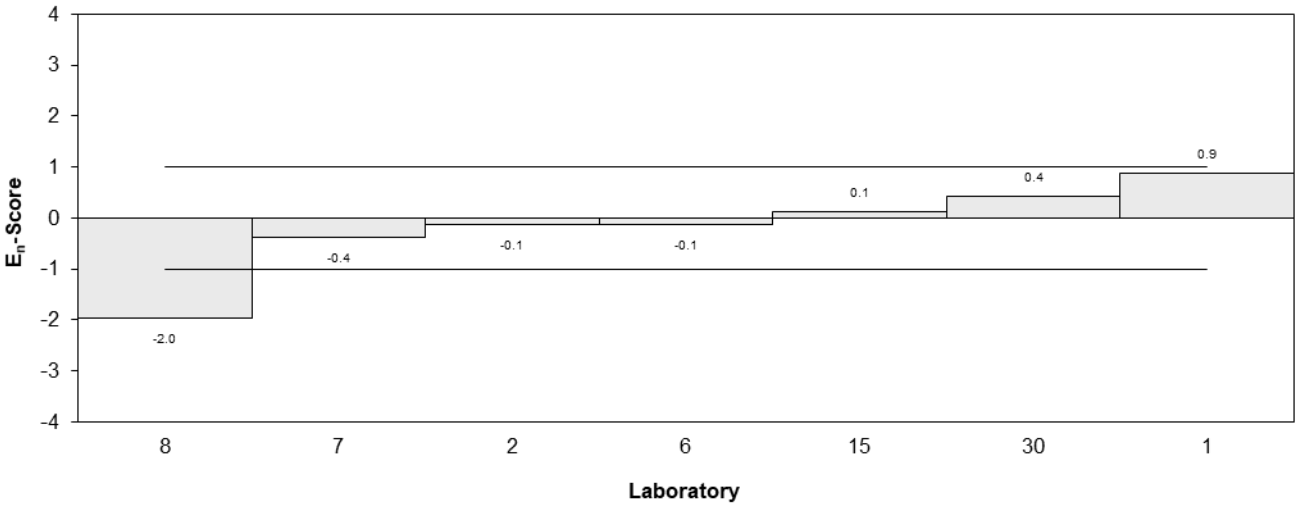

En-Scores: S1 - Th
En-Score
Laboratory
8 7 2 6 15 30 1
-2.0
-0.4
-0.1
-0.1
0.1
0.4
0.9

Figure 15

Table 28

Sample Details

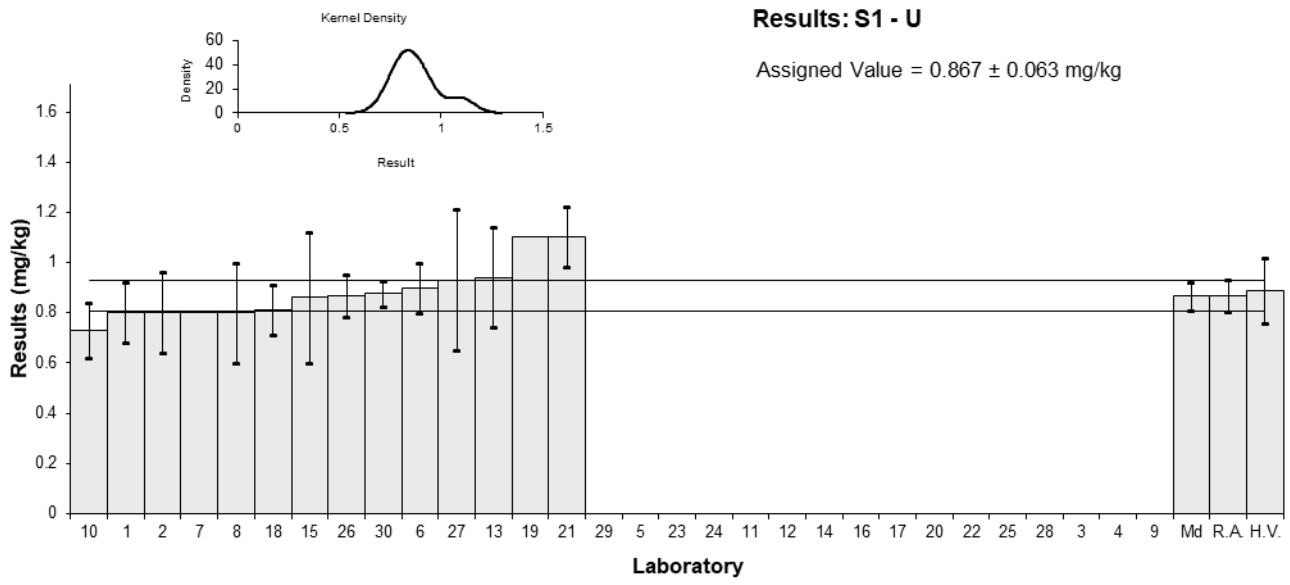
Sample No.	S1
Matrix.	Sediment
Analyte.	U
Units	mg/kg

Participant Results

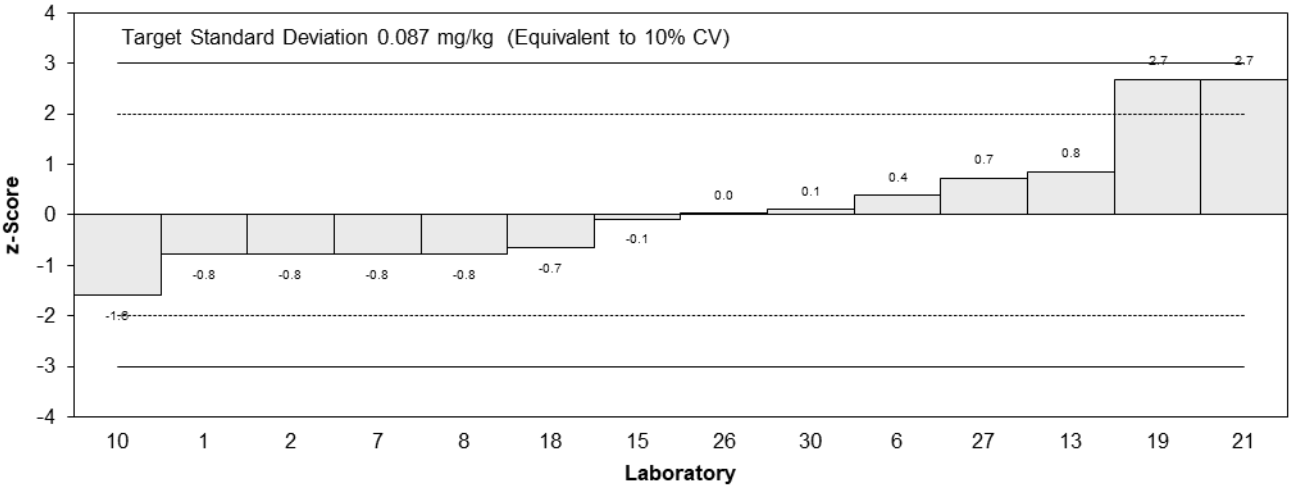
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	0.8	0.12	-0.77	-0.49
2	0.8	0.16	-0.77	-0.39
3	NT	NT		
4	NT	NT		
5	<10	NR		
6	0.90	0.1	0.38	0.28
7	0.8	NR	-0.77	-1.06
8	0.8	0.2	-0.77	-0.32
9	NT	NT		
10	0.73	0.11	-1.58	-1.08
11	NT	NT		
12	NT	NT		
13	0.94	0.2	0.84	0.35
14	NT	NT		
15	0.86	0.26	-0.08	-0.03
16	NT	NT		
17	NT	NT		
18	0.81	0.1	-0.66	-0.48
19	1.1	NR	2.69	3.70
20	NT	NT		
21	1.10	0.12	2.69	1.72
22	NT	NT		
23	NR	NR		
24	NR	NR		
25	NT	NT		
26	0.869	0.085	0.02	0.02
27	0.93	0.28	0.73	0.22
28	NT	NT		
29	<10	NR		
30	0.876	0.05	0.10	0.11

Statistics

Assigned Value	0.867	0.063
Spike	Not Spiked	
Homogeneity Value	0.89	0.13
Robust Average	0.867	0.063
Median	0.865	0.055
Mean	0.880	
N	14	
Max.	1.1	
Min.	0.73	
Robust SD	0.095	
Robust CV	11%	



z-Scores: S1 - U



En-Scores: S1 - U

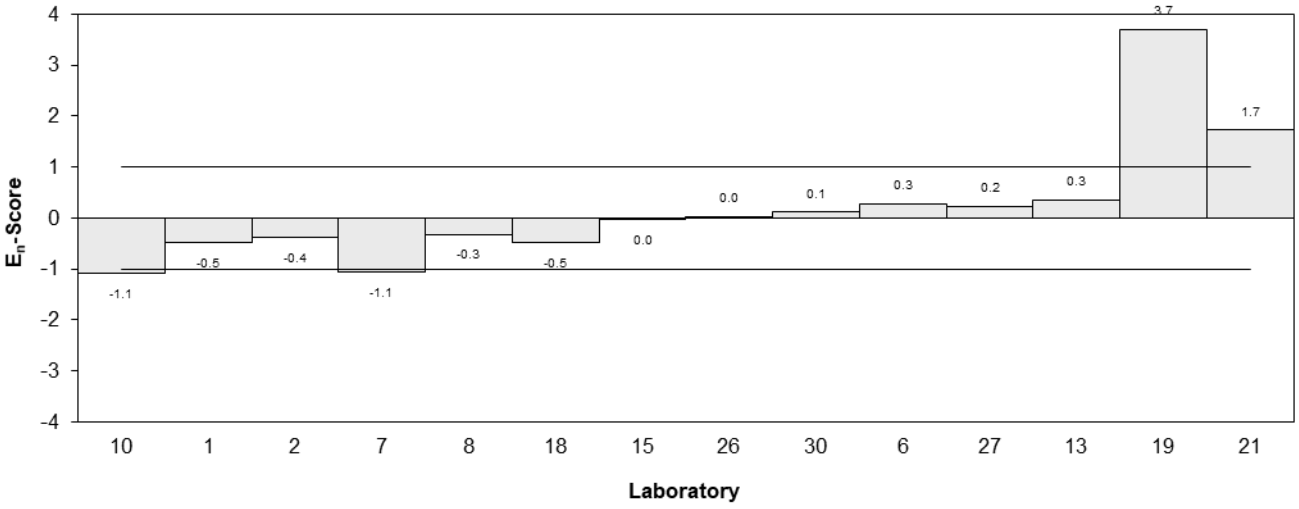


Figure 16

Table 29

Sample Details

Sample No.	S1
Matrix.	Sediment
Analyte.	V
Units	mg/kg

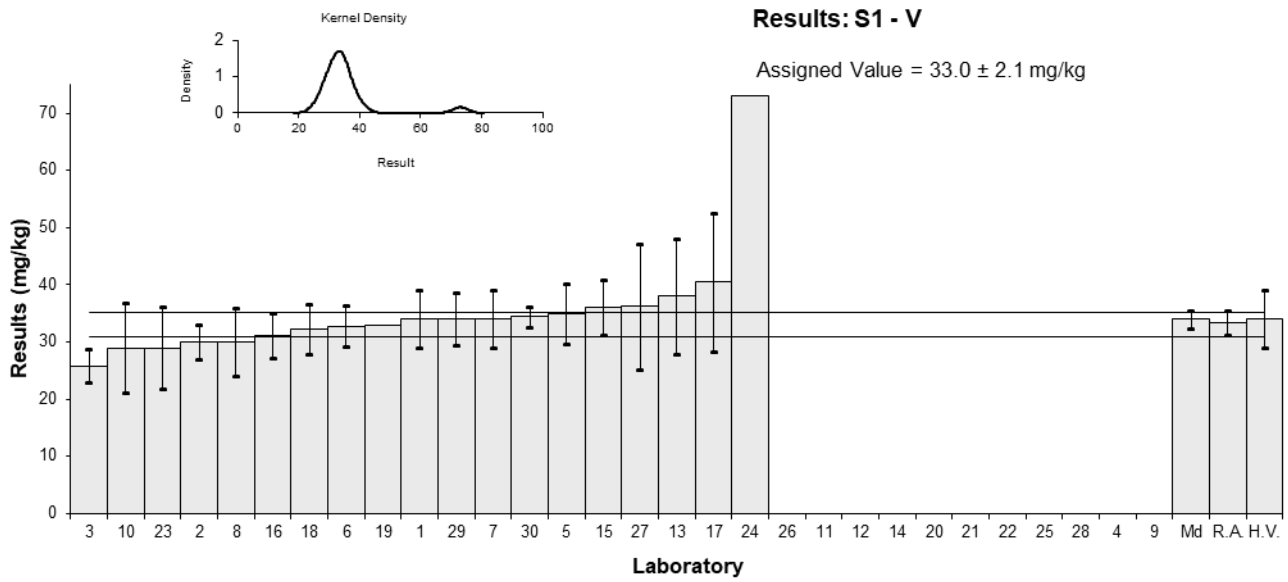
Participant Results

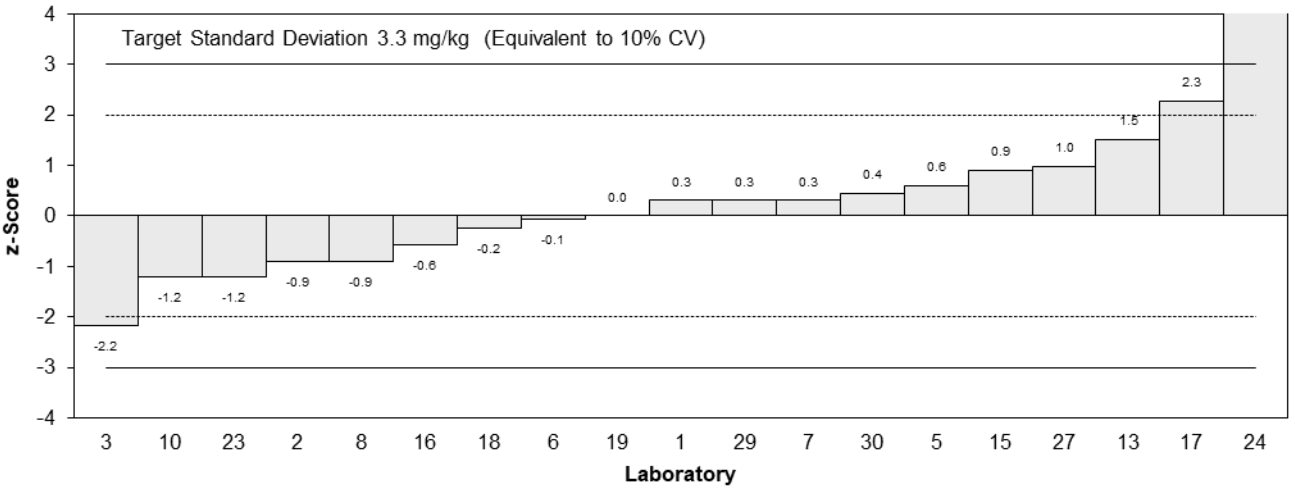
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	34	5.1	0.30	0.18
2	30	3	-0.91	-0.82
3	25.85	3	-2.17	-1.95
4	NT	NT		
5	35	5.3	0.61	0.35
6	32.8	3.5	-0.06	-0.05
7	34	5	0.30	0.18
8	30	6	-0.91	-0.47
9	NT	NT		
10	29	7.8	-1.21	-0.50
11	NT	NT		
12	NT	NT		
13	38	10	1.52	0.49
14	NT	NT		
15	36.0	4.8	0.91	0.57
16	31.1	3.89	-0.58	-0.43
17	40.5	12.1	2.27	0.61
18	32.2	4.4	-0.24	-0.16
19	33	NR	0.00	0.00
20	NT	NT		
21	NT	NT		
22	NT	NT		
23	29.0	7.2	-1.21	-0.53
24	73.066	NR	12.14	19.08
25	NT	NT		
26	< 100	67		
27	36.2	10.9	0.97	0.29
28	NT	NT		
29	34	4.6	0.30	0.20
30	34.44	1.8	0.44	0.52

Statistics

Assigned Value*	33.0	2.1
Spike	Not Spiked	
Homogeneity Value	34.0	5.1
Robust Average	33.4	2.2
Median	34.0	1.6
Mean	35.2	
N	19	
Max.	73.066	
Min.	25.85	
Robust SD	3.9	
Robust CV	12%	

*Robust Average excluding laboratory 24.


Kernel Density
Density
Result
Results: S1 - V
Assigned Value = 33.0 ± 2.1 mg/kg
Results (mg/kg)
Laboratory
3 10 23 2 8 16 18 6 19 1 29 7 30 5 15 27 13 17 24 26 11 12 14 20 21 22 25 28 4 9 Md R.A. H.V.


z-Scores: S1 - V
Target Standard Deviation 3.3 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
3 10 23 2 8 16 18 6 19 1 29 7 30 5 15 27 13 17 24

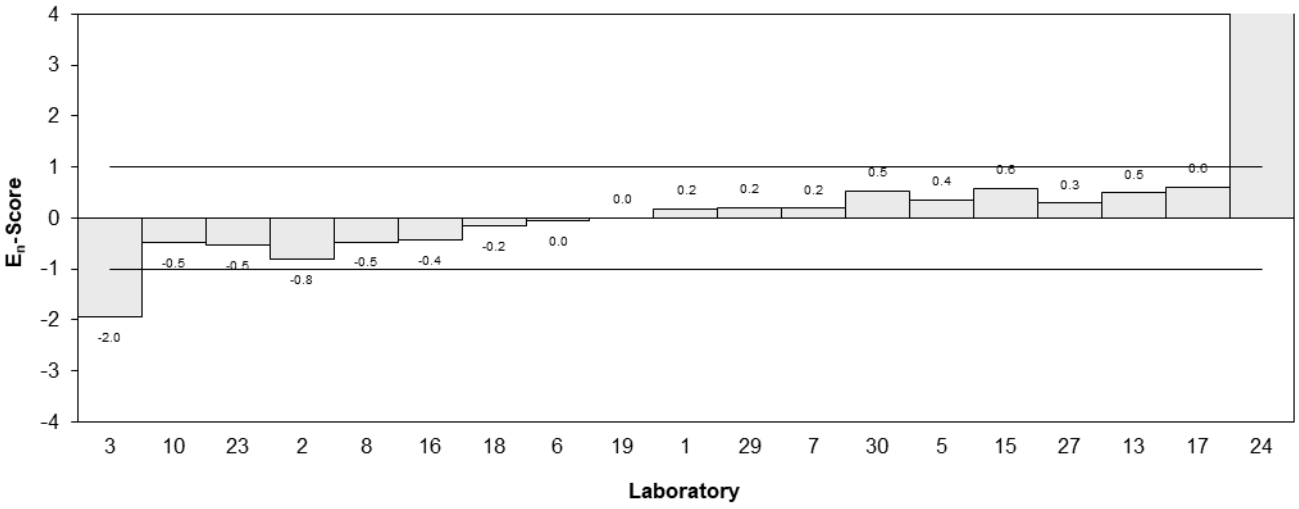

En-Scores: S1 - V
En-Score
Laboratory
3 10 23 2 8 16 18 6 19 1 29 7 30 5 15 27 13 17 24

Figure 17

Table 30

Sample Details

Sample No.	S1
Matrix.	Sediment
Analyte.	Zn
Units	mg/kg

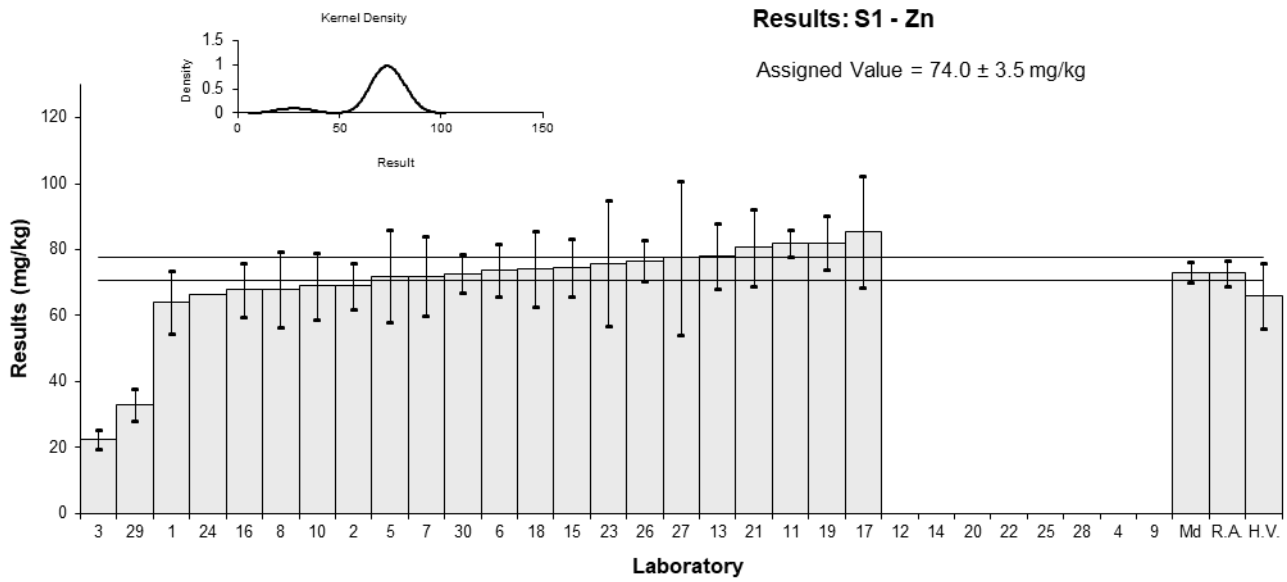
Participant Results

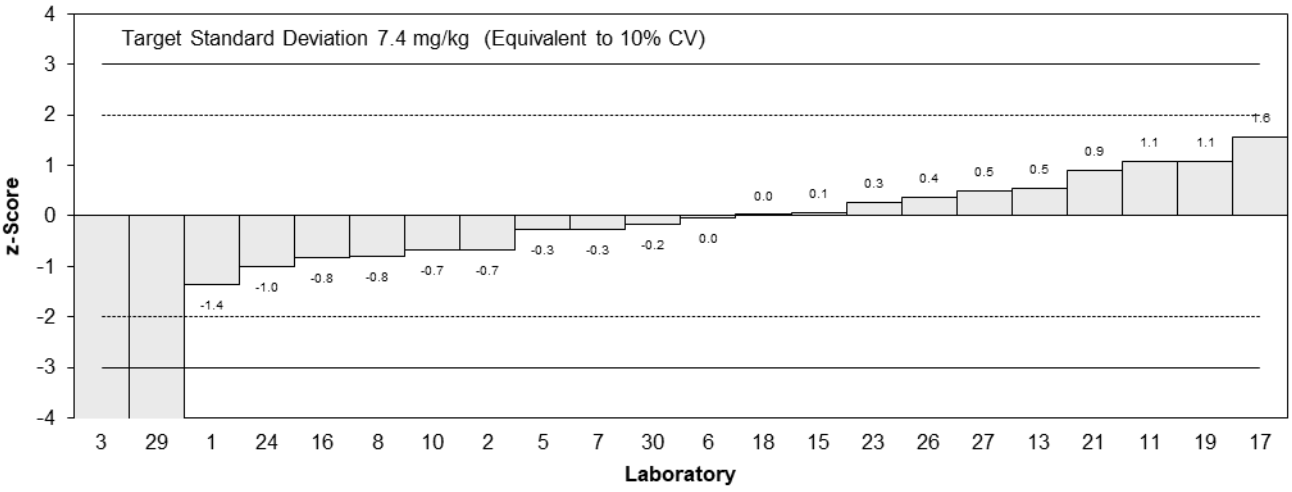
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	64	9.6	-1.35	-0.98
2	69	7	-0.68	-0.64
3	22.6	3	-6.95	-11.15
4	NT	NT		
5	72	14	-0.27	-0.14
6	73.7	8.0	-0.04	-0.03
7	72	12	-0.27	-0.16
8	68.1	11.5	-0.80	-0.49
9	NT	NT		
10	69	10	-0.68	-0.47
11	82	4	1.08	1.51
12	NT	NT		
13	78	10	0.54	0.38
14	NT	NT		
15	74.5	8.8	0.07	0.05
16	67.9	8.15	-0.82	-0.69
17	85.5	17	1.55	0.66
18	74.2	11.3	0.03	0.02
19	82	8.2	1.08	0.90
20	NT	NT		
21	80.7	11.6	0.91	0.55
22	NT	NT		
23	75.9	19.0	0.26	0.10
24	66.482	NR	-1.02	-2.15
25	NT	NT		
26	76.7	6.1	0.36	0.38
27	77.6	23.3	0.49	0.15
28	NT	NT		
29	33	5.0	-5.54	-6.72
30	72.72	5.9	-0.17	-0.19

Statistics

Assigned Value*	74.0	3.5
Spike	Not Spiked	
Homogeneity Value	66	10
Robust Average	72.9	3.9
Median	73.2	3.0
Mean	69.9	
N	22	
Max.	85.5	
Min.	22.6	
Robust SD	7.2	
Robust CV	9.9%	

*Robust Average excluding laboratories 3 and 29.


Kernel Density
Density
Result
Results: S1 - Zn
Assigned Value = 74.0 ± 3.5 mg/kg
Results (mg/kg)
Laboratory
3 29 1 24 16 8 10 2 5 7 30 6 18 15 23 26 27 13 21 11 19 17 12 14 20 22 25 28 4 9 Md R.A. H.V.


z-Scores: S1 - Zn
Target Standard Deviation 7.4 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
3 29 1 24 16 8 10 2 5 7 30 6 18 15 23 26 27 13 21 11 19 17

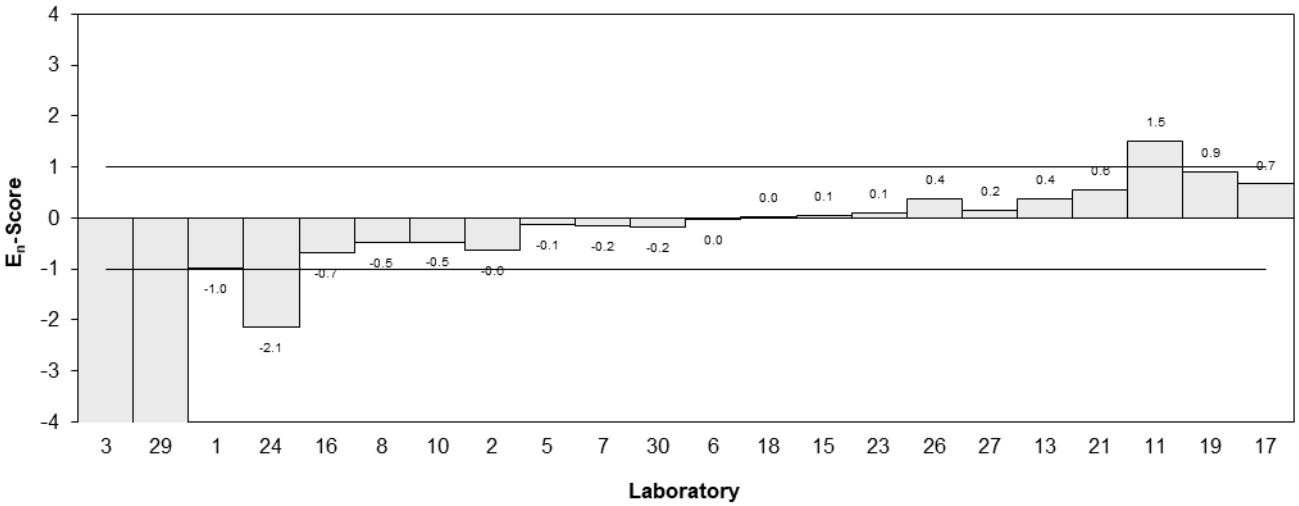

En-Scores: S1 - Zn
En-Score
Laboratory
3 29 1 24 16 8 10 2 5 7 30 6 18 15 23 26 27 13 21 11 19 17

Figure 18

Table 31

Sample Details

Sample No.	S2
Matrix.	Soil
Analyte.	Ag
Units	mg/kg

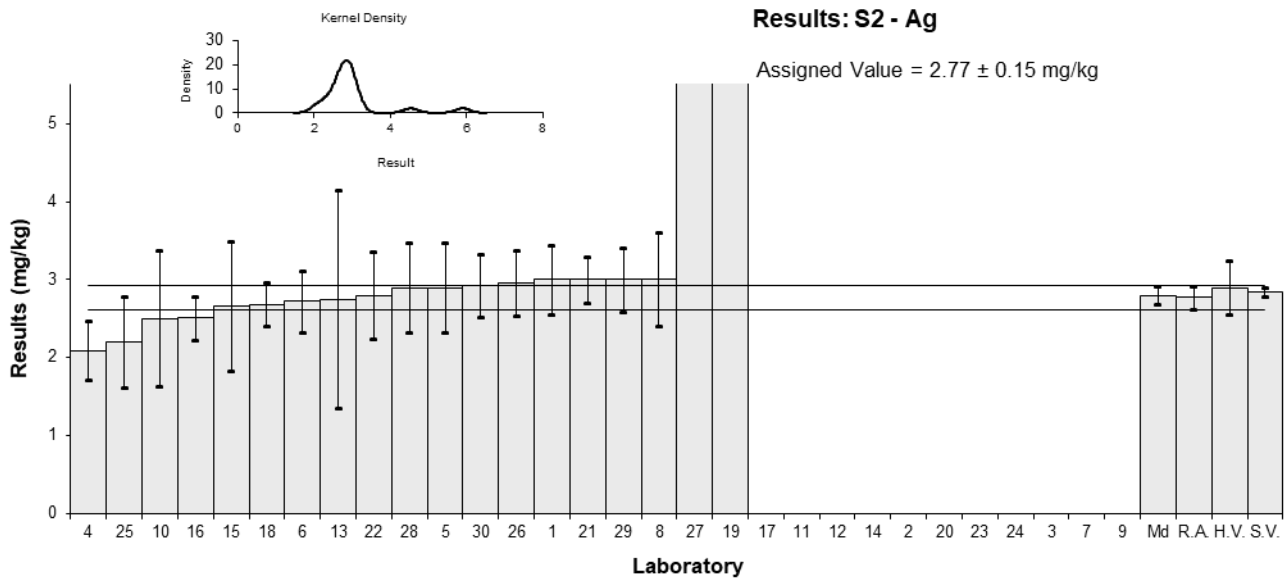
Participant Results

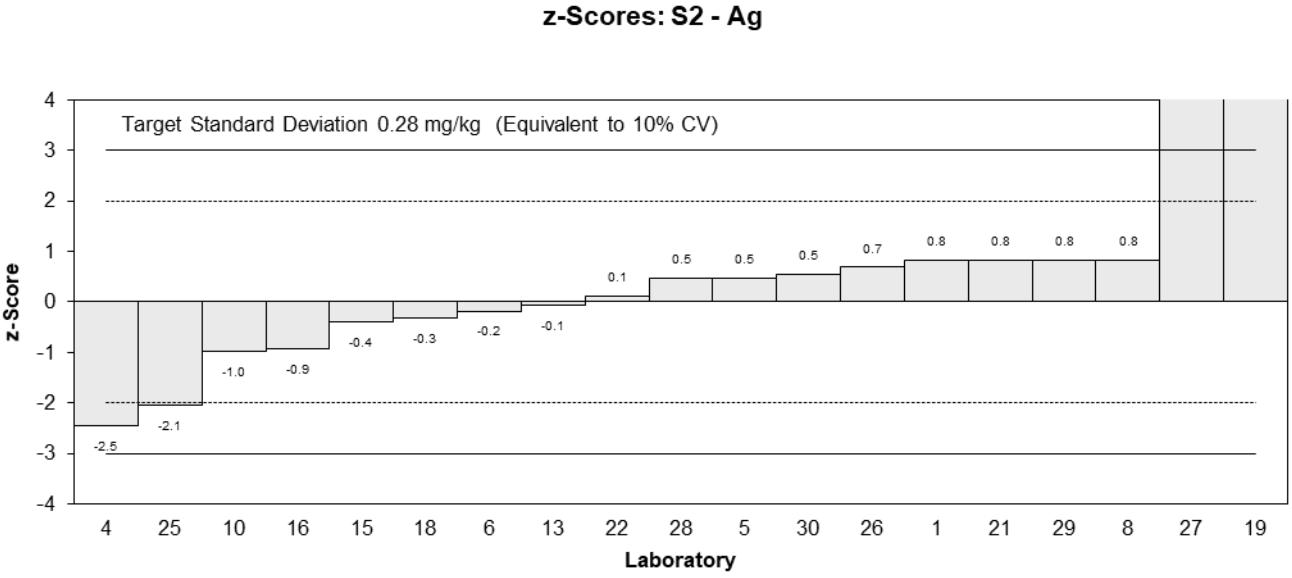
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	3	0.45	0.83	0.48
2	NT	NT		
3	NT	NT		
4	2.09	0.38	-2.45	-1.66
5	2.9	0.58	0.47	0.22
6	2.72	0.4	-0.18	-0.12
7	NT	NT		
8	3.0	0.6	0.83	0.37
9	NT	NT		
10	2.5	0.87	-0.97	-0.31
11	NT	NT		
12	NT	NT		
13	2.75	1.4	-0.07	-0.01
14	NT	NT		
15	2.66	0.83	-0.40	-0.13
16	2.51	0.28	-0.94	-0.82
17	<1	NR		
18	2.68	0.28	-0.32	-0.28
19	59	NR	203.00	374.87
20	NT	NT		
21	3.0	0.3	0.83	0.69
22	2.8	0.56	0.11	0.05
23	NT	NT		
24	NT	NT		
25	2.2	0.59	-2.06	-0.94
26	2.96	0.42	0.69	0.43
27	45.5	13.6	154.26	3.14
28	2.9	0.58	0.47	0.22
29	3.0	0.41	0.83	0.53
30	2.92	0.4	0.54	0.35

Statistics*

Assigned Value	2.77	0.15
Spike	2.84	0.06
Homogeneity Value	2.90	0.35
Robust Average	2.77	0.15
Median	2.80	0.12
Mean	2.74	
N	17	
Max.	3	
Min.	2.09	
Robust SD	0.24	
Robust CV	8.7%	

*Laboratories 19 and 27 were excluded from statistical calculation (extreme outlier).


Results: S2 - Ag
Assigned Value = 2.77 ± 0.15 mg/kg
Kernel Density
Density
Result
Results (mg/kg)
Laboratory
4 25 10 16 15 18 6 13 22 28 5 30 26 1 21 29 8 27 19 17 11 12 14 2 20 23 24 3 7 9 Md R.A. H.V. S.V.


z-Scores: S2 - Ag
Target Standard Deviation 0.28 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
4 25 10 16 15 18 6 13 22 28 5 30 26 1 21 29 8 27 19
-2.5 -2.1 -1.0 -0.9 -0.4 -0.3 -0.2 -0.1 0.1 0.5 0.5 0.5 0.7 0.8 0.8 0.8 0.8

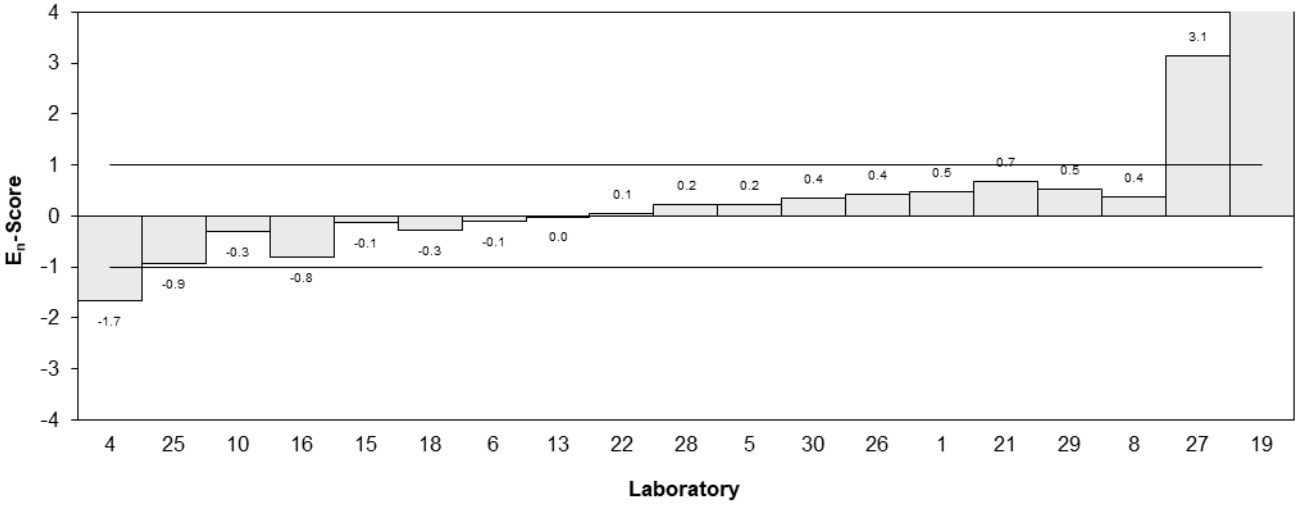

En-Scores: S2 - Ag
En-Score
Laboratory
4 25 10 16 15 18 6 13 22 28 5 30 26 1 21 29 8 27 19
-1.7 -0.9 -0.3 -0.8 -0.1 -0.3 -0.1 0.0 0.1 0.2 0.2 0.4 0.4 0.5 0.7 0.5 0.4 3.1

Figure 19

Table 32

Sample Details

Sample No.	S2
Matrix.	Soil
Analyte.	B
Units	mg/kg

Participant Results

Lab Code	Result	Uncertainty
1	28	4.2
2	NT	NT
3	8.6	1
4	<50	NR
5	37	7.4
6	33.1	3.5
7	NT	NT
8	<50	NR
9	NT	NT
10	19	4.8
11	NT	NT
12	NT	NT
13	32	3
14	NT	NT
15	11.9	3.5
16	50.4	7.41
17	32.0	8
18	20.5	3
19	17	NR
20	NT	NT
21	10.7	1.8
22	33	6.6
23	NT	NT
24	NT	NT
25	5	1.3
26	25.7	3.9
27	24.7	7.4
28	36	7.2
29	30	5.8
30	27.97	3.7

Statistics

Assigned Value	Not Set	
Spike	38.9	0.9
Homogeneity Value	27.0	3.2
Robust Average	25.1	6.7
Median	28.0	5.3
Mean	25.4	
N	19	
Max.	50.4	
Min.	5	
Robust SD	12	
Robust CV	47%	

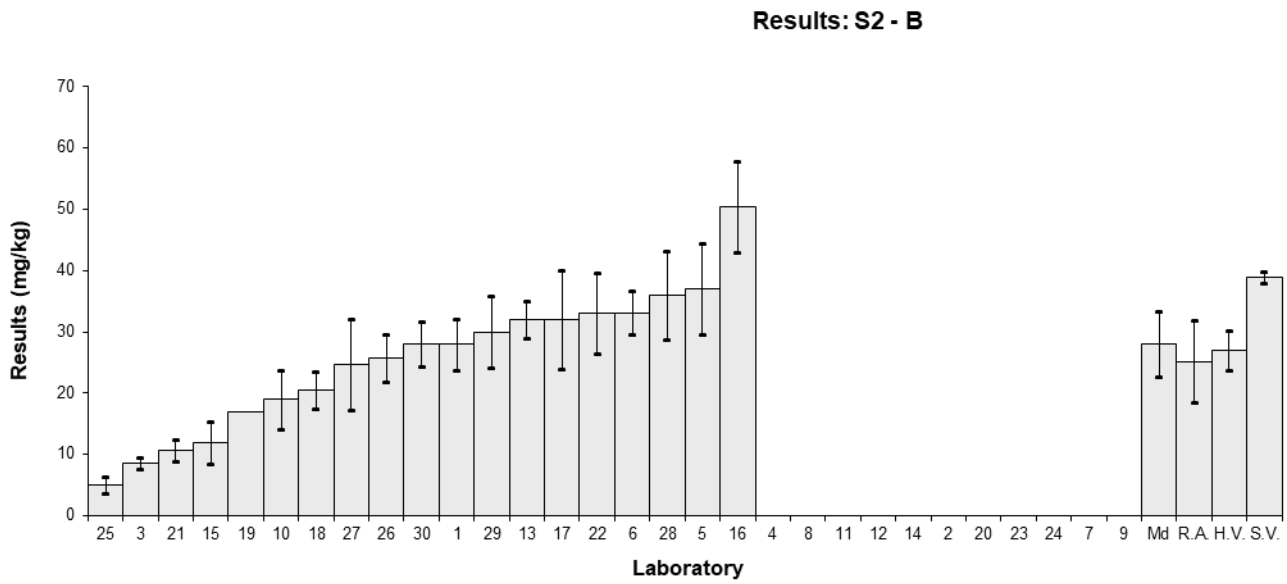

Results: S2 - B
Results (mg/kg)
70
60
50
40
30
20
10
0
25 3 21 15 19 10 18 27 26 30 1 29 13 17 22 6 28 5 16 4 8 11 12 14 2 20 23 24 7 9 Md R.A. H.V. S.V.
Laboratory

Figure 20

Table 33

Sample Details

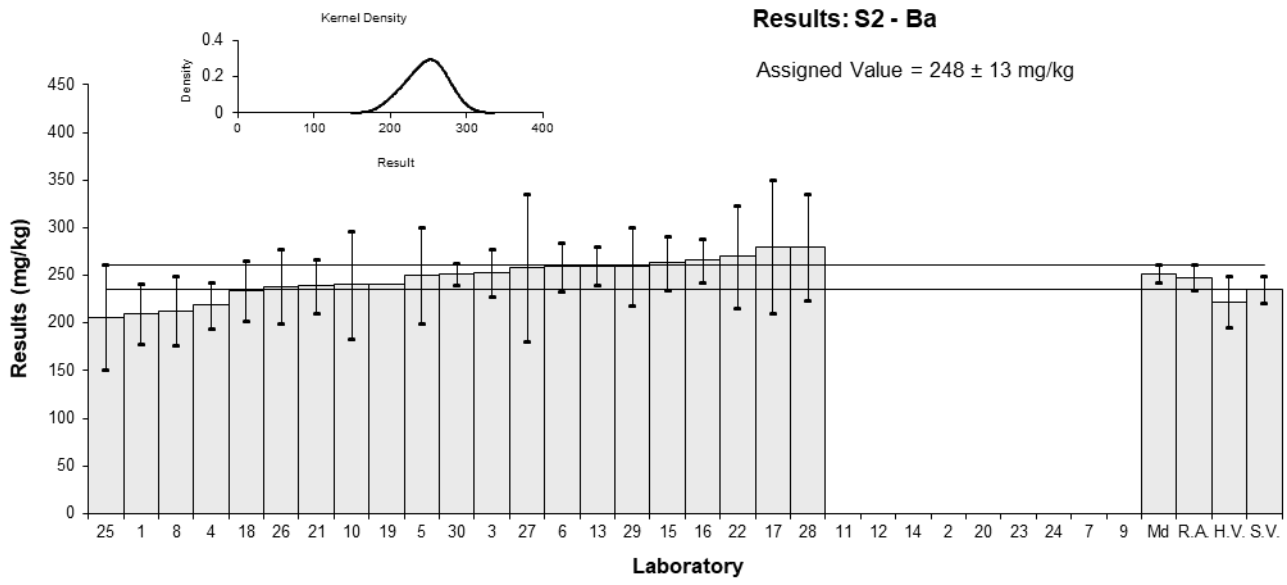
Sample No.	S2
Matrix.	Soil
Analyte.	Ba
Units	mg/kg

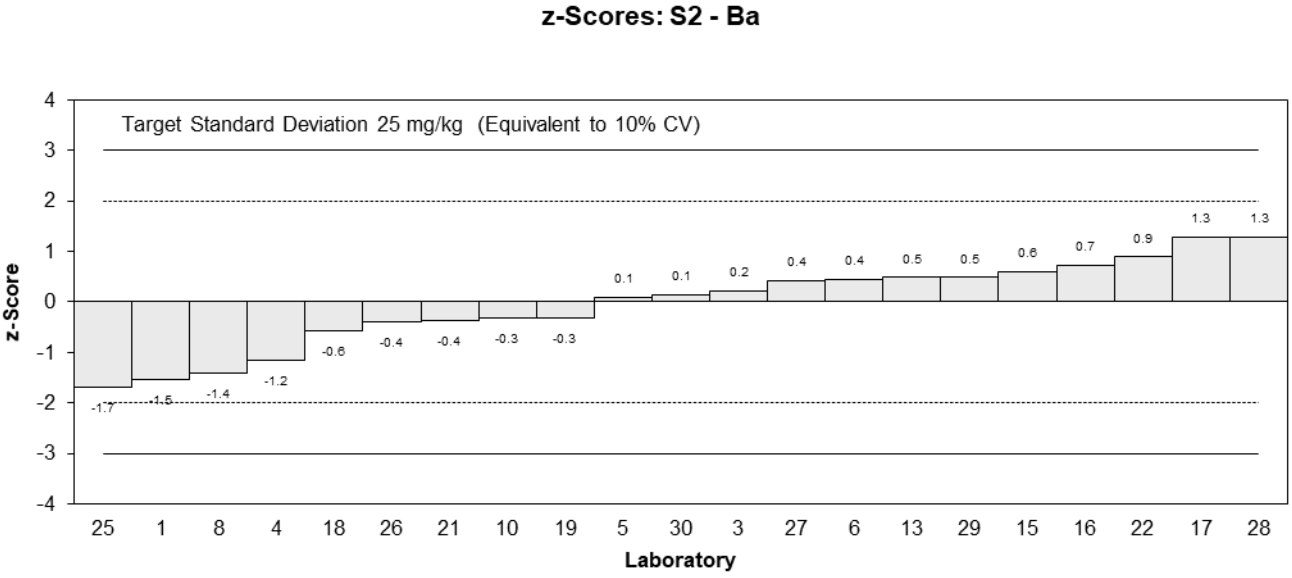
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	210	31.5	-1.53	-1.12
2	NT	NT		
3	253.1	25	0.21	0.18
4	219	24.3	-1.17	-1.05
5	250	50	0.08	0.04
6	259	26	0.44	0.38
7	NT	NT		
8	213	36	-1.41	-0.91
9	NT	NT		
10	240	57	-0.32	-0.14
11	NT	NT		
12	NT	NT		
13	260	20	0.48	0.50
14	NT	NT		
15	263	28	0.60	0.49
16	266	22.9	0.73	0.68
17	280	70	1.29	0.45
18	234	32	-0.56	-0.41
19	240	NR	-0.32	-0.62
20	NT	NT		
21	239	28	-0.36	-0.29
22	270	54	0.89	0.40
23	NT	NT		
24	NT	NT		
25	206	55.0	-1.69	-0.74
26	238	39	-0.40	-0.24
27	258.3	77.5	0.42	0.13
28	280	56	1.29	0.56
29	260	41	0.48	0.28
30	251.6	11	0.15	0.21

Statistics

Assigned Value	248	13
Spike	235	14
Homogeneity Value	222	27
Robust Average	248	13
Median	252	9
Mean	247	
N	21	
Max.	280	
Min.	206	
Robust SD	24	
Robust CV	9.6%	


Kernel Density
Density
Result
Results: S2 - Ba
Assigned Value = 248 ± 13 mg/kg
Results (mg/kg)
Laboratory
25 1 8 4 18 26 21 10 19 5 30 3 27 6 13 29 15 16 22 17 28 11 12 14 2 20 23 24 7 9 Md R.A. H.V. S.V.


z-Scores: S2 - Ba
Target Standard Deviation 25 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
25 1 8 4 18 26 21 10 19 5 30 3 27 6 13 29 15 16 22 17 28

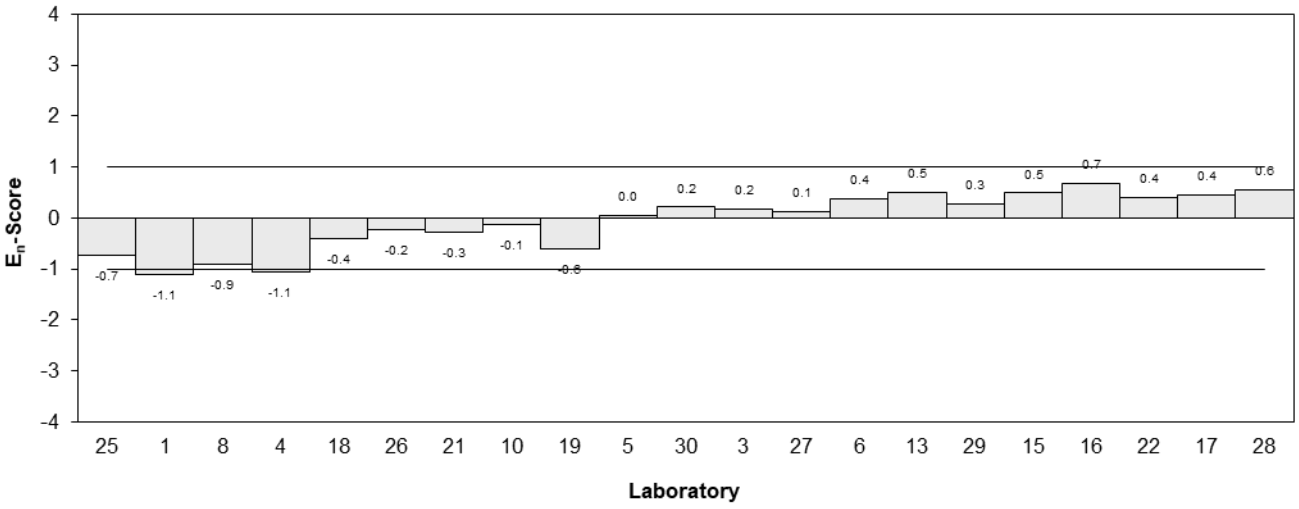

En-Scores: S2 - Ba
En-Score
Laboratory
25 1 8 4 18 26 21 10 19 5 30 3 27 6 13 29 15 16 22 17 28

Figure 21

Table 34

Sample Details

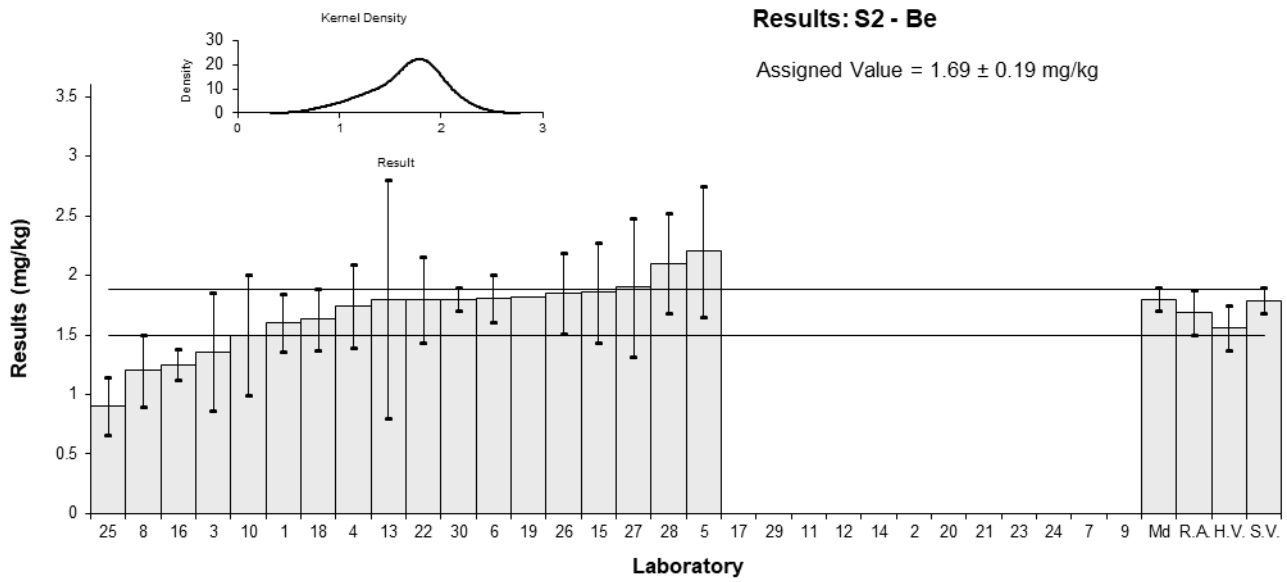
Sample No.	S2
Matrix.	Soil
Analyte.	Be
Units	mg/kg

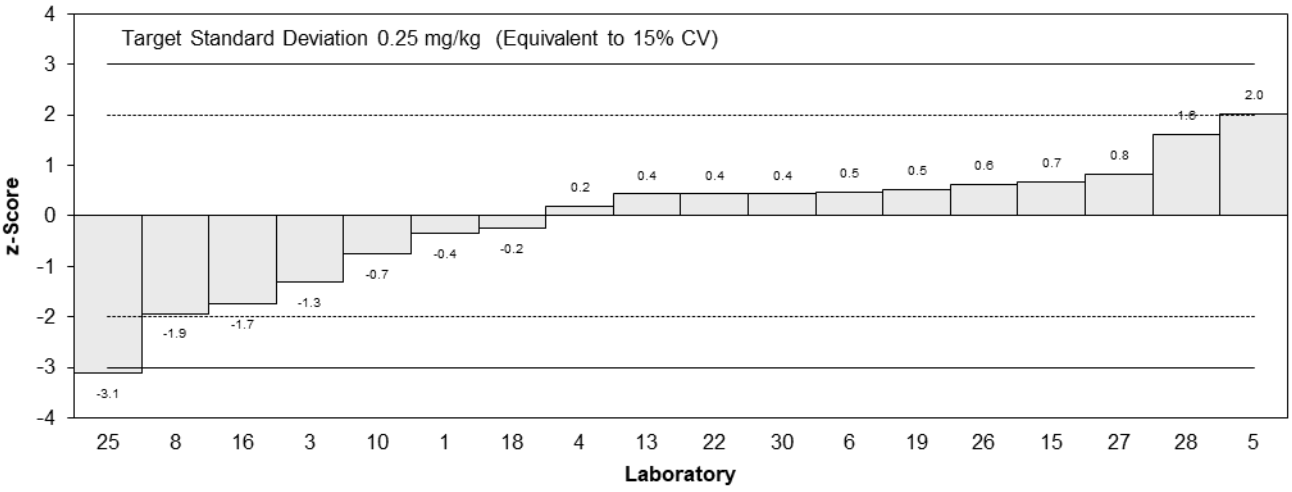
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	1.6	0.24	-0.36	-0.29
2	NT	NT		
3	1.36	0.5	-1.30	-0.62
4	1.74	0.35	0.20	0.13
5	2.2	0.55	2.01	0.88
6	1.81	0.2	0.47	0.43
7	NT	NT		
8	1.2	0.3	-1.93	-1.38
9	NT	NT		
10	1.5	0.51	-0.75	-0.35
11	NT	NT		
12	NT	NT		
13	1.80	1	0.43	0.11
14	NT	NT		
15	1.86	0.42	0.67	0.37
16	1.25	0.13	-1.74	-1.91
17	<1	NR		
18	1.63	0.26	-0.24	-0.19
19	1.82	NR	0.51	0.68
20	NT	NT		
21	NT	NT		
22	1.8	0.36	0.43	0.27
23	NT	NT		
24	NT	NT		
25	0.9	0.24	-3.12	-2.58
26	1.85	0.34	0.63	0.41
27	1.9	0.58	0.83	0.34
28	2.1	0.42	1.62	0.89
29	<2	NR		
30	1.80	0.1	0.43	0.51

Statistics

Assigned Value	1.69	0.19
Spike	1.79	0.11
Homogeneity Value	1.56	0.19
Robust Average	1.69	0.19
Median	1.80	0.10
Mean	1.67	
N	18	
Max.	2.2	
Min.	0.9	
Robust SD	0.33	
Robust CV	19%	


Kernel Density
Density
Result
Results: S2 - Be
Assigned Value = 1.69 ± 0.19 mg/kg
Results (mg/kg)
Laboratory
25 8 16 3 10 1 18 4 13 22 30 6 19 26 15 27 28 5 17 29 11 12 14 2 20 21 23 24 7 9 Md R.A. H.V. S.V.


z-Scores: S2 - Be
Target Standard Deviation 0.25 mg/kg (Equivalent to 15% CV)
z-Score
Laboratory
25 8 16 3 10 1 18 4 13 22 30 6 19 26 15 27 28 5
-3.1 -1.9 -1.7 -1.3 -0.7 -0.4 -0.2 0.2 0.4 0.4 0.4 0.5 0.5 0.6 0.7 0.8 1.6 2.0

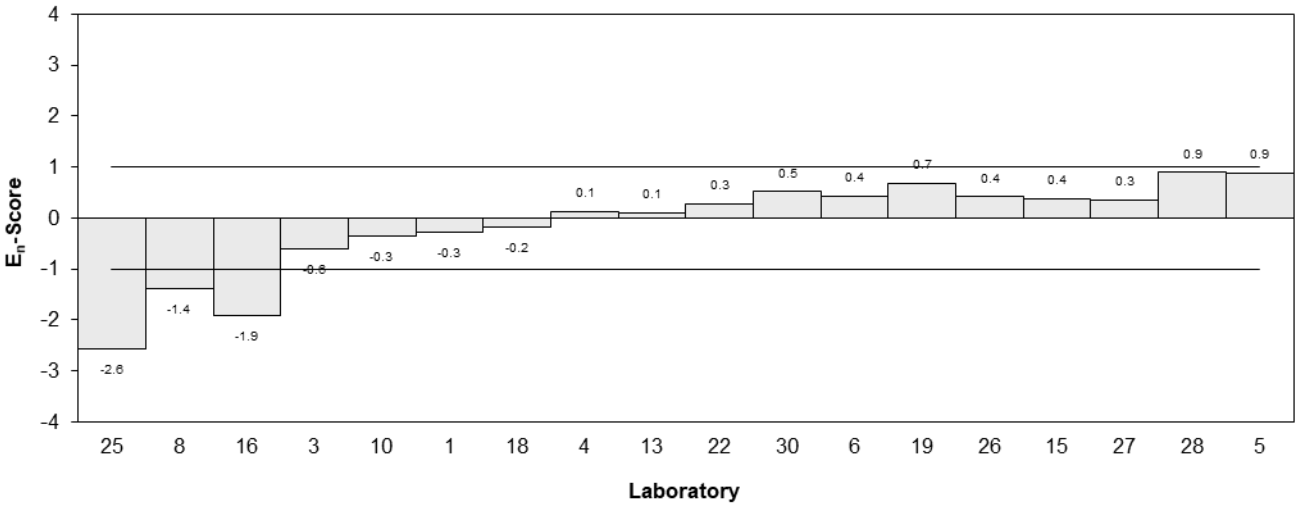

En-Scores: S2 - Be
En-Score
Laboratory
25 8 16 3 10 1 18 4 13 22 30 6 19 26 15 27 28 5
-2.6 -1.4 -1.9 -0.6 -0.3 -0.3 -0.2 0.1 0.1 0.3 0.5 0.4 0.7 0.4 0.4 0.3 0.9 0.9

Figure 22

Table 35

Sample Details

Sample No.	S2
Matrix.	Soil
Analyte.	Bi
Units	mg/kg

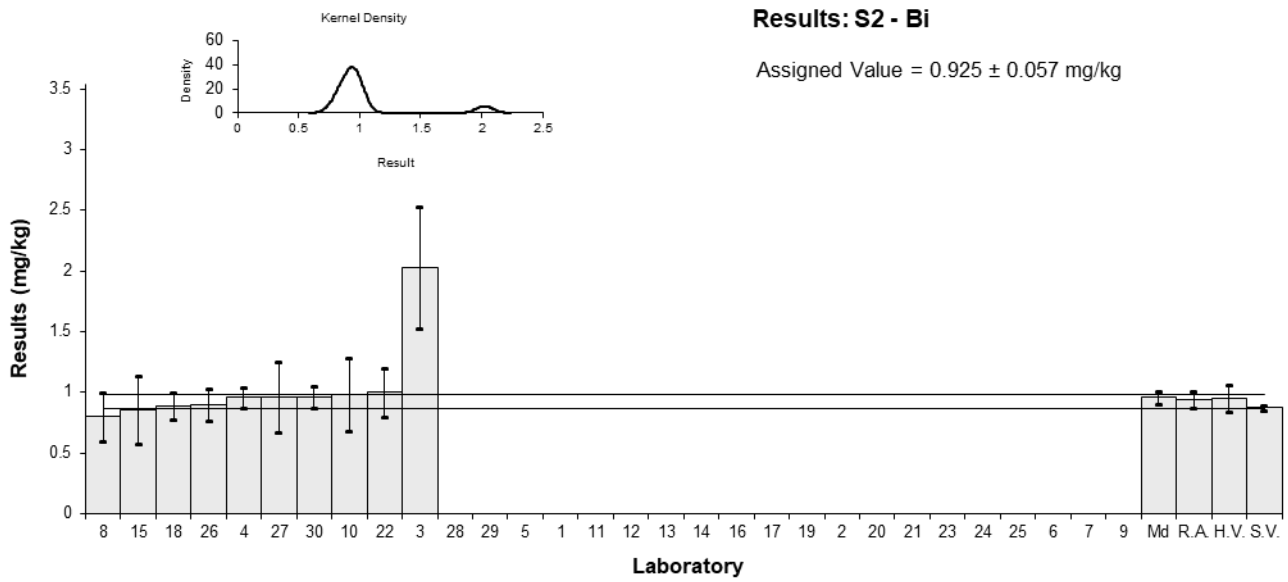
Participant Results

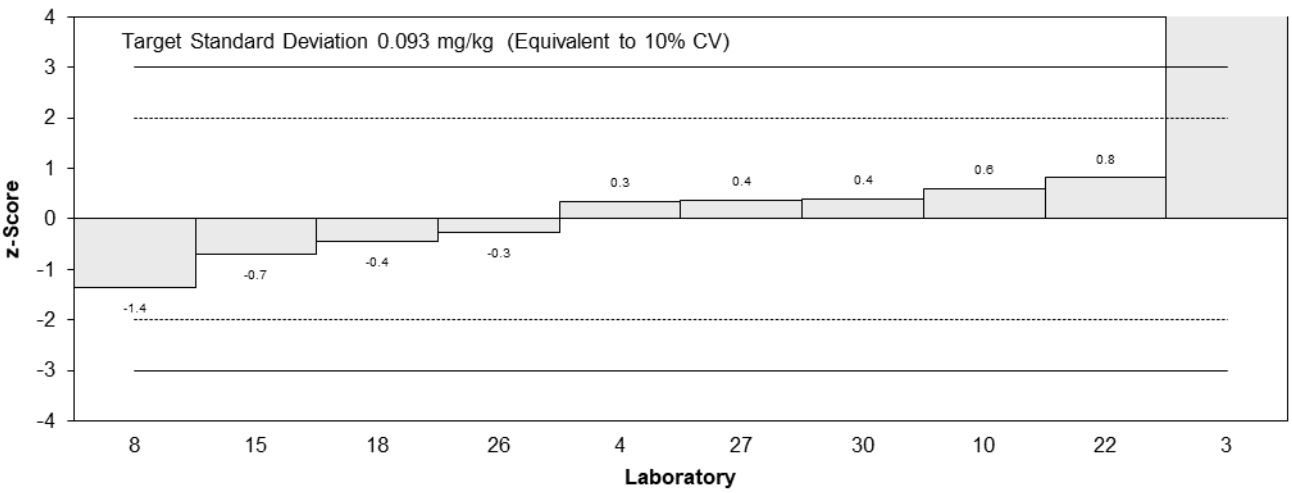
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	NT	NT		
3	2.025	0.5	11.89	2.19
4	0.956	0.085	0.34	0.30
5	<10	NR		
6	NT	NT		
7	NT	NT		
8	0.8	0.2	-1.35	-0.60
9	NT	NT		
10	0.98	0.30	0.59	0.18
11	NT	NT		
12	NT	NT		
13	NT	NT		
14	NT	NT		
15	0.86	0.28	-0.70	-0.23
16	NT	NT		
17	NT	NT		
18	0.884	0.11	-0.44	-0.33
19	NT	NT		
20	NT	NT		
21	NT	NT		
22	1.0	0.20	0.81	0.36
23	NT	NT		
24	NT	NT		
25	NT	NT		
26	0.90	0.13	-0.27	-0.18
27	0.96	0.29	0.38	0.12
28	<10	NR		
29	<10	NR		
30	0.962	0.09	0.40	0.35

Statistics

Assigned Value*	0.925	0.057
Spike	0.872	0.022
Homogeneity Value	0.95	0.11
Robust Average	0.938	0.066
Median	0.958	0.053
Mean	1.03	
N	10	
Max.	2.025	
Min.	0.8	
Robust SD	0.083	
Robust CV	8.9%	

*Robust Average excluding laboratory 3.


Kernel Density
Density
Result
Results: S2 - Bi
Assigned Value = 0.925 ± 0.057 mg/kg
Results (mg/kg)
Laboratory
8 15 18 26 4 27 30 10 22 3 28 29 5 1 11 12 13 14 16 17 19 2 20 21 23 24 25 6 7 9 Md R.A. H.V. S.V.


z-Scores: S2 - Bi
Target Standard Deviation 0.093 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
8 15 18 26 4 27 30 10 22 3
-1.4 -0.7 -0.4 -0.3 0.3 0.4 0.4 0.6 0.8

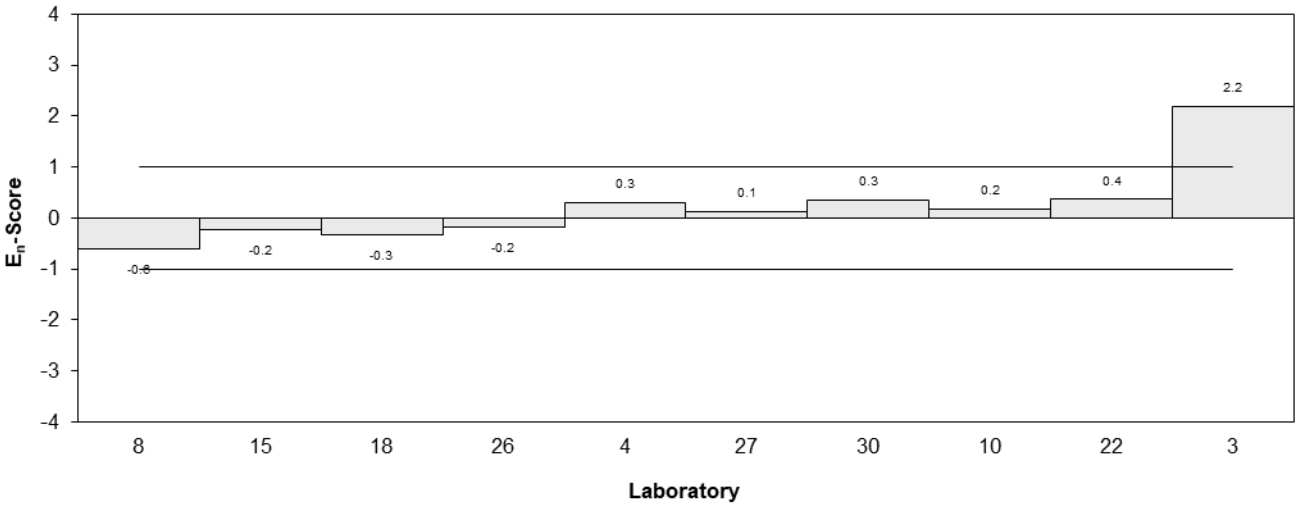

En-Scores: S2 - Bi
En-Score
Laboratory
8 15 18 26 4 27 30 10 22 3
-0.6 -0.2 -0.3 -0.2 0.3 0.1 0.3 0.2 0.4 2.2

Figure 23

Table 36

Sample Details

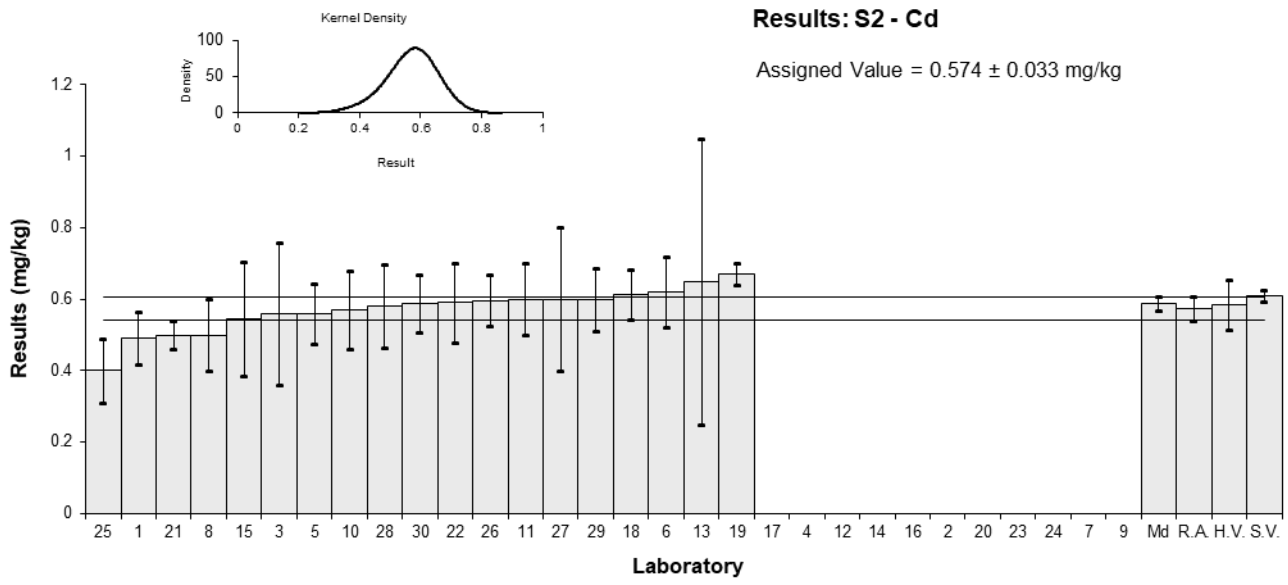
Sample No.	S2
Matrix.	Soil
Analyte.	Cd
Units	mg/kg

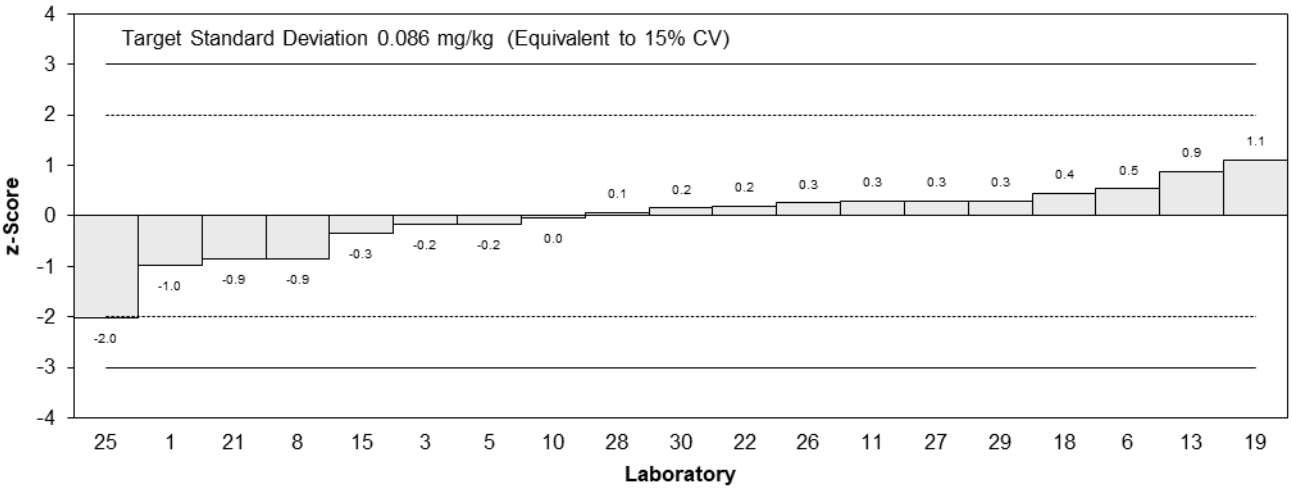
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	0.49	0.074	-0.98	-1.04
2	NT	NT		
3	0.56	0.2	-0.16	-0.07
4	<1.0	NR		
5	0.56	0.084	-0.16	-0.16
6	0.62	0.1	0.53	0.44
7	NT	NT		
8	0.5	0.1	-0.86	-0.70
9	NT	NT		
10	0.57	0.11	-0.05	-0.03
11	0.6	0.1	0.30	0.25
12	NT	NT		
13	0.65	0.4	0.88	0.19
14	NT	NT		
15	0.544	0.16	-0.35	-0.18
16	NT	NT		
17	<1	NR		
18	0.612	0.07	0.44	0.49
19	0.67	0.03	1.11	2.15
20	NT	NT		
21	0.50	0.04	-0.86	-1.43
22	0.59	0.11	0.19	0.14
23	NT	NT		
24	NT	NT		
25	0.4	0.09	-2.02	-1.82
26	0.596	0.072	0.26	0.28
27	0.6	0.2	0.30	0.13
28	0.58	0.116	0.07	0.05
29	0.60	0.088	0.30	0.28
30	0.587	0.08	0.15	0.15

Statistics

Assigned Value	0.574	0.033
Spike	0.608	0.016
Homogeneity Value	0.583	0.070
Robust Average	0.574	0.033
Median	0.587	0.019
Mean	0.570	
N	19	
Max.	0.67	
Min.	0.4	
Robust SD	0.058	
Robust CV	10%	


Kernel Density
Density
Result
Results: S2 - Cd
Assigned Value = 0.574 ± 0.033 mg/kg
Results (mg/kg)
Laboratory
25 1 21 8 15 3 5 10 28 30 22 26 11 27 29 18 6 13 19 17 4 12 14 16 2 20 23 24 7 9 Md R.A. H.V. S.V.


z-Scores: S2 - Cd
Target Standard Deviation 0.086 mg/kg (Equivalent to 15% CV)
z-Score
Laboratory
25 1 21 8 15 3 5 10 28 30 22 26 11 27 29 18 6 13 19
-2.0 -1.0 -0.9 -0.9 -0.3 -0.2 -0.2 0.0 0.1 0.2 0.2 0.3 0.3 0.3 0.3 0.4 0.5 0.9 1.1

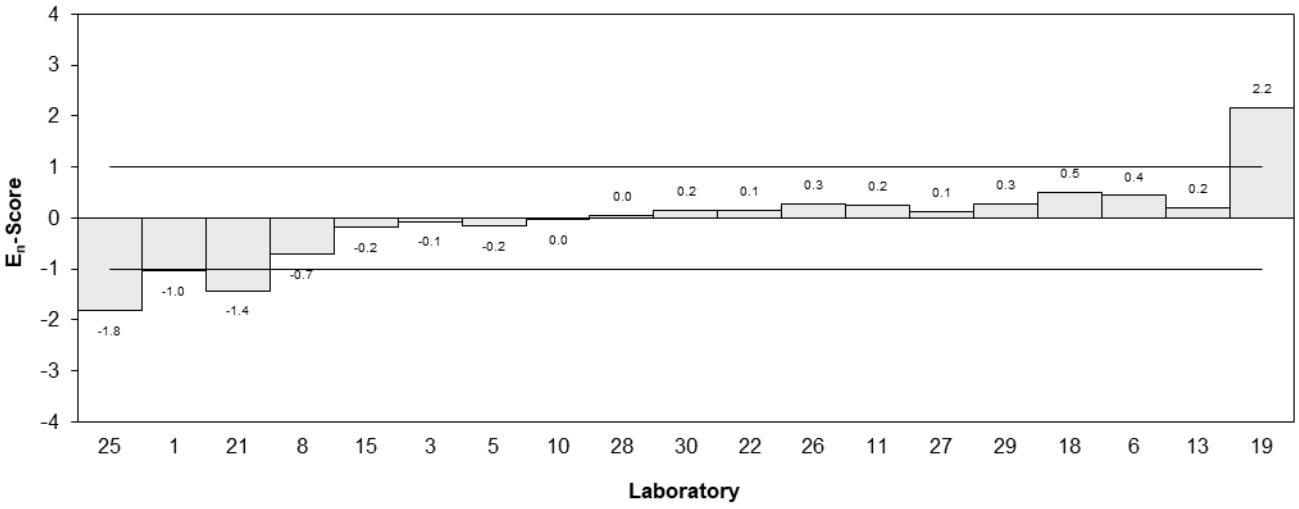

En-Scores: S2 - Cd
En-Score
Laboratory
25 1 21 8 15 3 5 10 28 30 22 26 11 27 29 18 6 13 19
-1.8 -1.0 -1.4 -0.7 -0.2 -0.1 -0.2 0.0 0.0 0.2 0.1 0.3 0.2 0.1 0.3 0.5 0.4 0.2 2.2

Figure 24

Table 37

Sample Details

Sample No.	S2
Matrix.	Soil
Analyte.	Cs
Units	mg/kg

Participant Results

Lab Code	Result	Uncertainty
1	NT	NT
2	NT	NT
3	NT	NT
4	2.5	0.23
5	NT	NT
6	NT	NT
7	NT	NT
8	1.3	0.3
9	NT	NT
10	1.6	0.25
11	NT	NT
12	NT	NT
13	NT	NT
14	NT	NT
15	NR	NR
16	NT	NT
17	NT	NT
18	NT	NT
19	NT	NT
20	NT	NT
21	NT	NT
22	3.6	0.72
23	NT	NT
24	NT	NT
25	NT	NT
26	2.42	0.30
27	3.1	0.9
28	NT	NT
29	NT	NT
30	NT	NT

Statistics

Assigned Value	Not Set	
Spike	3.58	0.16
Homogeneity Value	2.88	0.35
Robust Average	2.4	1.0
Median	2.5	1.2
Mean	2.4	
N	6	
Max.	3.6	
Min.	1.3	
Robust SD	0.99	
Robust CV	41%	

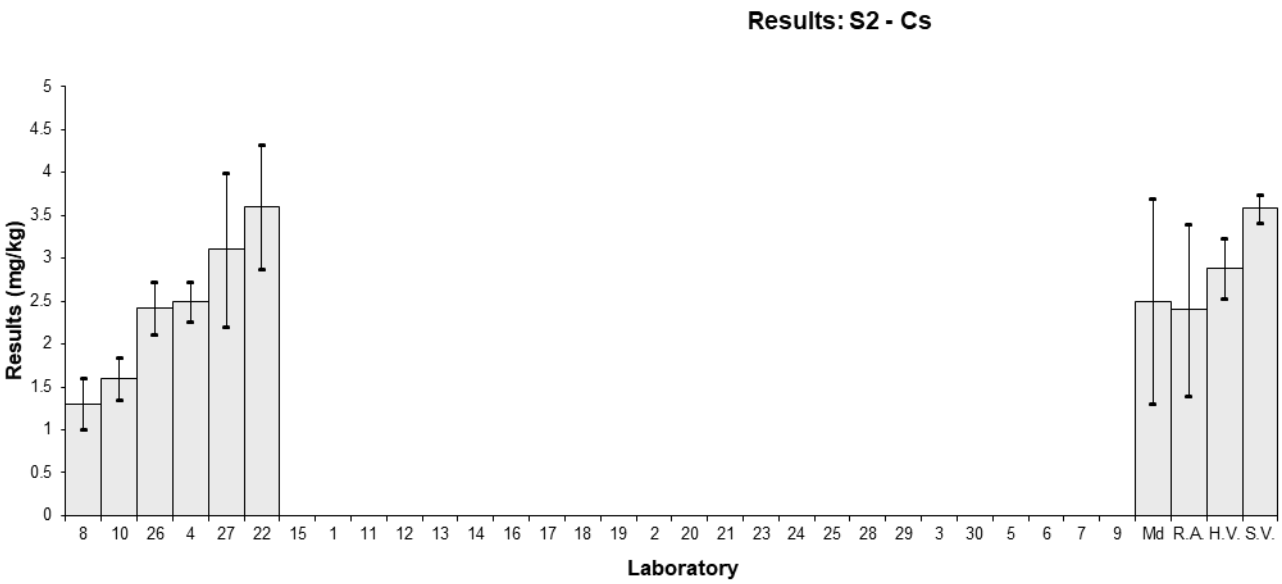

Results: S2 - Cs
Results (mg/kg)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
8 10 26 4 27 22 15 1 11 12 13 14 16 17 18 19 2 20 21 23 24 25 28 29 3 30 5 6 7 9 Md R.A. H.V. S.V.
Laboratory

Figure 25

Table 38

Sample Details

Sample No.	S2
Matrix.	Soil
Analyte.	Ga
Units	mg/kg

Participant Results

Lab Code	Result	Uncertainty
1	NT	NT
2	NT	NT
3	NT	NT
4	10.8	1.12
5	NT	NT
6	NT	NT
7	NT	NT
8	6.7	1.1
9	NT	NT
10	NT	NT
11	NT	NT
12	NT	NT
13	NT	NT
14	NT	NT
15	NR	NR
16	NT	NT
17	NT	NT
18	NT	NT
19	NT	NT
20	NT	NT
21	NT	NT
22	13	2.6
23	NT	NT
24	NT	NT
25	NT	NT
26	NT	NT
27	NT	NT
28	NT	NT
29	NT	NT
30	NT	NT

Statistics*

Assigned Value	Not Set	
Spike	13.1	1.0
Homogeneity Value	11.2	1.3
Mean	10.2	
N	3	
Max.	13	
Min.	6.7	

*Insufficienct data to calculate statistics.

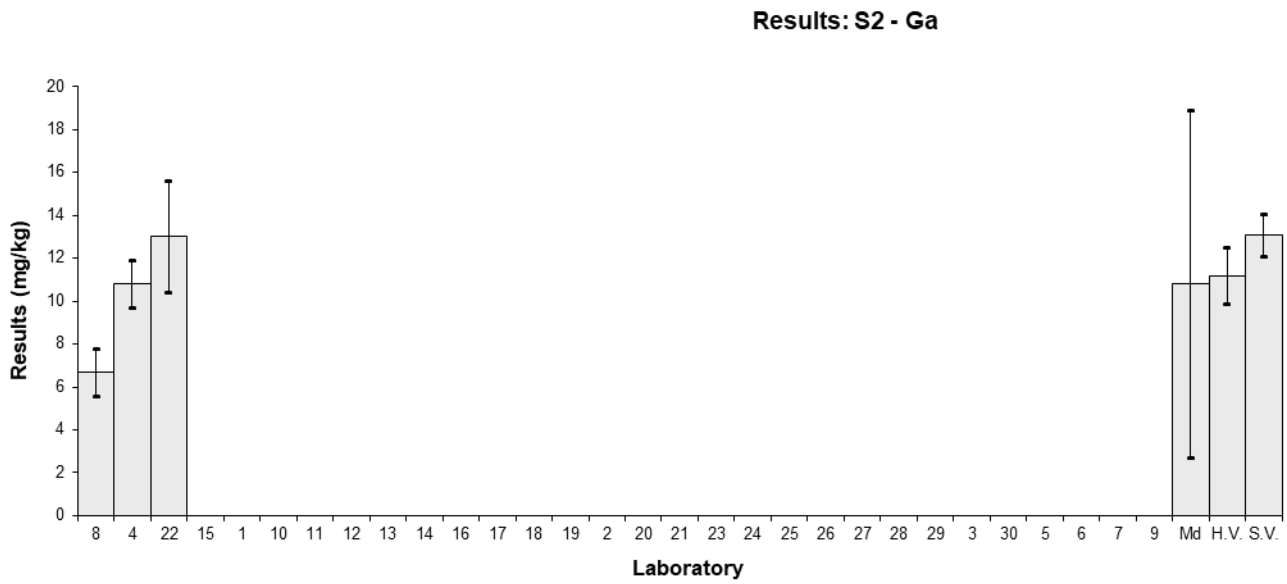

Results: S2 - Ga
Results (mg/kg)
20
18
16
14
12
10
8
6
4
2
0
8 4 22 15 1 10 11 12 13 14 16 17 18 19 2 20 21 23 24 25 26 27 28 29 3 30 5 6 7 9 Md H.V. S.V.
Laboratory

Figure 26

Table 39

Sample Details

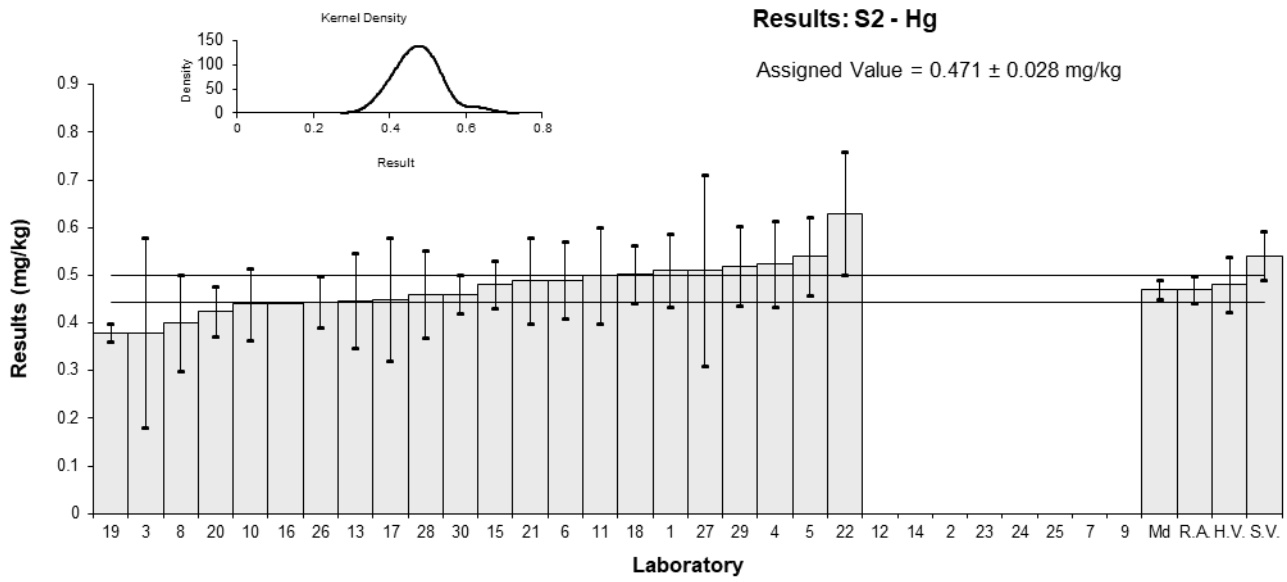
Sample No.	S2
Matrix.	Soil
Analyte.	Hg
Units	mg/kg

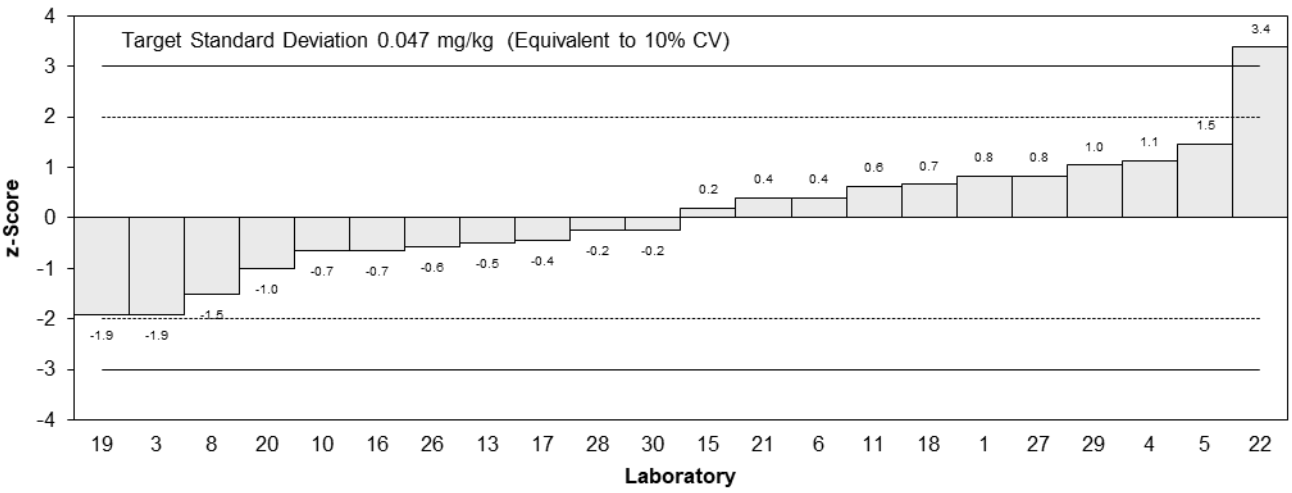
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	0.51	0.077	0.83	0.48
2	NT	NT		
3	0.38	0.2	-1.93	-0.45
4	0.524	0.09	1.13	0.56
5	0.54	0.081	1.46	0.81
6	0.49	0.08	0.40	0.22
7	NT	NT		
8	0.4	0.1	-1.51	-0.68
9	NT	NT		
10	0.44	0.075	-0.66	-0.39
11	0.5	0.1	0.62	0.28
12	NT	NT		
13	0.447	0.1	-0.51	-0.23
14	NT	NT		
15	0.48	0.05	0.19	0.16
16	0.44	NR	-0.66	-1.11
17	0.45	0.13	-0.45	-0.16
18	0.502	0.06	0.66	0.47
19	0.38	0.02	-1.93	-2.64
20	0.424	0.053	-1.00	-0.78
21	0.49	0.09	0.40	0.20
22	0.63	0.13	3.38	1.20
23	NT	NT		
24	NT	NT		
25	NT	NT		
26	0.444	0.054	-0.57	-0.44
27	0.51	0.2	0.83	0.19
28	0.46	0.092	-0.23	-0.11
29	0.52	0.084	1.04	0.55
30	0.460	0.04	-0.23	-0.23

Statistics

Assigned Value	0.471	0.028
Spike	0.541	0.051
Homogeneity Value	0.482	0.058
Robust Average	0.471	0.028
Median	0.470	0.020
Mean	0.474	
N	22	
Max.	0.63	
Min.	0.38	
Robust SD	0.053	
Robust CV	11%	


Results: S2 - Hg
Assigned Value = 0.471 ± 0.028 mg/kg
Kernel Density
Density
Result
Results (mg/kg)
Laboratory
19 3 8 20 10 16 26 13 17 28 30 15 21 6 11 18 1 27 29 4 5 22 12 14 2 23 24 25 7 9 Md R.A. H.V. S.V.


z-Scores: S2 - Hg
Target Standard Deviation 0.047 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
19 3 8 20 10 16 26 13 17 28 30 15 21 6 11 18 1 27 29 4 5 22

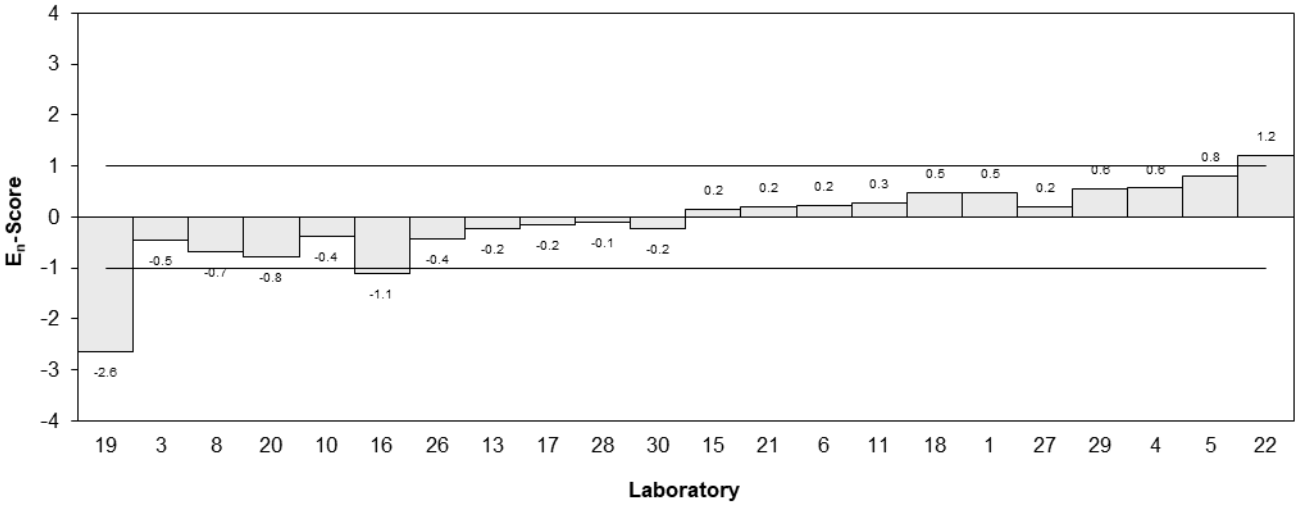

En-Scores: S2 - Hg
En-Score
Laboratory
19 3 8 20 10 16 26 13 17 28 30 15 21 6 11 18 1 27 29 4 5 22

Figure 27

Table 40

Sample Details

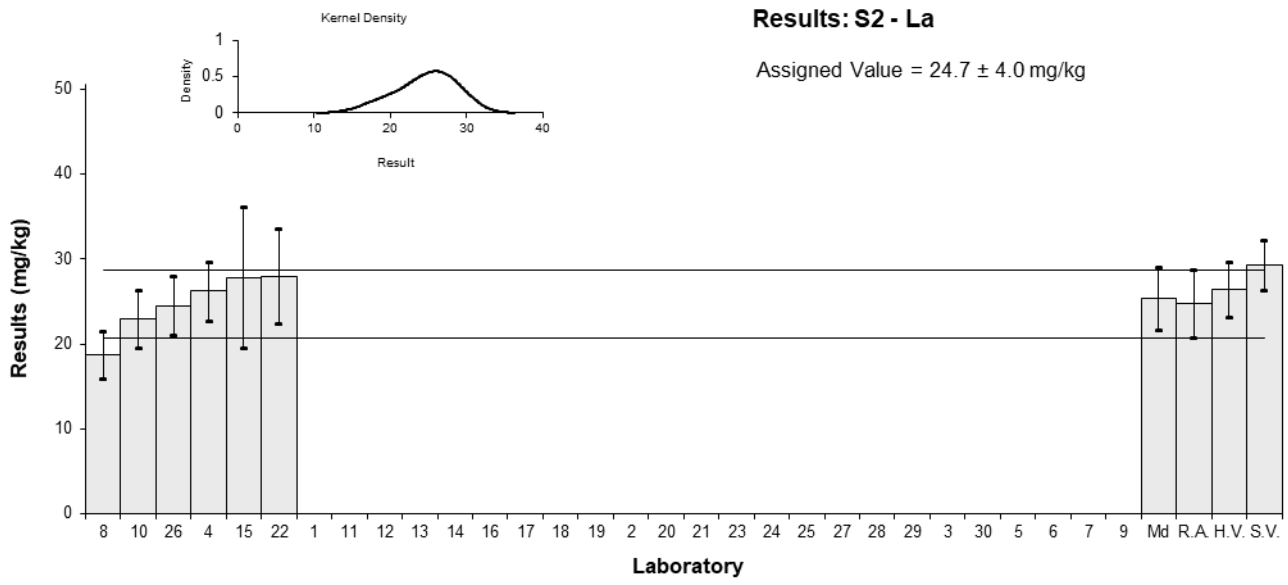
Sample No.	S2
Matrix.	Soil
Analyte.	La
Units	mg/kg

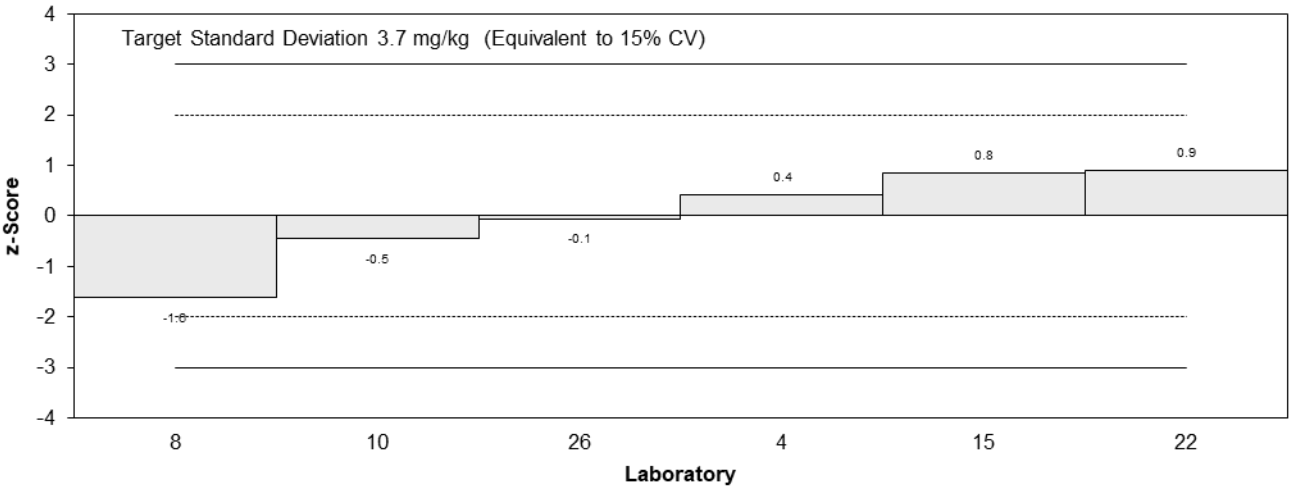
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	NT	NT		
3	NT	NT		
4	26.2	3.42	0.40	0.29
5	NT	NT		
6	NT	NT		
7	NT	NT		
8	18.7	2.8	-1.62	-1.23
9	NT	NT		
10	23	3.4	-0.46	-0.32
11	NT	NT		
12	NT	NT		
13	NT	NT		
14	NT	NT		
15	27.8	8.3	0.84	0.34
16	NT	NT		
17	NT	NT		
18	NT	NT		
19	NT	NT		
20	NT	NT		
21	NT	NT		
22	28	5.6	0.89	0.48
23	NT	NT		
24	NT	NT		
25	NT	NT		
26	24.5	3.5	-0.05	-0.04
27	NT	NT		
28	NT	NT		
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value	24.7	4.0
Spike	29.3	2.9
Homogeneity Value	26.4	3.2
Robust Average	24.7	4.0
Median	25.4	3.7
Mean	24.7	
N	6	
Max.	28	
Min.	18.7	
Robust SD	3.9	
Robust CV	16%	


Kernel Density
Density
Result
Results: S2 - La
Assigned Value = 24.7 ± 4.0 mg/kg
Results (mg/kg)
Laboratory
8 10 26 4 15 22 1 11 12 13 14 16 17 18 19 2 20 21 23 24 25 27 28 29 3 30 5 6 7 9 Md R.A. H.V. S.V.


z-Scores: S2 - La
Target Standard Deviation 3.7 mg/kg (Equivalent to 15% CV)
z-Score
Laboratory
-1.6
-0.5
-0.1
0.4
0.8
0.9
8 10 26 4 15 22

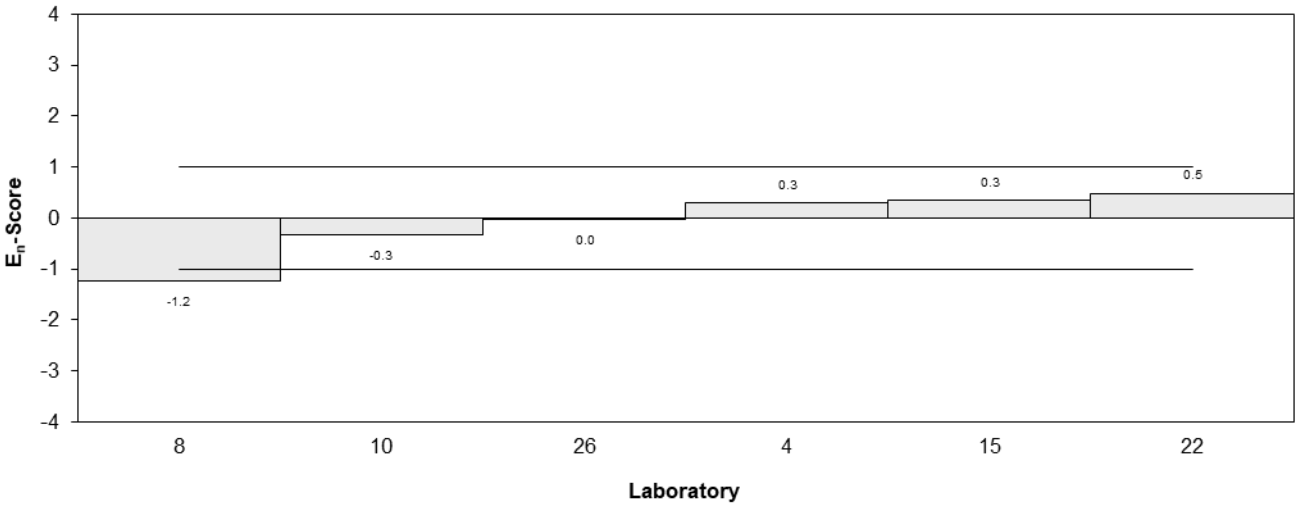

En-Scores: S2 - La
En-Score
Laboratory
-1.2
-0.3
0.0
0.3
0.3
0.5
8 10 26 4 15 22

Figure 28

Table 41

Sample Details

Sample No.	S2
Matrix.	Soil
Analyte.	Li
Units	mg/kg

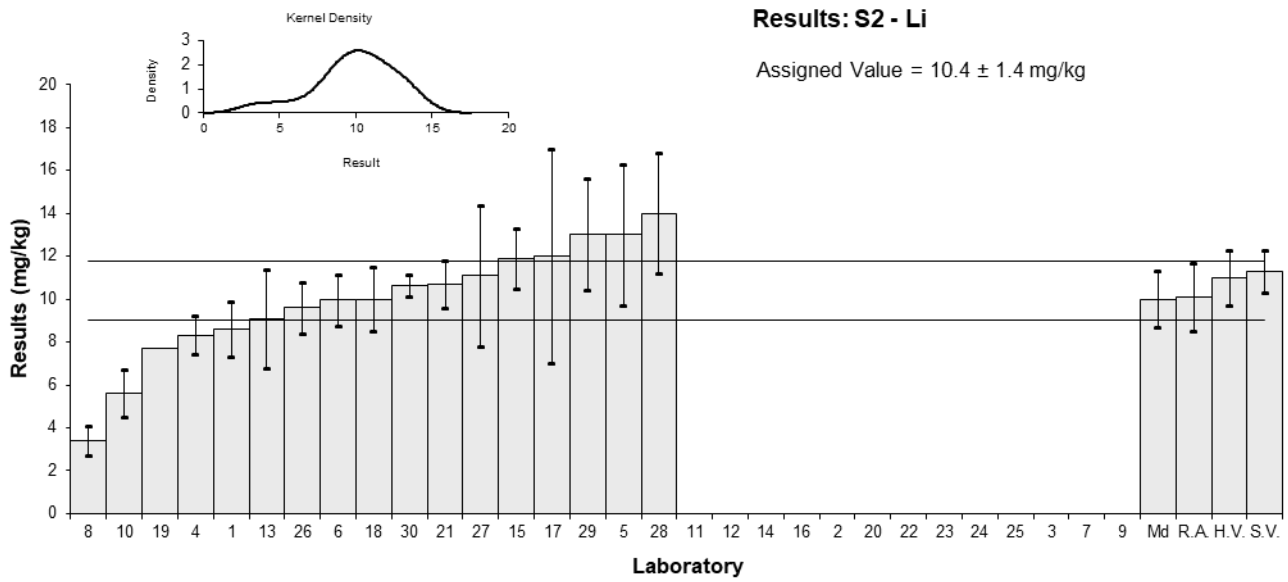
Participant Results

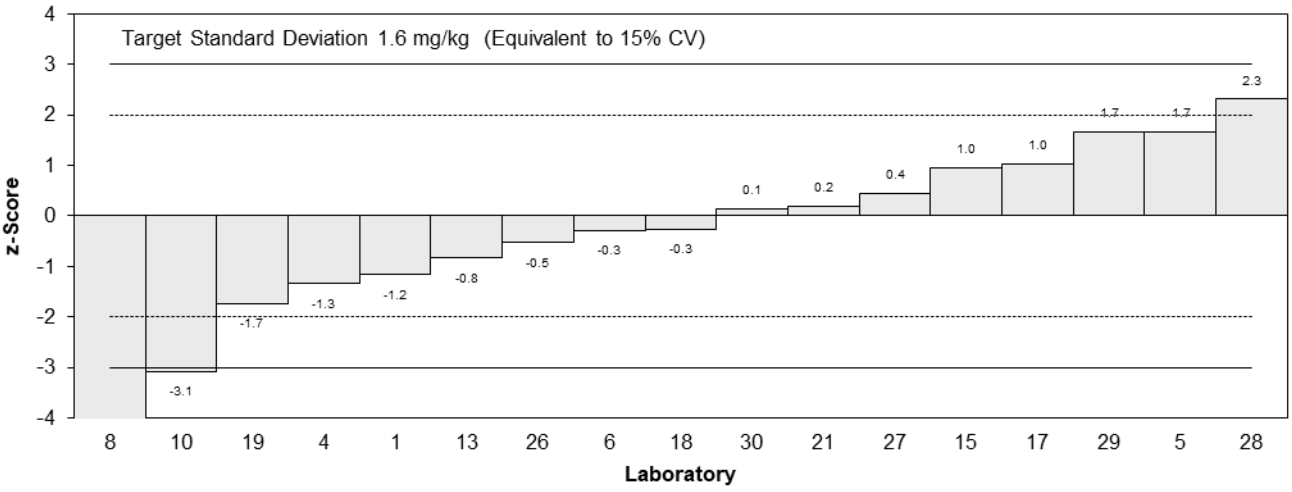
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	8.6	1.29	-1.15	-0.95
2	NT	NT		
3	NT	NT		
4	8.33	0.89	-1.33	-1.25
5	13	3.3	1.67	0.73
6	9.96	1.2	-0.28	-0.24
7	NT	NT		
8	3.4	0.7	-4.49	-4.47
9	NT	NT		
10	5.6	1.1	-3.08	-2.70
11	NT	NT		
12	NT	NT		
13	9.1	2.3	-0.83	-0.48
14	NT	NT		
15	11.9	1.4	0.96	0.76
16	NT	NT		
17	12.0	5	1.03	0.31
18	10.0	1.5	-0.26	-0.19
19	7.7	NR	-1.73	-1.93
20	NT	NT		
21	10.7	1.1	0.19	0.17
22	NT	NT		
23	NT	NT		
24	NT	NT		
25	NT	NT		
26	9.6	1.2	-0.51	-0.43
27	11.1	3.3	0.45	0.20
28	14	2.8	2.31	1.15
29	13	2.6	1.67	0.88
30	10.63	0.5	0.15	0.15

Statistics

Assigned Value*	10.4	1.4
Spike	11.3	1.0
Homogeneity Value	11.0	1.3
Robust Average	10.1	1.6
Median	10.0	1.3
Mean	9.92	
N	17	
Max.	14	
Min.	3.4	
Robust SD	2.6	
Robust CV	25%	

*Robust Average excluding laboratory 8.


Kernel Density
Density
Result
Results: S2 - Li
Assigned Value = 10.4 ± 1.4 mg/kg
Results (mg/kg)
Laboratory
8 10 19 4 1 13 26 6 18 30 21 27 15 17 29 5 28 11 12 14 16 2 20 22 23 24 25 3 7 9 Md R.A. H.V. S.V.


z-Scores: S2 - Li
Target Standard Deviation 1.6 mg/kg (Equivalent to 15% CV)
z-Score
Laboratory
8 10 19 4 1 13 26 6 18 30 21 27 15 17 29 5 28
-3.1 -1.7 -1.3 -1.2 -0.8 -0.5 -0.3 -0.3 0.1 0.2 0.4 1.0 1.0 1.7 1.7 2.3

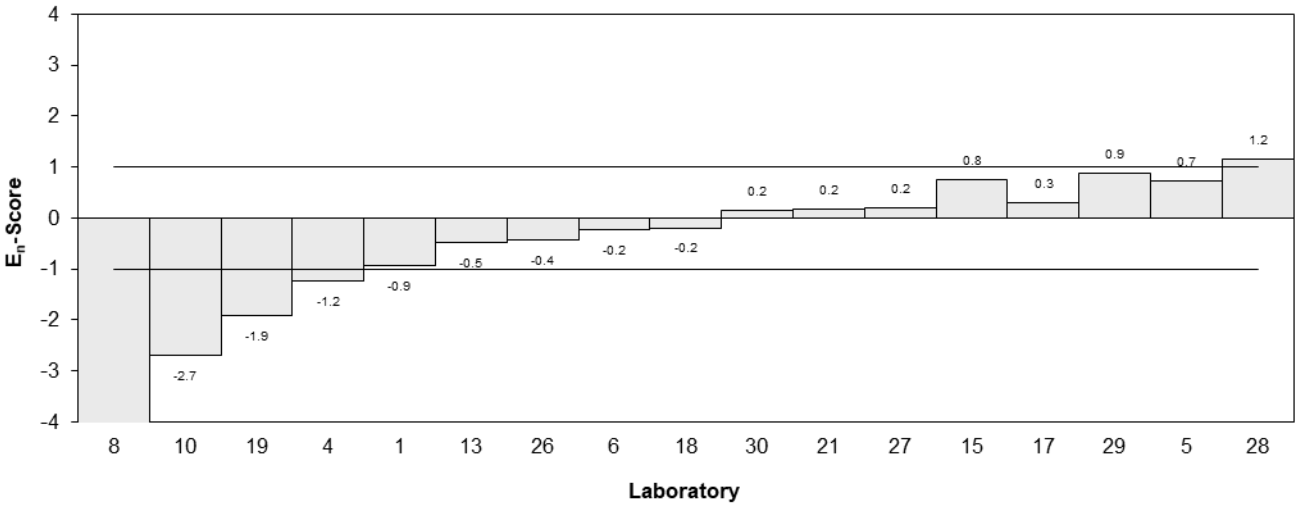

En-Scores: S2 - Li
En-Score
Laboratory
8 10 19 4 1 13 26 6 18 30 21 27 15 17 29 5 28
-2.7 -1.9 -1.2 -0.9 -0.5 -0.4 -0.2 -0.2 0.2 0.2 0.2 0.8 0.3 0.9 0.7 1.2

Figure 29

Table 42

Sample Details

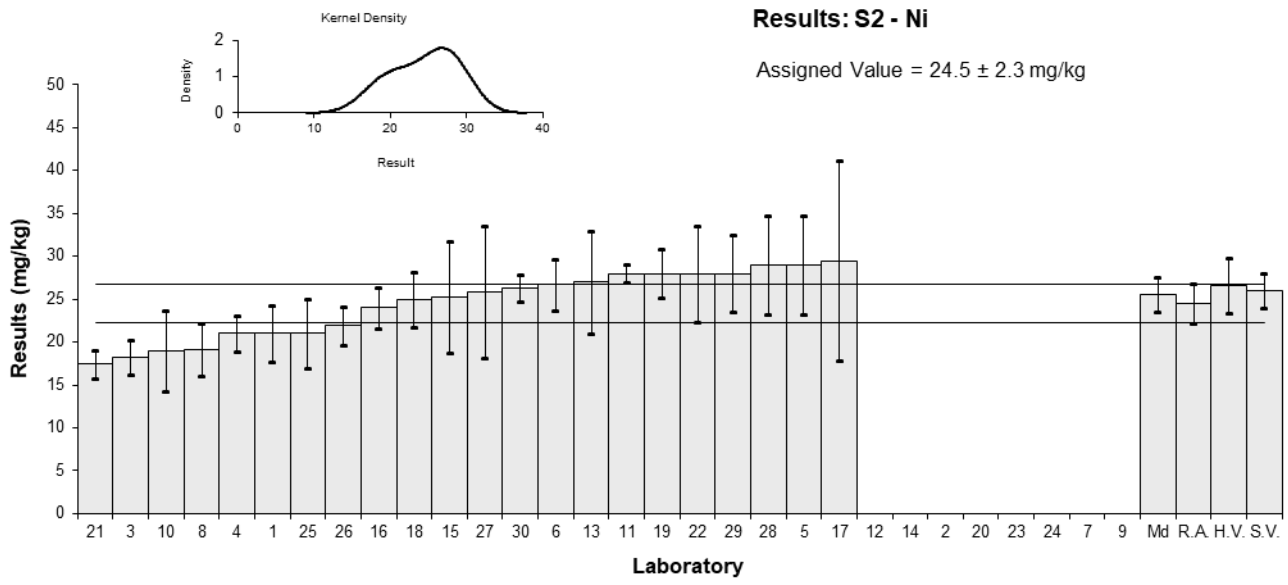
Sample No.	S2
Matrix.	Soil
Analyte.	Ni
Units	mg/kg

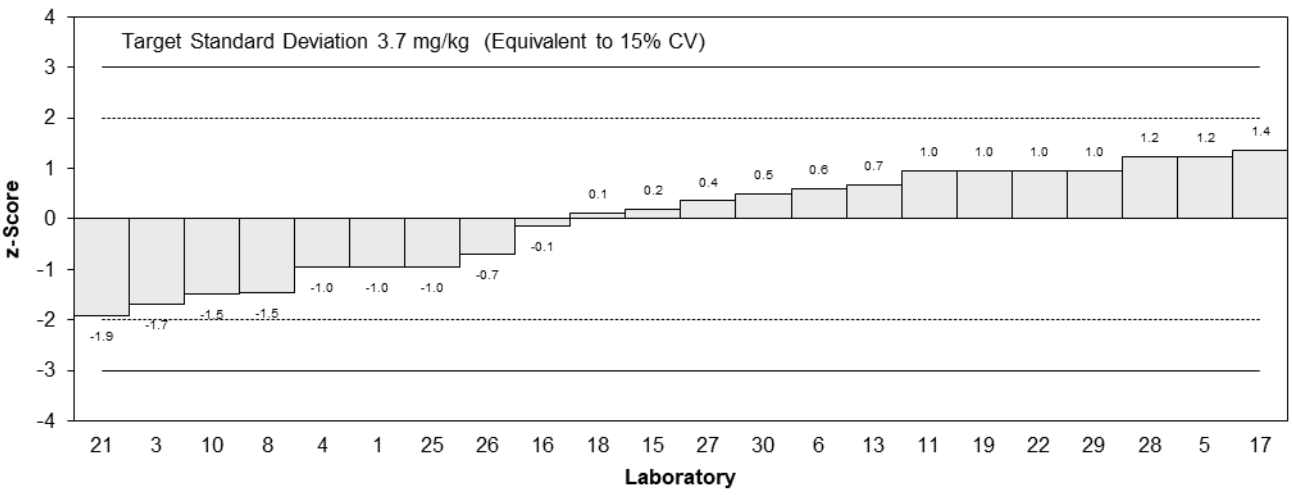
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	21	3.3	-0.95	-0.87
2	NT	NT		
3	18.25	2	-1.70	-2.05
4	20.99	2.16	-0.96	-1.11
5	29	5.8	1.22	0.72
6	26.7	3.0	0.60	0.58
7	NT	NT		
8	19.1	3.1	-1.47	-1.40
9	NT	NT		
10	19	4.7	-1.50	-1.05
11	28	1	0.95	1.40
12	NT	NT		
13	27	6	0.68	0.39
14	NT	NT		
15	25.2	6.5	0.19	0.10
16	24	2.4	-0.14	-0.15
17	29.5	11.6	1.36	0.42
18	24.9	3.2	0.11	0.10
19	28	2.8	0.95	0.97
20	NT	NT		
21	17.4	1.6	-1.93	-2.53
22	28	5.6	0.95	0.58
23	NT	NT		
24	NT	NT		
25	21	4.0	-0.95	-0.76
26	21.9	2.2	-0.71	-0.82
27	25.8	7.7	0.35	0.16
28	29	5.8	1.22	0.72
29	28	4.5	0.95	0.69
30	26.3	1.6	0.49	0.64

Statistics

Assigned Value	24.5	2.3
Spike	26.0	2.0
Homogeneity Value	26.6	3.2
Robust Average	24.5	2.3
Median	25.5	2.0
Mean	24.5	
N	22	
Max.	29.5	
Min.	17.4	
Robust SD	4.4	
Robust CV	18%	


Kernel Density
Density
Result
Results: S2 - Ni
Assigned Value = 24.5 ± 2.3 mg/kg
Results (mg/kg)
Laboratory
21 3 10 8 4 1 25 26 16 18 15 27 30 6 13 11 19 22 29 28 5 17 12 14 2 20 23 24 7 9 Md R.A. H.V. S.V.


z-Scores: S2 - Ni
Target Standard Deviation 3.7 mg/kg (Equivalent to 15% CV)
z-Score
Laboratory
21 3 10 8 4 1 25 26 16 18 15 27 30 6 13 11 19 22 29 28 5 17

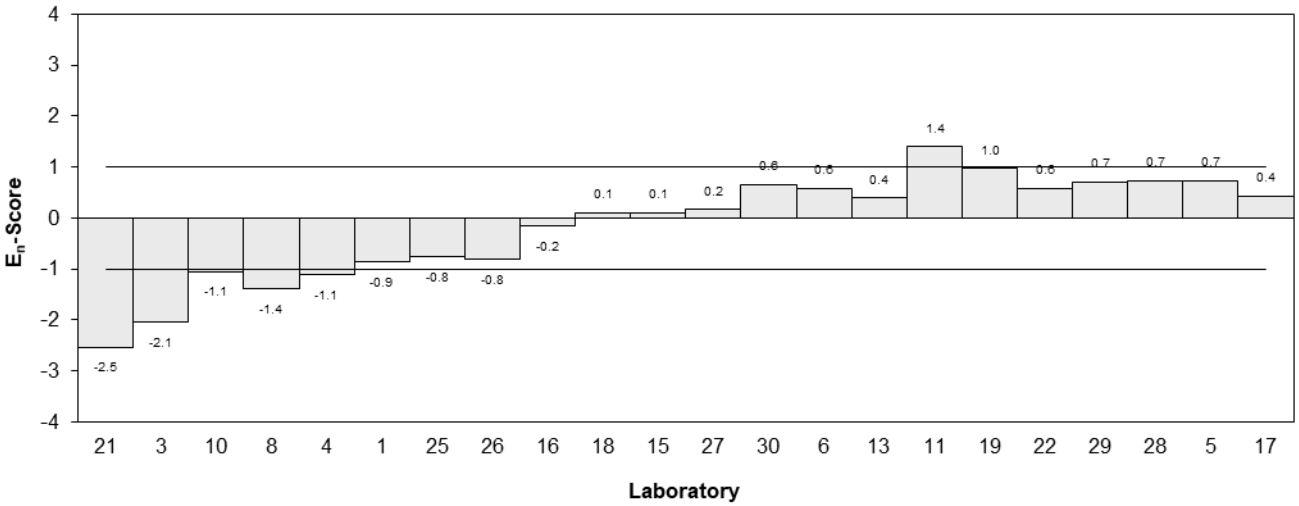

En-Scores: S2 - Ni
En-Score
Laboratory
21 3 10 8 4 1 25 26 16 18 15 27 30 6 13 11 19 22 29 28 5 17

Figure 30

Table 43

Sample Details

Sample No.	S2
Matrix.	Soil
Analyte.	Rb
Units	mg/kg

Participant Results

Lab Code	Result	Uncertainty
1	NT	NT
2	NT	NT
3	NT	NT
4	24	2.05
5	NT	NT
6	NT	NT
7	NT	NT
8	13.4	1.5
9	NT	NT
10	16	5.1
11	NT	NT
12	NT	NT
13	NT	NT
14	NT	NT
15	NR	NR
16	NT	NT
17	NT	NT
18	NT	NT
19	NT	NT
20	NT	NT
21	NT	NT
22	NT	NT
23	NT	NT
24	NT	NT
25	NT	NT
26	21.7	4.4
27	25.7	7.7
28	NT	NT
29	NT	NT
30	NT	NT

Statistics*

Assigned Value	Not Set	
Spike	7.01	0.14
Median	21.7	7.4
Mean	20.2	
N	5	
Max.	25.7	
Min.	13.4	

*Insufficient data to calculate statistics.

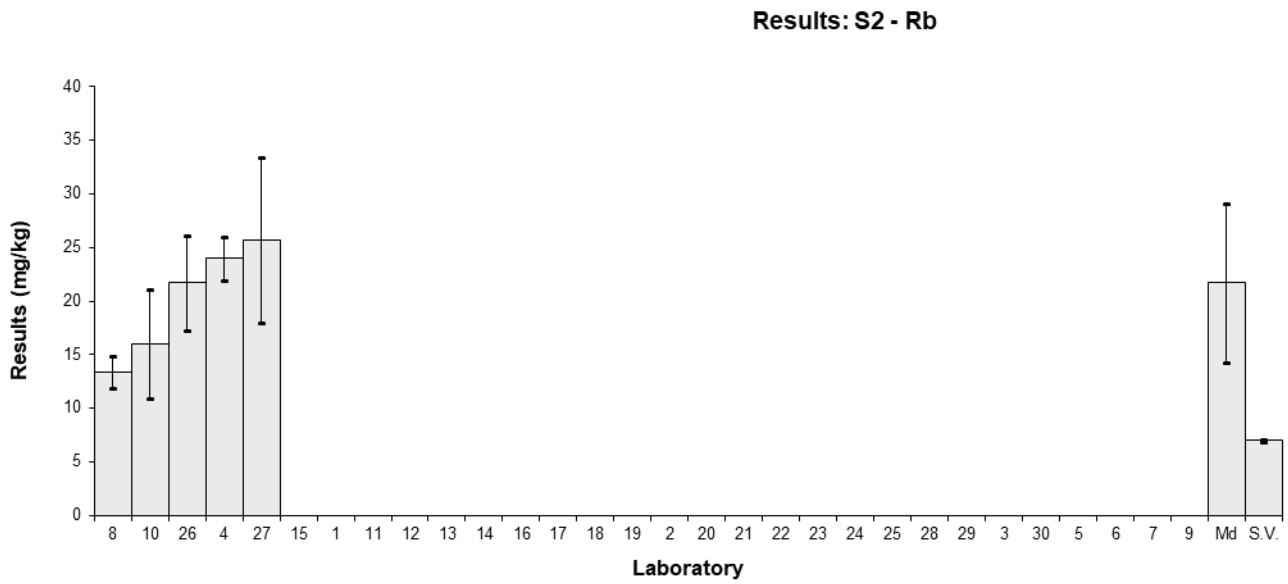

Results: S2 - Rb
Results (mg/kg)
40
35
30
25
20
15
10
5
0
8 10 26 4 27 15 1 11 12 13 14 16 17 18 19 2 20 21 22 23 24 25 28 29 3 30 5 6 7 9 Md S.V.
Laboratory

Figure 31

Table 44

Sample Details

Sample No.	S2
Matrix.	Soil
Analyte.	Sb
Units	mg/kg

Participant Results

Lab Code	Result	Uncertainty
1	9.5	1.4
2	NT	NT
3	12.4	2
4	6.23	2.12
5	18	3.6
6	26.7	3.1
7	NT	NT
8	5.0	1.3
9	NT	NT
10	8.0	2.6
11	NT	NT
12	NT	NT
13	NT	NT
14	NT	NT
15	8.83	2.50
16	12.0	1.32
17	<100	NR
18	19.2	2.6
19	NT	NT
20	NT	NT
21	4.8	0.5
22	11	2.2
23	NT	NT
24	NT	NT
25	NT	NT
26	7.0	1.5
27	15.0	4.5
28	21	4.2
29	18	2.6
30	20.40	1.7

Statistics

Assigned Value	Not Set	
Spike	22.2	0.4
Robust Average	12.9	4.2
Median	12.0	4.4
Mean	13.1	
N	17	
Max.	26.7	
Min.	4.8	
Robust SD	6.9	
Robust CV	53%	

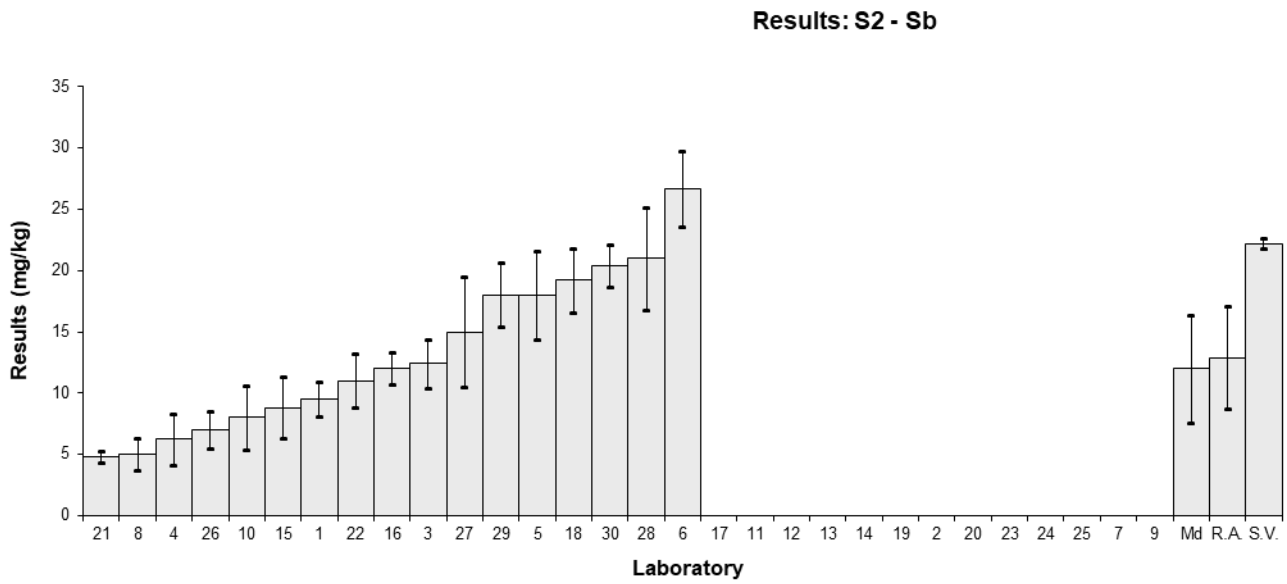

Results: S2 - Sb
Results (mg/kg)
35
30
25
20
15
10
5
0
21 8 4 26 10 15 1 22 16 3 27 29 5 18 30 28 6 17 11 12 13 14 19 2 20 23 24 25 7 9 Md R.A. S.V.
Laboratory

Figure 32

Table 45

Sample Details

Sample No.	S2
Matrix.	Soil
Analyte.	Se
Units	mg/kg

Participant Results

Lab Code	Result	Uncertainty
1	9.6	1.44
2	NT	NT
3	0.93	0.5
4	<5	NR
5	<2	NR
6	1.74	0.2
7	NT	NT
8	1	0.5
9	NT	NT
10	0.95	0.17
11	NT	NT
12	NT	NT
13	<5	NR
14	NT	NT
15	1.10	0.42
16	1.08	0.13
17	<100	NR
18	1.43	0.17
19	2.4	0.12
20	<5	NR
21	NR	NR
22	1.8	0.36
23	NT	NT
24	NT	NT
25	NT	NT
26	< 2	1.4
27	2.00	0.6
28	2.1	0.42
29	<2	NR
30	1.22	0.05

Statistics

Assigned Value	Not Set	
Spike	1.98	0.20
Homogeneity Value	1.60	0.19
Robust Average	1.56	0.45
Median	1.43	0.39
Mean	2.10	
N	13	
Max.	9.6	
Min.	0.93	
Robust SD	0.64	
Robust CV	41%	

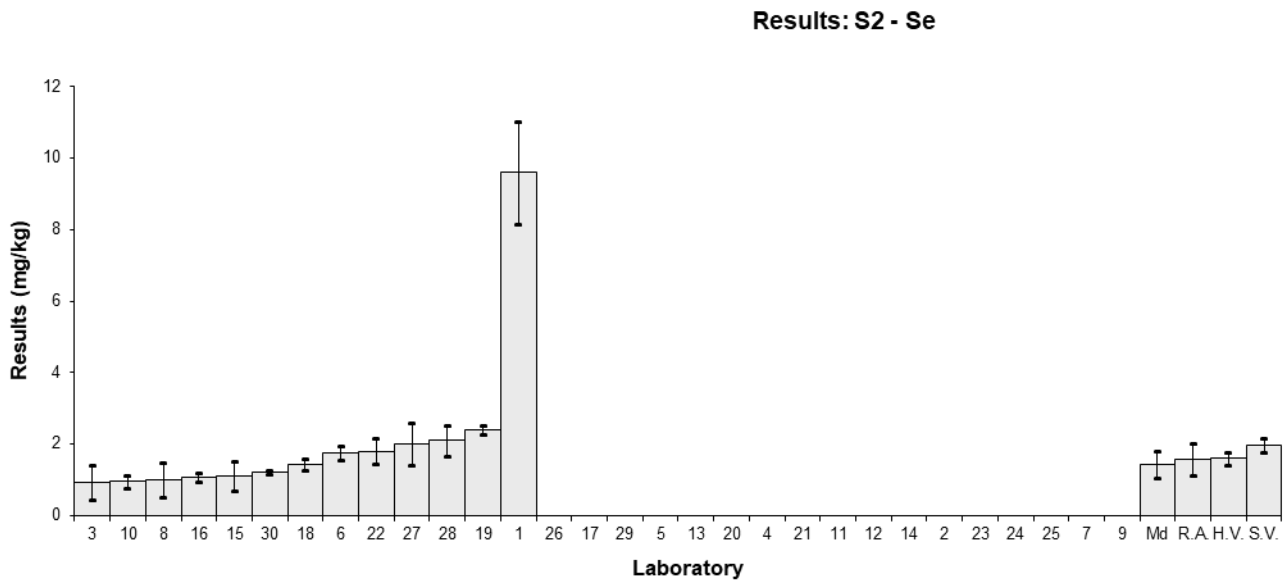

Results: S2 - Se
Results (mg/kg)
0
2
4
6
8
10
12
3 10 8 16 15 30 18 6 22 27 28 19 1 26 17 29 5 13 20 4 21 11 12 14 2 23 24 25 7 9 Md R.A. H.V. S.V.
Laboratory

Figure 33

Table 46

Sample Details

Sample No.	S2
Matrix.	Soil
Analyte.	Sn
Units	mg/kg

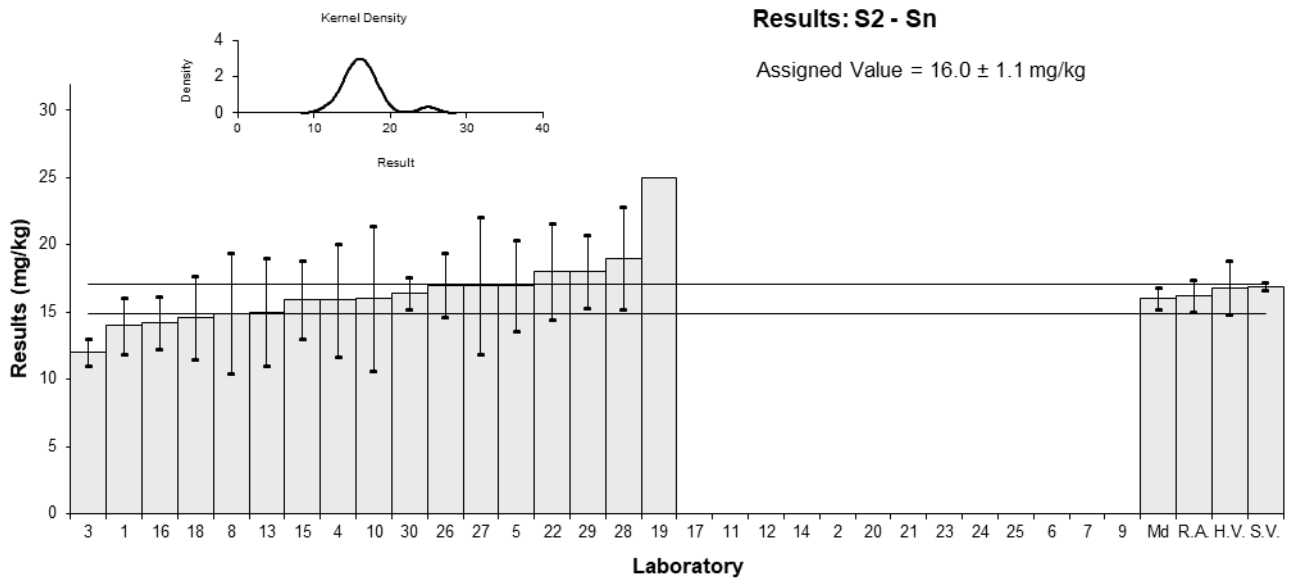
Participant Results

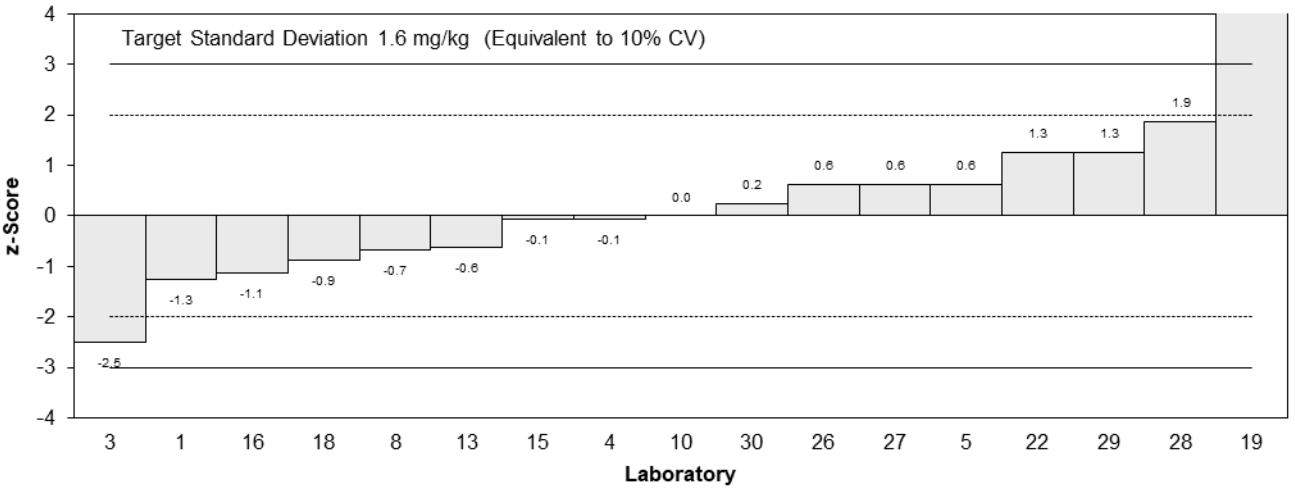
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	14	2.1	-1.25	-0.84
2	NT	NT		
3	12	1	-2.50	-2.69
4	15.9	4.18	-0.06	-0.02
5	17	3.4	0.62	0.28
6	NT	NT		
7	NT	NT		
8	14.9	4.5	-0.69	-0.24
9	NT	NT		
10	16	5.4	0.00	0.00
11	NT	NT		
12	NT	NT		
13	15	4	-0.62	-0.24
14	NT	NT		
15	15.9	2.9	-0.06	-0.03
16	14.2	1.99	-1.13	-0.79
17	<50	NR		
18	14.6	3.1	-0.88	-0.43
19	25	NR	5.62	8.18
20	NT	NT		
21	NT	NT		
22	18	3.6	1.25	0.53
23	NT	NT		
24	NT	NT		
25	NT	NT		
26	17.0	2.4	0.62	0.38
27	17.0	5.1	0.62	0.19
28	19	3.8	1.88	0.76
29	18	2.7	1.25	0.69
30	16.37	1.2	0.23	0.23

Statistics

Assigned Value*	16.0	1.1
Spike	16.9	0.3
Homogeneity Value	16.8	2.0
Robust Average	16.2	1.2
Median	16.0	0.8
Mean	16.5	
N	17	
Max.	25	
Min.	12	
Robust SD	2.0	
Robust CV	12%	

*Robust Average excluding laboratory 19.


Kernel Density
Density
Result
Results: S2 - Sn
Assigned Value = 16.0 ± 1.1 mg/kg
Results (mg/kg)
Laboratory
3 1 16 18 8 13 15 4 10 30 26 27 5 22 29 28 19 17 11 12 14 2 20 21 23 24 25 6 7 9 Md R.A. H.V. S.V.


z-Scores: S2 - Sn
Target Standard Deviation 1.6 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
3 1 16 18 8 13 15 4 10 30 26 27 5 22 29 28 19
-2.5 -1.3 -1.1 -0.9 -0.7 -0.6 -0.1 -0.1 0.0 0.2 0.6 0.6 0.6 1.3 1.3 1.9

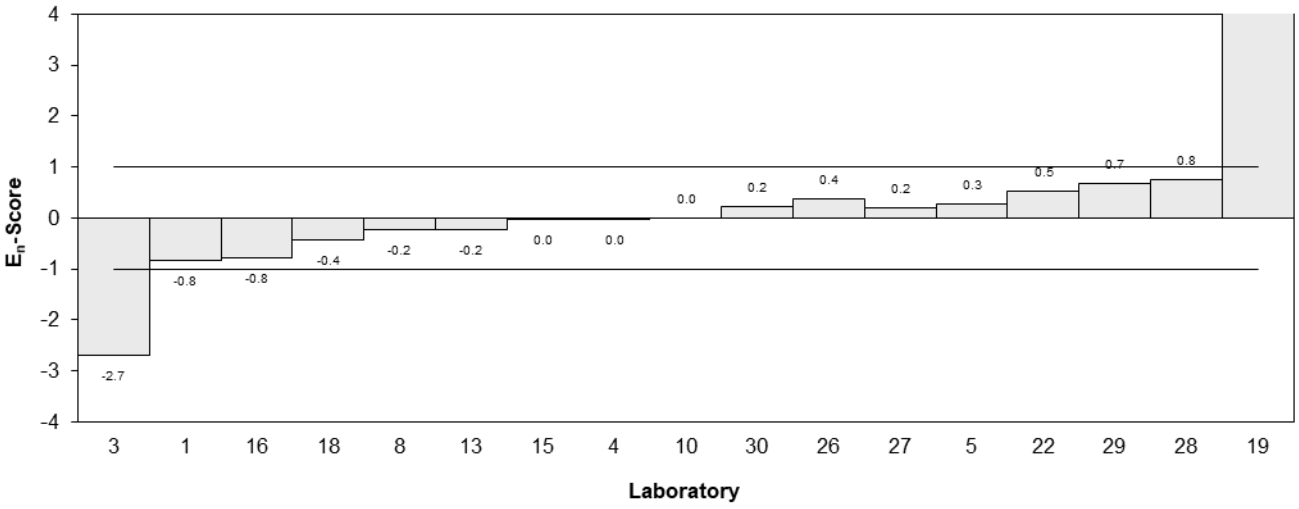

En-Scores: S2 - Sn
En-Score
Laboratory
3 1 16 18 8 13 15 4 10 30 26 27 5 22 29 28 19
-2.7 -0.8 -0.8 -0.4 -0.2 -0.2 0.0 0.0 0.0 0.2 0.4 0.2 0.3 0.5 0.7 0.8

Figure 34

Table 47

Sample Details

Sample No.	S2
Matrix.	Soil
Analyte.	Tl
Units	mg/kg

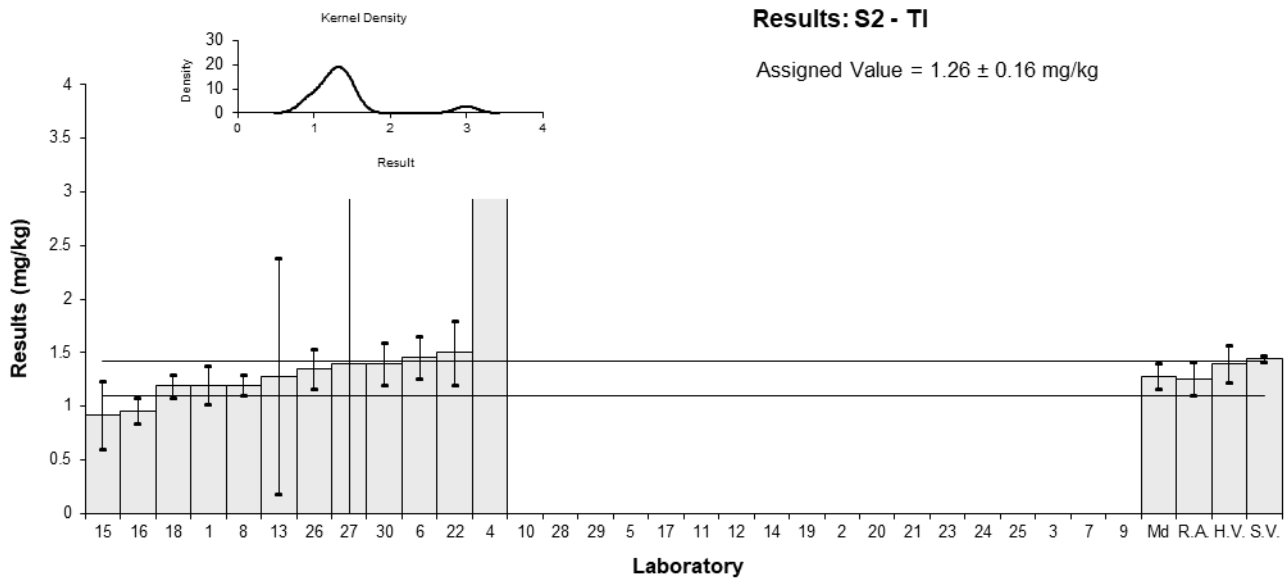
Participant Results

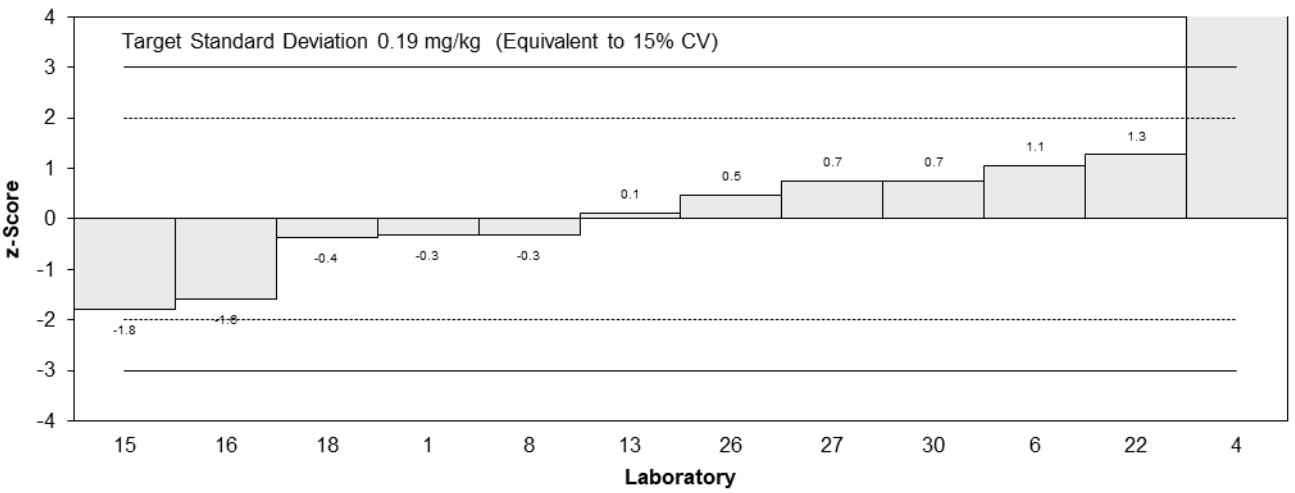
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	1.2	0.18	-0.32	-0.25
2	NT	NT		
3	NT	NT		
4	126.9	9.92	664.76	12.66
5	<10	NR		
6	1.46	0.2	1.06	0.78
7	NT	NT		
8	1.2	0.1	-0.32	-0.32
9	NT	NT		
10	<1.8	NR		
11	NT	NT		
12	NT	NT		
13	1.28	1.1	0.11	0.02
14	NT	NT		
15	0.92	0.32	-1.80	-0.95
16	0.96	0.12	-1.59	-1.50
17	<2	NR		
18	1.19	0.11	-0.37	-0.36
19	NT	NT		
20	NT	NT		
21	NT	NT		
22	1.5	0.30	1.27	0.71
23	NT	NT		
24	NT	NT		
25	NT	NT		
26	1.35	0.19	0.48	0.36
27	1.4	4.3	0.74	0.03
28	<10	NR		
29	<10	NR		
30	1.40	0.2	0.74	0.55

Statistics*

Assigned Value	1.26	0.16
Spike	1.44	0.03
Homogeneity Value	1.40	0.17
Robust Average	1.26	0.16
Median	1.28	0.12
Mean	1.26	
N	11	
Max.	1.5	
Min.	0.92	
Robust SD	0.21	
Robust CV	17%	

*Laboratory 4 was excluded from statistical calculation (extreme outlier).


Kernel Density
Density
Result
Results: S2 - Tl
Assigned Value = 1.26 ± 0.16 mg/kg
Results (mg/kg)
Laboratory
15 16 18 1 8 13 26 27 30 6 22 4 10 28 29 5 17 11 12 14 19 2 20 21 23 24 25 3 7 9 Md R.A. H.V. S.V.


z-Scores: S2 - Tl
Target Standard Deviation 0.19 mg/kg (Equivalent to 15% CV)
z-Score
Laboratory
-1.8 -1.6 -0.4 -0.3 -0.3 0.1 0.5 0.7 0.7 1.1 1.3
15 16 18 1 8 13 26 27 30 6 22 4

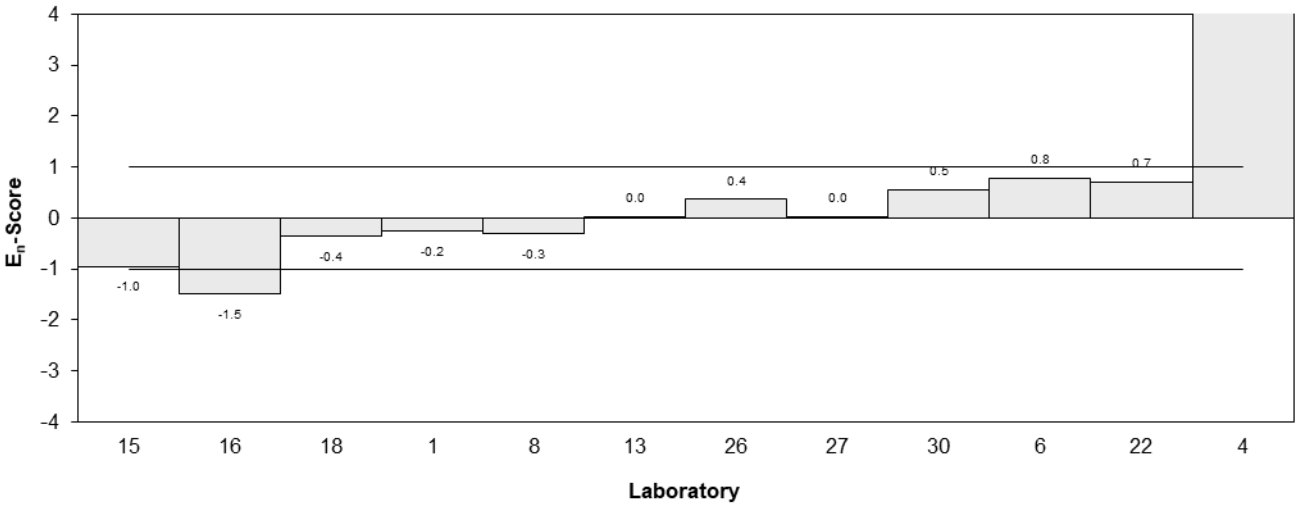

En-Scores: S2 - Tl
En-Score
Laboratory
-1.0 -1.5 -0.4 -0.2 -0.3 0.0 0.4 0.0 0.5 0.8 0.7
15 16 18 1 8 13 26 27 30 6 22 4

Figure 35

Table 48

Sample Details

Sample No.	S2
Matrix.	Soil
Analyte.	Zn
Units	mg/kg

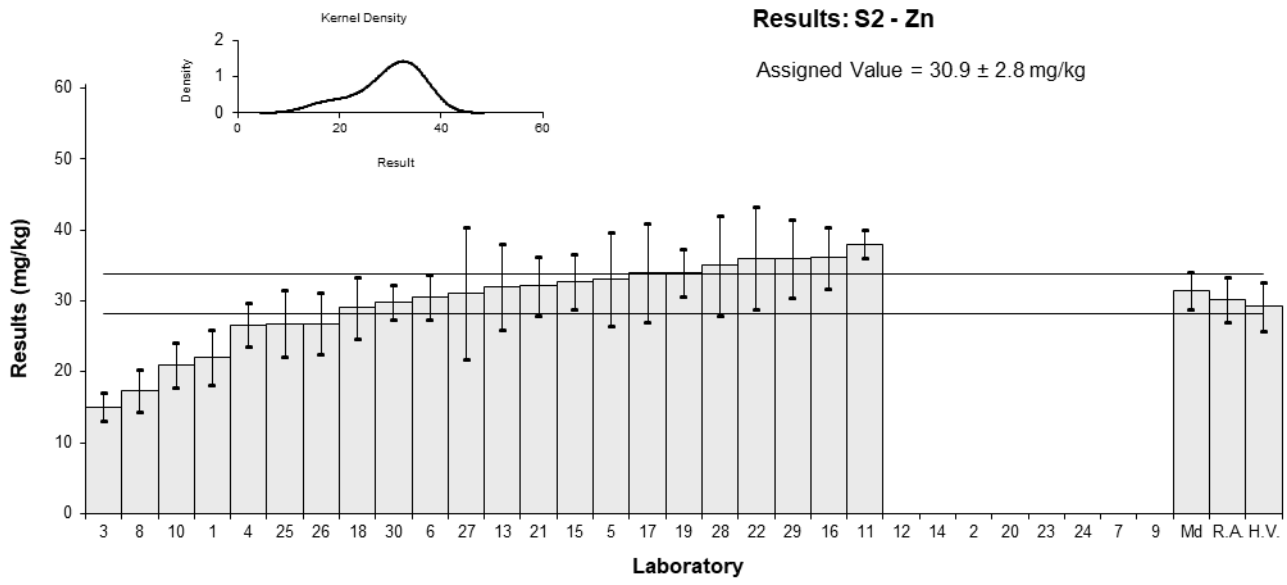
Participant Results

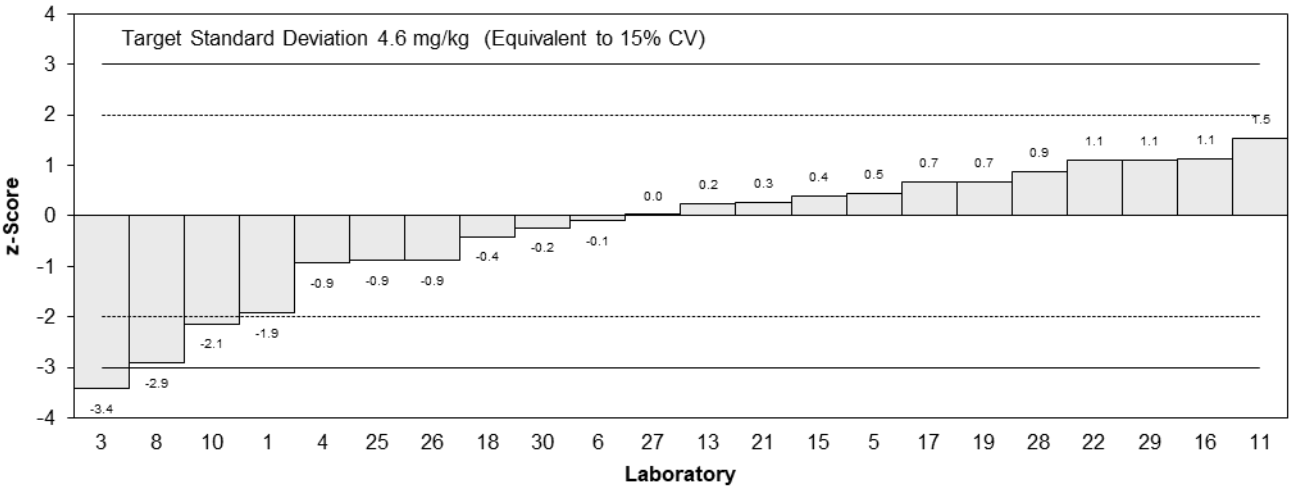
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	22	3.9	-1.92	-1.85
2	NT	NT		
3	15	2	-3.43	-4.62
4	26.6	3.09	-0.93	-1.03
5	33	6.6	0.45	0.29
6	30.5	3.2	-0.09	-0.09
7	NT	NT		
8	17.4	3.0	-2.91	-3.29
9	NT	NT		
10	21	3.2	-2.14	-2.33
11	38	2	1.53	2.06
12	NT	NT		
13	32	6	0.24	0.17
14	NT	NT		
15	32.7	3.9	0.39	0.37
16	36.1	4.33	1.12	1.01
17	34.0	7	0.67	0.41
18	29.0	4.4	-0.41	-0.36
19	34	3.4	0.67	0.70
20	NT	NT		
21	32.1	4.1	0.26	0.24
22	36	7.2	1.10	0.66
23	NT	NT		
24	NT	NT		
25	26.8	4.7	-0.88	-0.75
26	26.8	4.4	-0.88	-0.79
27	31	9.3	0.02	0.01
28	35	7	0.88	0.54
29	36	5.5	1.10	0.83
30	29.82	2.4	-0.23	-0.29

Statistics

Assigned Value*	30.9	2.8
Spike	Not Spiked	
Homogeneity Value	29.2	3.5
Robust Average	30.2	3.2
Median	31.5	2.6
Mean	29.8	
N	22	
Max.	38	
Min.	15	
Robust SD	5.9	
Robust CV	20%	

*Robust Average excluding laboratory 3.


Kernel Density
Density
Result
Results: S2 - Zn
Assigned Value = 30.9 ± 2.8 mg/kg
Results (mg/kg)
Laboratory
3 8 10 1 4 25 26 18 30 6 27 13 21 15 5 17 19 28 22 29 16 11 12 14 2 20 23 24 7 9 Md R.A. H.V.


z-Scores: S2 - Zn
Target Standard Deviation 4.6 mg/kg (Equivalent to 15% CV)
z-Score
Laboratory
3 8 10 1 4 25 26 18 30 6 27 13 21 15 5 17 19 28 22 29 16 11
-3.4 -2.9 -2.1 -1.9 -0.9 -0.9 -0.9 -0.4 -0.2 -0.1 0.0 0.2 0.3 0.4 0.5 0.7 0.7 0.9 1.1 1.1 1.1 1.5

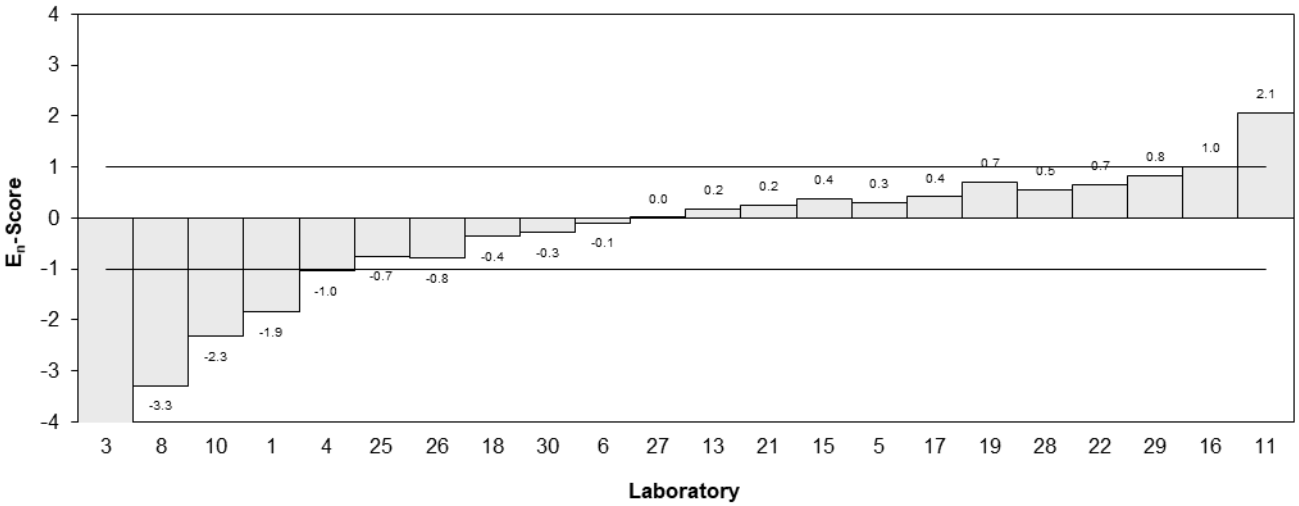

En-Scores: S2 - Zn
En-Score
Laboratory
3 8 10 1 4 25 26 18 30 6 27 13 21 15 5 17 19 28 22 29 16 11
-3.3 -2.3 -1.9 -1.0 -0.7 -0.8 -0.4 -0.3 -0.1 0.0 0.2 0.2 0.4 0.3 0.4 0.7 0.5 0.7 0.8 1.0 2.1

Figure 36

Table 49

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	Ammonium-N
Units	mg/kg

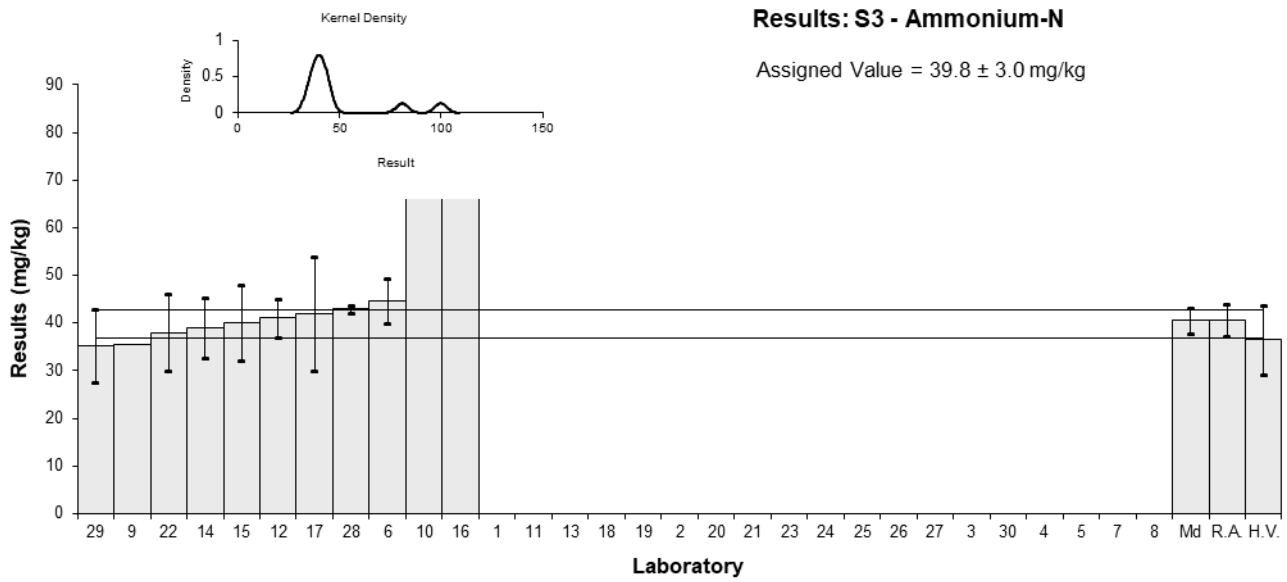
Participant Results

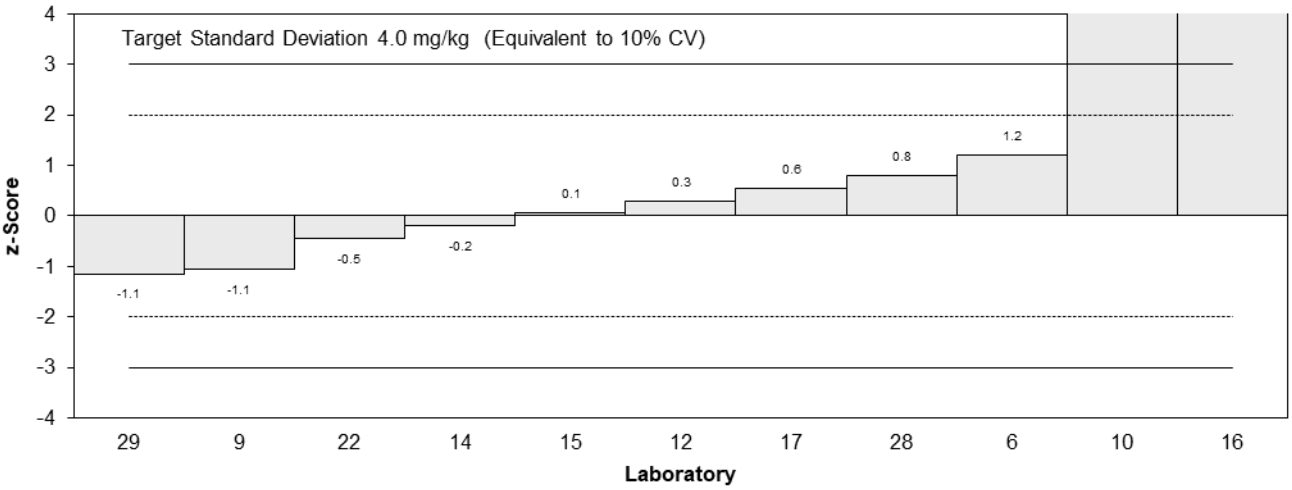
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	NT	NT		
3	NT	NT		
4	NT	NT		
5	NT	NT		
6	44.6	4.8	1.21	0.85
7	NT	NT		
8	NT	NT		
9	35.6	NR	-1.06	-1.40
10	81	12	10.35	3.33
11	NT	NT		
12	41	4.0	0.30	0.24
13	NT	NT		
14	39	6.3	-0.20	-0.11
15	40.05	8.01	0.06	0.03
16	420	68	95.53	5.59
17	42.0	12	0.55	0.18
18	NT	NT		
19	NT	NT		
20	NT	NT		
21	NT	NT		
22	38	8	-0.45	-0.21
23	NT	NT		
24	NT	NT		
25	NT	NT		
26	NT	NT		
27	NT	NT		
28	43	0.8	0.80	1.03
29	35.24	7.56	-1.15	-0.56
30	NT	NT		

Statistics*

Assigned Value**	39.8	3.0
Spike	Not Spiked	
Homogeneity Value	36.5	7.3
Robust Average	40.5	3.4
Median	40.5	2.7
Mean	43.9	
N	10	
Max.	81	
Min.	35.24	
Robust SD	4.3	
Robust CV	11%	

*Laboratory 16 was excluded from statistical calculation (extreme outlier)
**Robust Average excluding laboratory 10.


Kernel Density
Density
Result
Results: S3 - Ammonium-N
Assigned Value = 39.8 ± 3.0 mg/kg
Results (mg/kg)
29 9 22 14 15 12 17 28 6 10 16 1 11 13 18 19 2 20 21 23 24 25 26 27 3 30 4 5 7 8 Md R.A. H.V.
Laboratory


z-Scores: S3 - Ammonium-N
Target Standard Deviation 4.0 mg/kg (Equivalent to 10% CV)
z-Score
-1.1 -1.1 -0.5 -0.2 0.1 0.3 0.6 0.8 1.2
29 9 22 14 15 12 17 28 6 10 16
Laboratory

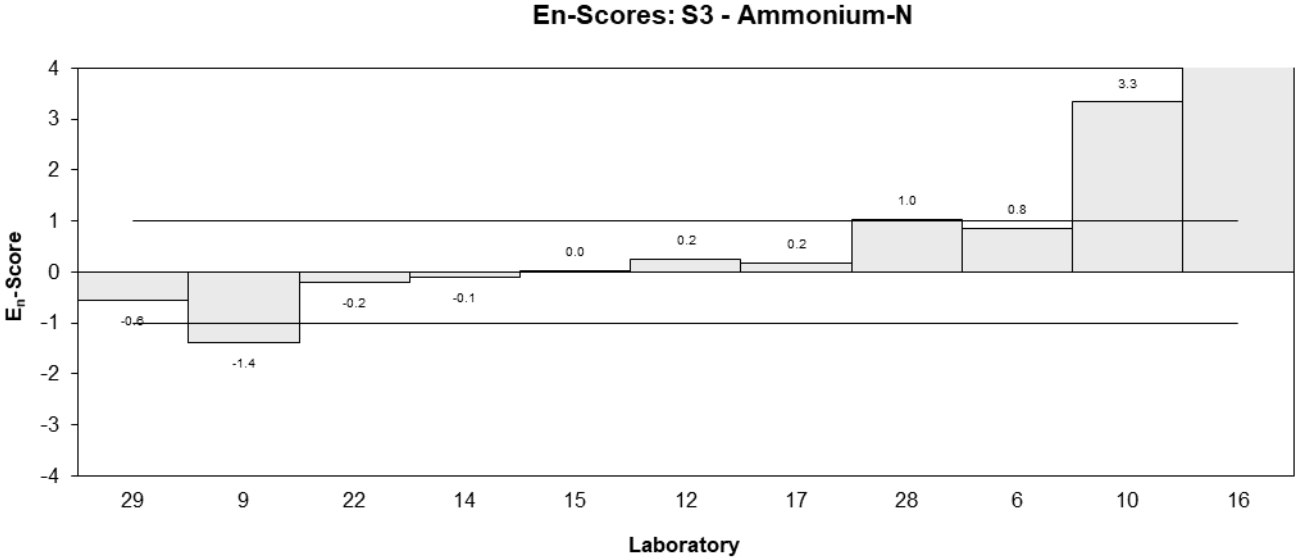

En-Scores: S3 - Ammonium-N
En-Score
-0.6 -1.4 -0.2 -0.1 0.0 0.2 0.2 1.0 0.8 3.3
29 9 22 14 15 12 17 28 6 10 16
Laboratory

Figure 37

Table 50

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	Bromide
Units	mg/kg

Participant Results

Lab Code	Result	Uncertainty
1	NT	NT
2	NT	NT
3	NT	NT
4	NT	NT
5	NT	NT
6	NT	NT
7	1.58	0.14
8	1.92	0.19
9	NR	NR
10	NT	NT
11	NT	NT
12	NR	NR
13	<5	NR
14	<5	NR
15	NR	NR
16	NT	NT
17	NT	NT
18	NT	NT
19	NT	NT
20	NT	NT
21	2.41	0.3
22	2.0	0.4
23	NT	NT
24	NT	NT
25	NT	NT
26	NT	NT
27	NT	NT
28	NT	NT
29	1.92	0.49
30	NT	NT

Statistics*

Assigned Value	Not Set	
Spike	Not Spiked	
Homogeneity Value	2.00	0.30
Median	1.92	0.15
Mean	1.97	
N	5	
Max.	2.41	
Min.	1.58	

*Insufficient data to calculate statistics.

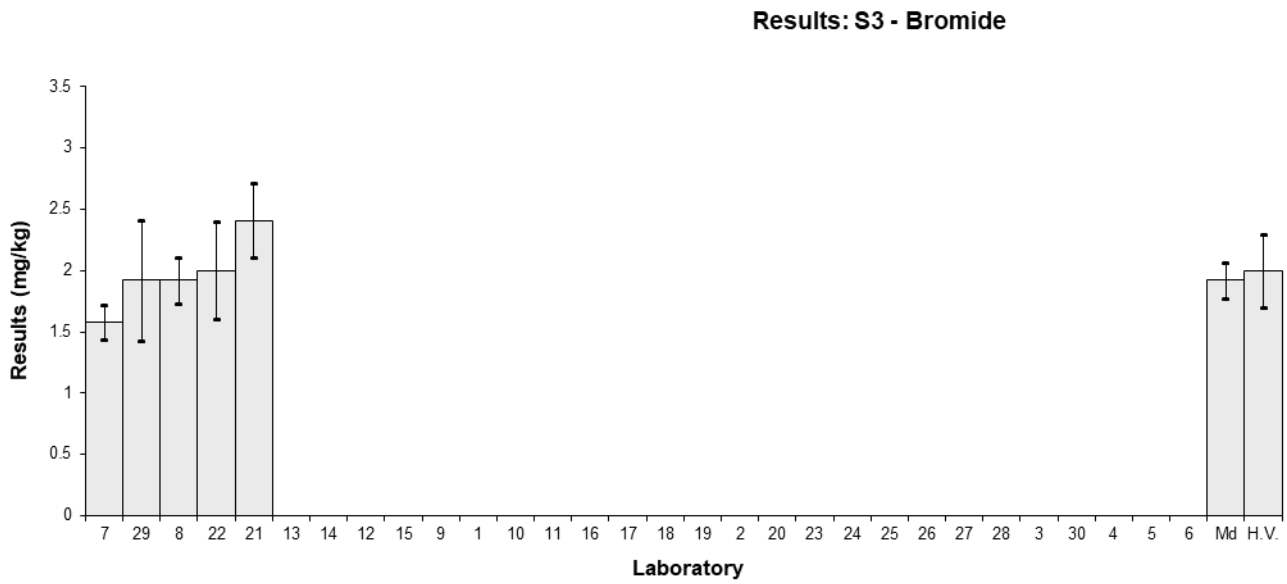

Results: S3 - Bromide
Results (mg/kg)
3.5
3
2.5
2
1.5
1
0.5
0
7 29 8 22 21 13 14 12 15 9 1 10 11 16 17 18 19 2 20 23 24 25 26 27 28 3 30 4 5 6 Md H.V.
Laboratory

Figure 38

Table 51

Sample Details

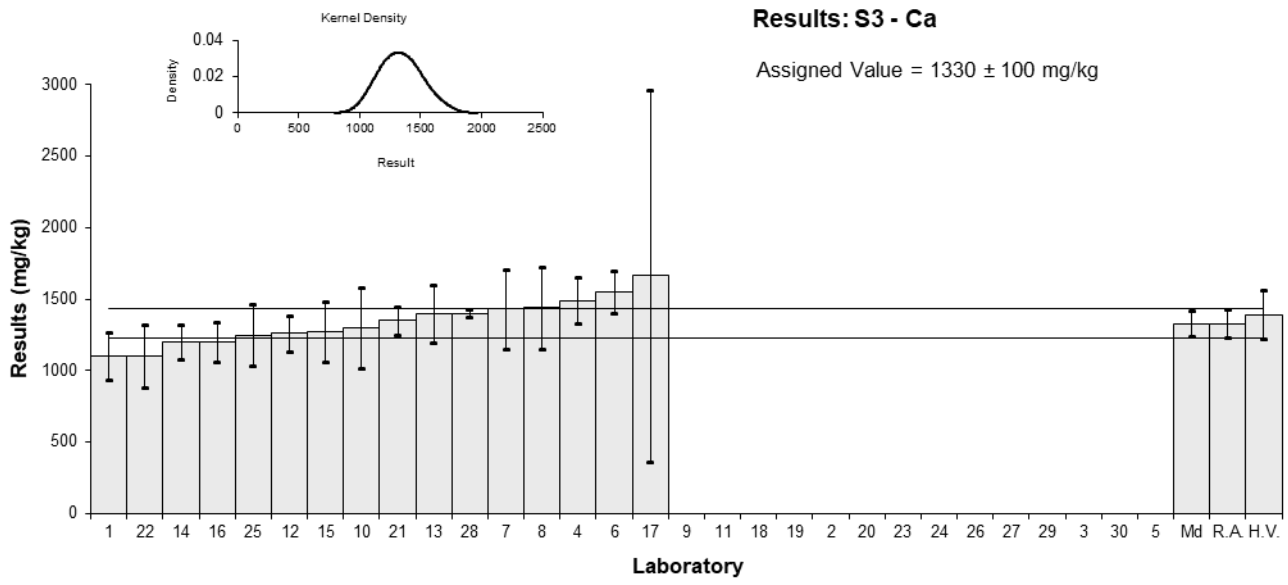
Sample No.	S3
Matrix.	Soil
Analyte.	Ca
Units	mg/kg

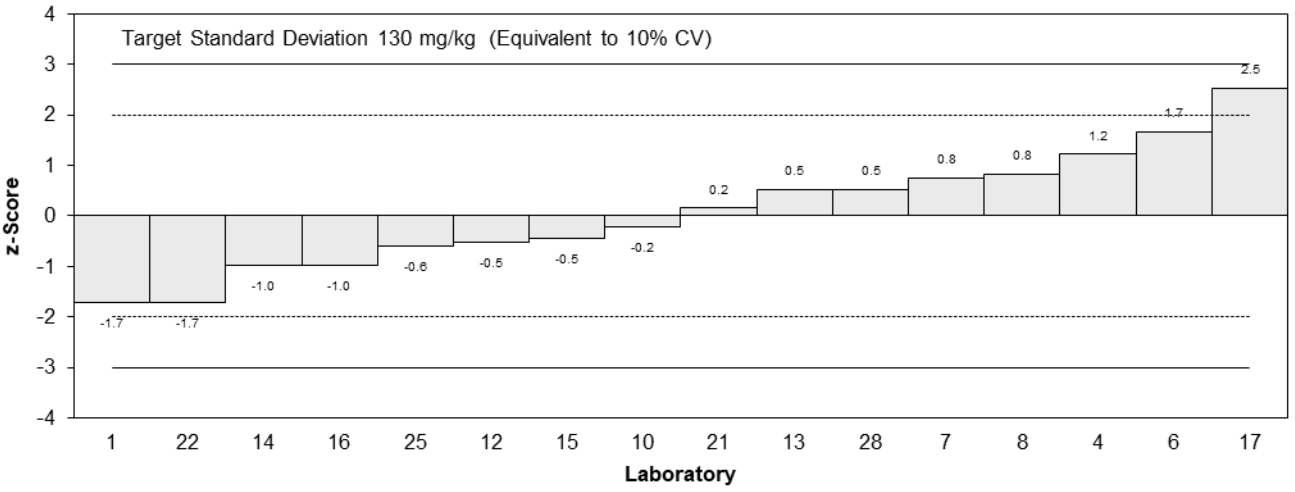
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	1100	165	-1.73	-1.19
2	NT	NT		
3	NT	NT		
4	1492	162.1	1.22	0.85
5	NT	NT		
6	1550	150	1.65	1.22
7	1430	280	0.75	0.34
8	1440	285	0.83	0.36
9	NR	NR		
10	1300	280	-0.23	-0.10
11	NT	NT		
12	1260	125	-0.53	-0.44
13	1400	200	0.53	0.31
14	1200	120	-0.98	-0.83
15	1270	210	-0.45	-0.26
16	1200	138	-0.98	-0.76
17	1665	1300	2.52	0.26
18	NT	NT		
19	NT	NT		
20	NT	NT		
21	1350	96	0.15	0.14
22	1100	220	-1.73	-0.95
23	NT	NT		
24	NT	NT		
25	1250	214	-0.60	-0.34
26	NT	NT		
27	NT	NT		
28	1400	28	0.53	0.67
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value	1330	100
Spike	Not Spiked	
Homogeneity Value	1390	170
Robust Average	1330	100
Median	1330	90
Mean	1340	
N	16	
Max.	1665	
Min.	1100	
Robust SD	170	
Robust CV	13%	


Kernel Density
Density
Result
Results: S3 - Ca
Assigned Value = 1330 ± 100 mg/kg
Results (mg/kg)
Laboratory
1 22 14 16 25 12 15 10 21 13 28 7 8 4 6 17 9 11 18 19 2 20 23 24 26 27 29 3 30 5 Md R.A. H.V.


z-Scores: S3 - Ca
Target Standard Deviation 130 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
1 22 14 16 25 12 15 10 21 13 28 7 8 4 6 17
-1.7 -1.7 -1.0 -1.0 -0.6 -0.5 -0.5 -0.2 0.2 0.5 0.5 0.8 0.8 1.2 1.7 2.5

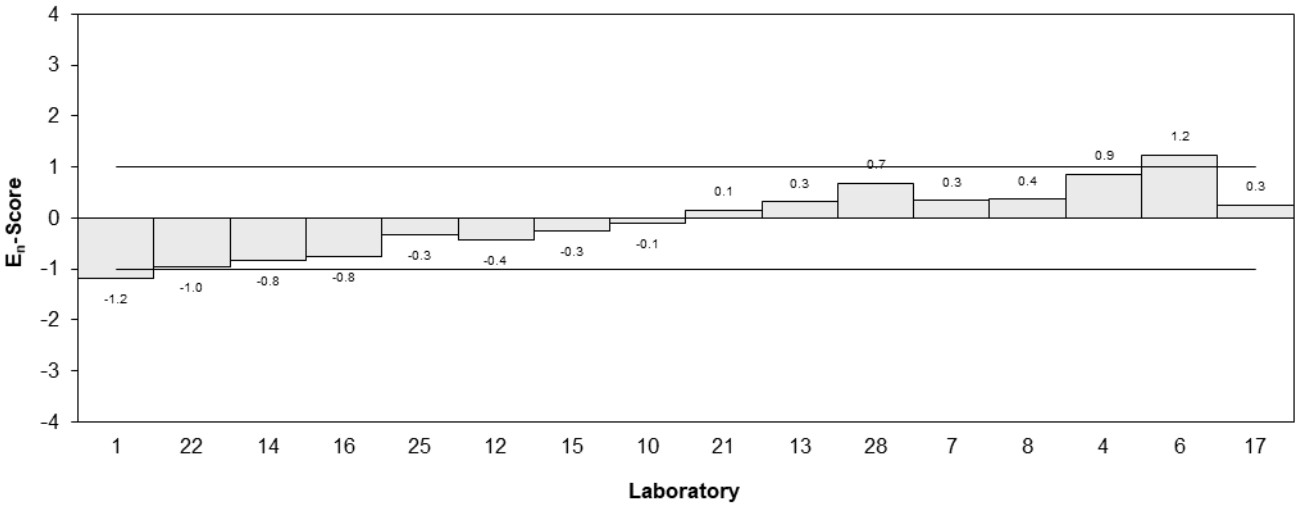

En-Scores: S3 - Ca
En-Score
Laboratory
1 22 14 16 25 12 15 10 21 13 28 7 8 4 6 17
-1.2 -1.0 -0.8 -0.8 -0.3 -0.4 -0.3 -0.1 0.1 0.3 0.7 0.3 0.4 0.9 1.2 0.3

Figure 39

Table 52

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	Chloride
Units	mg/kg

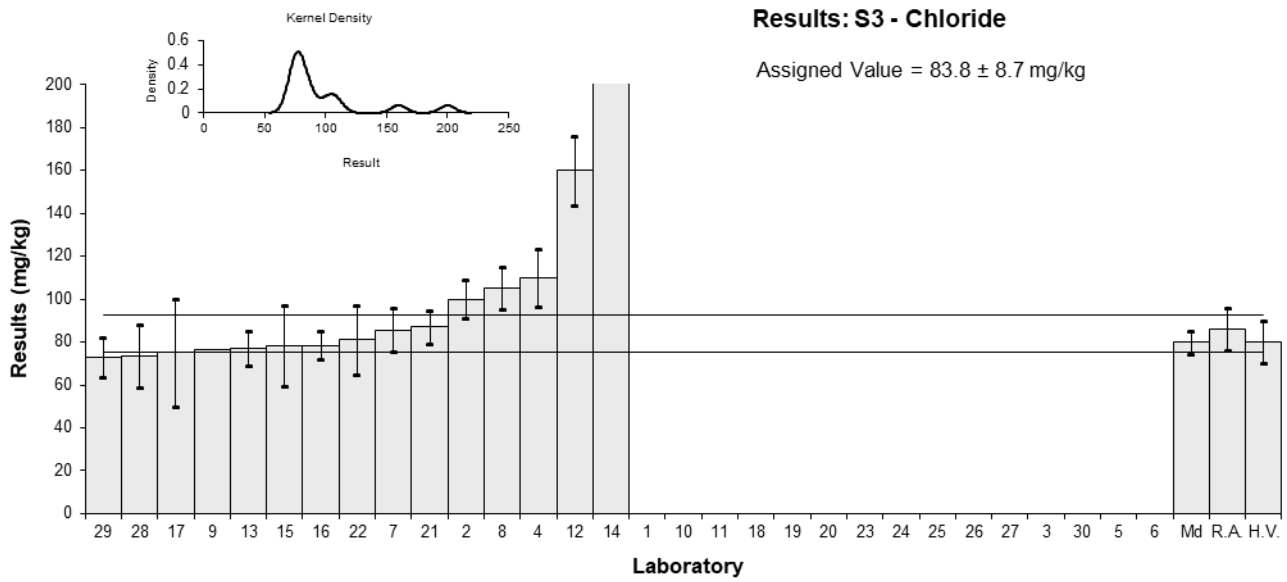
Participant Results

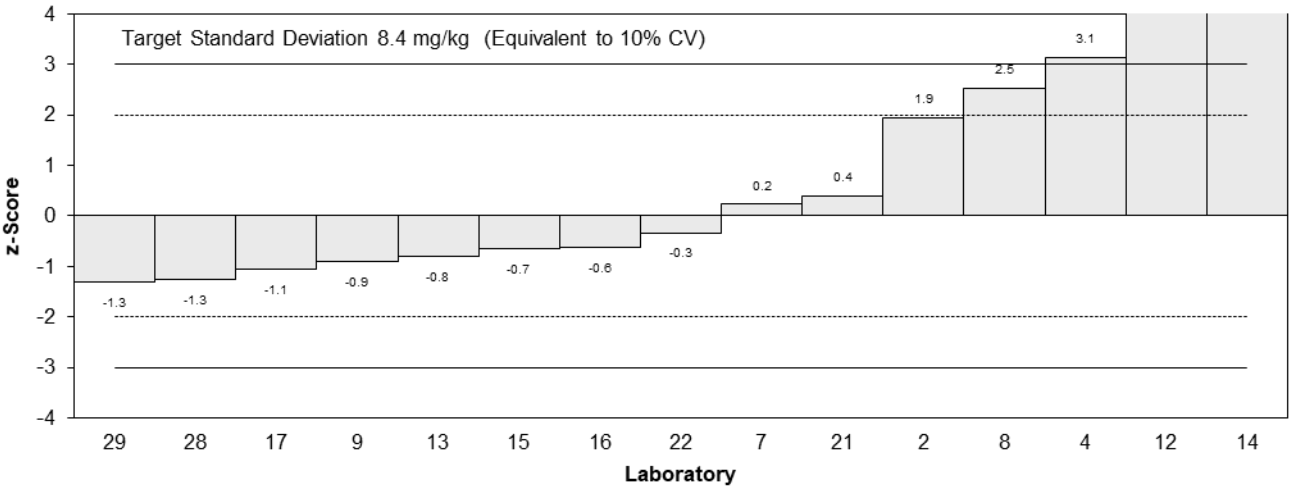
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	100	9	1.93	1.29
3	NT	NT		
4	110	13.5	3.13	1.63
5	NT	NT		
6	NT	NT		
7	85.7	10	0.23	0.14
8	105	10	2.53	1.60
9	76.2	NR	-0.91	-0.87
10	NT	NT		
11	NT	NT		
12	160	16	9.09	4.18
13	77	8	-0.81	-0.58
14	865	196	93.22	3.98
15	78.3	18.8	-0.66	-0.27
16	78.5	6.67	-0.63	-0.48
17	75	25	-1.05	-0.33
18	NT	NT		
19	NT	NT		
20	NT	NT		
21	87.1	7.8	0.39	0.28
22	81	16	-0.33	-0.15
23	NT	NT		
24	NT	NT		
25	NT	NT		
26	NT	NT		
27	NT	NT		
28	73.3	14.66	-1.25	-0.62
29	72.74	9.20	-1.32	-0.87
30	NT	NT		

Statistics*

Assigned Value**	83.8	8.7
Spike	Not Spiked	
Homogeneity Value	80	10
Robust Average	86	10
Median	79.8	5.3
Mean	90.0	
N	14	
Max.	160	
Min.	72.74	
Robust SD	16	
Robust CV	18%	

*Laboratory 14 was excluded from statistical calculation (extreme outlier).
**Robust Average excluding laboratory 12.


Results: S3 - Chloride
Assigned Value = 83.8 ± 8.7 mg/kg
Kernel Density
Density
Result
Results (mg/kg)
Laboratory
29 28 17 9 13 15 16 22 7 21 2 8 4 12 14 1 10 11 18 19 20 23 24 25 26 27 3 30 5 6 Md R.A. H.V.


z-Scores: S3 - Chloride
Target Standard Deviation 8.4 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
29 28 17 9 13 15 16 22 7 21 2 8 4 12 14
-1.3 -1.3 -1.1 -0.9 -0.8 -0.7 -0.6 -0.3 0.2 0.4 1.9 2.5 3.1

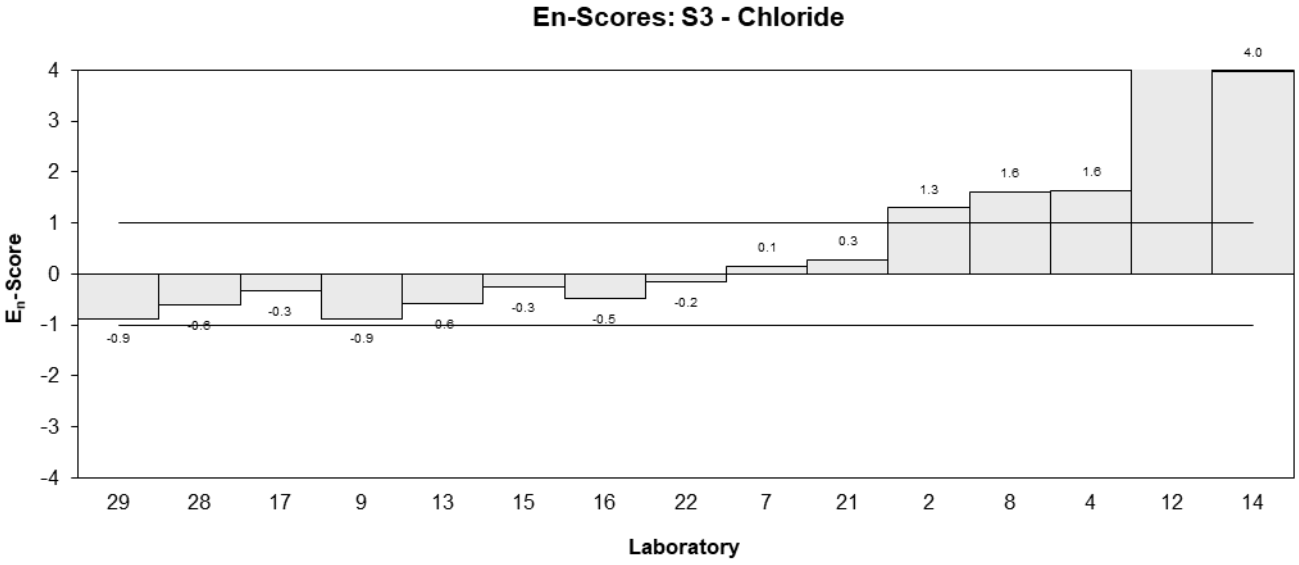

En-Scores: S3 - Chloride
En-Score
Laboratory
29 28 17 9 13 15 16 22 7 21 2 8 4 12 14
-0.9 -0.6 -0.3 -0.9 -0.6 -0.3 -0.5 -0.2 0.1 0.3 1.3 1.6 1.6 4.0

Figure 40

Table 53

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	EC
Units	µS/cm

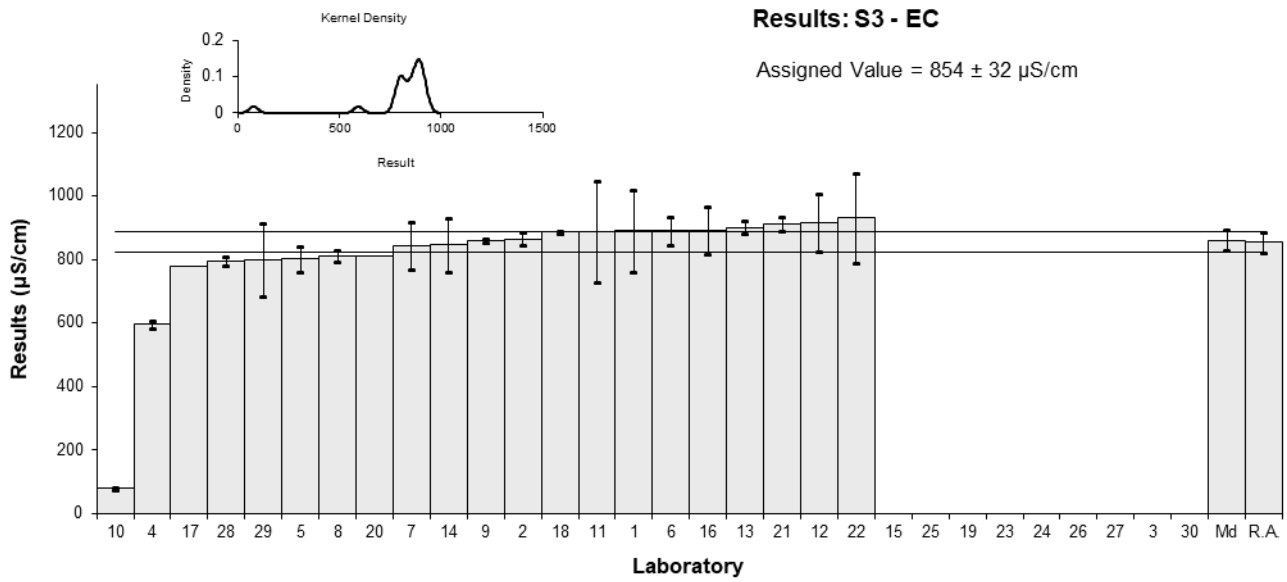
Participant Results

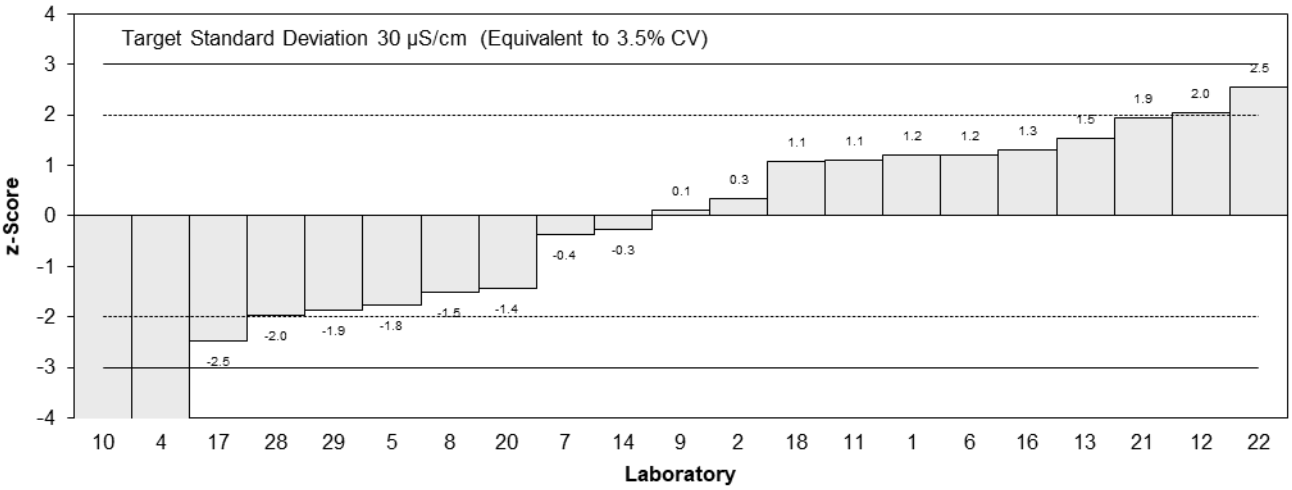
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	890	130	1.20	0.27
2	864	21	0.33	0.26
3	NT	NT		
4	595	12.1	-8.67	-7.57
5	801	40	-1.77	-1.03
6	890	45	1.20	0.65
7	843	76	-0.37	-0.13
8	809	18	-1.51	-1.23
9	857.3	6	0.11	0.10
10	79	3.9	-25.93	-24.04
11	887.20	160	1.11	0.20
12	915	90	2.04	0.64
13	900	20	1.54	1.22
14	846	85	-0.27	-0.09
15	NR	NR		
16	893	75	1.30	0.48
17	780	NR	-2.48	-2.31
18	886	3.4	1.07	0.99
19	NT	NT		
20	811	NR	-1.44	-1.34
21	912	23	1.94	1.47
22	930	140	2.54	0.53
23	NT	NT		
24	NT	NT		
25	NR	NR		
26	NT	NT		
27	NT	NT		
28	794.8	15.8	-1.98	-1.66
29	797.9	114.66	-1.88	-0.47
30	NT	NT		

Statistics*

Assigned Value	854	32
Spike	Not Spiked	
Robust Average	854	32
Median	861	31
Mean	845	
N	20	
Max.	930	
Min.	595	
Robust SD	57	
Robust CV	6.7%	

*Laboratory 10 was excluded from statistical calculation (extreme outlier).


Results: S3 - EC
Assigned Value = 854 ± 32 µS/cm
Kernel Density
Density
Result
Results (µS/cm)
Laboratory
10 4 17 28 29 5 8 20 7 14 9 2 18 11 1 6 16 13 21 12 22 15 25 19 23 24 26 27 3 30 Md R.A.


z-Scores: S3 - EC
Target Standard Deviation 30 µS/cm (Equivalent to 3.5% CV)
z-Score
Laboratory
10 4 17 28 29 5 8 20 7 14 9 2 18 11 1 6 16 13 21 12 22

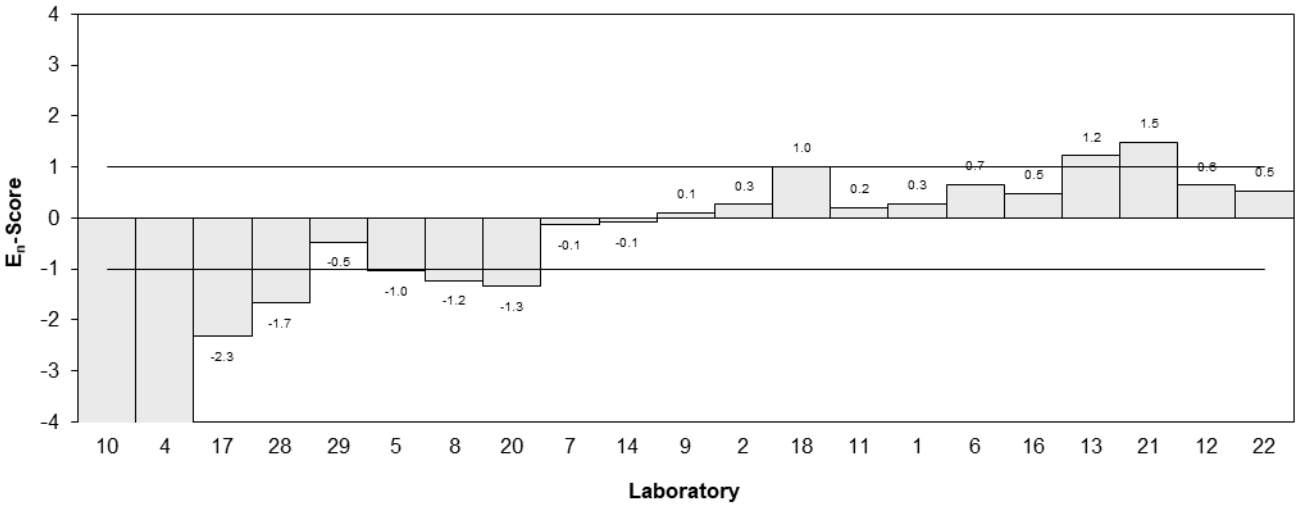

En-Scores: S3 - EC
En-Score
Laboratory
10 4 17 28 29 5 8 20 7 14 9 2 18 11 1 6 16 13 21 12 22

Figure 41

Table 54

Sample Details

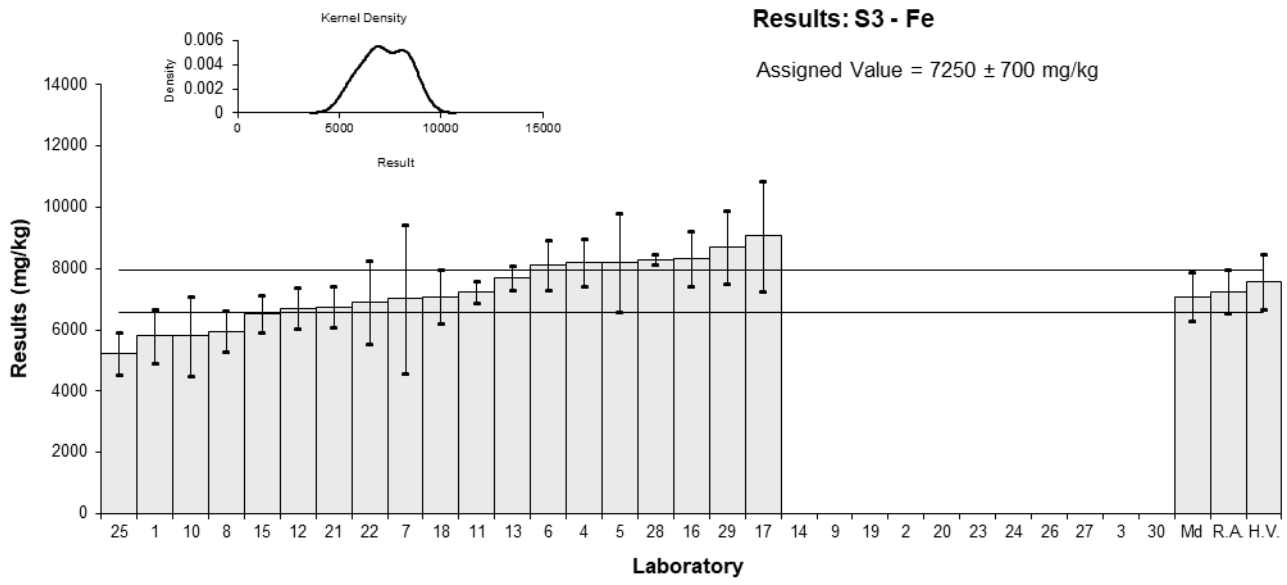
Sample No.	S3
Matrix.	Soil
Analyte.	Fe
Units	mg/kg

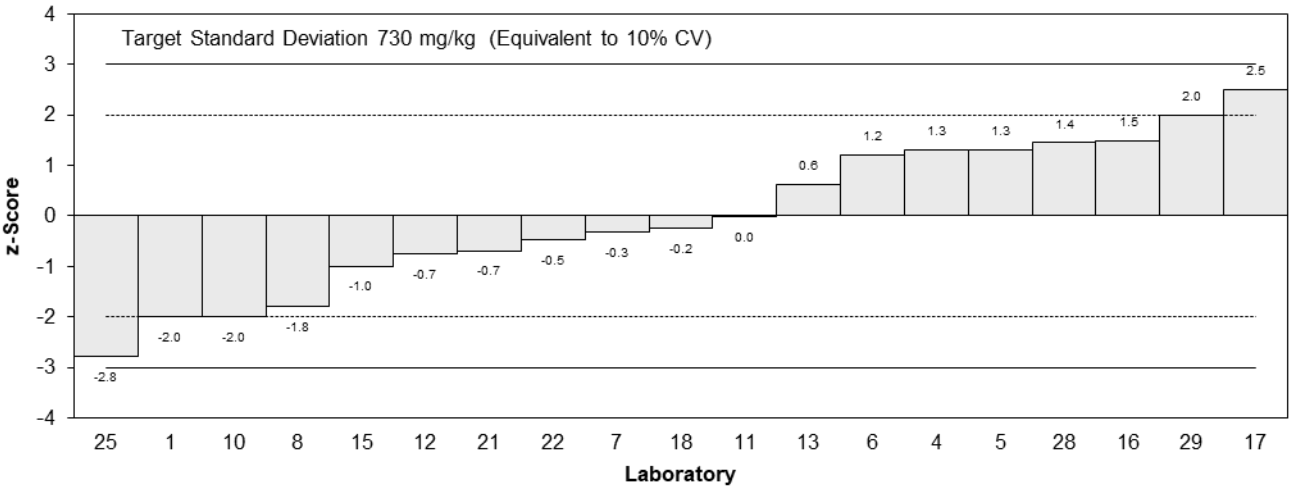
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	5800	885	-2.00	-1.29
2	NT	NT		
3	NT	NT		
4	8191	770	1.30	0.90
5	8200	1600	1.31	0.54
6	8130	820	1.21	0.82
7	7010	2440	-0.33	-0.09
8	5950	681	-1.79	-1.33
9	NR	NR		
10	5800	1300	-2.00	-0.98
11	7230	360	-0.03	-0.03
12	6710	670	-0.74	-0.56
13	7700	400	0.62	0.56
14	NR	NR		
15	6530	610	-0.99	-0.78
16	8324	916	1.48	0.93
17	9065	1800	2.50	0.94
18	7080	870	-0.23	-0.15
19	NT	NT		
20	NT	NT		
21	6750	675	-0.69	-0.51
22	6900	1380	-0.48	-0.23
23	NT	NT		
24	NT	NT		
25	5230	677	-2.79	-2.07
26	NT	NT		
27	NT	NT		
28	8300	166	1.45	1.46
29	8700	1200	2.00	1.04
30	NT	NT		

Statistics

Assigned Value	7250	700
Spike	Not Spiked	
Homogeneity Value	7570	910
Robust Average	7250	700
Median	7080	790
Mean	7240	
N	19	
Max.	9065	
Min.	5230	
Robust SD	1200	
Robust CV	17%	


Kernel Density
Density
Result
Results: S3 - Fe
Assigned Value = 7250 ± 700 mg/kg
Results (mg/kg)
Laboratory
25 1 10 8 15 12 21 22 7 18 11 13 6 4 5 28 16 29 17 14 9 19 2 20 23 24 26 27 3 30 Md R.A. H.V.


z-Scores: S3 - Fe
Target Standard Deviation 730 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
25 1 10 8 15 12 21 22 7 18 11 13 6 4 5 28 16 29 17

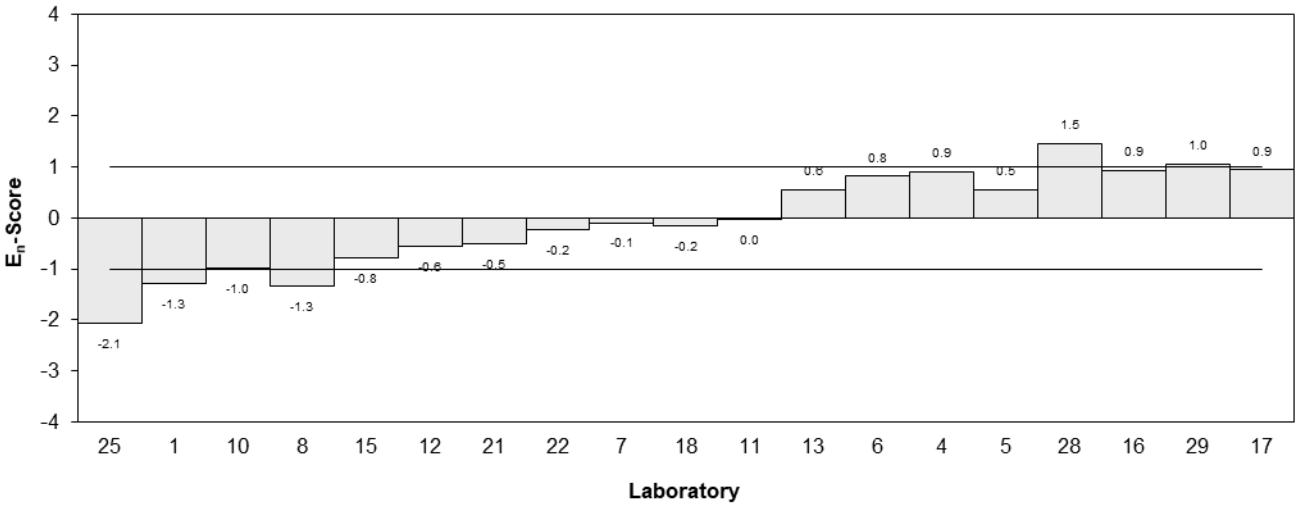

En-Scores: S3 - Fe
En-Score
Laboratory
25 1 10 8 15 12 21 22 7 18 11 13 6 4 5 28 16 29 17

Figure 42

Table 55

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	Fluoride
Units	mg/kg

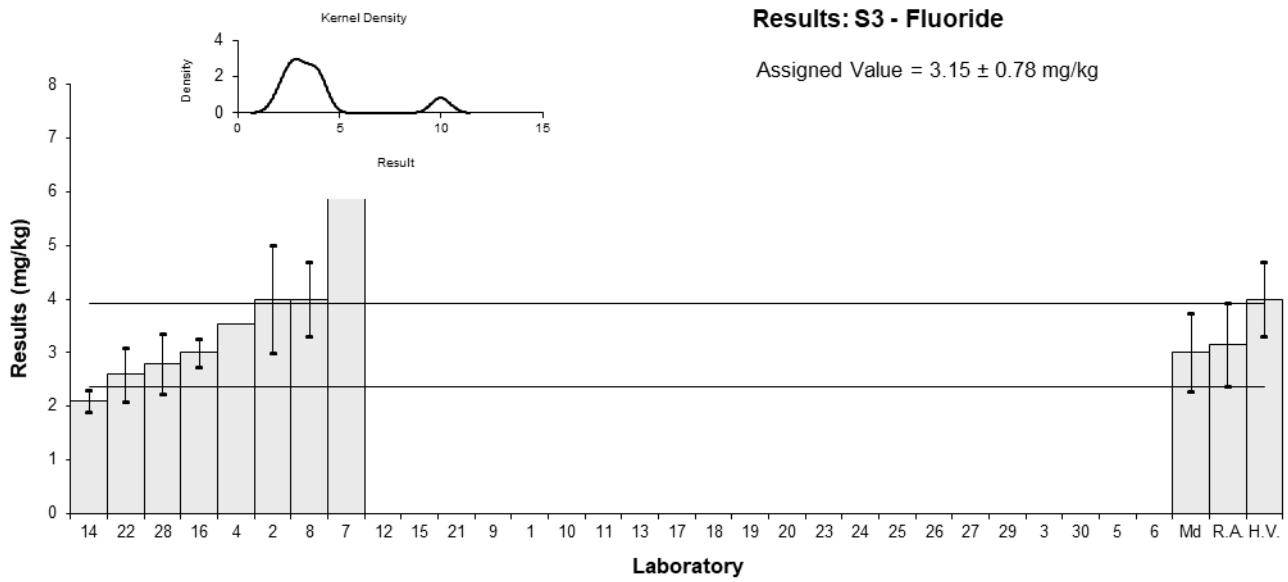
Participant Results

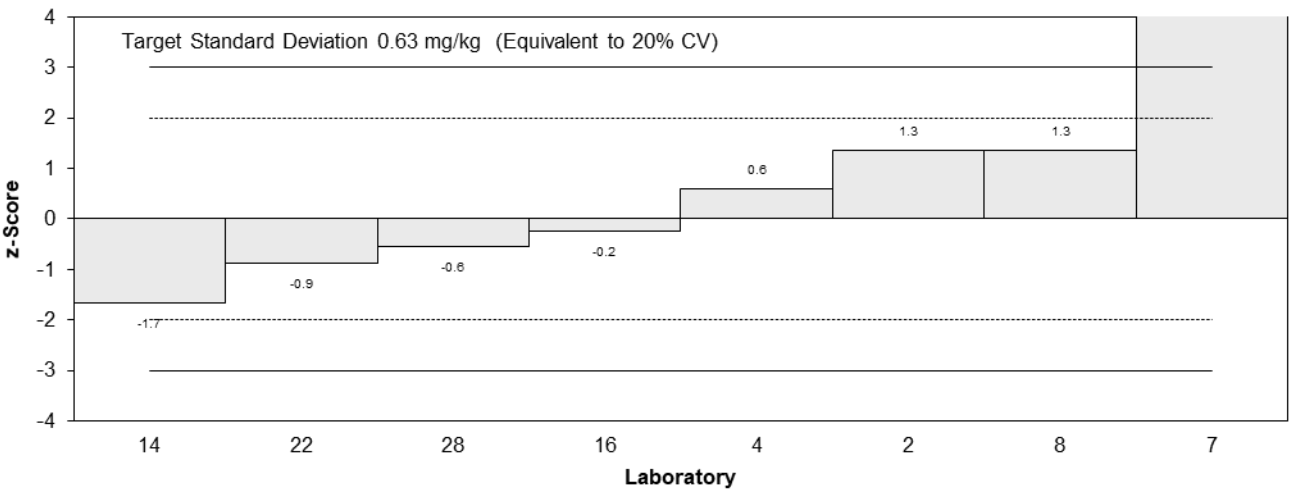
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	4	1	1.35	0.67
3	NT	NT		
4	3.53	NR	0.60	0.49
5	NT	NT		
6	NT	NT		
7	29.8	2.7	42.30	9.48
8	4	0.7	1.35	0.81
9	NR	NR		
10	NT	NT		
11	NT	NT		
12	NR	NR		
13	NT	NT		
14	2.1	0.21	-1.67	-1.30
15	NR	NR		
16	3.0	0.26	-0.24	-0.18
17	NT	NT		
18	NT	NT		
19	NT	NT		
20	NT	NT		
21	NR	NR		
22	2.6	0.5	-0.87	-0.59
23	NT	NT		
24	NT	NT		
25	NT	NT		
26	NT	NT		
27	NT	NT		
28	2.8	0.56	-0.56	-0.36
29	NT	NT		
30	NT	NT		

Statistics*

Assigned Value	3.15	0.78
Spike	Not Spiked	
Homogeneity Value	4.00	0.70
Robust Average	3.15	0.78
Median	3.00	0.73
Mean	3.15	
N	7	
Max.	4	
Min.	2.1	
Robust SD	0.82	
Robust CV	26%	

*Laboratory 7 was excluded from statistical calculation (extreme outlier).


Kernel Density
Density
Result
Results: S3 - Fluoride
Assigned Value = 3.15 ± 0.78 mg/kg
Results (mg/kg)
14 22 28 16 4 2 8 7 12 15 21 9 1 10 11 13 17 18 19 20 23 24 25 26 27 29 3 30 5 6 Md R.A. H.V.
Laboratory


z-Scores: S3 - Fluoride
Target Standard Deviation 0.63 mg/kg (Equivalent to 20% CV)
z-Score
-1.7
-0.9
-0.6
-0.2
0.6
1.3
1.3
14 22 28 16 4 2 8 7
Laboratory

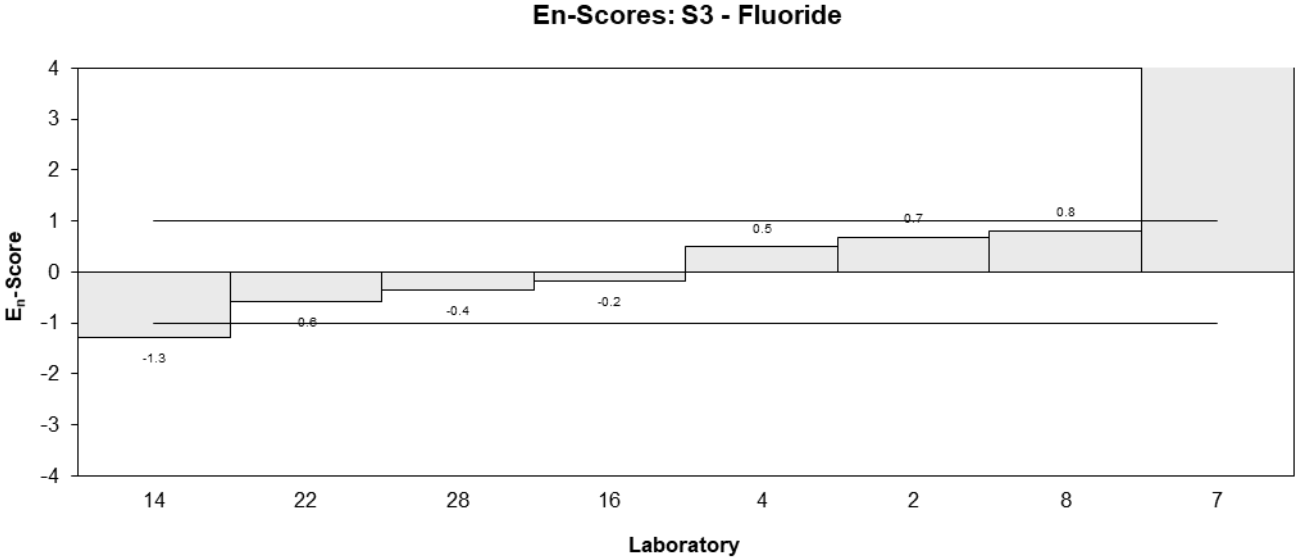

En-Scores: S3 - Fluoride
En-Score
-1.3
-0.6
-0.4
-0.2
0.5
0.7
0.8
14 22 28 16 4 2 8 7
Laboratory

Figure 43

Table 56

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	Iodide
Units	mg/kg

Participant Results

Lab Code	Result	Uncertainty
1	NT	NT
2	NT	NT
3	NT	NT
4	NT	NT
5	NT	NT
6	NT	NT
7	0.58	0.09
8	<0.25	NR
9	NR	NR
10	NT	NT
11	NT	NT
12	NR	NR
13	NT	NT
14	<5	NR
15	NR	NR
16	NT	NT
17	NT	NT
18	NT	NT
19	NT	NT
20	NT	NT
21	NT	NT
22	<1	0.2
23	NT	NT
24	NT	NT
25	NT	NT
26	NT	NT
27	NT	NT
28	NT	NT
29	4.00	0.84
30	NT	NT

Statistics*

Assigned Value	Not Set	
Spike	Not Spiked	
Mean	2.29	
N	2	
Max.	4	
Min.	0.58	

*Insufficient data to calculate statistics.

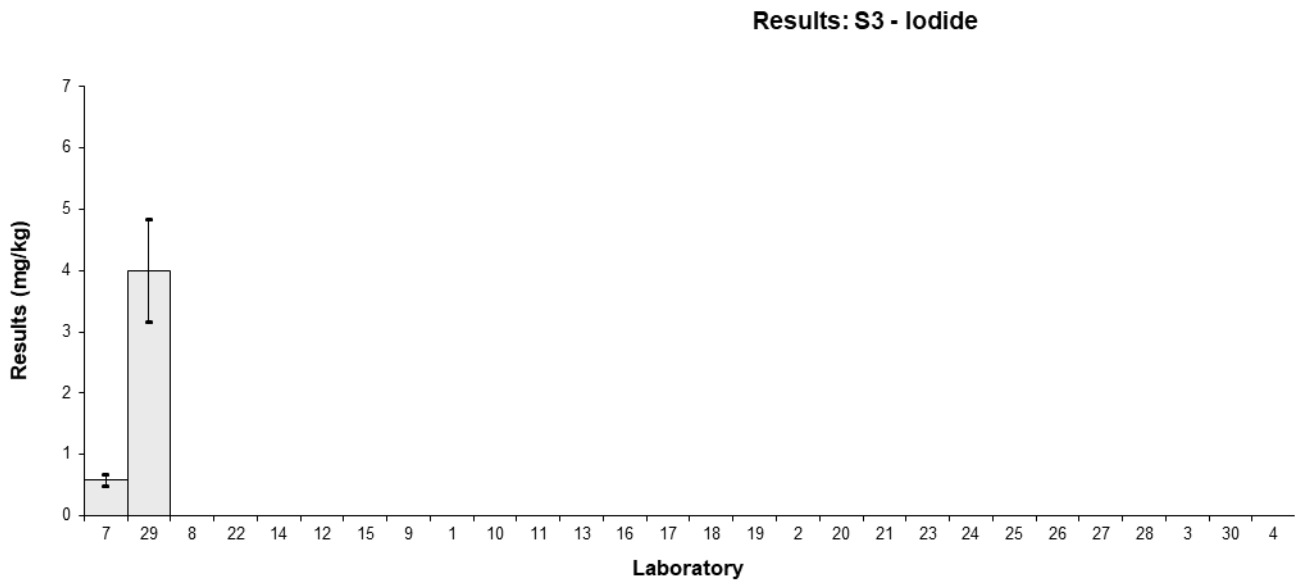

Results: S3 - Iodide
Results (mg/kg)
0
1
2
3
4
5
6
7
7
29
8
22
14
12
15
9
1
10
11
13
16
17
18
19
2
20
21
23
24
25
26
27
28
3
30
4
Laboratory

Figure 44

Table 57

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	K
Units	mg/kg

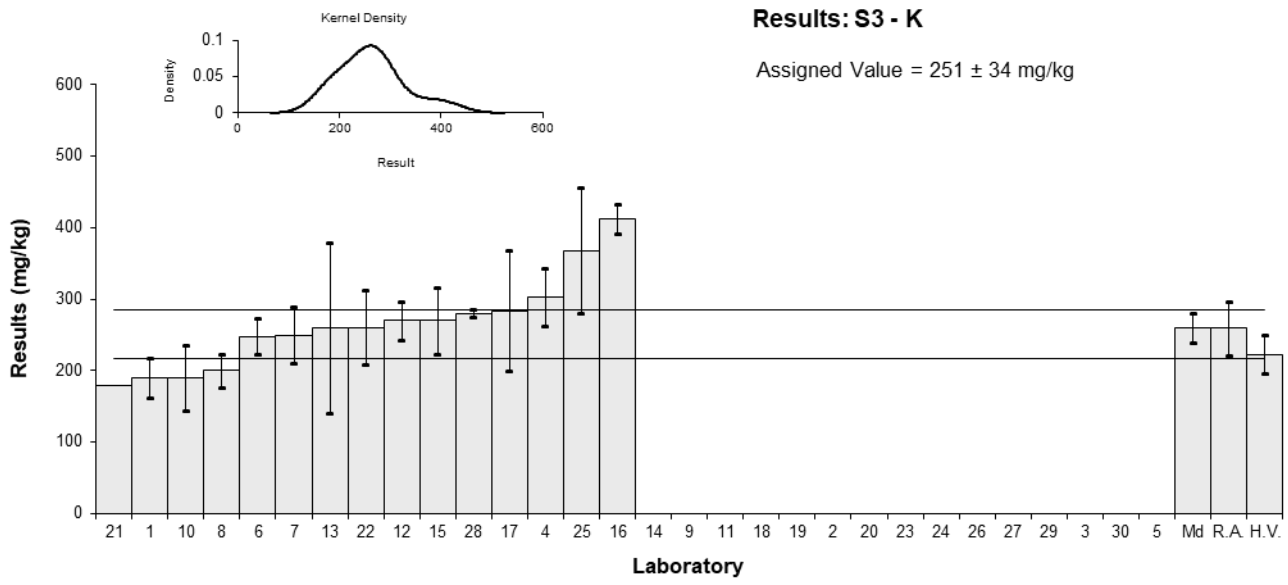
Participant Results

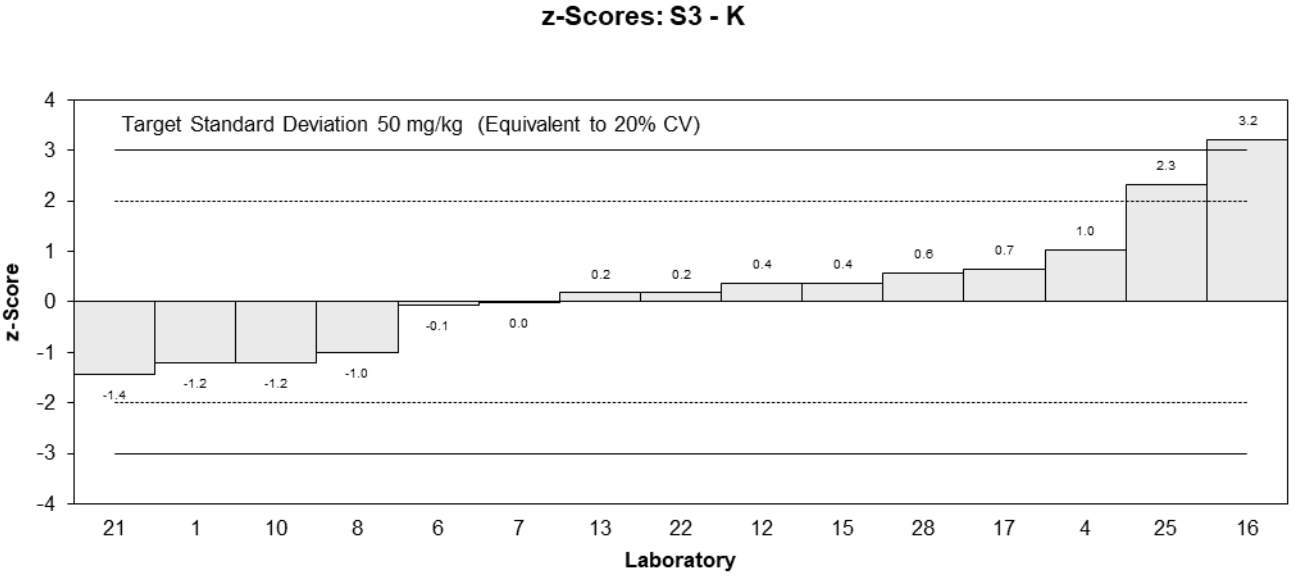
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	190	28.5	-1.22	-1.37
2	NT	NT		
3	NT	NT		
4	302.3	40.6	1.02	0.97
5	NT	NT		
6	248	25	-0.06	-0.07
7	250	40	-0.02	-0.02
8	200	24	-1.02	-1.23
9	NR	NR		
10	190	46	-1.22	-1.07
11	NT	NT		
12	270	27	0.38	0.44
13	260	120	0.18	0.07
14	NR	NR		
15	270	47	0.38	0.33
16	412	20.2	3.21	4.07
17	284	85	0.66	0.36
18	NT	NT		
19	NT	NT		
20	NT	NT		
21	179	NR	-1.43	-2.12
22	260	52	0.18	0.14
23	NT	NT		
24	NT	NT		
25	368	88	2.33	1.24
26	NT	NT		
27	NT	NT		
28	280	5.6	0.58	0.84
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value*	251	34
Spike	Not Spiked	
Homogeneity Value	223	27
Robust Average	259	38
Median	260	20
Mean	264	
N	15	
Max.	412	
Min.	179	
Robust SD	59	
Robust CV	23%	

*Robust Average excluding laboratory 16.


Results: S3 - K
Assigned Value = 251 ± 34 mg/kg
Kernel Density
Density
Result
Results (mg/kg)
Laboratory
21 1 10 8 6 7 13 22 12 15 28 17 4 25 16 14 9 11 18 19 2 20 23 24 26 27 29 3 30 5 Md R.A. H.V.


z-Scores: S3 - K
Target Standard Deviation 50 mg/kg (Equivalent to 20% CV)
z-Score
Laboratory
21 1 10 8 6 7 13 22 12 15 28 17 4 25 16

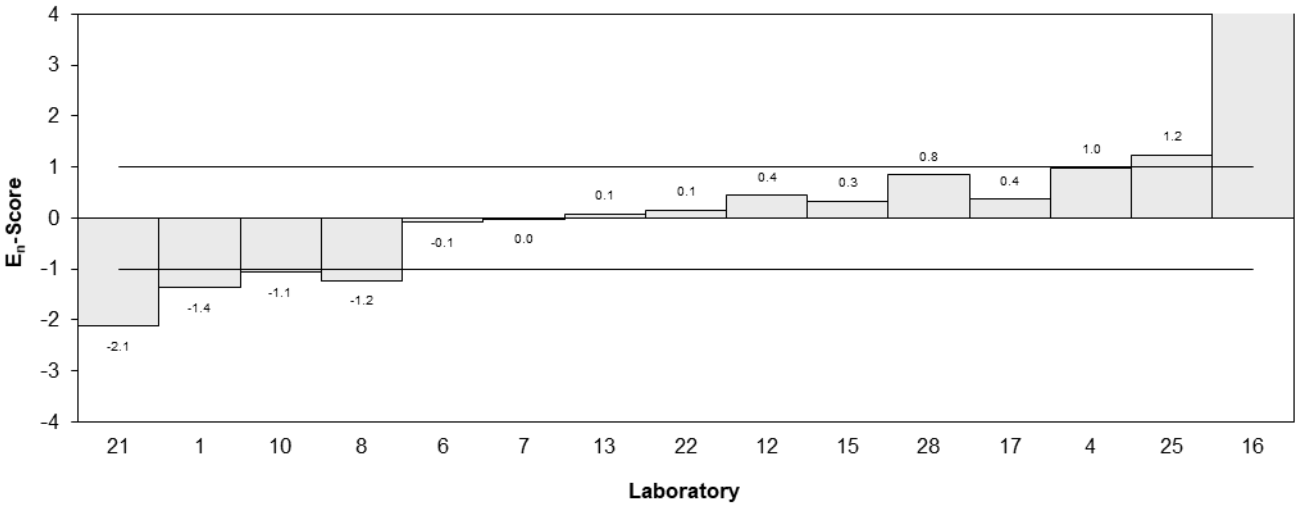

En-Scores: S3 - K
En-Score
Laboratory
21 1 10 8 6 7 13 22 12 15 28 17 4 25 16

Figure 45

Table 58

Sample Details

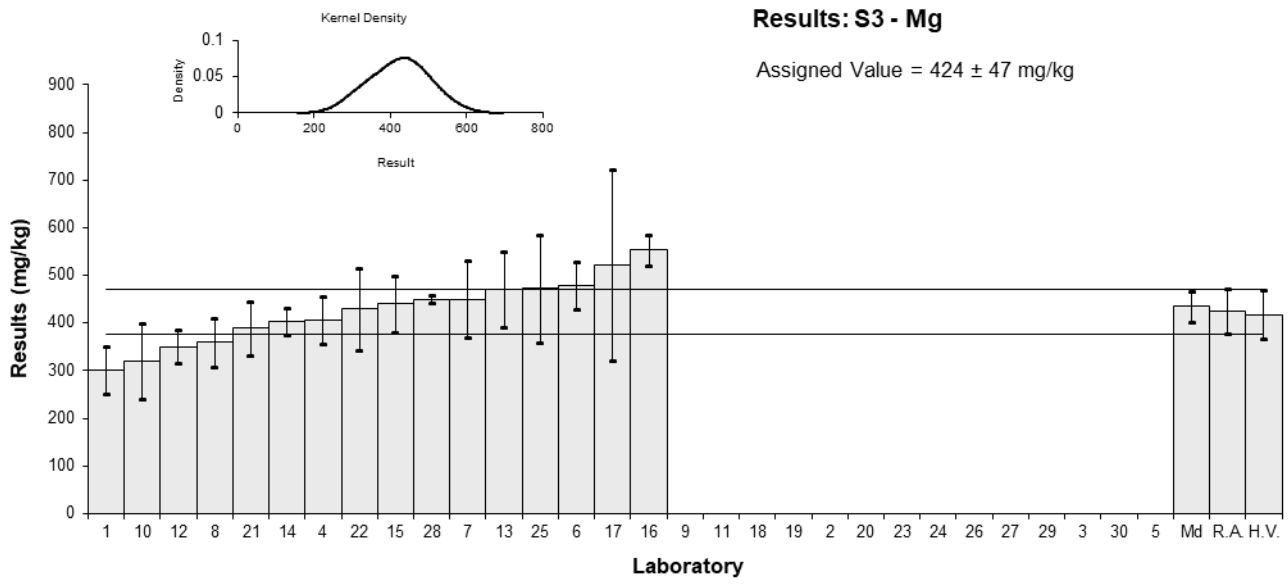
Sample No.	S3
Matrix.	Soil
Analyte.	Mg
Units	mg/kg

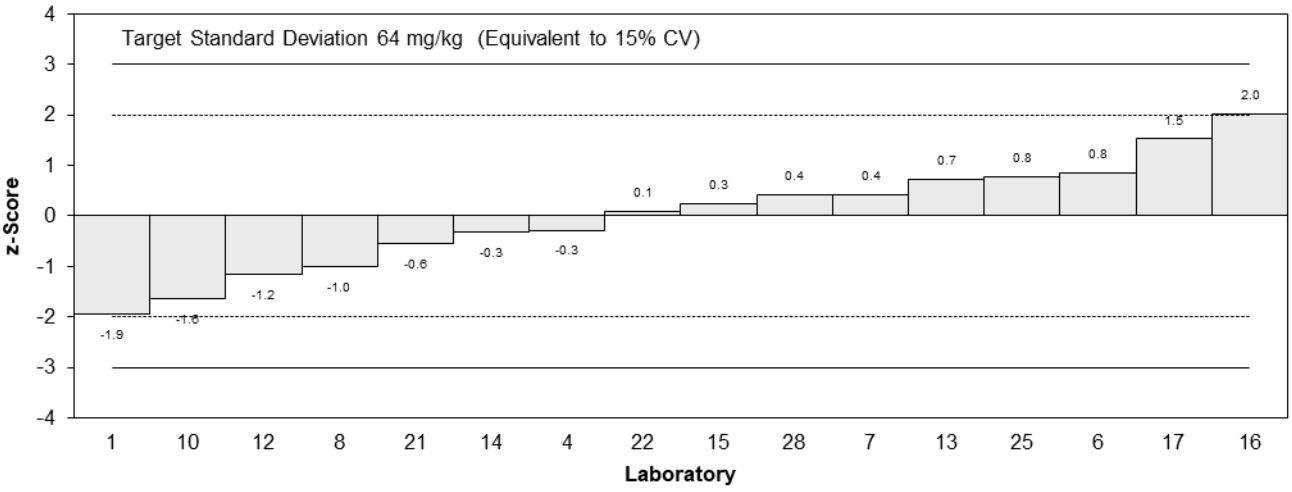
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	300	49.5	-1.95	-1.82
2	NT	NT		
3	NT	NT		
4	406	50.2	-0.28	-0.26
5	NT	NT		
6	478	50	0.85	0.79
7	450	80	0.41	0.28
8	360	51	-1.01	-0.92
9	NR	NR		
10	320	80	-1.64	-1.12
11	NT	NT		
12	350	35	-1.16	-1.26
13	470	80	0.72	0.50
14	403	28	-0.33	-0.38
15	440	60	0.25	0.21
16	553	31.5	2.03	2.28
17	521	200	1.53	0.47
18	NT	NT		
19	NT	NT		
20	NT	NT		
21	389	56	-0.55	-0.48
22	430	86	0.09	0.06
23	NT	NT		
24	NT	NT		
25	473	113	0.77	0.40
26	NT	NT		
27	NT	NT		
28	450	9	0.41	0.54
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value	424	47
Spike	Not Spiked	
Homogeneity Value	418	50
Robust Average	424	47
Median	435	32
Mean	425	
N	16	
Max.	553	
Min.	300	
Robust SD	76	
Robust CV	18%	


Kernel Density
Density
Result
Results: S3 - Mg
Assigned Value = 424 ± 47 mg/kg
Results (mg/kg)
Laboratory
1 10 12 8 21 14 4 22 15 28 7 13 25 6 17 16 9 11 18 19 2 20 23 24 26 27 29 3 30 5 Md R.A. H.V.


z-Scores: S3 - Mg
Target Standard Deviation 64 mg/kg (Equivalent to 15% CV)
z-Score
Laboratory
1 10 12 8 21 14 4 22 15 28 7 13 25 6 17 16
-1.9 -1.6 -1.2 -1.0 -0.6 -0.3 -0.3 0.1 0.3 0.4 0.4 0.7 0.8 0.8 1.5 2.0

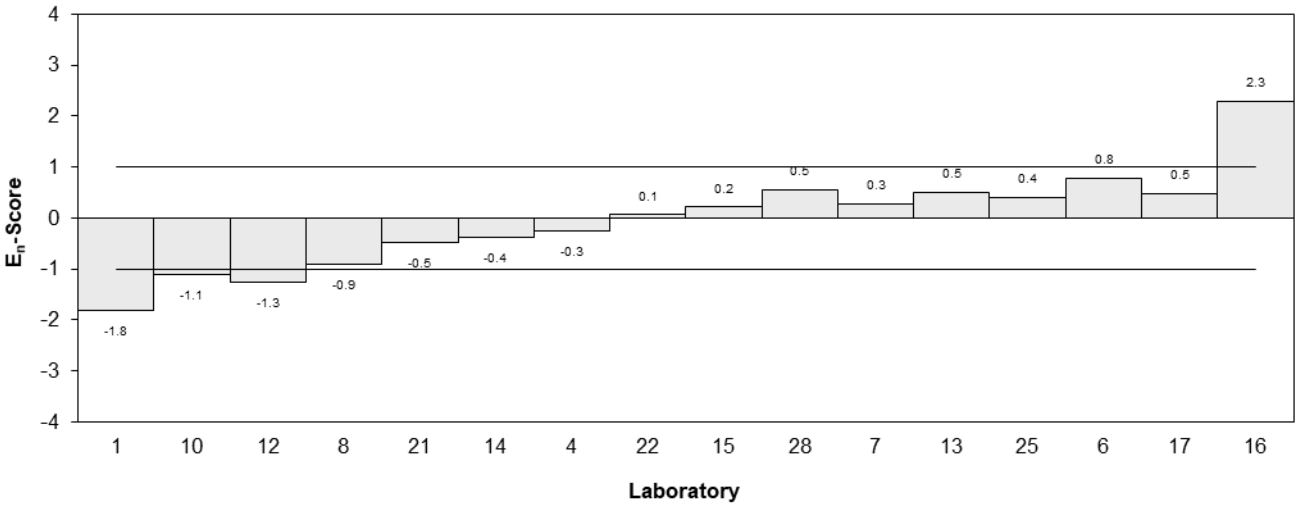

En-Scores: S3 - Mg
En-Score
Laboratory
1 10 12 8 21 14 4 22 15 28 7 13 25 6 17 16
-1.8 -1.1 -1.3 -0.9 -0.5 -0.4 -0.3 0.1 0.2 0.5 0.3 0.5 0.4 0.8 0.5 2.3

Figure 46

Table 59

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	Na
Units	mg/kg

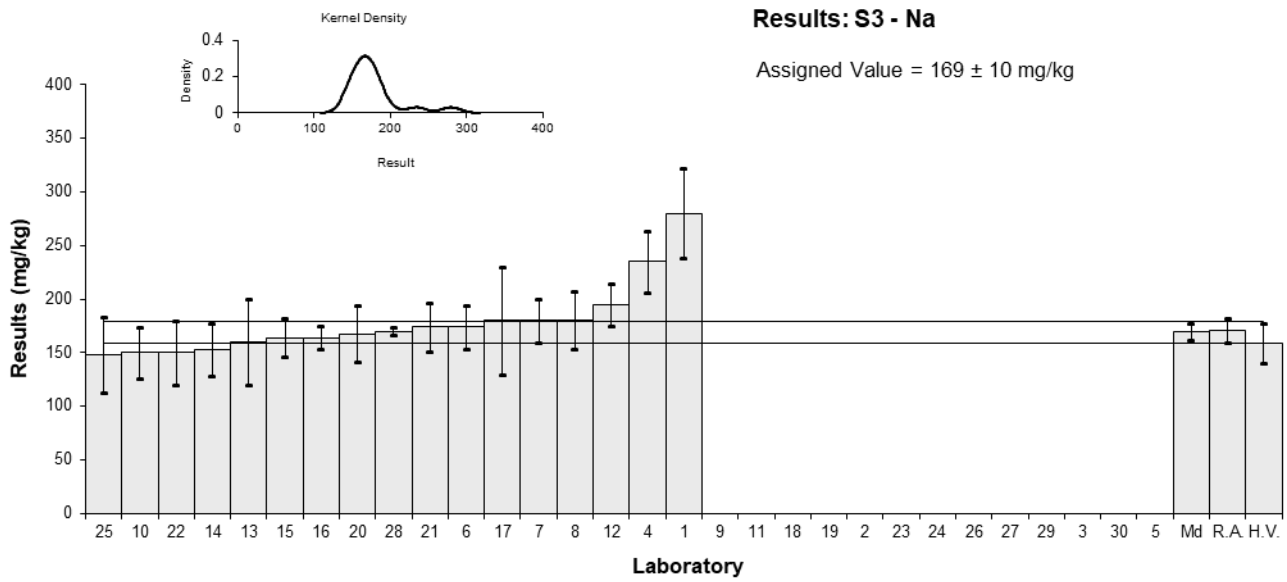
Participant Results

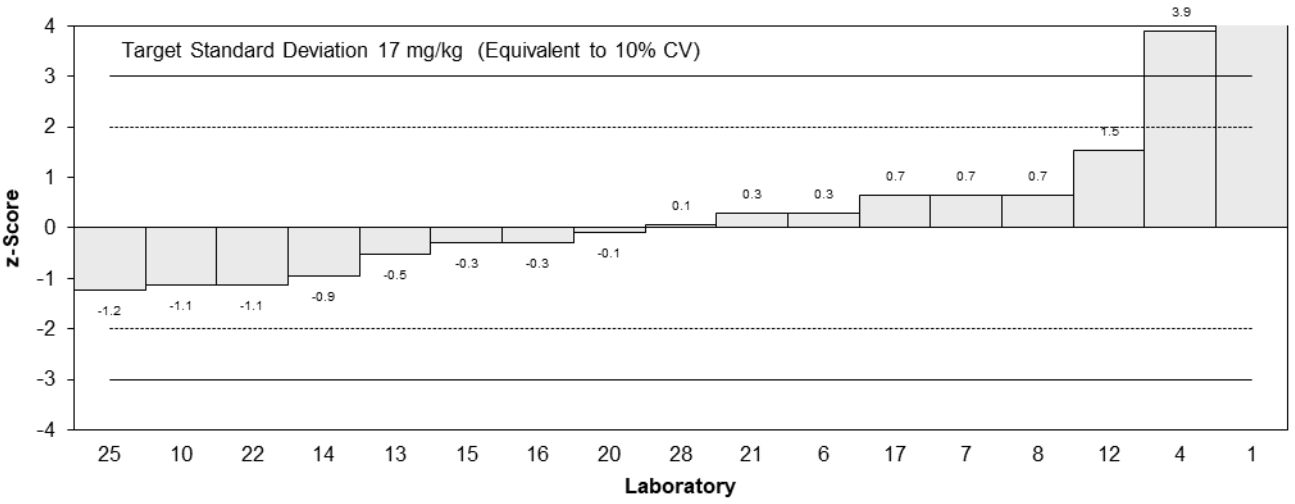
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	280	42	6.57	2.57
2	NT	NT		
3	NT	NT		
4	234.9	29.2	3.90	2.14
5	NT	NT		
6	174	20	0.30	0.22
7	180	20	0.65	0.49
8	180	27	0.65	0.38
9	NR	NR		
10	150	24	-1.12	-0.73
11	NT	NT		
12	195	20	1.54	1.16
13	160	40	-0.53	-0.22
14	153	25	-0.95	-0.59
15	164	18	-0.30	-0.24
16	164	11	-0.30	-0.34
17	180	50	0.65	0.22
18	NT	NT		
19	NT	NT		
20	167.6	26.574	-0.08	-0.05
21	174	23	0.30	0.20
22	150	30	-1.12	-0.60
23	NT	NT		
24	NT	NT		
25	148	35.3	-1.24	-0.57
26	NT	NT		
27	NT	NT		
28	170	3.4	0.06	0.09
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value*	169	10
Spike	Not Spiked	
Homogeneity Value	159	19
Robust Average	171	11
Median	170	8
Mean	178	
N	17	
Max.	280	
Min.	148	
Robust SD	19	
Robust CV	11%	

*Robust Average excluding laboratory 1.


Kernel Density
Density
Result
Results: S3 - Na
Assigned Value = 169 ± 10 mg/kg
Results (mg/kg)
Laboratory
25 10 22 14 13 15 16 20 28 21 6 17 7 8 12 4 1 9 11 18 19 2 23 24 26 27 29 3 30 5 Md R.A. H.V.


z-Scores: S3 - Na
Target Standard Deviation 17 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
25 10 22 14 13 15 16 20 28 21 6 17 7 8 12 4 1
-1.2 -1.1 -1.1 -0.9 -0.5 -0.3 -0.3 -0.1 0.1 0.3 0.3 0.7 0.7 0.7 1.5 3.9

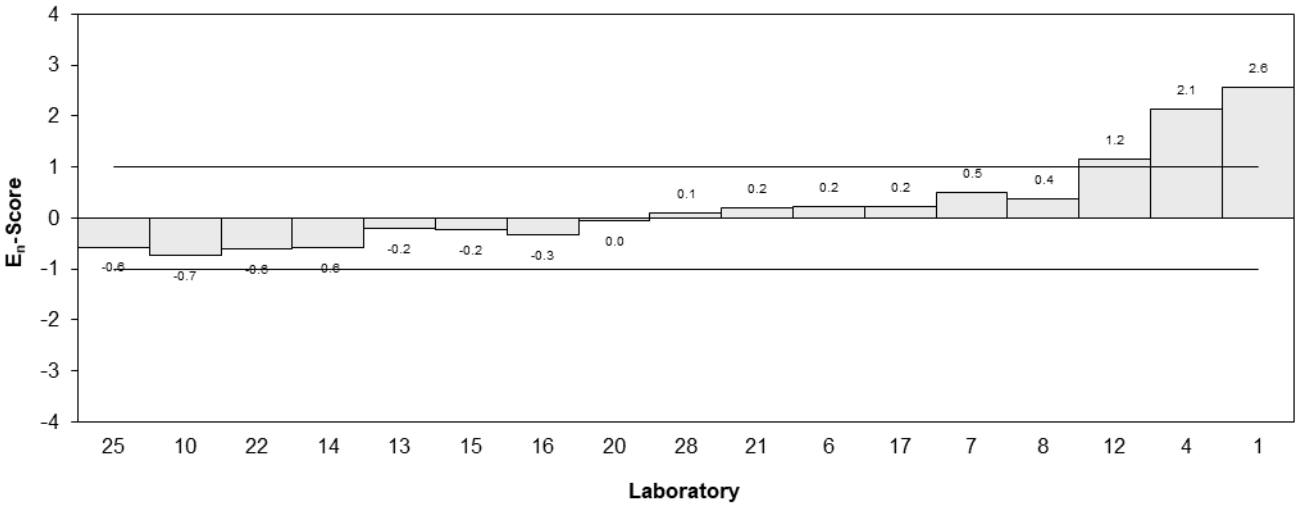

En-Scores: S3 - Na
En-Score
Laboratory
25 10 22 14 13 15 16 20 28 21 6 17 7 8 12 4 1
-0.6 -0.7 -0.6 -0.6 -0.2 -0.2 -0.3 0.0 0.1 0.2 0.2 0.2 0.5 0.4 1.2 2.1 2.6

Figure 47

Table 60

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	Nitrate-N
Units	mg/kg

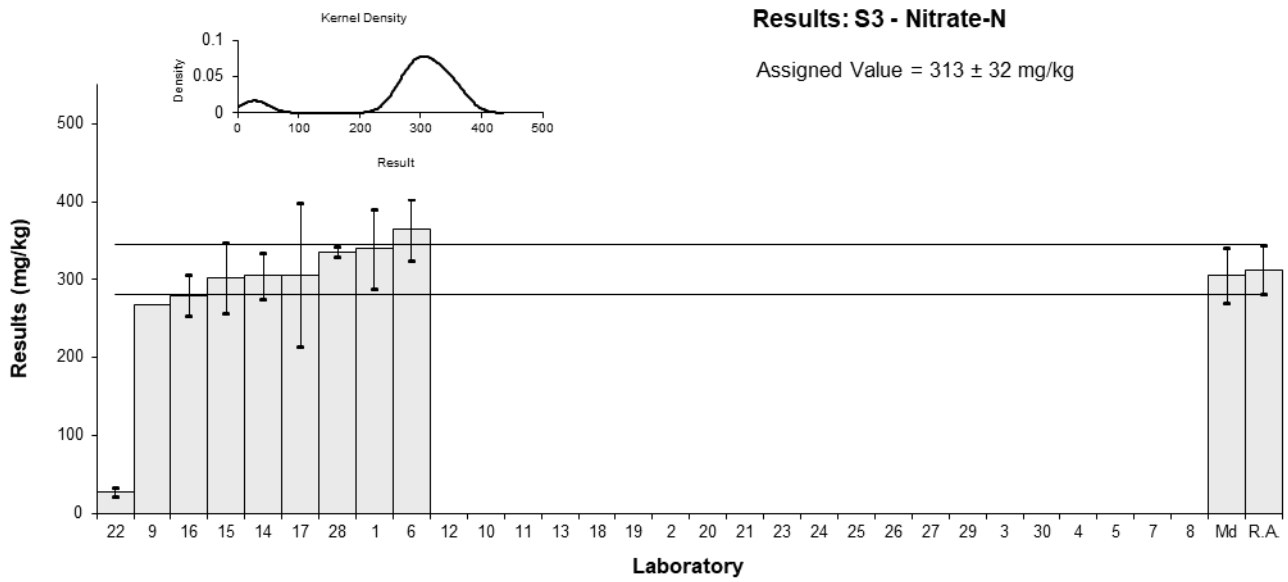
Participant Results

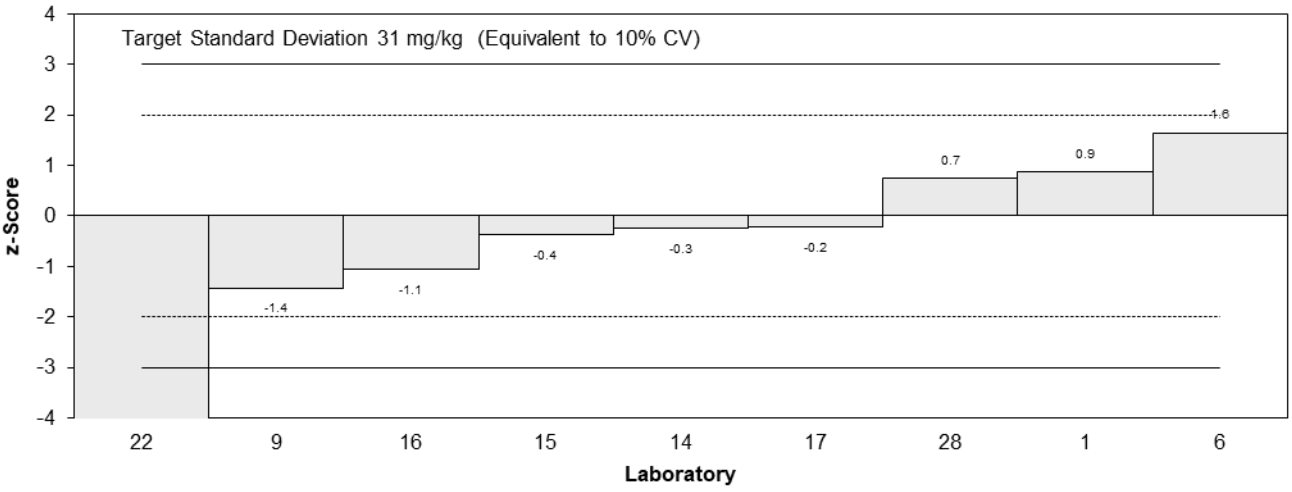
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	340	51	0.86	0.45
2	NT	NT		
3	NT	NT		
4	NT	NT		
5	NT	NT		
6	364	40	1.63	1.00
7	NT	NT		
8	NT	NT		
9	268.4	NR	-1.42	-1.39
10	NT	NT		
11	NT	NT		
12	NR	NR		
13	NT	NT		
14	305	30	-0.26	-0.18
15	301.61	45.24	-0.36	-0.21
16	280	25.8	-1.05	-0.80
17	306	92	-0.22	-0.07
18	NT	NT		
19	NT	NT		
20	NT	NT		
21	NT	NT		
22	28	5.6	-9.11	-8.77
23	NT	NT		
24	NT	NT		
25	NT	NT		
26	NT	NT		
27	NT	NT		
28	336	6.72	0.73	0.70
29	NT	NT		
30	NT	NT		

Statistics*

Assigned Value	313	32
Spike	Not Spiked	
Robust Average	313	32
Median	306	35
Mean	313	
N	8	
Max.	364	
Min.	268.4	
Robust SD	36	
Robust CV	12%	

Laboratory 22 was excluded from statistical calcculation (extreme outlier).


Kernel Density
Density
Result
Results: S3 - Nitrate-N
Assigned Value = 313 ± 32 mg/kg
Results (mg/kg)
Laboratory
22 9 16 15 14 17 28 1 6 12 10 11 13 18 19 2 20 21 23 24 25 26 27 29 3 30 4 5 7 8 Md R.A.


z-Scores: S3 - Nitrate-N
Target Standard Deviation 31 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
22 9 16 15 14 17 28 1 6
-1.4
-1.1
-0.4
-0.3
-0.2
0.7
0.9
1.6

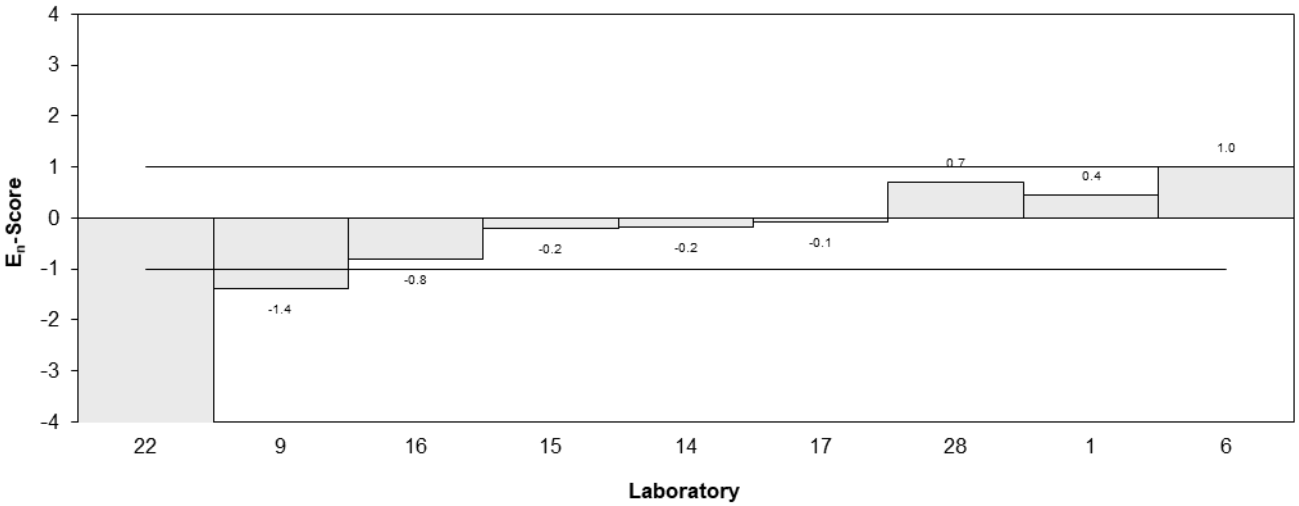

En-Scores: S3 - Nitrate-N
En-Score
Laboratory
22 9 16 15 14 17 28 1 6
-1.4
-0.8
-0.2
-0.2
-0.1
0.7
0.4
1.0

Figure 48

Table 61

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	Orthophosphate-P
Units	mg/kg

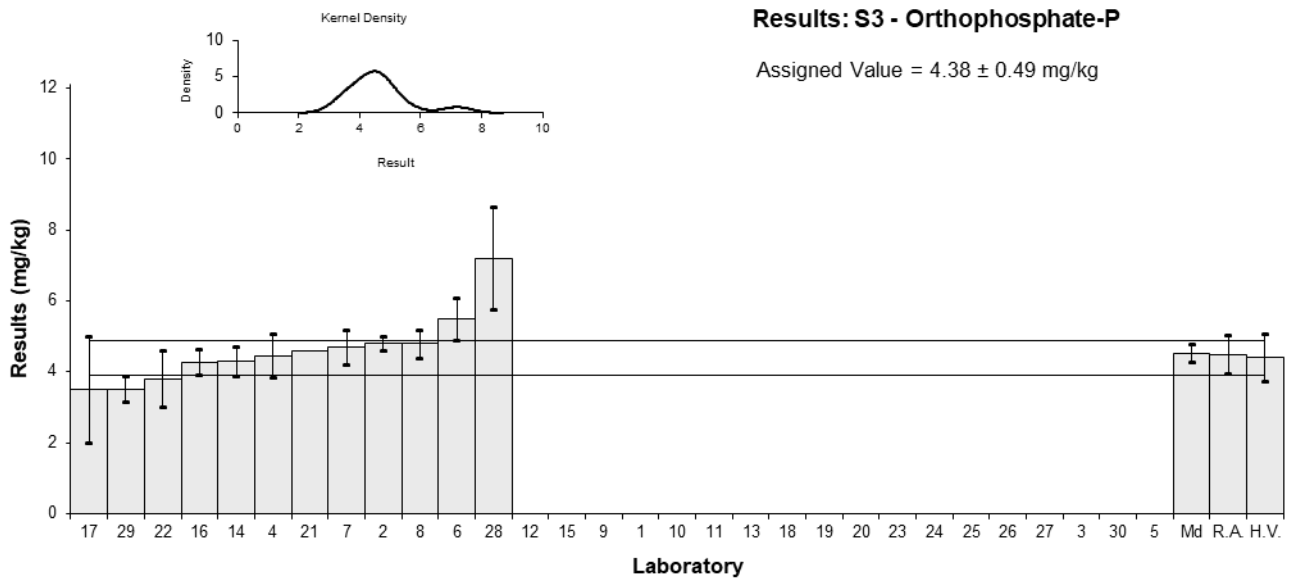
Participant Results

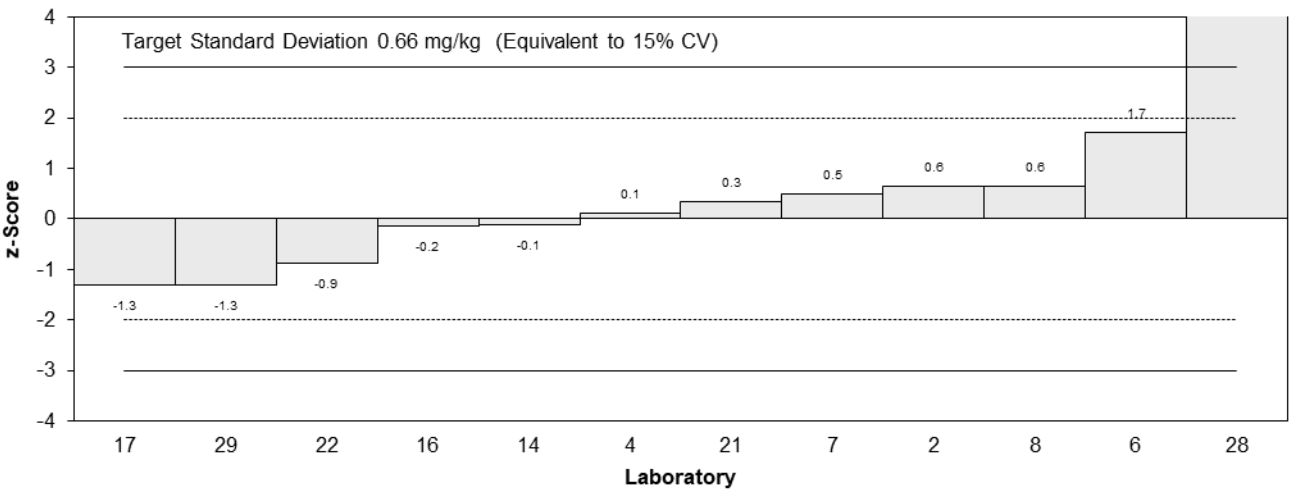
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	4.8	0.2	0.64	0.79
3	NT	NT		
4	4.46	0.6	0.12	0.10
5	NT	NT		
6	5.5	0.6	1.70	1.45
7	4.7	0.5	0.49	0.46
8	4.8	0.4	0.64	0.66
9	NR	NR		
10	NT	NT		
11	NT	NT		
12	NR	NR		
13	NT	NT		
14	4.3	0.4	-0.12	-0.13
15	NR	NR		
16	4.28	0.36	-0.15	-0.16
17	3.52	1.5	-1.31	-0.54
18	NT	NT		
19	NT	NT		
20	NT	NT		
21	4.6	NR	0.33	0.45
22	3.8	0.8	-0.88	-0.62
23	NT	NT		
24	NT	NT		
25	NT	NT		
26	NT	NT		
27	NT	NT		
28	7.2	1.44	4.29	1.85
29	3.52	0.37	-1.31	-1.40
30	NT	NT		

Statistics

Assigned Value*	4.38	0.49
Spike	Not Spiked	
Homogeneity Value	4.40	0.66
Robust Average	4.49	0.55
Median	4.53	0.25
Mean	4.62	
N	12	
Max.	7.2	
Min.	3.52	
Robust SD	0.77	
Robust CV	17%	

*Robust Average excluding laboratory 28.


Kernel Density
Density
Result
Results: S3 - Orthophosphate-P
Assigned Value = 4.38 ± 0.49 mg/kg
Results (mg/kg)
Laboratory
17 29 22 16 14 4 21 7 2 8 6 28 12 15 9 1 10 11 13 18 19 20 23 24 25 26 27 3 30 5 Md R.A. H.V.


z-Scores: S3 - Orthophosphate-P
Target Standard Deviation 0.66 mg/kg (Equivalent to 15% CV)
z-Score
Laboratory
17 29 22 16 14 4 21 7 2 8 6 28
-1.3 -1.3 -0.9 -0.2 -0.1 0.1 0.3 0.5 0.6 0.6 1.7

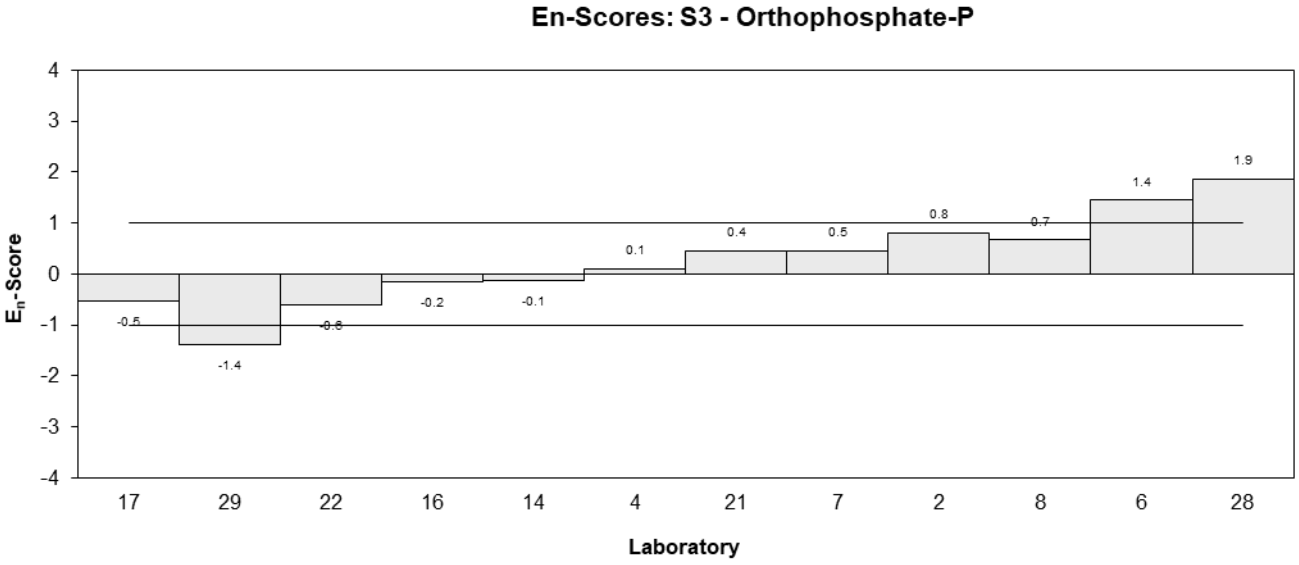

En-Scores: S3 - Orthophosphate-P
En-Score
Laboratory
17 29 22 16 14 4 21 7 2 8 6 28
-0.5 -1.4 -0.6 -0.2 -0.1 0.1 0.4 0.5 0.8 0.7 1.4 1.9

Figure 49

Table 62

Sample Details

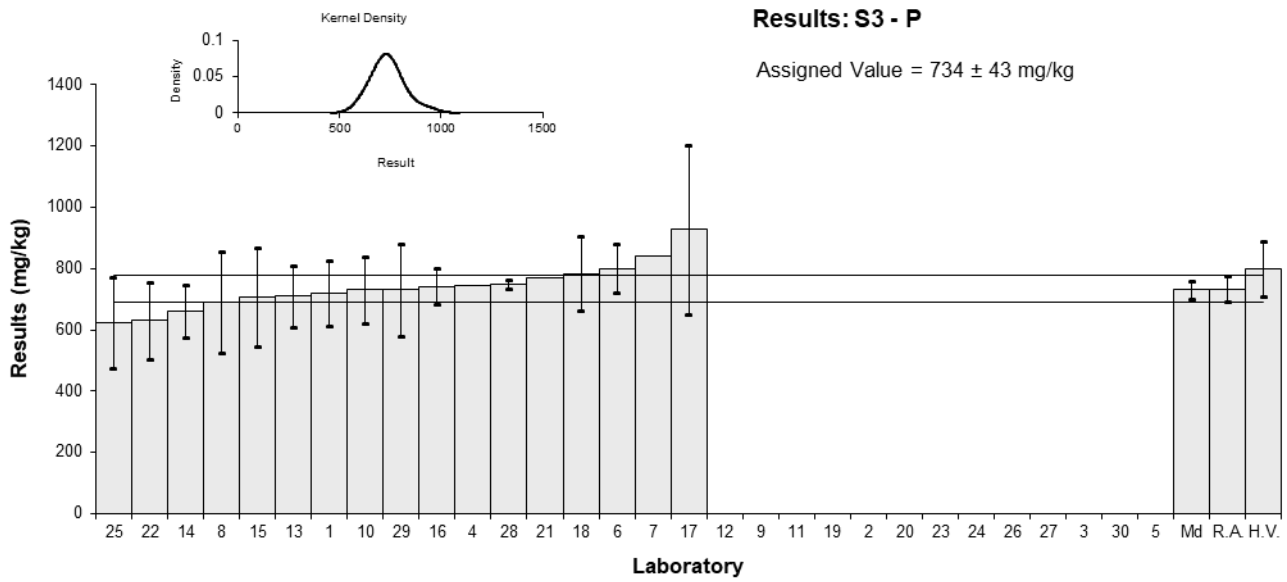
Sample No.	S3
Matrix.	Soil
Analyte.	P
Units	mg/kg

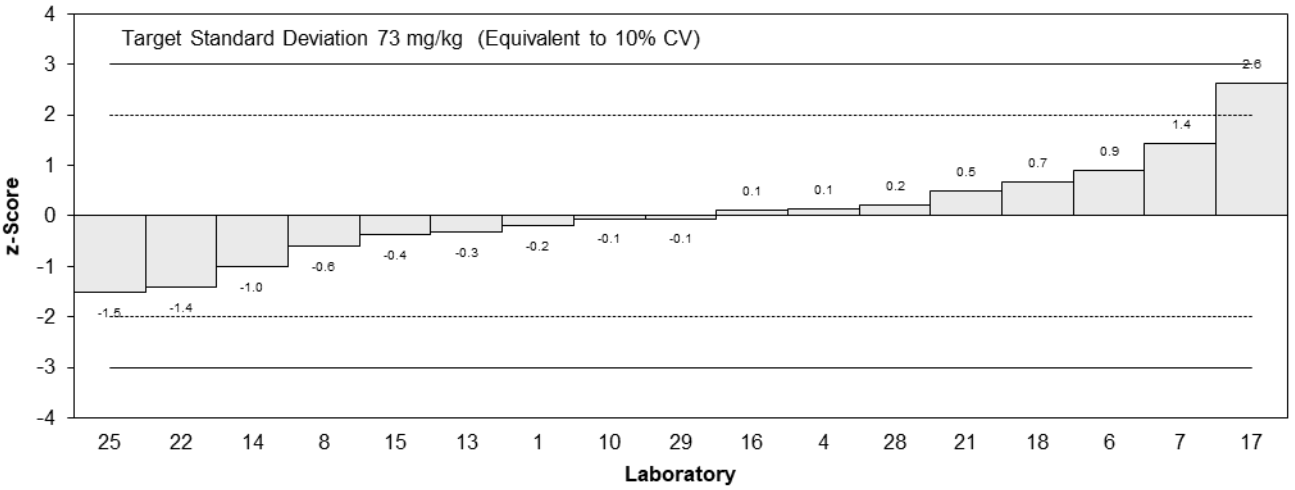
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	720	108	-0.19	-0.12
2	NT	NT		
3	NT	NT		
4	743.9	NR	0.13	0.23
5	NT	NT		
6	800	80	0.90	0.73
7	840	NR	1.44	2.47
8	690	165	-0.60	-0.26
9	NR	NR		
10	730	110	-0.05	-0.03
11	NT	NT		
12	NR	NR		
13	710	100	-0.33	-0.22
14	660	86	-1.01	-0.77
15	707	160	-0.37	-0.16
16	742	59.4	0.11	0.11
17	927	275	2.63	0.69
18	783	121	0.67	0.38
19	NT	NT		
20	NT	NT		
21	770	NR	0.49	0.84
22	630	126	-1.42	-0.78
23	NT	NT		
24	NT	NT		
25	622	149	-1.53	-0.72
26	NT	NT		
27	NT	NT		
28	750	15	0.22	0.35
29	730	150	-0.05	-0.03
30	NT	NT		

Statistics

Assigned Value	734	43
Spike	Not Spiked	
Homogeneity Value	800	90
Robust Average	734	43
Median	730	30
Mean	739	
N	17	
Max.	927	
Min.	622	
Robust SD	70	
Robust CV	9.6%	


Results: S3 - P
Assigned Value = 734 ± 43 mg/kg
Kernel Density
Density
Result
Results (mg/kg)
Laboratory
25 22 14 8 15 13 1 10 29 16 4 28 21 18 6 7 17 12 9 11 19 2 20 23 24 26 27 3 30 5 Md R.A. H.V.


z-Scores: S3 - P
Target Standard Deviation 73 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
25 22 14 8 15 13 1 10 29 16 4 28 21 18 6 7 17

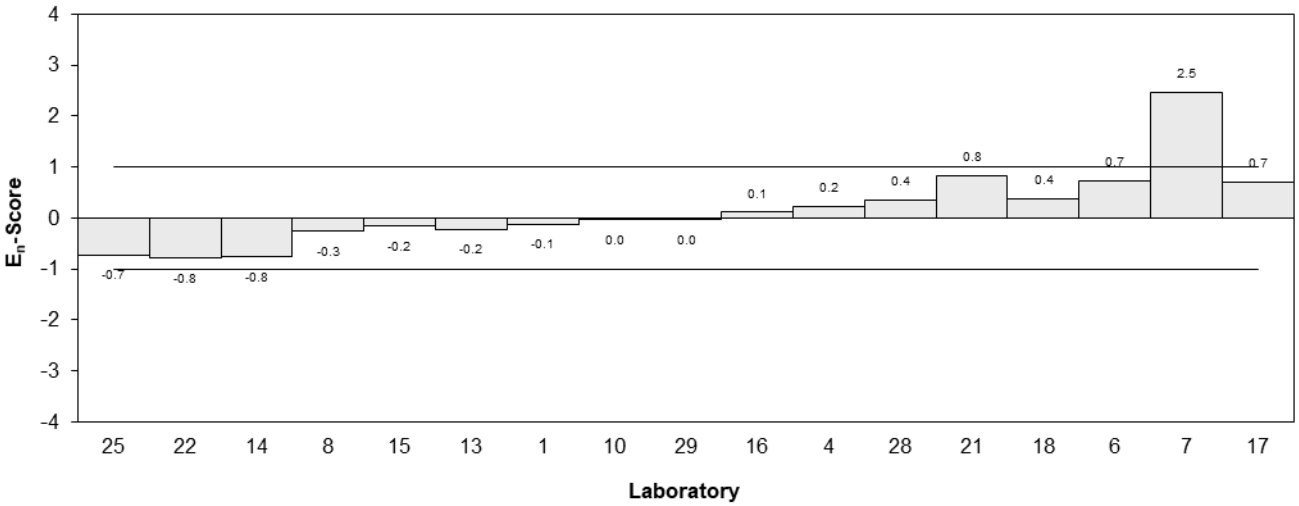

En-Scores: S3 - P
En-Score
Laboratory
25 22 14 8 15 13 1 10 29 16 4 28 21 18 6 7 17

Figure 50

Table 63

Sample Details

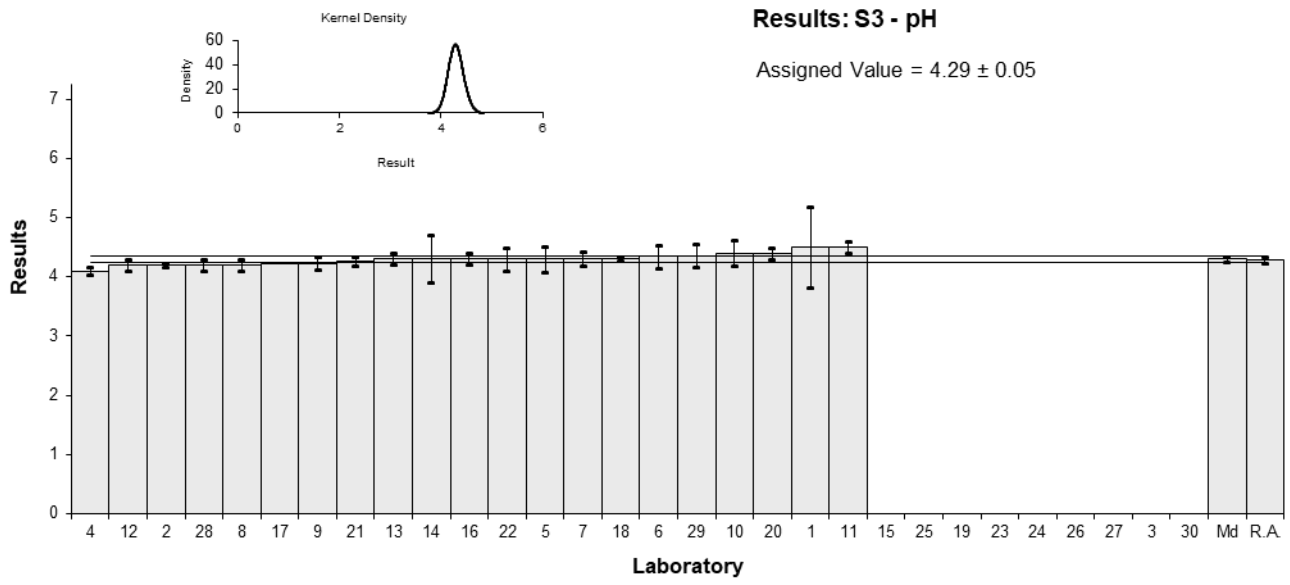
Sample No.	S3
Matrix.	Soil
Analyte.	pH
Units	mg/kg

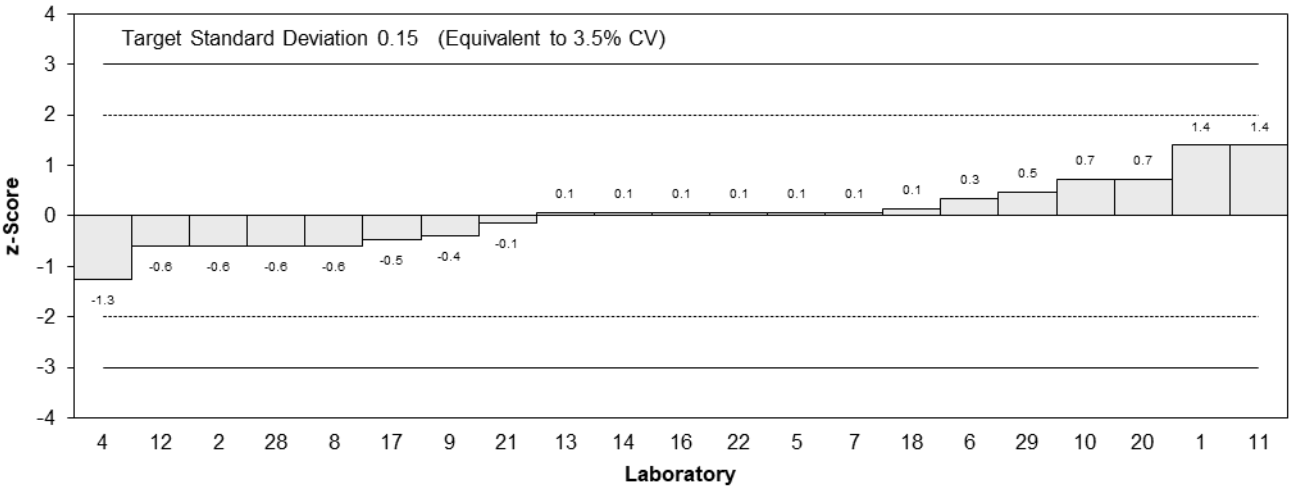
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	4.5	0.675	1.40	0.31
2	4.2	0.04	-0.60	-1.41
3	NT	NT		
4	4.1	0.07	-1.27	-2.21
5	4.3	0.215	0.07	0.05
6	4.34	0.2	0.33	0.24
7	4.3	0.12	0.07	0.08
8	4.2	0.1	-0.60	-0.80
9	4.23	0.10	-0.40	-0.54
10	4.4	0.22	0.73	0.49
11	4.5	0.1	1.40	1.88
12	4.2	0.1	-0.60	-0.80
13	4.3	0.1	0.07	0.09
14	4.3	0.4	0.07	0.02
15	NR	NR		
16	4.30	0.1	0.07	0.09
17	4.22	NR	-0.47	-1.40
18	4.31	0.04	0.13	0.31
19	NT	NT		
20	4.4	0.1	0.73	0.98
21	4.27	0.08	-0.13	-0.21
22	4.3	0.2	0.07	0.05
23	NT	NT		
24	NT	NT		
25	NR	NR		
26	NT	NT		
27	NT	NT		
28	4.2	0.1	-0.60	-0.80
29	4.36	0.2	0.47	0.34
30	NT	NT		

Statistics

Assigned Value	4.29	0.05
Spike	Not Spiked	
Robust Average	4.29	0.05
Median	4.30	0.05
Mean	4.30	
N	21	
Max.	4.5	
Min.	4.1	
Robust SD	0.092	
Robust CV	2.1%	


Kernel Density
Density
Result
Results: S3 - pH
Assigned Value = 4.29 ± 0.05
Results
Laboratory
4 12 2 28 8 17 9 21 13 14 16 22 5 7 18 6 29 10 20 1 11 15 25 19 23 24 26 27 3 30 Md R.A.


z-Scores: S3 - pH
Target Standard Deviation 0.15 (Equivalent to 3.5% CV)
z-Score
Laboratory
4 12 2 28 8 17 9 21 13 14 16 22 5 7 18 6 29 10 20 1 11
-1.3 -0.6 -0.6 -0.6 -0.6 -0.5 -0.4 -0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.3 0.5 0.7 0.7 1.4 1.4

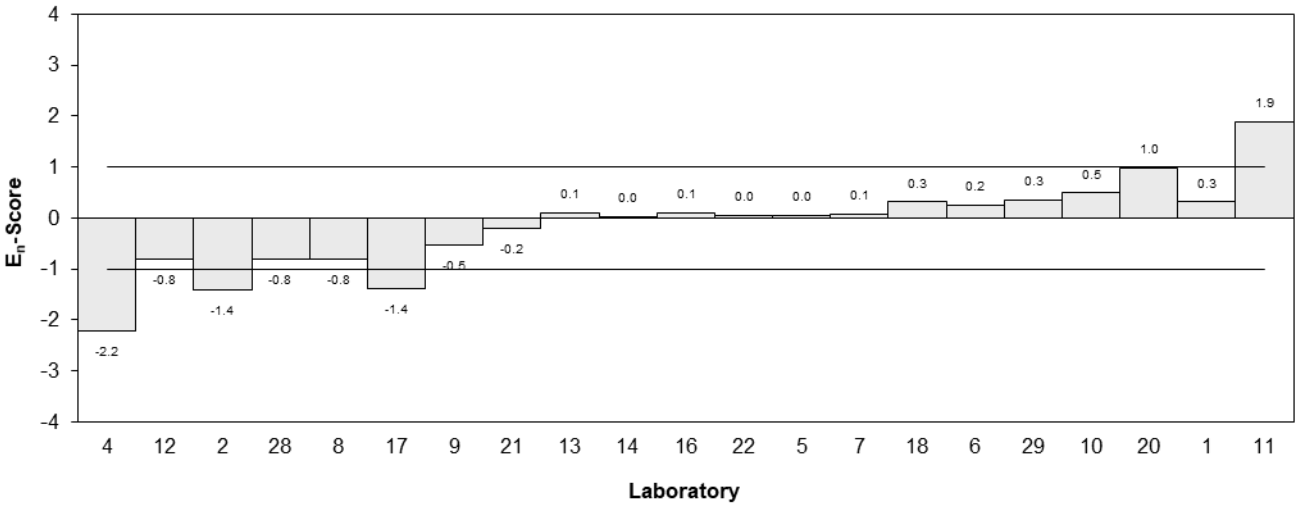

En-Scores: S3 - pH
En-Score
Laboratory
4 12 2 28 8 17 9 21 13 14 16 22 5 7 18 6 29 10 20 1 11
-2.2 -0.8 -1.4 -0.8 -0.8 -1.4 -0.5 -0.2 0.1 0.0 0.1 0.0 0.0 0.1 0.3 0.2 0.3 0.5 1.0 0.3 1.9

Figure 51

Table 64

Sample Details

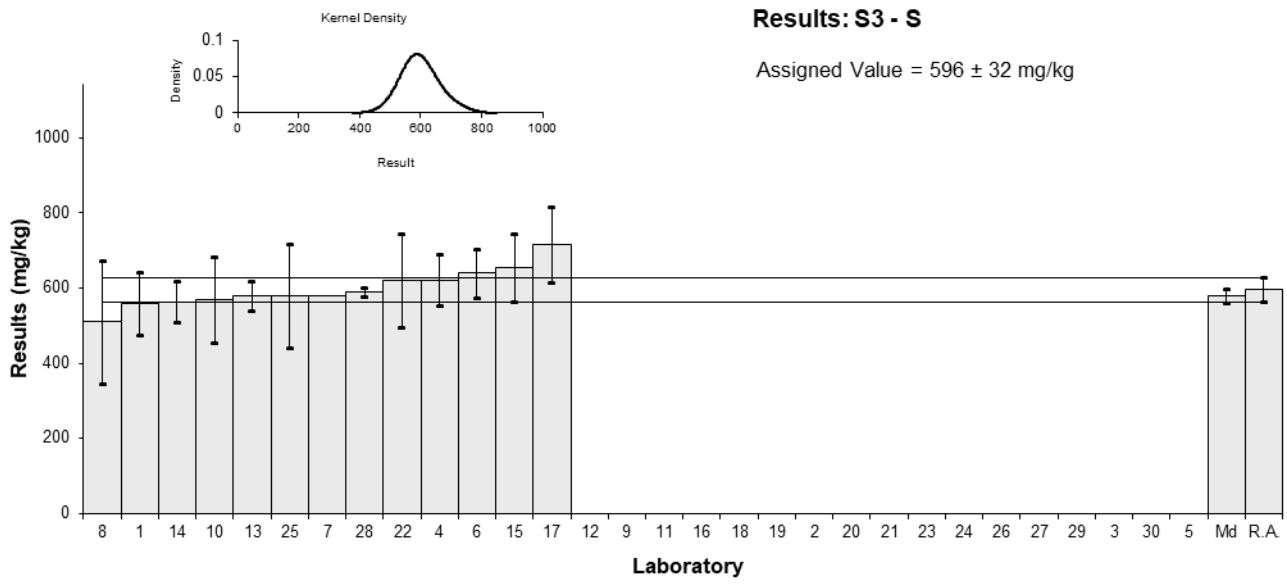
Sample No.	S3
Matrix.	Soil
Analyte.	S
Units	mg/kg

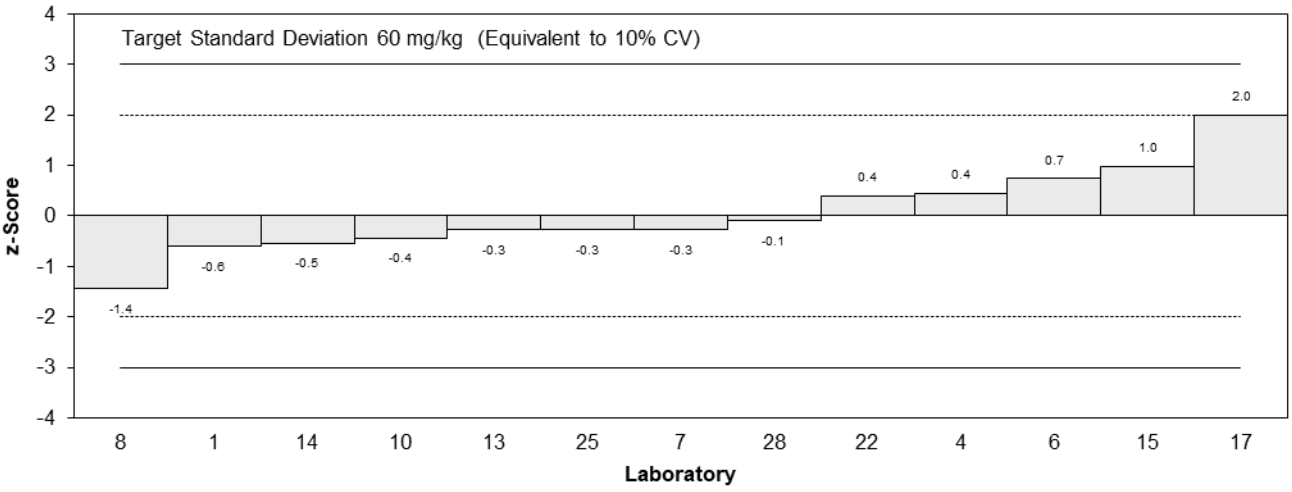
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	560	84	-0.60	-0.40
2	NT	NT		
3	NT	NT		
4	622	67.8	0.44	0.35
5	NT	NT		
6	640	64	0.74	0.61
7	580	NR	-0.27	-0.50
8	510	163	-1.44	-0.52
9	NR	NR		
10	570	114	-0.44	-0.22
11	NT	NT		
12	NR	NR		
13	580	40	-0.27	-0.31
14	564	56	-0.54	-0.50
15	654	90	0.97	0.61
16	NT	NT		
17	715	100	2.00	1.13
18	NT	NT		
19	NT	NT		
20	NT	NT		
21	NT	NT		
22	620	124	0.40	0.19
23	NT	NT		
24	NT	NT		
25	580	138	-0.27	-0.11
26	NT	NT		
27	NT	NT		
28	590	11.8	-0.10	-0.18
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value	596	32
Spike	Not Spiked	
Robust Average	596	32
Median	580	18
Mean	599	
N	13	
Max.	715	
Min.	510	
Robust SD	46	
Robust CV	7.8%	


Results: S3 - S
Assigned Value = 596 ± 32 mg/kg
Kernel Density
Density
Result
Results (mg/kg)
Laboratory
8 1 14 10 13 25 7 28 22 4 6 15 17 12 9 11 16 18 19 2 20 21 23 24 26 27 29 3 30 5 Md R.A.


z-Scores: S3 - S
Target Standard Deviation 60 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
8 1 14 10 13 25 7 28 22 4 6 15 17
-1.4 -0.6 -0.5 -0.4 -0.3 -0.3 -0.3 -0.1 0.4 0.4 0.7 1.0 2.0

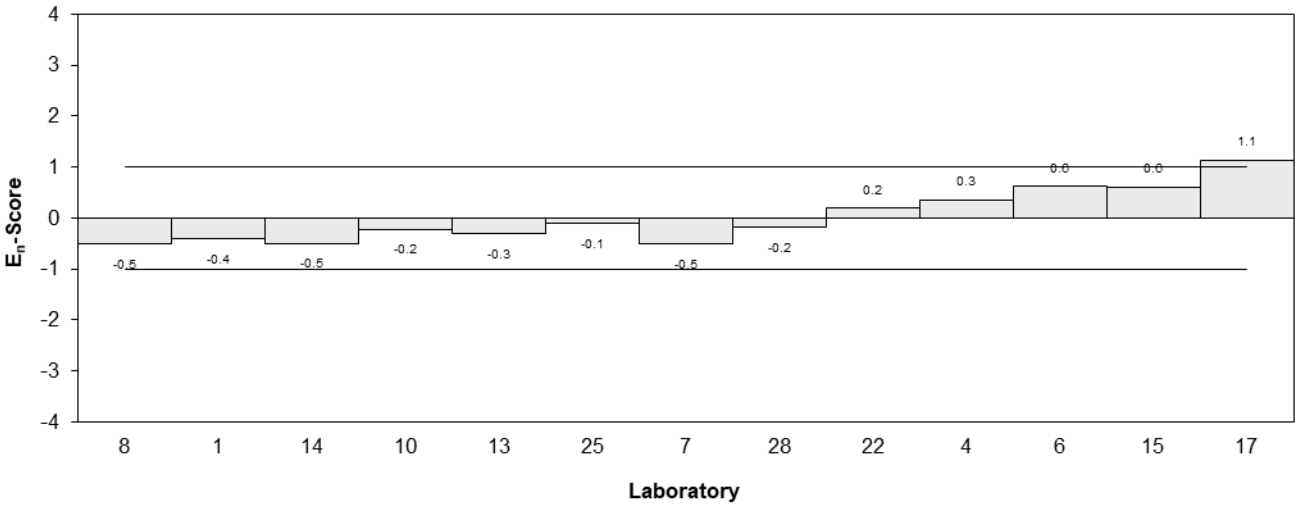

En-Scores: S3 - S
En-Score
Laboratory
8 1 14 10 13 25 7 28 22 4 6 15 17
-0.5 -0.4 -0.5 -0.2 -0.3 -0.1 -0.5 -0.2 0.2 0.3 0.6 0.6 1.1

Figure 52

Table 65

Sample Details

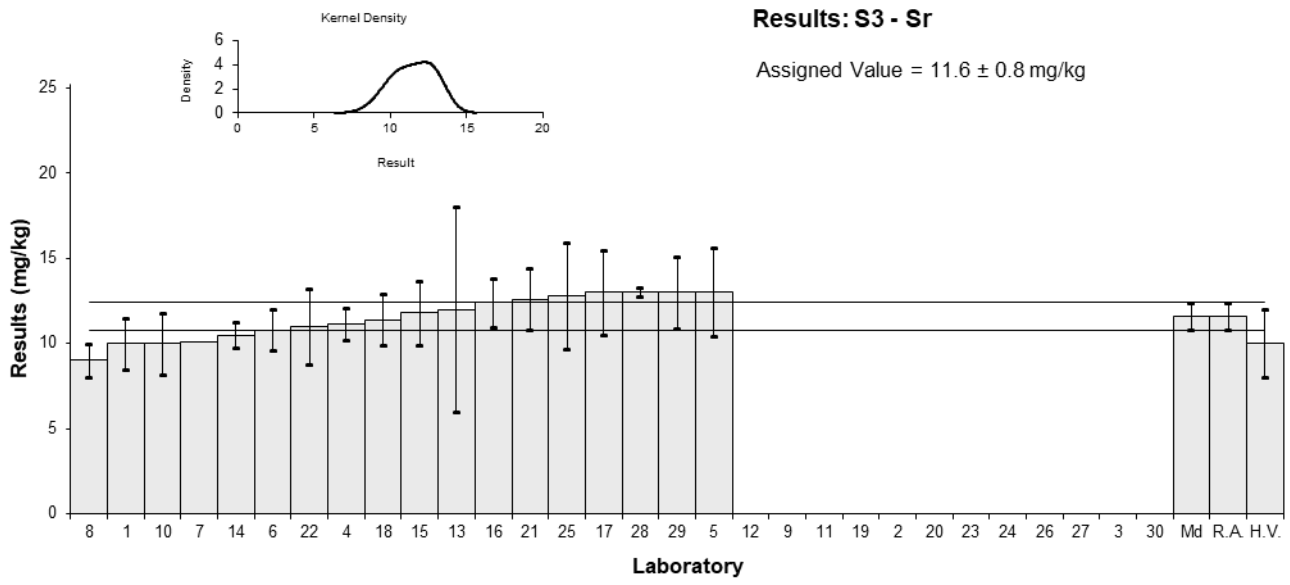
Sample No.	S3
Matrix.	Soil
Analyte.	Sr
Units	mg/kg

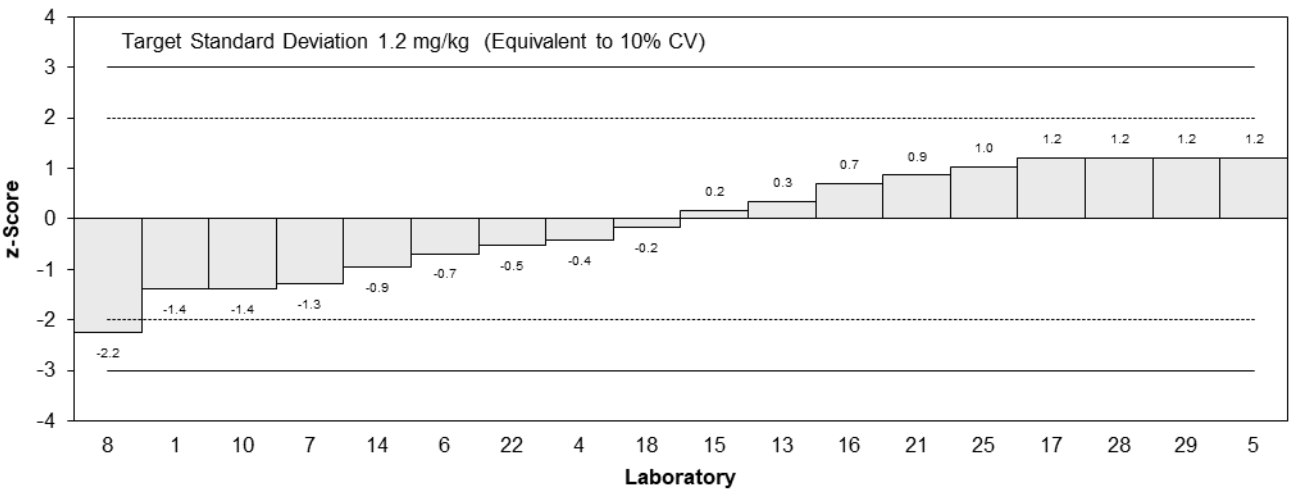
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	10	1.5	-1.38	-0.94
2	NT	NT		
3	NT	NT		
4	11.12	0.93	-0.41	-0.39
5	13	2.6	1.21	0.51
6	10.8	1.2	-0.69	-0.55
7	10.1	NR	-1.29	-1.88
8	9	1	-2.24	-2.03
9	NR	NR		
10	10	1.8	-1.38	-0.81
11	NT	NT		
12	NR	NR		
13	12	6	0.34	0.07
14	10.5	0.72	-0.95	-1.02
15	11.8	1.9	0.17	0.10
16	12.4	1.41	0.69	0.49
17	13.0	2.5	1.21	0.53
18	11.4	1.5	-0.17	-0.12
19	NT	NT		
20	NT	NT		
21	12.6	1.8	0.86	0.51
22	11	2.2	-0.52	-0.26
23	NT	NT		
24	NT	NT		
25	12.8	3.1	1.03	0.37
26	NT	NT		
27	NT	NT		
28	13	0.26	1.21	1.66
29	13	2.1	1.21	0.62
30	NT	NT		

Statistics

Assigned Value	11.6	0.8
Spike	Not Spiked	
Homogeneity Value	10.0	2.0
Robust Average	11.6	0.8
Median	11.6	0.8
Mean	11.5	
N	18	
Max.	13	
Min.	9	
Robust SD	1.4	
Robust CV	12%	


Kernel Density
Density
Result
Results: S3 - Sr
Assigned Value = 11.6 ± 0.8 mg/kg
Results (mg/kg)
Laboratory
8 1 10 7 14 6 22 4 18 15 13 16 21 25 17 28 29 5 12 9 11 19 2 20 23 24 26 27 3 30 Md R.A. H.V.


z-Scores: S3 - Sr
Target Standard Deviation 1.2 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
8 1 10 7 14 6 22 4 18 15 13 16 21 25 17 28 29 5
-2.2 -1.4 -1.4 -1.3 -0.9 -0.7 -0.5 -0.4 -0.2 0.2 0.3 0.7 0.9 1.0 1.2 1.2 1.2 1.2

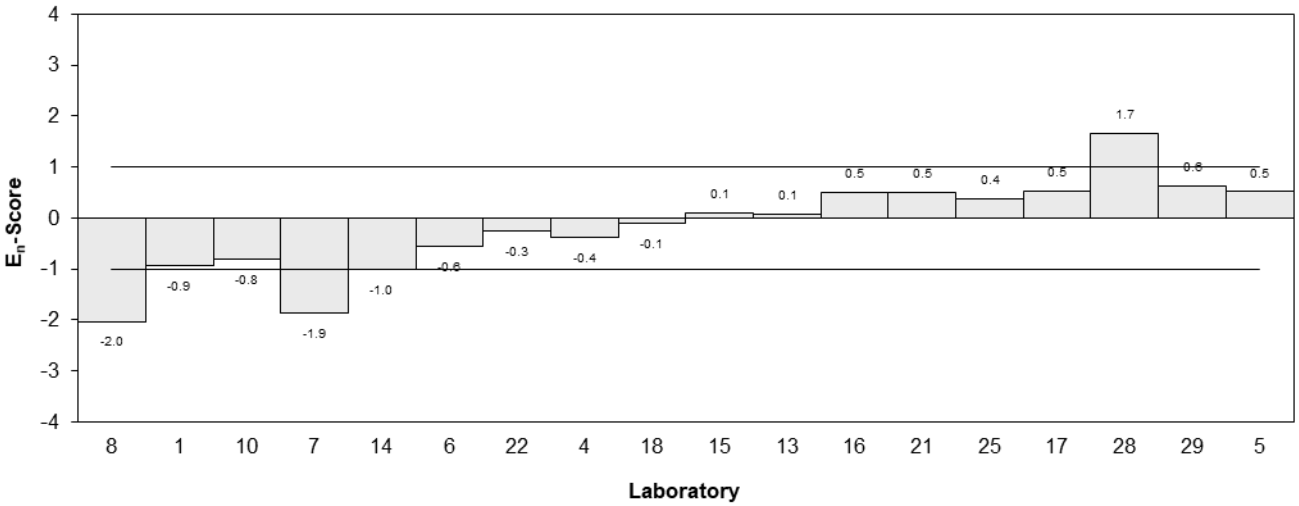

En-Scores: S3 - Sr
En-Score
Laboratory
8 1 10 7 14 6 22 4 18 15 13 16 21 25 17 28 29 5
-2.0 -0.9 -0.8 -1.9 -1.0 -0.6 -0.3 -0.4 -0.1 0.1 0.1 0.5 0.5 0.4 0.5 1.7 0.6 0.5

Figure 53

Table 66

Sample Details

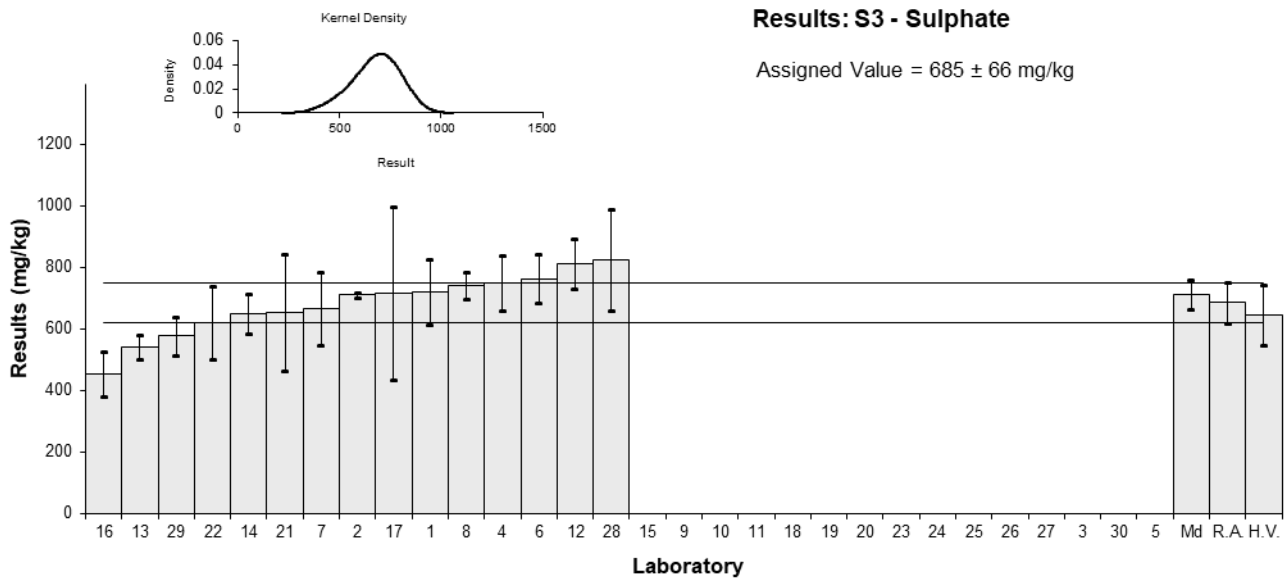
Sample No.	S3
Matrix.	Soil
Analyte.	Sulphate
Units	mg/kg

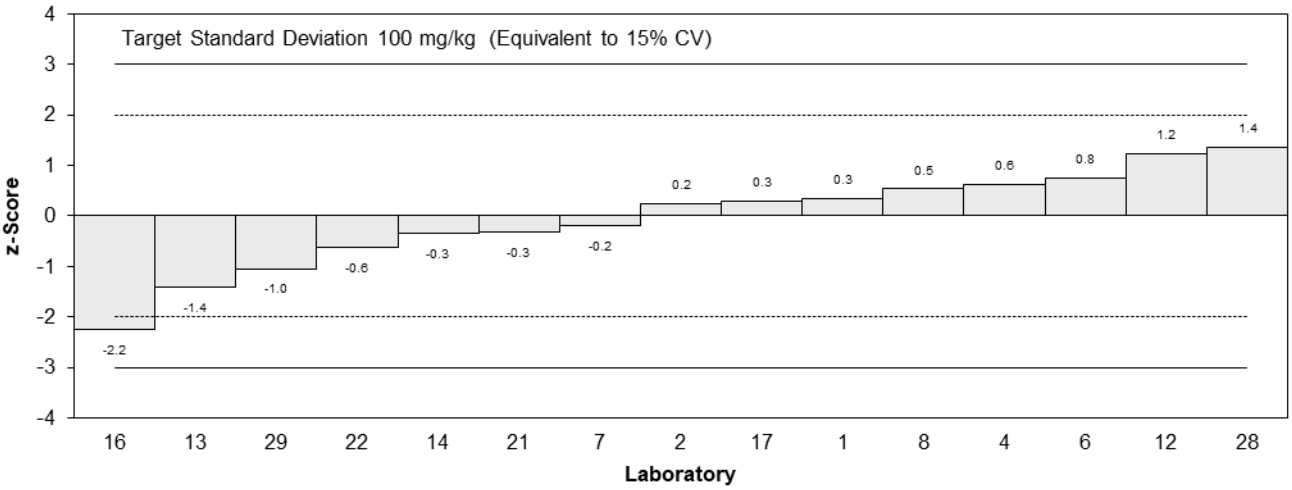
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	720	108	0.34	0.28
2	710	8	0.24	0.38
3	NT	NT		
4	750	90.3	0.63	0.58
5	NT	NT		
6	763	80	0.76	0.75
7	666	118	-0.18	-0.14
8	740	43	0.54	0.70
9	NR	NR		
10	NT	NT		
11	NT	NT		
12	811	81	1.23	1.21
13	540	40	-1.41	-1.88
14	650	65	-0.34	-0.38
15	NR	NR		
16	454	74	-2.25	-2.33
17	715	280	0.29	0.10
18	NT	NT		
19	NT	NT		
20	NT	NT		
21	652	190	-0.32	-0.16
22	620	120	-0.63	-0.47
23	NT	NT		
24	NT	NT		
25	NT	NT		
26	NT	NT		
27	NT	NT		
28	825	165	1.36	0.79
29	577.67	61.97	-1.04	-1.19
30	NT	NT		

Statistics

Assigned Value	685	66
Spike	Not Spiked	
Homogeneity Value	645	97
Robust Average	685	66
Median	710	48
Mean	680	
N	15	
Max.	825	
Min.	454	
Robust SD	100	
Robust CV	15%	


Kernel Density
Density
0.06
0.04
0.02
0
0
500
1000
1500
Result
Results: S3 - Sulphate
Assigned Value = 685 ± 66 mg/kg
Results (mg/kg)
1200
1000
800
600
400
200
0
16 13 29 22 14 21 7 2 17 1 8 4 6 12 28 15 9 10 11 18 19 20 23 24 25 26 27 3 30 5 Md R.A. H.V.
Laboratory


z-Scores: S3 - Sulphate
Target Standard Deviation 100 mg/kg (Equivalent to 15% CV)
z-Score
4
3
2
1
0
-1
-2
-3
-4
-2.2
-1.4
-1.0
-0.6
-0.3
-0.3
-0.2
0.2
0.3
0.3
0.5
0.6
0.8
1.2
1.4
16 13 29 22 14 21 7 2 17 1 8 4 6 12 28
Laboratory

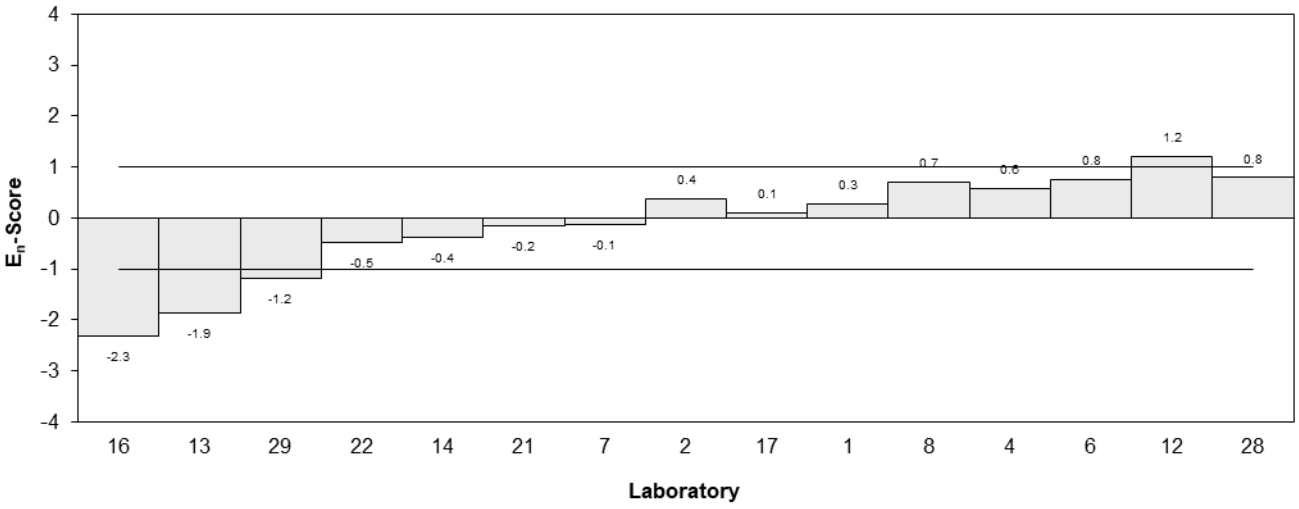

En-Scores: S3 - Sulphate
En-Score
4
3
2
1
0
-1
-2
-3
-4
-2.3
-1.9
-1.2
-0.5
-0.4
-0.2
-0.1
0.4
0.1
0.3
0.7
0.6
0.8
1.2
0.8
16 13 29 22 14 21 7 2 17 1 8 4 6 12 28
Laboratory

Figure 54

Table 67

Sample Details

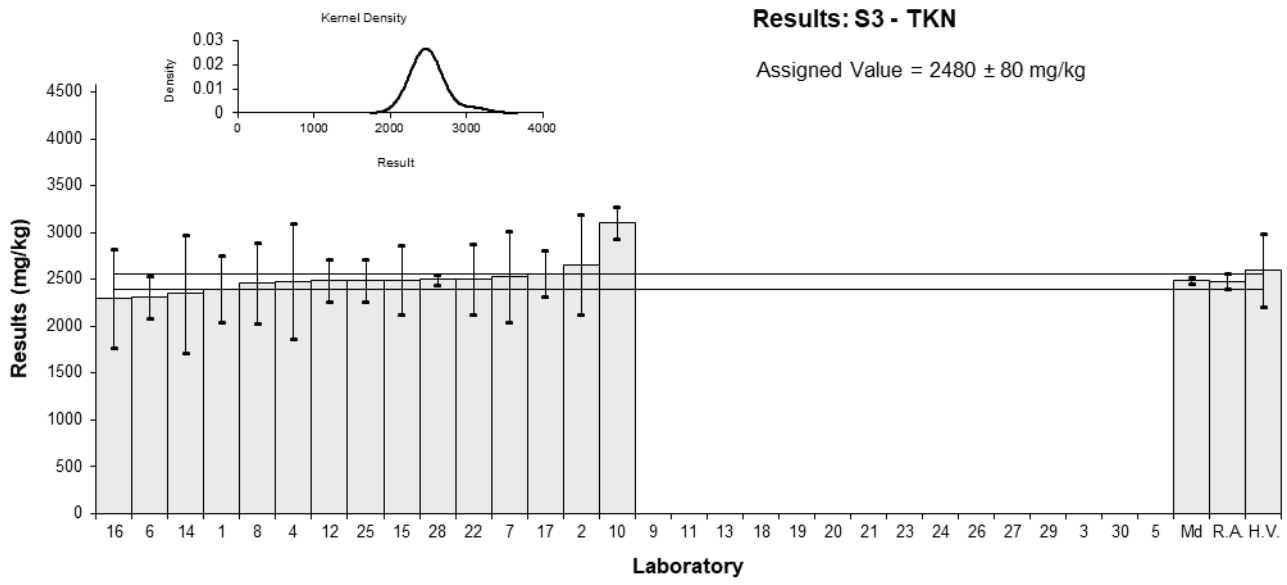
Sample No.	S3
Matrix.	Soil
Analyte.	TKN
Units	mg/kg

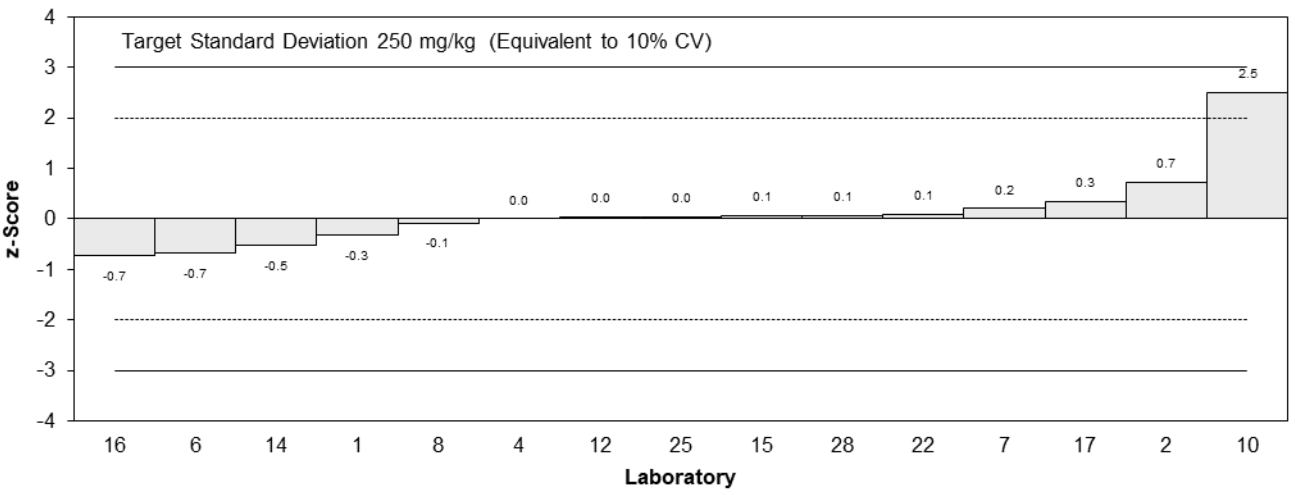
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	2400	360	-0.32	-0.22
2	2660	532	0.73	0.33
3	NT	NT		
4	2480	619	0.00	0.00
5	NT	NT		
6	2310	230	-0.69	-0.70
7	2530	480	0.20	0.10
8	2460	436	-0.08	-0.05
9	NR	NR		
10	3100	170	2.50	3.30
11	NT	NT		
12	2490	220	0.04	0.04
13	NT	NT		
14	2350	630	-0.52	-0.20
15	2495.52	374.33	0.06	0.04
16	2300	529	-0.73	-0.34
17	2564	250	0.34	0.32
18	NT	NT		
19	NT	NT		
20	NT	NT		
21	NT	NT		
22	2500	380	0.08	0.05
23	NT	NT		
24	NT	NT		
25	2490	227	0.04	0.04
26	NT	NT		
27	NT	NT		
28	2498	50	0.07	0.19
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value	2480	80
Spike	Not Spiked	
Homogeneity Value	2600	390
Robust Average	2480	80
Median	2490	30
Mean	2510	
N	15	
Max.	3100	
Min.	2300	
Robust SD	120	
Robust CV	4.9%	


Kernel Density
Density
Result
Results: S3 - TKN
Assigned Value = 2480 ± 80 mg/kg
Results (mg/kg)
Laboratory
16 6 14 1 8 4 12 25 15 28 22 7 17 2 10 9 11 13 18 19 20 21 23 24 26 27 29 3 30 5 Md R.A. H.V.


z-Scores: S3 - TKN
Target Standard Deviation 250 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
16 6 14 1 8 4 12 25 15 28 22 7 17 2 10
-0.7 -0.7 -0.5 -0.3 -0.1 0.0 0.0 0.0 0.1 0.1 0.1 0.2 0.3 0.7 2.5

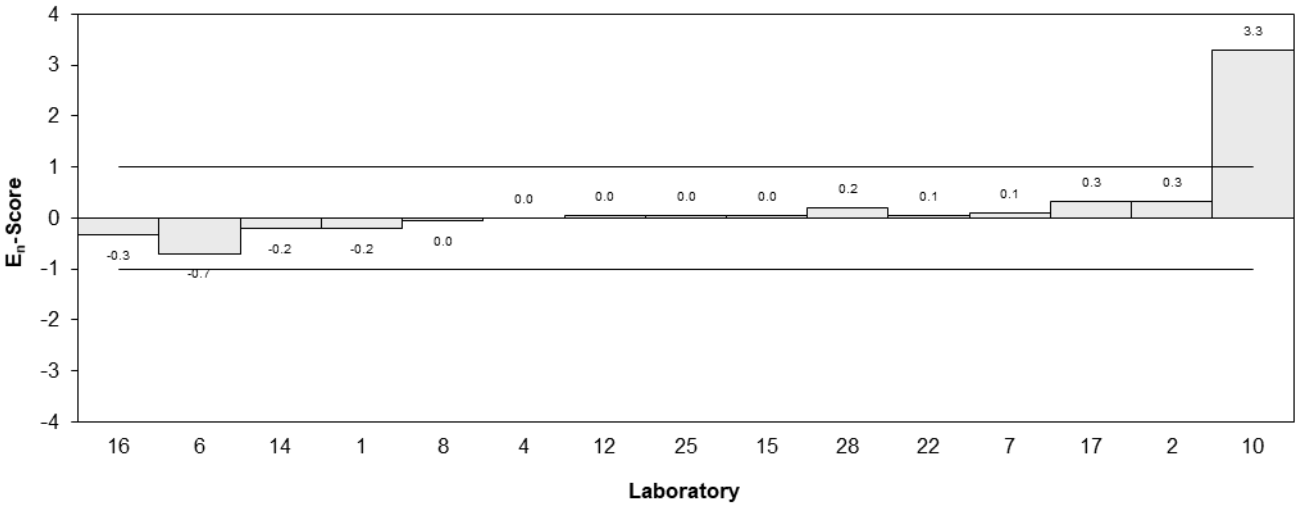

En-Scores: S3 - TKN
En-Score
Laboratory
16 6 14 1 8 4 12 25 15 28 22 7 17 2 10
-0.3 -0.7 -0.2 -0.2 0.0 0.0 0.0 0.0 0.0 0.2 0.1 0.1 0.3 0.3 3.3

Figure 55

7 DISCUSSION OF RESULTS

7.1 Assigned Value and Traceability

Assigned Values were the robust average of participants' results. The robust averages used as assigned values and their associated expanded uncertainties were calculated using the procedure described in ISO13528:2015(E) 'Statistical methods for use in proficiency testing by interlaboratory comparisons'. Results less than 50% and more than 150% of the robust average were investigated and then removed before calculation of the assigned value.[6] Appendix 2 sets out the calculation of the robust average of As in Sample S1 and its associated uncertainty.

No assigned value was set for Sb in S1, B, Ga, Rb, Sb and Cs and Se in S2 and bromide and iodide in S3 because the reported results were either too few or too variable.

Traceability The assigned value is not traceable to any external reference; it is traceable to the consensus of participants' results deriving from a variety of measurement methods and (presumably) a variety of calibrators. So although expressed in SI units, the metrological traceability of the assigned values has not been established.

7.2 Measurement Uncertainty Reported by Participants

Participants were asked to report an estimate of the expanded measurement uncertainty associated with their results. Of 871 numerical results, 825 (95%) were reported with an expanded measurement uncertainty. The magnitude of these expanded uncertainties was within the range 0.38% to 307% of the reported value. The participants used a wide variety of procedures to estimate the expanded measurement uncertainty. These are presented in Tables 11 and 12.

Approaches to estimating measurement uncertainty include: standard deviation of replicate analysis, Horwitz formula, long term reproducibility, professional judgement, bottom up approach, top down approach using precision and estimates of method and laboratory bias, and top down approach using only the reproducibility from inter-laboratory comparison studies.[9 – 14]

Participation in proficiency testing programs allows participants to check how reasonable their estimates of uncertainty are. Results and the expanded MU are presented in the bar charts for each analyte (Figure 2 to 55). As a simple rule of thumb, when the uncertainty estimate is smaller than uncertainty of the assigned value, or larger than the uncertainty of the assigned value plus twice the target standard deviation, then this should be reviewed as suspect. For example, 22 laboratories reported results for Al in S1. The uncertainty of the assigned value estimated from the robust standard deviation of the 22 laboratories' results is 1000 mg/kg (see equation 4, Appendix 2). Laboratory 3 might have under-estimated its expanded measurement uncertainties reported for Al in S1 (100 mg/kg) as an uncertainty estimated from one measurement cannot be smaller than the uncertainty estimated from 22 measurements. Alternatively, estimates of uncertainties for Ag in S2 larger than 0.71 mg/kg (the uncertainty of the assigned value, 0.15 mg/kg plus the allowable variation from the assigned value, the target standard deviation of 0.28 mg/kg, multiplied by 2, the coverage factor for a confidence interval of 95%), should also be viewed as suspect. For example, the expanded measurement uncertainties reported by laboratory 13 for Ag in S2 might have been over-estimated.

Laboratory 28 should review their procedure for estimating measurement uncertainty as most of their estimated uncertainties were under-estimated.

Laboratory 13 should also review the procedure they have used for estimating measurement uncertainty as most of their estimated uncertainties were over-estimated.

When a laboratory has successfully participated in at least 6 proficiency testing studies, the standard deviation from proficiency testing studies only, can also be used to estimate the uncertainty of their measurement results. [10] An example of estimating measurement uncertainty using proficiency testing data only is given in Appendix 3.

Laboratory 26 attached estimates of the expanded measurement uncertainty to results reported as less than their limit of detection. An estimate of uncertainty expressed as a value cannot be attached to a result expressed as a range.[9]

Laboratory 27 reported an estimate of expanded uncertainty for their Tl in S2 measurement result larger than the result itself.

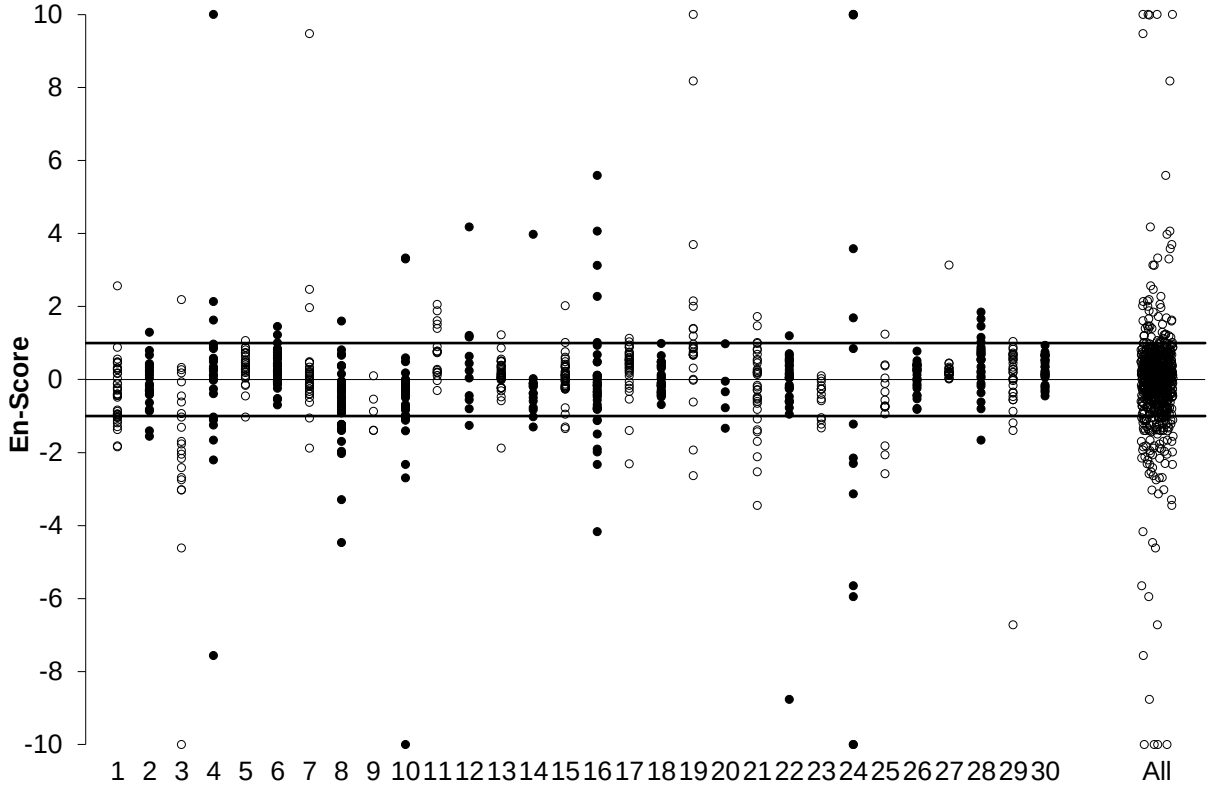
In some cases the results were reported with an inappropriate number of significant figures. The recommended format is to write uncertainty to no more than two significant figures and then to write the result with the corresponding number of decimal places. For example, instead of 2495.52 ± 374.33 mg/kg, it is better to report 2500 ± 370 mg/kg or instead of 9910 ± 1486.50 mg/kg, it is better to report 9910 ± 1500 mg/kg.[9]

7.3 E_n-score

E_n-score should be interpreted only in conjunction with z-scores. The E_n-score indicates how closely a result agrees with the assigned value taking into account the respective uncertainties. An unsatisfactory E_n score for an analyte can either be caused by an inappropriate measurement, an inappropriate estimation of measurement uncertainty, or both.

The dispersal of participants' E_n-scores is graphically presented in Figure 56. Where a laboratory did not report an expanded uncertainty with a result, an expanded uncertainty of zero (0) was used to calculate the E_n-score.

Of 785 results for which E_n-scores were calculated, 623 (79%) returned a satisfactory score of $|E_n| \leq 1.0$ indicating agreement of the participants' results with the assigned values within their respective expanded measurement uncertainties.



Scores of >10 or < -10 have been plotted as 10 or -10.

Figure 56 E_n-Score Dispersal by Laboratory

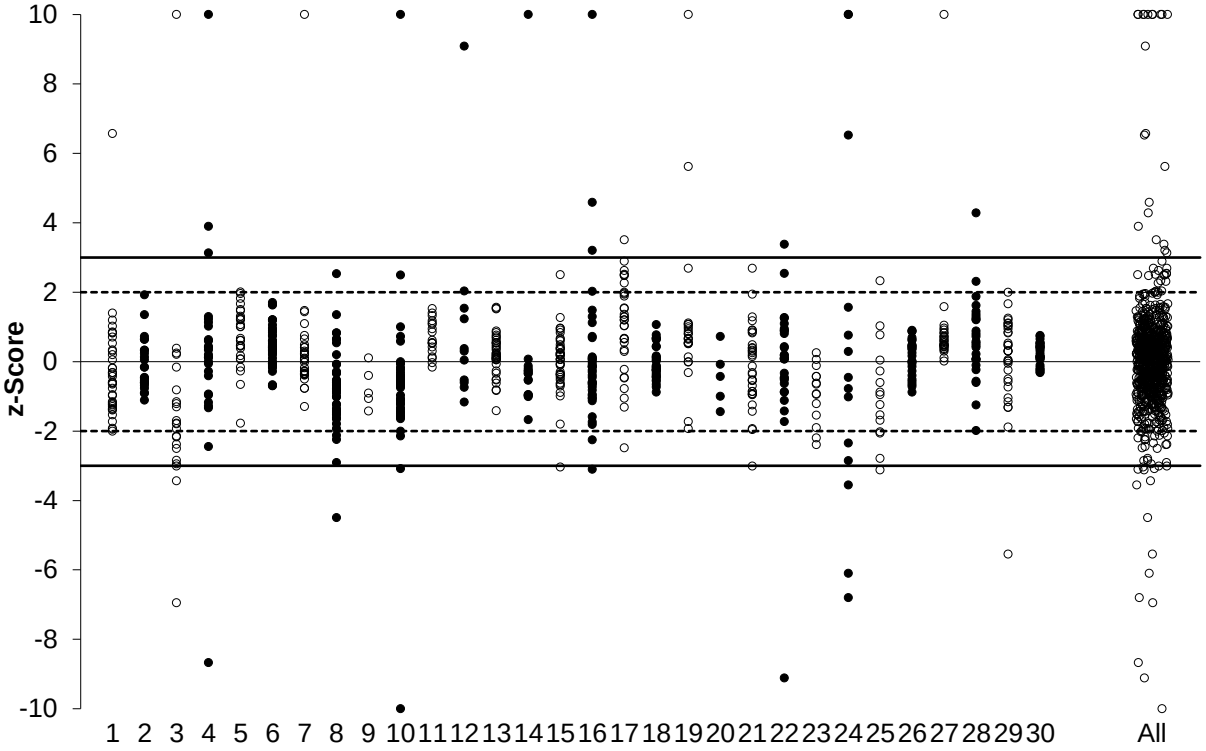
7.4 z-Score

The z-score compares the participant's deviation from the assigned value with the target standard deviation set for proficiency assessment.

The target standard deviation defines satisfactory performance in a proficiency test. Target standard deviations equivalent to 3.5% to 20% PCV were used to calculate z-scores. Unlike the standard deviation based on between laboratories CV, setting the target standard deviation as a realistic, set value enables z-scores to be used as fixed reference value points for assessment of laboratory performance, independent of group performance.

The between laboratory coefficient of variation predicted by the Thompson equation[7] and the participants' coefficient of variation resulted in this study are presented for comparison in Table 68.

The dispersal of participants' z-scores is presented in Figure 57 (by laboratory code) and in Figure 58 (by test). Of 785 results for which z-scores were calculated, 711 (91%) returned satisfactory score of $|z| \leq 2.0$ and 37 (5%) were questionable of $2.0 < |z| < 3.0$. Participants with multiple z-scores larger than 2.0 or smaller than -2.0 should check for laboratory bias.



Scores of >10 or <-10 have been plotted as 10 or -10.

Figure 57 z-Score Dispersal by Laboratory

No Laboratories reported results for all analytes for which a z-score was calculated (45).

Laboratory 6 returned the highest number of satisfactory z scores (40 out of 40 reported). All results reported by **laboratories 13** (37), **18** (31), **30** (27), **26** (25), **2** (23), **11** (18), **9** (5), and **20** (5) also returned satisfactory z scores.

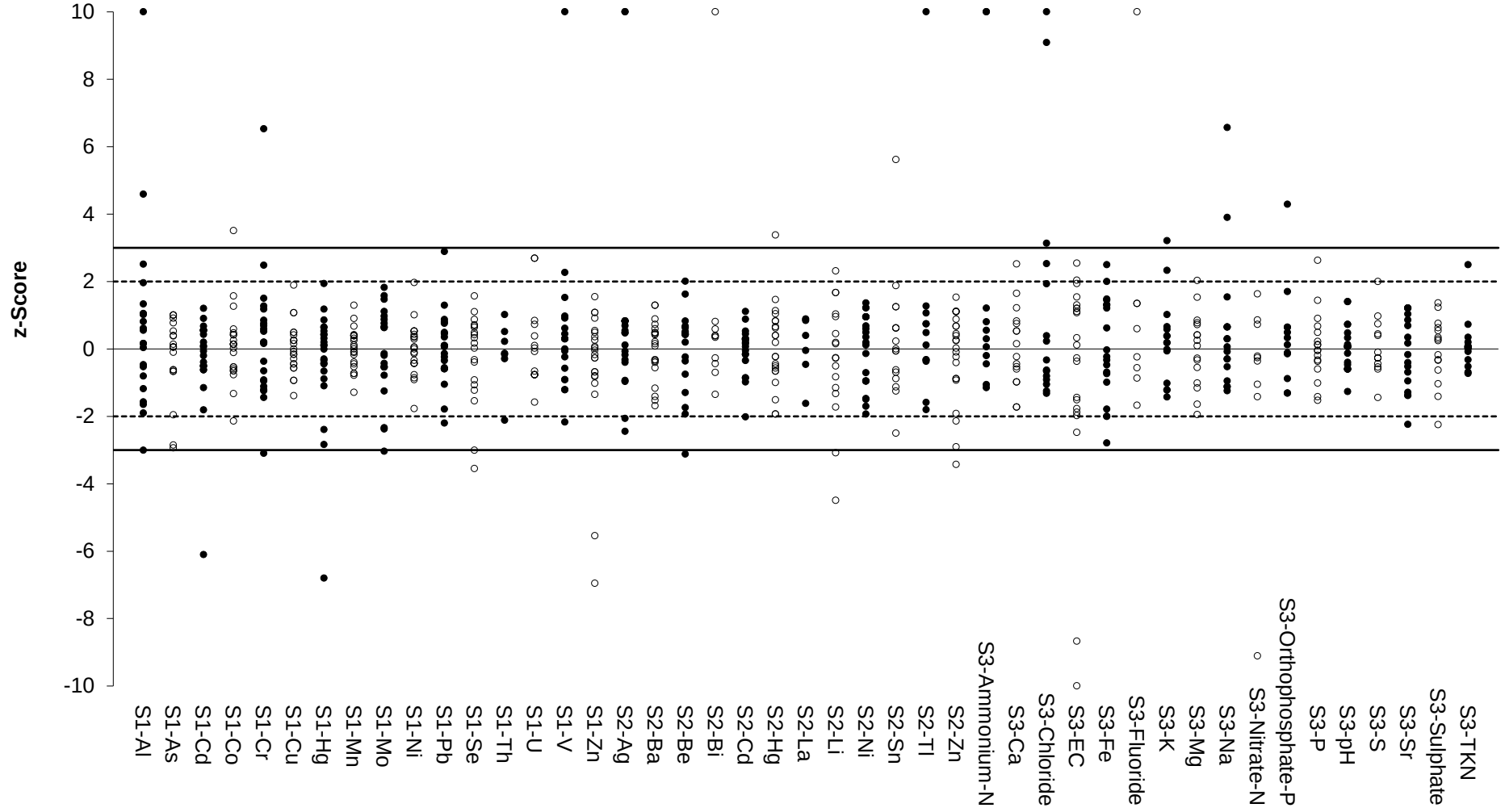
Laboratory 6 returned the highest number of satisfactory En scores (38 out of 40). All results reported by **laboratories 18** (31), **30** (27), and **26** (25) returned satisfactory En scores.

Table 68 Between Laboratory CV of this Study, Thompson CV and Set Target SD

Sample	Test	Assigned value (mg/kg)	Between Laboratories CV*	Thompson/ Horwitz CV	Target SD (as PCV)
S1	Al	8500	22%	4.1%	15%
S1	As	20.9	8.9%	10%	10%

Sample	Test	Assigned value (mg/kg)	Between Laboratories CV*	Thompson/ Horwitz CV	Target SD (as PCV)
S1	Cd	8.53	7.1%	12%	10%
S1	Co	8.88	8.2%	12%	10%
S1	Cr	20.4	18%	10%	15%
S1	Cu	24.4	7.2%	9.9%	10%
S1	Hg	9.21	8.4%	11	10%
S1	Mn	356	6.1%	6.6%	10%
S1	Mo	8.46	14%	12%	10%
S1	Ni	13.9	10%	11%	15%
S1	Pb	28.7	8.5%	9.7%	10%
S1	Sb	Not Set	38%	NA	NA
S1	Se	8.58	16%	12%	15%
S1	Th	3.82	16%	13%	20%
S1	U	0.867	11%	16%	10%
S1	V	33.0	11%	9.5%	10%
S1	Zn	74.0	8.4%	8.4%	10%
S2	Ag	2.77	8.7%	14%	10%
S2	B	Not Set	47%	NA	NA
S2	Ba	248	9.6%	7%	10%
S2	Be	1.69	19%	15%	15%
S2	Bi	0.925	7.4%	16%	10%
S2	Cd	0.574	10%	17%	15%
S2	Cs	Not Set	41%	NA	NA
S2	Ga	Not Set	36%	NA	NA
S2	Hg	0.471	11%	18%	10%
S2	La	24.7	16%	9.9%	15%
S2	Li	10.4	22%	11%	15%
S2	Ni	24.5	18%	9.9%	15%
S2	Rb	Not Set	30%	NA	NA
S2	Sb	Not Set	53%	NA	NA
S2	Se	Not Set	41%	NA	NA
S2	Sn	16.0	11%	11%	10%
S2	Tl	1.26	17%	15%	15%
S2	Zn	30.9	17%	9.6%	15%
S3	Ammonium-N	39.8	9.1%	9.2%	10%
S3	Bromide	Not Set	NA	NA	NA
S3	Ca	1330	13%	5.4%	10%
S3	Chloride	83.8	15%	8.2%	10%
S3	EC	854	6.7%	5.8%	3.5%
S3	Fe	7250	17%	4.2%	10%
S3	Fluoride	3.15	26%	13%	20%
S3	K	251	20%	7%	20%
S3	Mg	424	18%	6.4%	15%
S3	Na	169	9.8%	7.4%	10%
S3	Nitrate-N	313	12%	6.7%	10%
S3	Orthophosphate-P	4.38	15%	13%	15%
S3	P	734	9.6%	5.9%	10%
S3	pH	4.29	2.1%	13%	3.5%
S3	S	596	7.8%	6.1%	10%
S3	Sr	11.6	12%	11%	10%
S3	Sulphate	685	15%	6%	15%
S3	TKN	2480	4.9%	4.9%	10%

NA = Not Available, *Robust between Laboratories CV with outliers removed.



Scores of >10 or <-10 have been plotted as 10 or -10.

Figure 58 z-Score Dispersal by Test

Table 69 Summary of Participants' Results and Performance in Sample S1

Lab Code	Al (mg/kg)	As (mg/kg)	Cd (mg/kg)	Co (mg/kg)	Cr (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Mn (mg/kg)	Mo (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)	Se (mg/kg)	Th (mg/kg)	U (mg/kg)	V (mg/kg)	Zn (mg/kg)
A.V.	8500	20.9	8.53	8.88	20.4	24.4	9.21	356	8.46	13.9	28.7	Not Set	8.58	3.82	0.867	33.0	74.0
H.V.	8000	19.0	7.9	8.9	22.0	25.3	8.9	340	9.4	15.3	29.3	NA	9.0	4.60	0.89	34.0	66
1	7000	21	8.0	8.3	21	21	9.7	310	8.3	13	27	7	9.5	4.6	0.8	34	64
2	7900	21	8	9	17	24	9.8	340	8	12	27	4.5	9	3.7	0.8	30	69
3	7463.05	14.75	7.55	6.98	16.7	25	6.59	369.75	6.45	10.2	23.55	7.6	4.7	NT	NT	25.85	22.6
4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
5	11000	23	9.1	10	25	27	8.6	370	10	16	30	<10	8.8	NT	<10	35	72
6	9280	19.5	8.48	9.10	22.2	25.4	9.39	356	9.28	14.6	29.0	11.4	9.12	3.72	0.90	32.8	73.7
7	8546	21.74	8.1	8.2	19.26	25	9.3	342	9.7	13.2	27.7	5.9	10	3.6	0.8	34	72
8	6390	19.5	8.7	8.4	16.6	23.7	8.9	353	8.0	12.3	27.1	4.3	7	2.2	0.8	30	68.1
9	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
10	6500	23	8.2	7.7	16	23	8.2	350	8.0	13	27	5.1	7.2	NT	0.73	29	69
11	10200	22	9	9	24	24	10	371	NT	15	29	NT	NT	NT	NT	NT	82
12	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
13	8700	21	9.0	9.0	21	25	9.31	370	9.1	14	29	NT	10.6	NT	0.94	38	78
14	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
15	11700	19.6	8.09	9.24	24.3	25.6	8.39	365	5.89	13.7	29.7	4.94	9.40	3.99	0.86	36.0	74.5
16	14349	21.2	6.99	8.35	10.9	24.2	8.8	358	8.34	13.9	25.7	3.35	8.08	NT	NT	31.1	67.9
17	9820	<25	9.55	12.0	28.0	29.0	11.0	402	7.80	18.0	37.0	<100	<100	NT	NT	40.5	85.5
18	7830	22.5	8.36	8.78	20.9	23.3	9.61	330	8.99	14.0	28.3	8.50	9.47	NT	0.81	32.2	74.2
19	9530	23	9	9	22	27	9.2	380	9	15	31	NT	9.7	NT	1.1	33	82
20	NT	NT	NT	NT	NT	NT	8.81075	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
21	4660	16.8	9.3	8.4	17.5	22.1	10.3	337	7.4	12.1	32.4	4.1	7.4	NT	1.10	NT	80.7
22	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
23	6080	19.6	8.58	8.3	17.6	22.1	7.01	352	8.1	13.0	22.4	9.8	6.6	NR	NR	29.0	75.9
24	23607.181	14.949	3.326	10.278	40.385	23.302	2.950	328.349	6.480	14.495	30.892	7.762	4.006	NR	NR	73.066	66.482
25	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
26	8700	21.7	8.9	9.3	18.4	24.4	9.6	388	9.2	13.6	31.2	5.22	< 20	NT	0.869	< 100	76.7
27	9841	22.8	9.0	9.4	22.5	25.6	9.8	360	9.8	14.8	30.1	8.5	9.2	NT	0.93	36.2	77.6
28	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
29	9800	21	8.1	8.9	23	23	9.5	330	9.4	15	28	<10	8.6	NT	<10	34	33
30	9200	20.7	8.61	9.25	22.68	24.77	8.93	367.1	9.01	14.67	28.87	9.08	8.17	4.21	0.876	34.44	72.72

Shaded cells are results which returned a questionable or unsatisfactory z-score. A.V. = Assigned Value, H.V. = Homogeneity Value; NA= Not Available

Table 70 Summary of Participants' Results and Performance in Sample S2

Lab Code	Ag (mg/kg)	B (mg/kg)	Ba (mg/kg)	Be (mg/kg)	Bi (mg/kg)	Cd (mg/kg)	Cs (mg/kg)	Ga (mg/kg)	Hg (mg/kg)	La (mg/kg)	Li (mg/kg)	Ni (mg/kg)	Rb (mg/kg)	Sb (mg/kg)	Se (mg/kg)	Sn (mg/kg)	Tl (mg/kg)	Zn (mg/kg)
A.V.	2.77	Not Set	248	1.69	0.925	0.574	Not Set	Not Set	0.471	24.7	10.4	24.5	Not Set	Not Set	Not Set	16.0	1.26	30.9
S.V.	2.84	38.9	235	1.79	0.872	0.608	3.58	13.1	0.541	29.3	11.3	26.0	7.01	22.2	1.98	16.9	1.44	Not Spiked
H.V.	2.90	27.0	222	1.56	0.95	0.583	2.88	11.2	0.482	26.4	11.0	26.6	NA	12.0	1.60	16.8	1.40	29.2
1	3	28	210	1.6	NT	0.49	NT	NT	0.51	NT	8.6	21	NT	9.5	9.6	14	1.2	22
2	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
3	NT	8.6	253.1	1.36	2.025	0.56	NT	NT	0.38	NT	NT	18.25	NT	12.4	0.93	12	NT	15
4	2.09	<50	219	1.74	0.956	<1.0	2.5	10.8	0.524	26.2	8.33	20.99	24	6.23	<5	15.9	126.9	26.6
5	2.9	37	250	2.2	<10	0.56	NT	NT	0.54	NT	13	29	NT	18	<2	17	<10	33
6	2.72	33.1	259	1.81	NT	0.62	NT	NT	0.49	NT	9.96	26.7	NT	26.7	1.74	NT	1.46	30.5
7	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
8	3.0	<50	213	1.2	0.8	0.5	1.3	6.7	0.4	18.7	3.4	19.1	13.4	5.0	1	14.9	1.2	17.4
9	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
10	2.5	19	240	1.5	0.98	0.57	1.6	NT	0.44	23	5.6	19	16	8.0	0.95	16	<1.8	21
11	NT	NT	NT	NT	NT	0.6	NT	NT	0.5	NT	NT	28	NT	NT	NT	NT	NT	38
12	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
13	2.75	32	260	1.80	NT	0.65	NT	NT	0.447	NT	9.1	27	NT	NT	<5	15	1.28	32
14	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
15	2.66	11.9	263	1.86	0.86	0.544	NR	NR	0.48	27.8	11.9	25.2	NR	8.83	1.10	15.9	0.92	32.7
16	2.51	50.4	266	1.25	NT	NT	NT	NT	0.44	NT	NT	24	NT	12.0	1.08	14.2	0.96	36.1
17	<1	32.0	280	<1	NT	<1	NT	NT	0.45	NT	12.0	29.5	NT	<100	<100	<50	<2	34.0
18	2.68	20.5	234	1.63	0.884	0.612	NT	NT	0.502	NT	10.0	24.9	NT	19.2	1.43	14.6	1.19	29.0
19	59	17	240	1.82	NT	0.67	NT	NT	0.38	NT	7.7	28	NT	NT	2.4	25	NT	34
20	NT	NT	NT	NT	NT	NT	NT	NT	0.424	NT	NT	NT	NT	NT	<5	NT	NT	NT
21	3.0	10.7	239	NT	NT	0.50	NT	NT	0.49	NT	10.7	17.4	NT	4.8	NR	NT	NT	32.1
22	2.8	33	270	1.8	1.0	0.59	3.6	13	0.63	28	NT	28	NT	11	1.8	18	1.5	36
23	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
24	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
25	2.2	5	206	0.9	NT	0.4	NT	NT	NT	NT	NT	21	NT	NT	NT	NT	NT	26.8
26	2.96	25.7	238	1.85	0.90	0.596	2.42	NT	0.444	24.5	9.6	21.9	21.7	7.0	< 2	17.0	1.35	26.8
27	45.5	24.7	258.3	1.9	0.96	0.6	3.1	NT	0.51	NT	11.1	25.8	25.7	15.0	2.00	17.0	1.4	31
28	2.9	36	280	2.1	<10	0.58	NT	NT	0.46	NT	14	29	NT	21	2.1	19	<10	35
29	3.0	30	260	<2	<10	0.60	NT	NT	0.52	NT	13	28	NT	18	<2	18	<10	36
30	2.92	27.97	251.6	1.80	0.962	0.587	NT	NT	0.460	NT	10.63	26.3	NT	20.40	1.22	16.37	1.40	29.82

Shaded cells are results which returned a questionable or unsatisfactory z-score. A.V. = Assigned Value, S.V. = Spike Value, H.V. = Homogeneity Value, NA = Not Available.

Table 71 Summary of Participants' Results and Performance for Sample S3

Lab Code	Ca (mg/kg)	Fe (mg/kg)	K (mg/kg)	Mg (mg/kg)	Na (mg/kg)	P (mg/kg)	S (mg/kg)	Sr (mg/kg)
A.V.	1330	7250	251	424	169	734	596	11.6
H.V.	1390	7570	223	418	159	800	NA	10.0
1	1100	5800	190	300	280	720	560	10
2	NT	NT	NT	NT	NT	NT	NT	NT
3	NT	NT	NT	NT	NT	NT	NT	NT
4	1492	8191	302.3	406	234.9	743.9	622	11.12
5	NT	8200	NT	NT	NT	NT	NT	13
6	1550	8130	248	478	174	800	640	10.8
7	1430	7010	250	450	180	840	580	10.1
8	1440	5950	200	360	180	690	510	9
9	NR	NR	NR	NR	NR	NR	NR	NR
10	1300	5800	190	320	150	730	570	10
11	NT	7230	NT	NT	NT	NT	NT	NT
12	1260	6710	270	350	195	NR	NR	NR
13	1400	7700	260	470	160	710	580	12
14	1200	NR	NR	403	153	660	564	10.5
15	1270	6530	270	440	164	707	654	11.8
16	1200	8324	412	553	164	742	NT	12.4
17	1665	9065	284	521	180	927	715	13.0
18	NT	7080	NT	NT	NT	783	NT	11.4
19	NT	NT	NT	NT	NT	NT	NT	NT
20	NT	NT	NT	NT	167.6	NT	NT	NT
21	1350	6750	179	389	174	770	NT	12.6
22	1100	6900	260	430	150	630	620	11
23	NT	NT	NT	NT	NT	NT	NT	NT
24	NT	NT	NT	NT	NT	NT	NT	NT
25	1250	5230	368	473	148	622	580	12.8
26	NT	NT	NT	NT	NT	NT	NT	NT
27	NT	NT	NT	NT	NT	NT	NT	NT
28	1400	8300	280	450	170	750	590	13
29	NT	8700	NT	NT	NT	730	NT	13
30	NT	NT	NT	NT	NT	NT	NT	NT

Shaded cells are results which returned a questionable or unsatisfactory z-score. A.V. = Assigned Value, H.V. = Homogeneity Value, NA = Not Available.

Table 72 Summary of Participants' Results and Performance for Sample S3 Continued

Lab Code	Bromide (mg/kg)	Chloride (mg/kg)	Fluoride (mg/kg)	Iodide (mg/kg)	Orthophosphate-P (mg/kg)	Sulphate (mg/kg)	pH	EC (µS/cm)	TKN (mg/kg)	Ammonium-N (mg/kg)	Nitrate-N (mg/kg)
A.V.	Not Set	83.8	3.15	Not Set	4.38	685	429	854	2480	39.8	313
H.V.	2.00	80	4.00	NA	4.40	645	NA	NA	2600	36.5	NA
1	NT	NT	NT	NT	NT	720	4.5	890	2400	NT	340
2	NT	100	4	NT	4.8	710	4.2	864	2660	NT	NT
3	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
4	NT	110	3.53	NT	4.46	750	4.1	595	2480	NT	NT
5	NT	NT	NT	NT	NT	NT	4.3	801	NT	NT	NT
6	NT	NT	NT	NT	5.5	763	4.34	890	2310	44.6	364
7	1.58	85.7	29.8	0.58	4.7	666	4.3	843	2530	NT	NT
8	1.92	105	4	<0.25	4.8	740	4.2	809	2460	NT	NT
9	NR	76.2	NR	NR	NR	NR	4.23	857.3	NR	35.6	268.4
10	NT	NT	NT	NT	NT	NT	4.4	79	3100	81	NT
11	NT	NT	NT	NT	NT	NT	4.5	887.20	NT	NT	NT
12	NR	160	NR	NR	NR	811	4.2	915	2490	41	NR
13	<5	77	NT	NT	NT	540	4.3	900	NT	NT	NT
14	<5	865	2.1	<5	4.3	650	4.3	846	2350	39	305
15	NR	78.3	NR	NR	NR	NR	NR	NR	2495.52	40.05	301.61
16	NT	78.5	3.0	NT	4.28	454	4.30	893	2300	420	280
17	NT	75	NT	NT	3.52	715	4.22	780	2564	42.0	306
18	NT	NT	NT	NT	NT	NT	4.31	886	NT	NT	NT
19	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
20	NT	NT	NT	NT	NT	NT	4.4	811	NT	NT	NT
21	2.41	87.1	NR	NT	4.6	652	4.27	912	NT	NT	NT
22	2.0	81	2.6	<1	3.8	620	4.3	930	2500	38	28
23	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
24	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
25	NT	NT	NT	NT	NT	NT	NR	NR	2490	NT	NT
26	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
27	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
28	NT	73.3	2.8	NT	7.2	825	4.2	794.8	2498	43	336
29	1.92	72.74	NT	4.00	3.52	577.67	4.36	797.9	NT	35.24	NT
30	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT

Shaded cells are results which returned a questionable or unsatisfactory z-score. A.V. = Assigned Value, H.V. = Homogeneity Value, NA = Not Available.

7.5 Participants' Results and Analytical Methods for Acid Extractable Elements

A summary of participants' results and performance is presented in Tables 69 to 72 and in Figures 57 and 58.

Boron and antimony were elements which presented the most analytical difficulty. No agreement was found between the results reported by participants for these elements.

Measurement of low level Se in S2 also presented analytical difficulty to participants.

Manganese in S1 was the test which presented the least analytical difficulty to participating laboratories, with a between laboratory CV of 6.1 %.

All unsatisfactory results reported by laboratory 3 were lower than the assigned value and most were lower by the same factor of approximately 0.75. This laboratory should check their dilution and/or standard preparation procedure. The results from this laboratory were not included in the analyses of extraction methods and of instrumental techniques employed by participants.

All unsatisfactory results reported by laboratory 17 were higher than the assigned value. This is an indication of method or laboratory bias.

The method descriptions provided by participants for acid extractable elements are presented in Tables 1 and 10 while instrumental conditions are presented in Appendix 4.

Extraction Methods

The request was for acid extractable elements; NMI PT studies of metals in soil focus on 'pseudo-total' analyses of elements in soil rather than on true total metal content because when an assessment of the anthropogenic impact of the metal content in a soil sample is made, aggressive digestion regimes (HF, high digestion temperature) can lead to misleading conclusions – since metals can be extracted from the fraction naturally present in the soil matrix.[5, 15-18] While an aggressive digestion regime can produce high, misleading results, weak digestion regimes (low digestion temperature, reduced digestion time, diluted acids and/or a low ratio of acid to sample size) may extract just a fraction of the contaminants from the soil. There is no standardisation of methods for acid extractable elements. In general methods are conventionally defined by procedures involving extractions: with aqua regia or with various amounts of HNO_3, HCl, in combination or alone and most of these methods produce comparable results.[19-21]

Laboratory 10 extracted their sample at 96ºC for 30 min only; all results they reported for acid extractable elements were lower than the assigned value with the exception of two. Weak digestion regimes may only extract a fraction of the elements from soil.

Laboratory 24 used an extraction regime involving HF and a digestion temperature of 210ºC, which may explain the high, unsatisfactory results they reported for the method dependent elements Al, Cr and V. The high digestion temperature and HF which they employed for sample extraction might have facilitated extraction of these elements from silica lattice. This digestion regime is more appropriate for assessing the samples' geological content (total elements) and not the contamination introduced in the environment by anthropogenic activities (acid extractable elements).

According to Eurachem/CITAC Guide CG4, laboratories should consider using matrix matched control samples to assess their digestion regime (the bias of their analytical methods). Bias can be expressed as recovery and should be corrected for or included in the uncertainty estimate.[9]

Individual Element Commentary

Aluminium is an element which is strongly dependent on digestion regime. The between-laboratory coefficient of variation for Al in Sample S1 was high (22%), larger than that predicted by Thomson (4.1%).[9] A high extraction temperature (210°C) and the use of HF may explain the high result reported by Laboratory 24.

Plots of Al participants' performance versus instrumental technique used are presented in Figure 59.

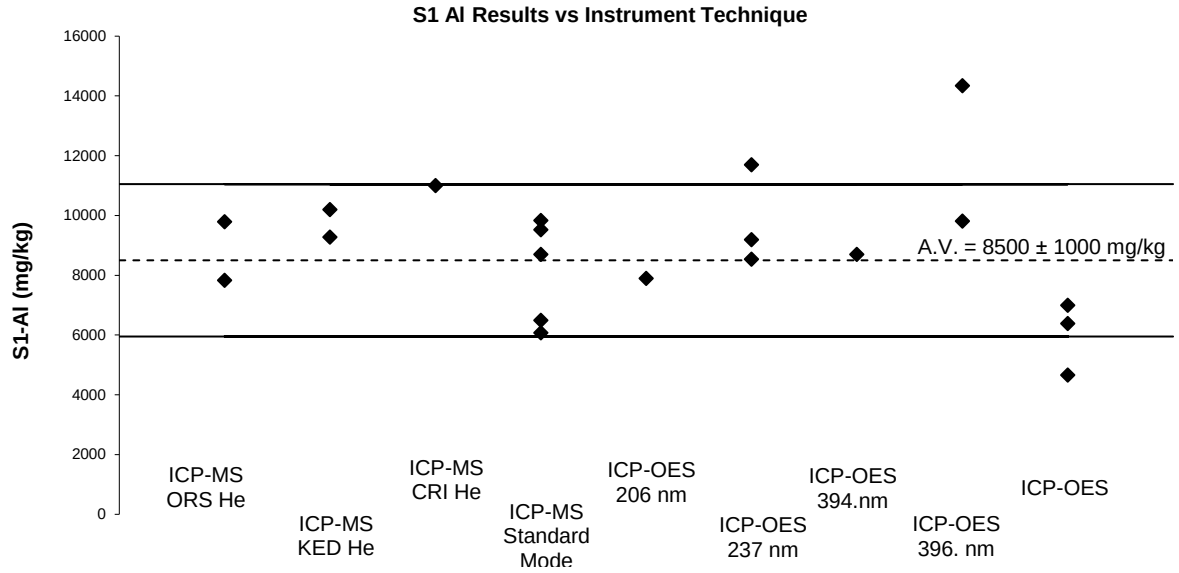


Figure 59 S1-Al z-Results vs. Instrumental Technique

Arsenic most participants used for As measurements ICP-MS with various collision/reaction cells and He as collision gas.

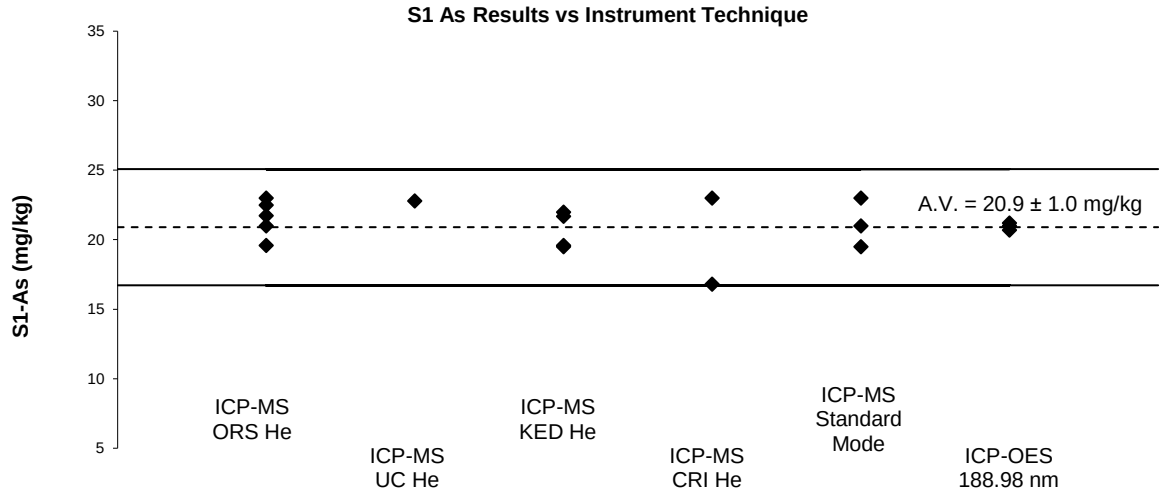


Figure 60 S1-As Results vs. Instrumental Technique

Antimony in the soil sample S1 was one of the most difficult elements to analyse. Participants used a wide variety of digestion methods; no agreement was found between the results they produced. Antimony is an element whose recovery strongly depends on the acids employed for digestion. It is known that in nitric acid only, Sb is transformed in a mixture of insoluble oxides (Sb_2O_3, Sb_2O_5, $Sb_4O_4(OH)_2(NO_3)_2$) but when hydrochloric acid is also involved it changes into chloro-complexes ($SbCl_6^-$). In aqueous solution, sufficient hydrogen ion concentration must be maintained in order to prevent $SbCl_6^-$ hydrolysis. [22-24]

Laboratories should consider using matrix matched control samples to assess their digestion regime and increase their estimates of uncertainty for Sb measurements in soil.

Boron level in Sample S2 was low and this may have presented difficulty to some laboratories. The between laboratory coefficient of variation was high (47%) no assigned value was set for this element. Boron is an element prone to contamination. The sampling system should be cleaned prior to low level B determination.

Caution should be exercised when ICP-OES with wavelength 249.7 nm is used for B measurement. Iron line 249.771 nm has direct overlap interference on B line 249.7 nm.

Plots of participants' results versus instrumental technique are presented in Figure 61.

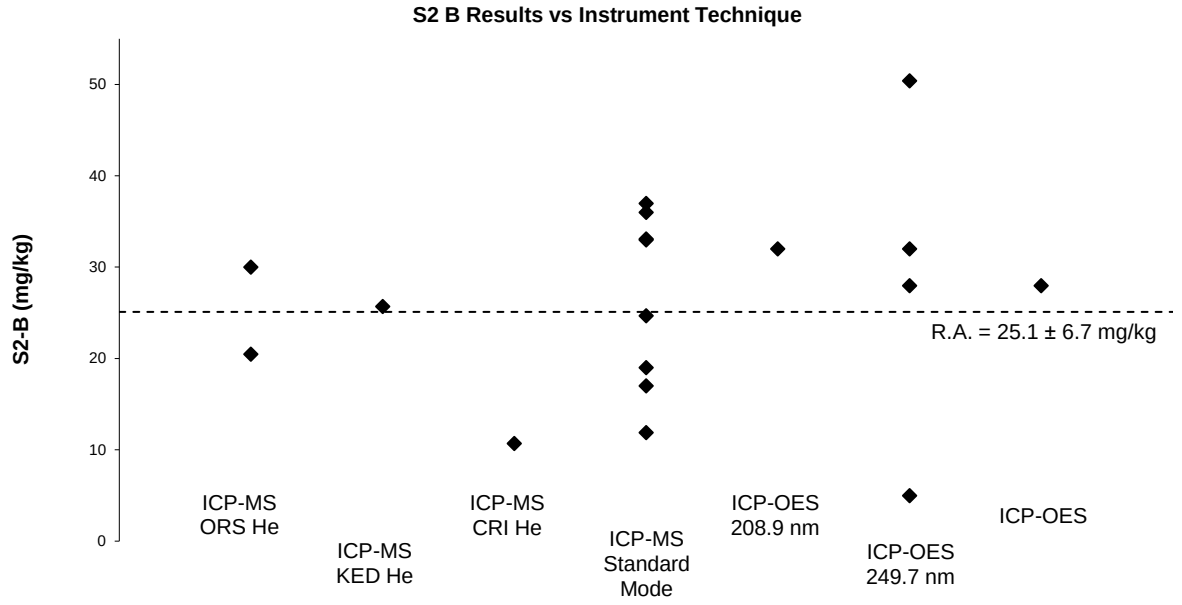


Figure 61 B z-Results vs. Instrumental Technique

Mercury level in S1 was 9.21 mg/kg while in S2 was almost 20 times lower at, 0.471 mg/kg. 22 laboratories reported results in both study samples and all used the same instrumental technique. ICP-MS in standard mode followed by CVAAS were the most popular instrumental techniques used for Hg measurement in S1 and S2 (Figure 62).

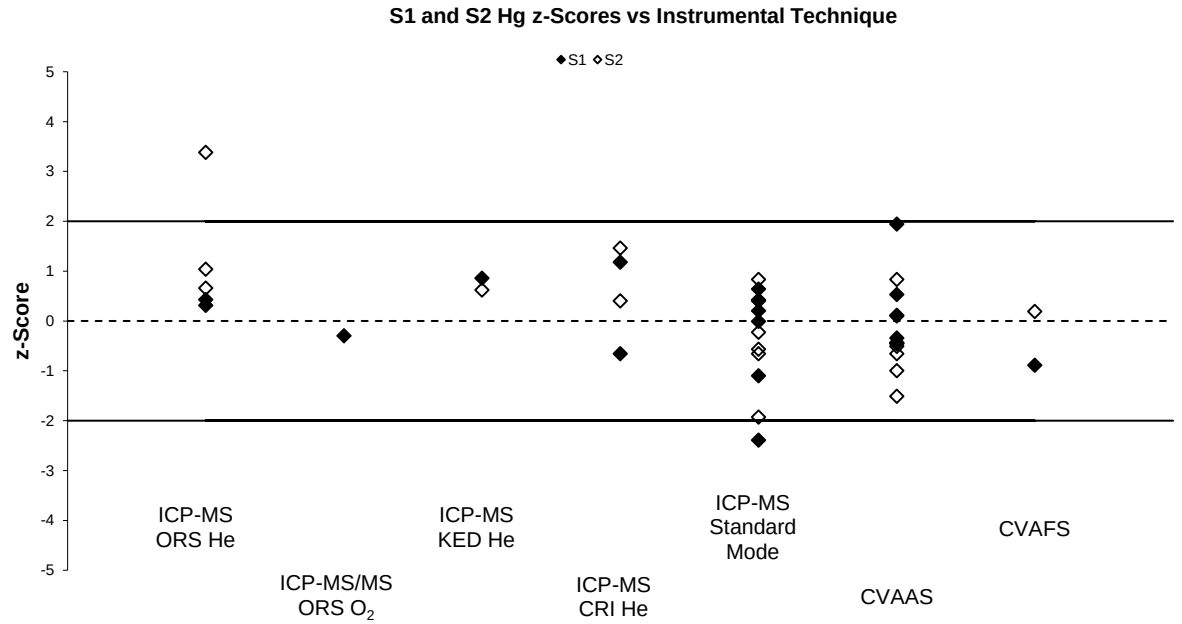


Figure 62 S1 and S2 Hg z-Scores vs. Instrumental Technique

Potassium and Sodium Plots of K and Na results versus instrumental technique are presented in Figures 63 and 64. ICP-OES was the preferred analytical technique.

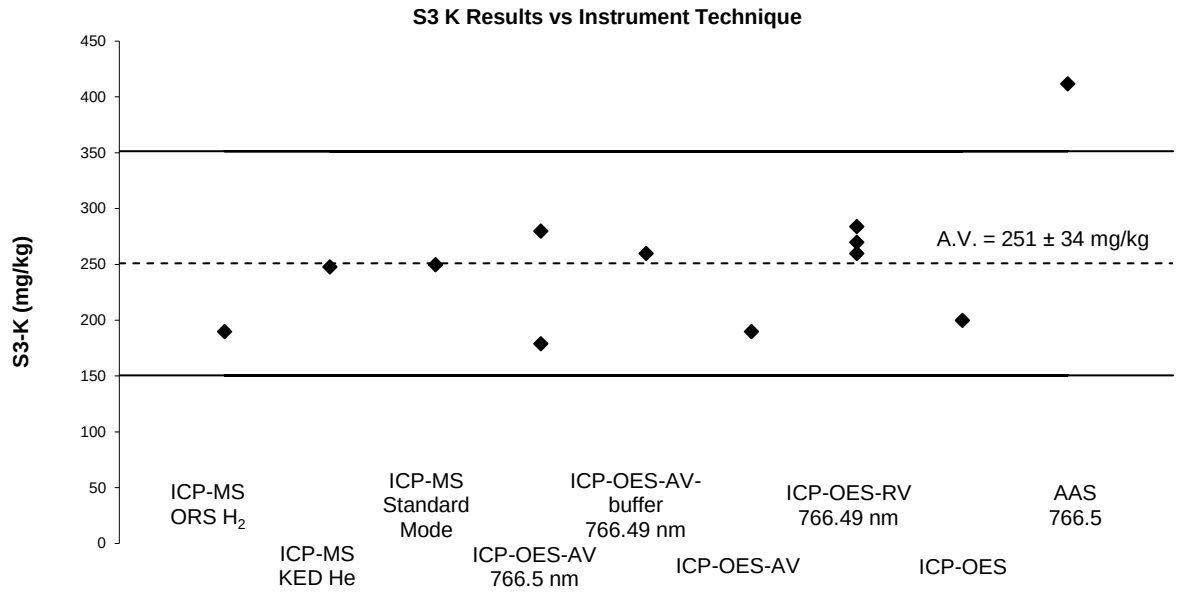


Figure 63 S3 K Results vs. Instrumental Technique

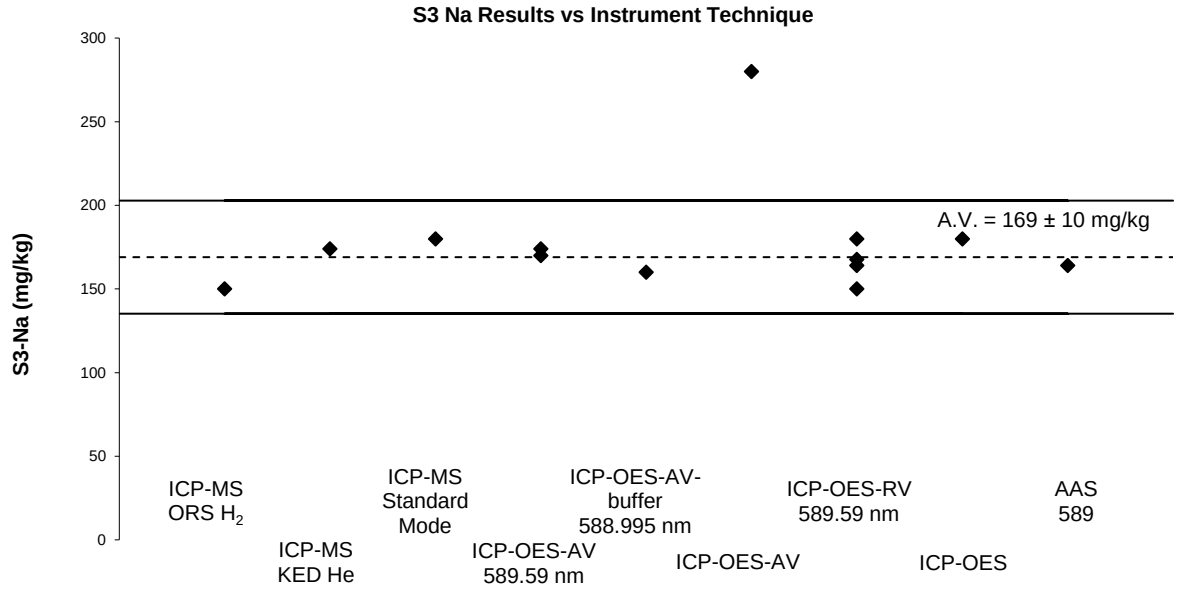
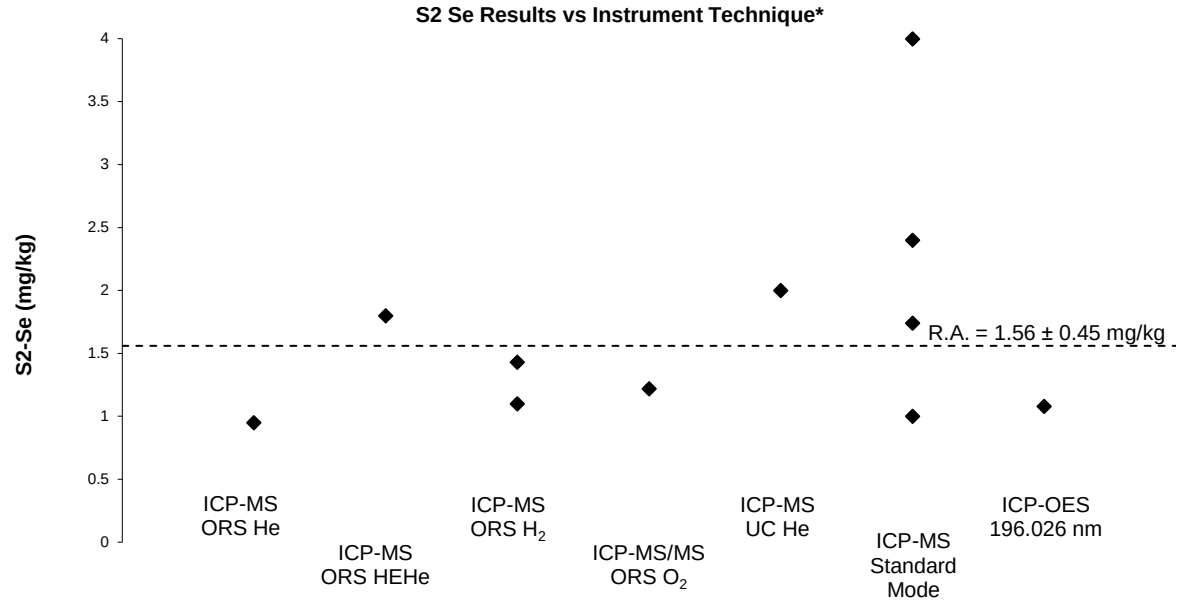


Figure 64 S3 Na Results vs. Instrumental Technique

Lithium The between-laboratory CV for this element was larger than predicted by Thomson and Harwitz (22%). ICP-MS has low sensitivity for light elements due to space-charge effects. An internal standard with similar behaviour may overcome this problem.

Selenium level in S2 was low and challenged participants' instrumental techniques, returning a between-laboratory CV of 41%. When ICP-MS with collision/reaction cell cannot be used, ICP-MS and isotope ^{82}Se may not be the best choice for Se measurements. Consider using ^{77}Se or ^{78}Se as these isotopes have less interferences.

Plots of participants results versus instrumental techniques used are presented in Figure 65.



*Laboratory 1 results of 9.6 mg/kg has been plotted as 4 mg/kg.

Figure 65 S2 Se Results vs. Instrumental Technique

Selenium level in S2 may be too low for accurate determination by ICP-OES.

7.6 Participants' Within-Laboratory Reproducibility

Sample S1 was a soil sample previously distributed as S2 of AQA 19-12.

Of 23 laboratories who reported results in the present study in S1, nine reported results in AQA 19-12 (Laboratories 3, 6, 7, 13, 16, 17, 26, 27 and 30).

Bar charts of laboratories' results in the two studies are presented in Figure 66. In some cases the participants' results reported in the two studies are significantly different.

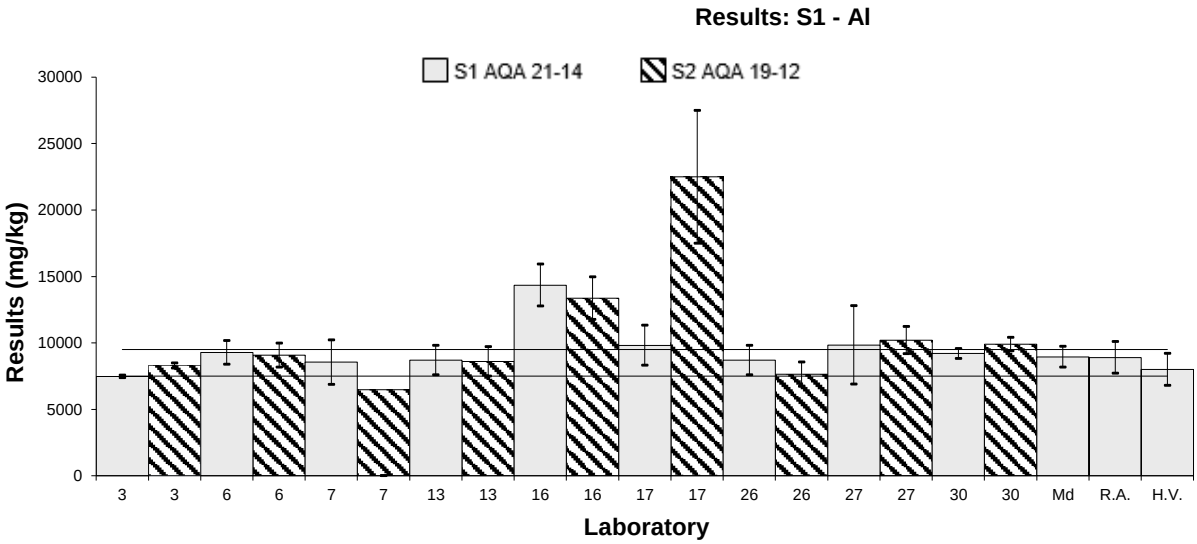
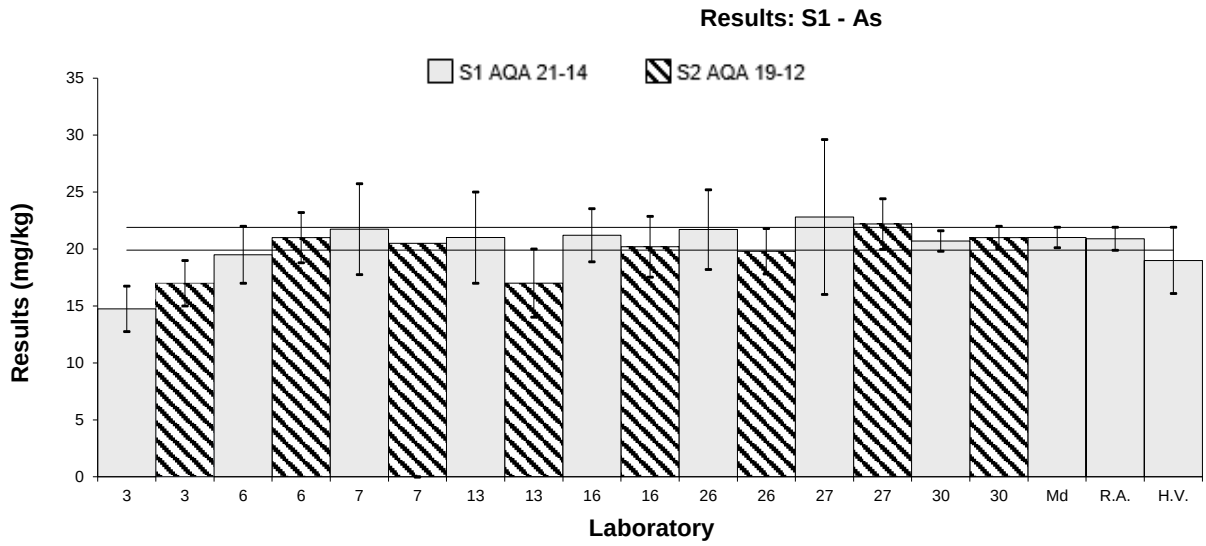
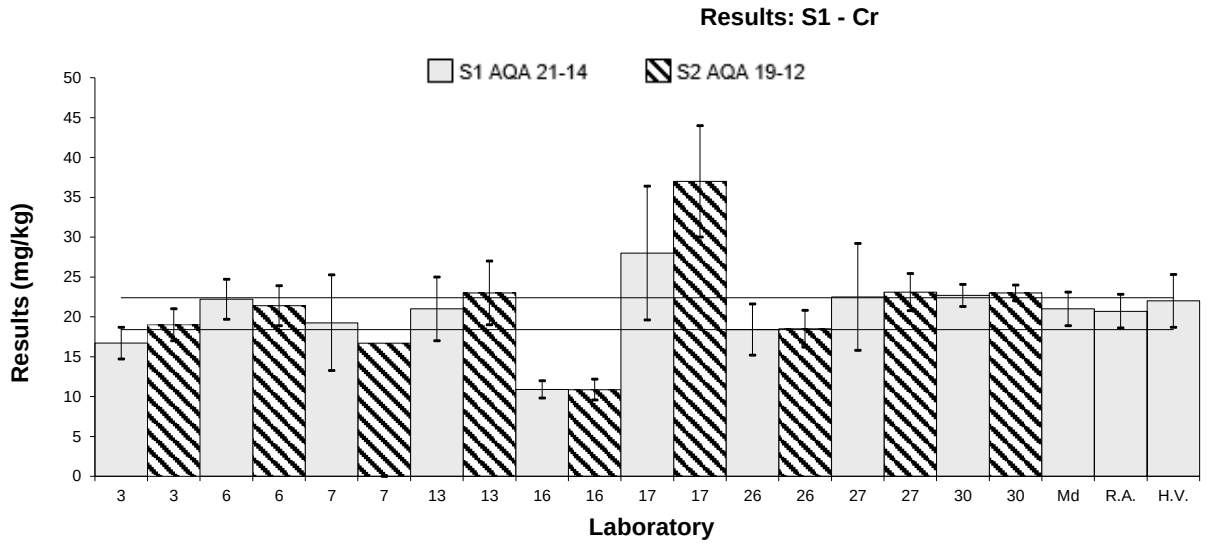


Figure 66 Bar charts of Results in S1 of AQA 21-14 and S2 of AQA 19-12





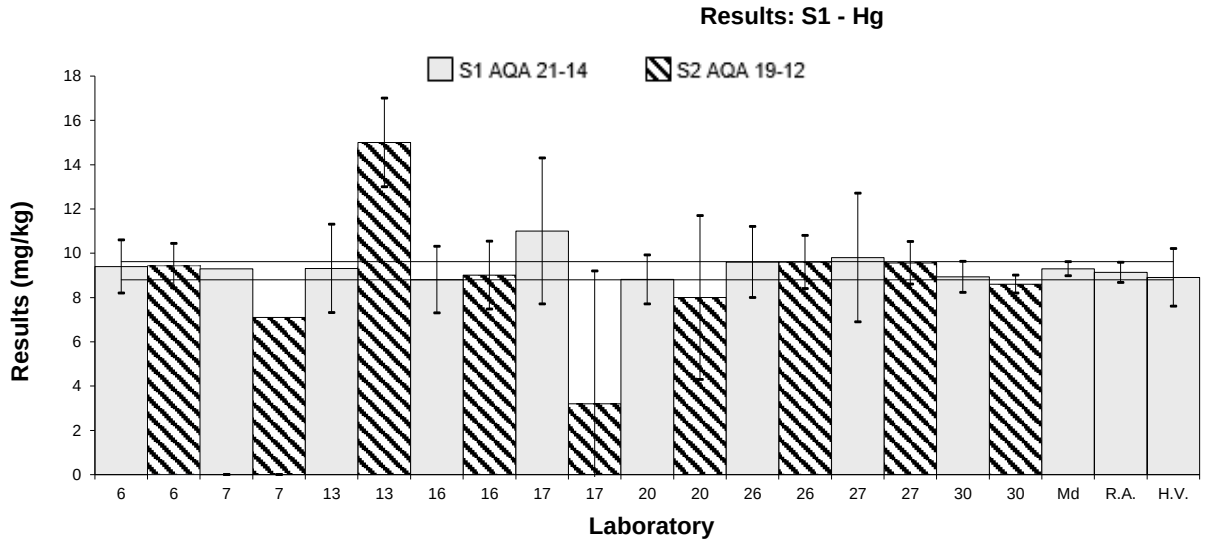
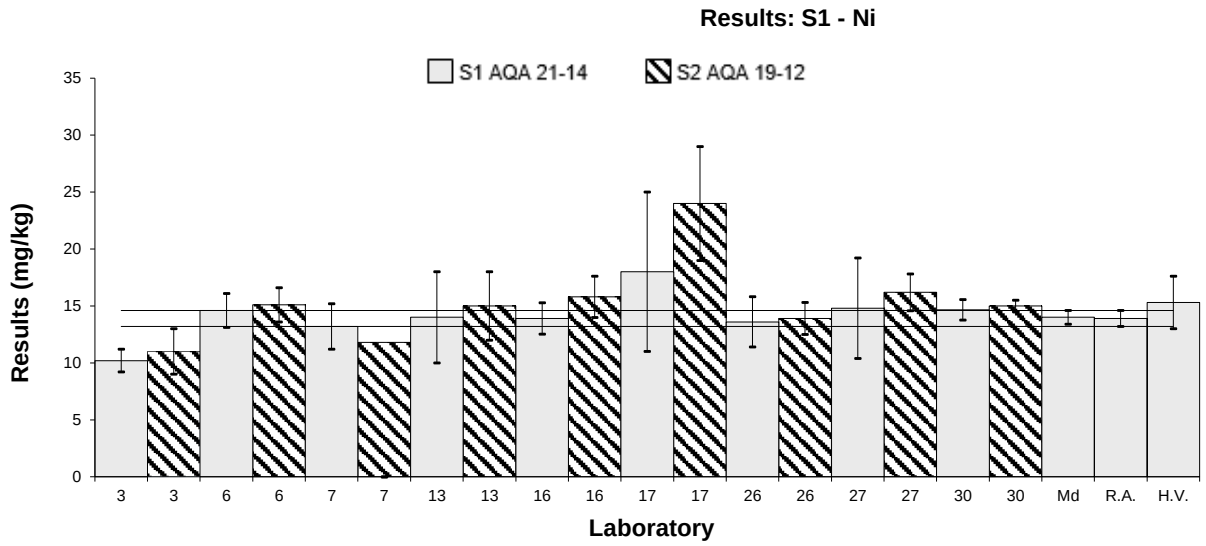
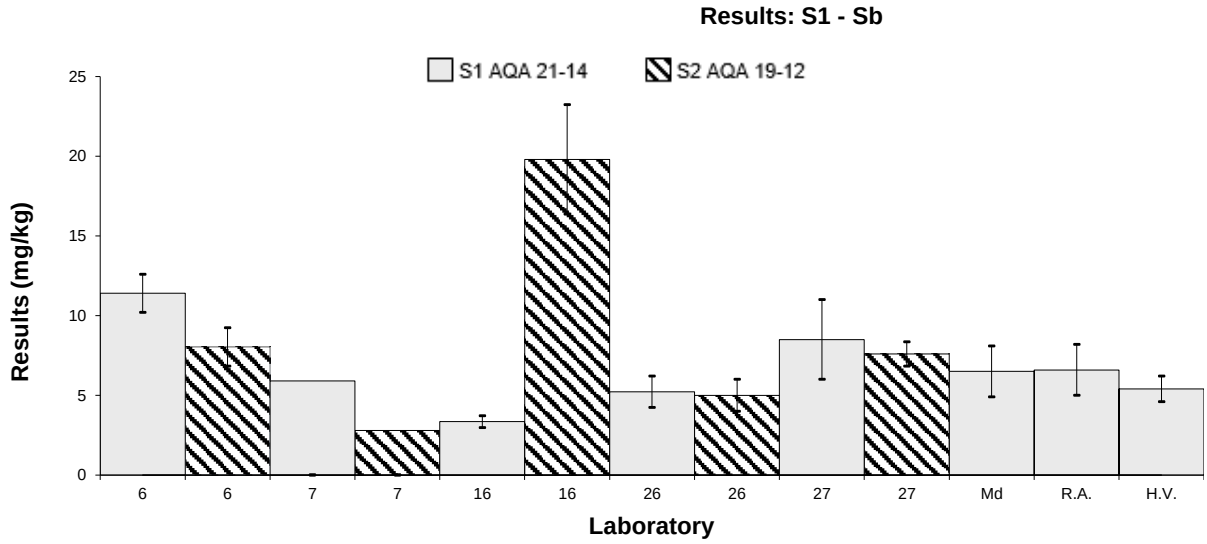


Figure 66 Bar charts of Results in S1 of AQA 21-14 and S2 of AQA 19-12 (continued)





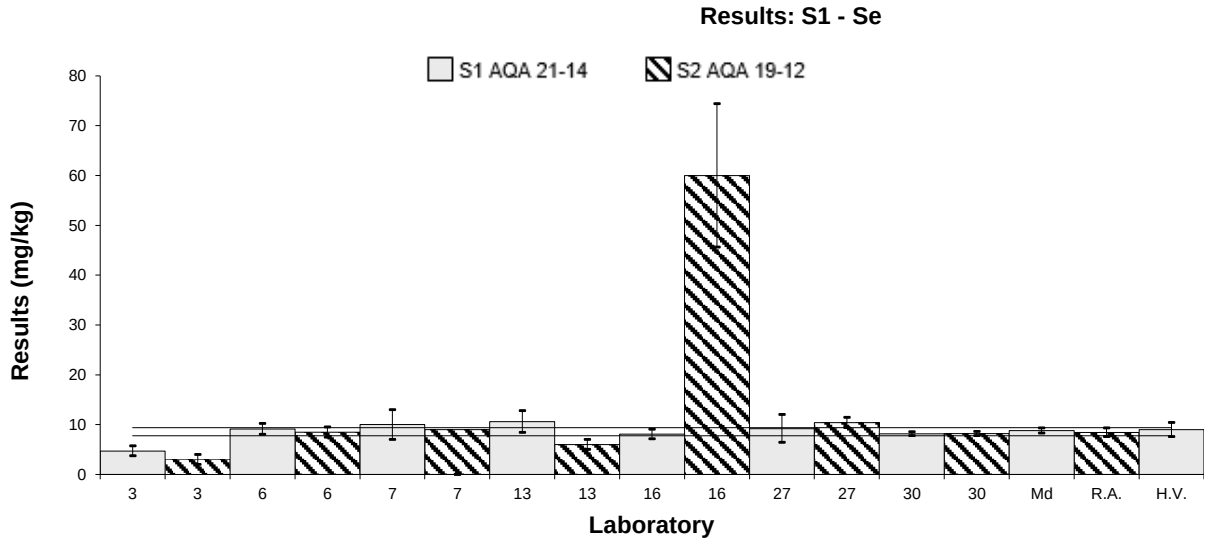
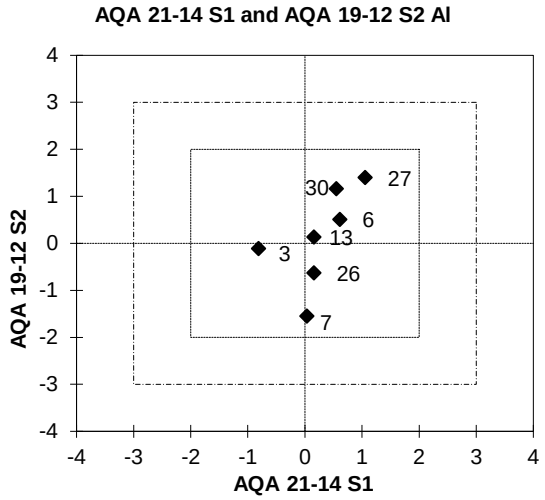
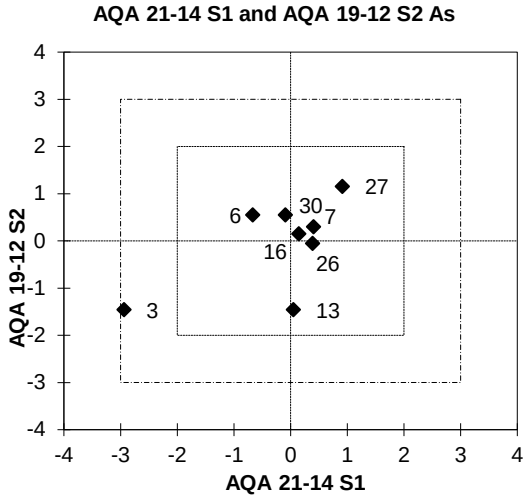


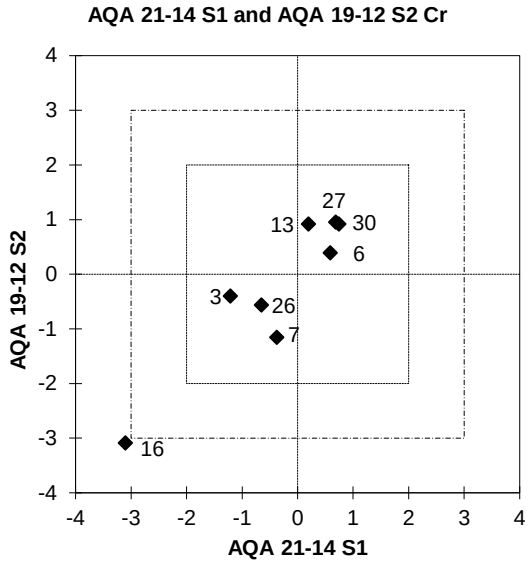
Figure 66 Bar Charts of Results in S1 of AQA 21-14 and S2 of AQA 19-12 (continued)

Figure 67 presents scatter plots of z-scores in Sample S1 of AQA 21-14 and S3 of AQA 19-12. Points close to the diagonal axis represent excellent reproducibility and points close to zero represent excellent reproducibility and accuracy.

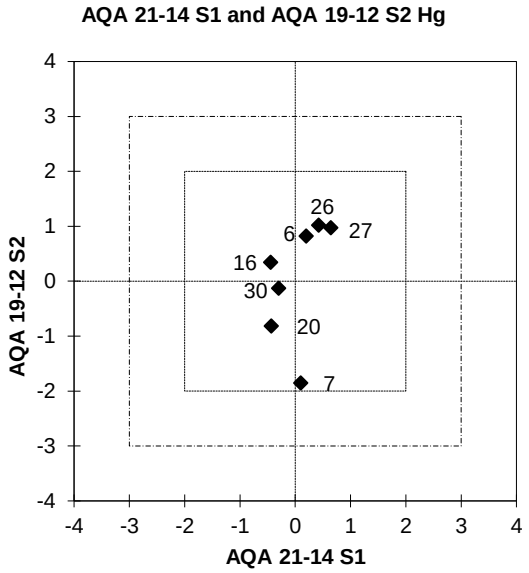


Laboratories 16 and 17 are off scale

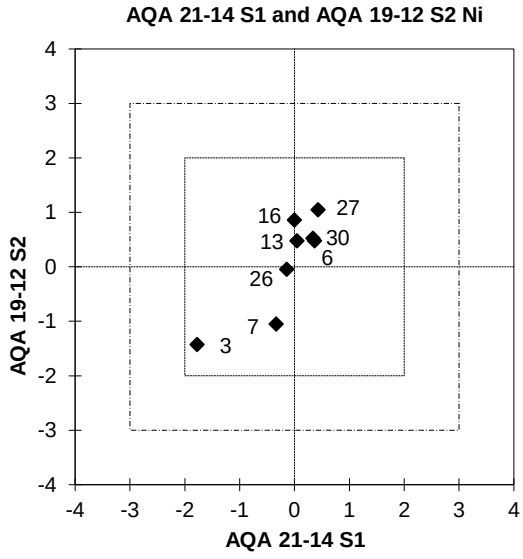




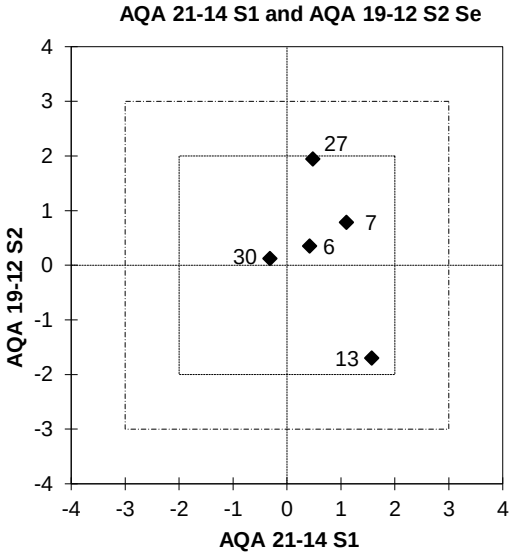
Laboratory 17 is off scale



Laboratories 13 and 17 are off scale



Laboratory 17 is off scale



Laboratories 3 and 16 are off scale

Figure 67 Scatter Plots of: z-Score in S1 of AQA 21-14 and S2 of AQA 19-12

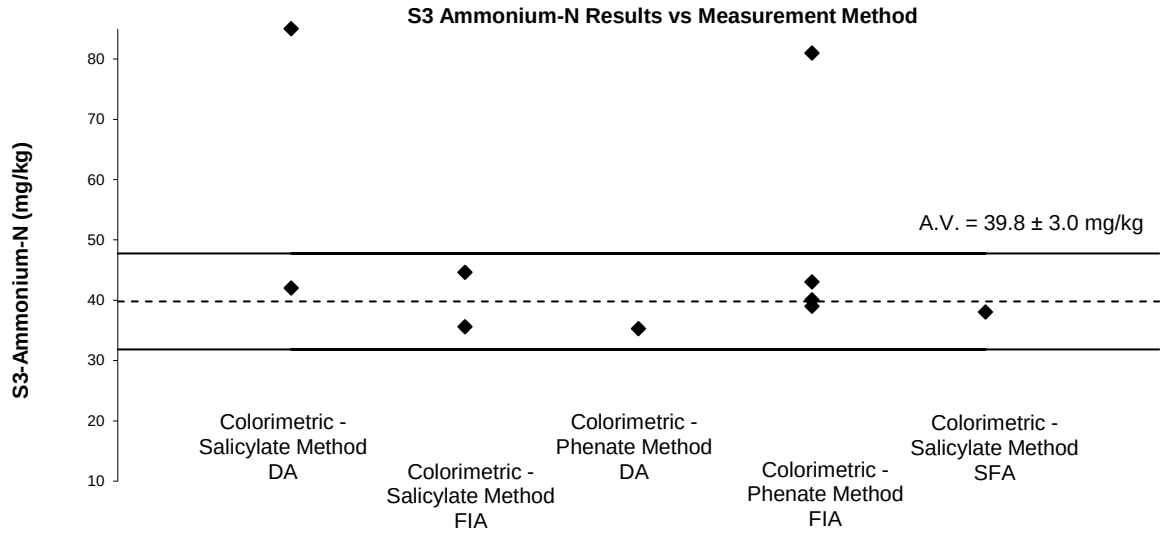
7.7 Participants' Results and Analytical Methods for 2M KCl Extractable Ammonium-N and Nitrate-N

Mineral nitrogen components, ammonium (NH_4^+), nitrite (NO_2^-) and nitrate (NO_3^-), are of particular interest when soil fertility is assessed. While water can extract NO_3^--N and NO_2^--N from a majority of soils, NH_4^+-N has to be displaced by another cation when the surface soil colloids are negatively charged.[25] The participating laboratories were asked to analyse the sample using their normal measurement technique but to follow the preparation procedure for the soil extract which involved: a soil/2M KCl ratio of 1:10 and a mixing time of one hour.

The method descriptions provided by participants are presented in Table 3. All but two participants used a soil/2M KCl ratio of 1:10.

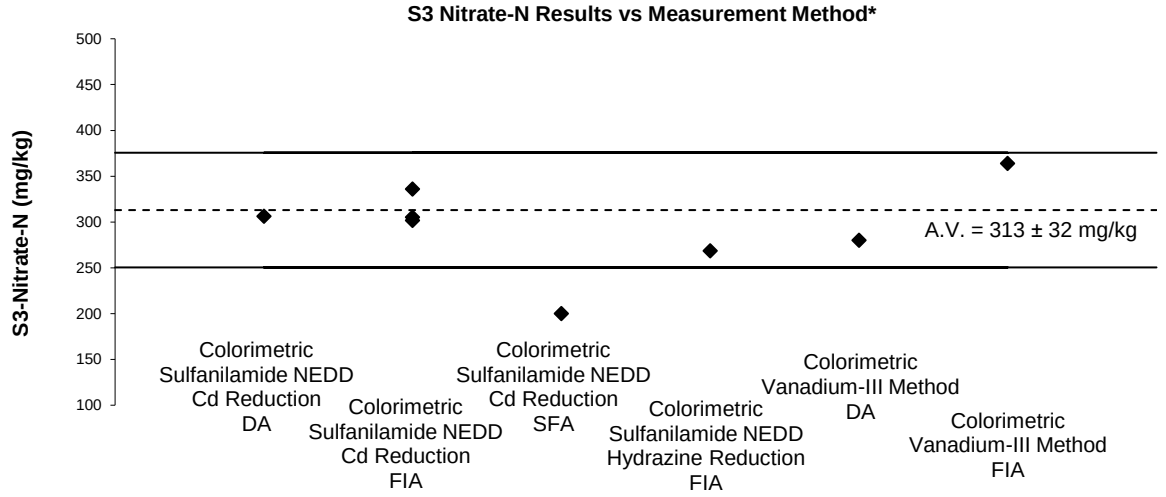
2M KCl Extractable Ammonium-Nitrogen Plots of participants' results versus the analytical methods and instrumental technique used are presented in Figure 68.

Typing errors and/or incorrect dilution factors may explain some of the high unsatisfactory ammonium-N results.



*Laboratory 16 result of 420 mg/kg has been plotted as 85 mg/kg.

Figure 68 S3-NH_4^+-N Results vs. Analytical Method and Measurement Technique



*Laboratory 22 results of 28 mg/kg has been plotted as 200 mg/kg.

Figure 69: S3-NO_3^--N Results vs. Measurement Technique

2M KCl Extractable Nitrate-Nitrogen The measurement method used by most laboratories involved NO_3^--N reduction to NO_2^--N by passage of the clarified soil extract through a Cd-Cu reduction column followed by NO_x (the reduced NO_2^--N plus original NO_2^--N) measurements. NO_x was determined colorimetrically based on Griess-Ilosvay reaction and NO_3^--N calculated by subtracting NO_2^--N value (obtained by analysis without passing the sample through the Cd-Cu reduction column), from the NO_x value.

Two laboratories used trivalent V for NO_3^--N reduction to NO_2^--N (Figure 69).

7.8 Participants' Results and Analytical Methods for Total Kjeldahl Nitrogen

TKN assigned value was 2480 mg/kg. Of 15 results reported for TKN in S3 only one returned an unsatisfactory z-score. Plots of participants' results versus analytical method and measurement technique are presented in Figure 70.

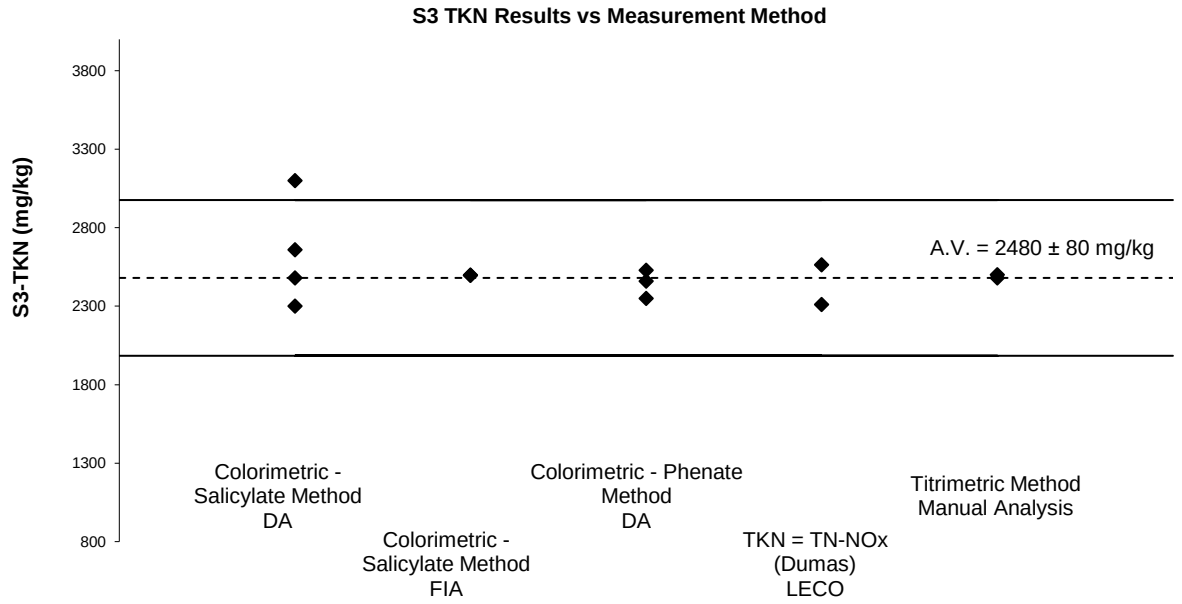


Figure 70 S3-TKN Results vs. Measurement Technique

Interferences from the coloured species in the extract might be the cause of the high, unsatisfactory TKN z-scores.

7.9 Participants' Results and Analytical Methods for Water Soluble Anions

Measurement of water soluble anions in soil is an empirical measurement – where the method of extraction defines the measurand.[25, 26] With testing laboratories using different methods, each could be considered to be measuring a different measurand that is their version of 'water soluble anions in soil'. This lack of uniformity in the procedures can make the comparison of participants' results difficult.

In the previous study of metals and anions in soil AQA 11-12, NMI conducted a study on water soluble anions content in soil using the same instrumental technique on two extraction procedures: one involved a soil/water ratio of 1: 5 and the other a soil/water ratio of 1:10. The **fluoride, orthophosphate and sulphate** results were found to change in direct proportion with the amount of water used in the extraction procedure.

In the present study participating laboratories were asked to analyse the sample using their normal measurement technique but to follow the same preparation procedure for the soil extract which involved: a soil/water ratio of 1:5 and a mixing time of one hour.

The method descriptions and instrumental techniques provided by participants are presented in Tables 4 to 9. All, but one laboratory, used a soil/water ratio of 1:5.

Individual Water Soluble Anion Commentary

Bromide. Only 5 participants reported results for bromide in S3. The results were in relatively good agreement with each other (CV17%) centred on a value of 1.97 mg/kg.

All participants used the Ion Chromatographic Method to measure bormide.

Chloride Fifteen participants reported results for chloride and 11 performed satisfactorily. Figure 71 presents a plot of participants' results versus measurement method and instrumental technique used for chloride analysis in S3.

Of 4 unsatisfactory results, 2 were from the ferricyanide colorimetric method by DA.

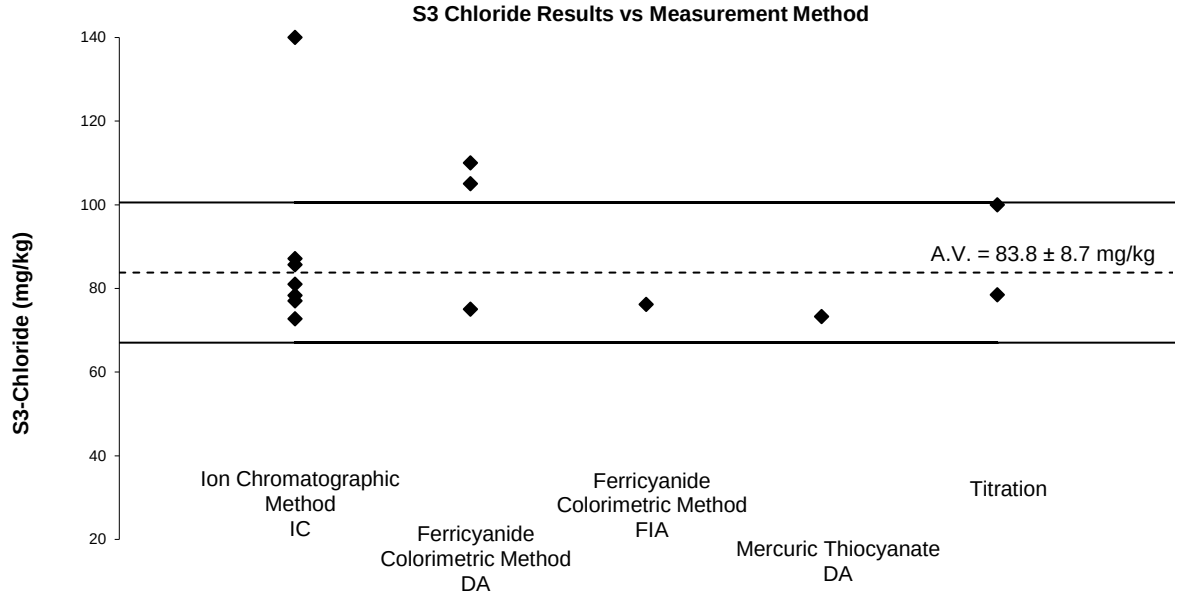


Figure 71 S3-Chloride Results vs. Measurement Method

Fluoride All but one participant who reported results for fluoride in S3 performed satisfactorily. Participants' results versus the methods used are presented in Figure 72.

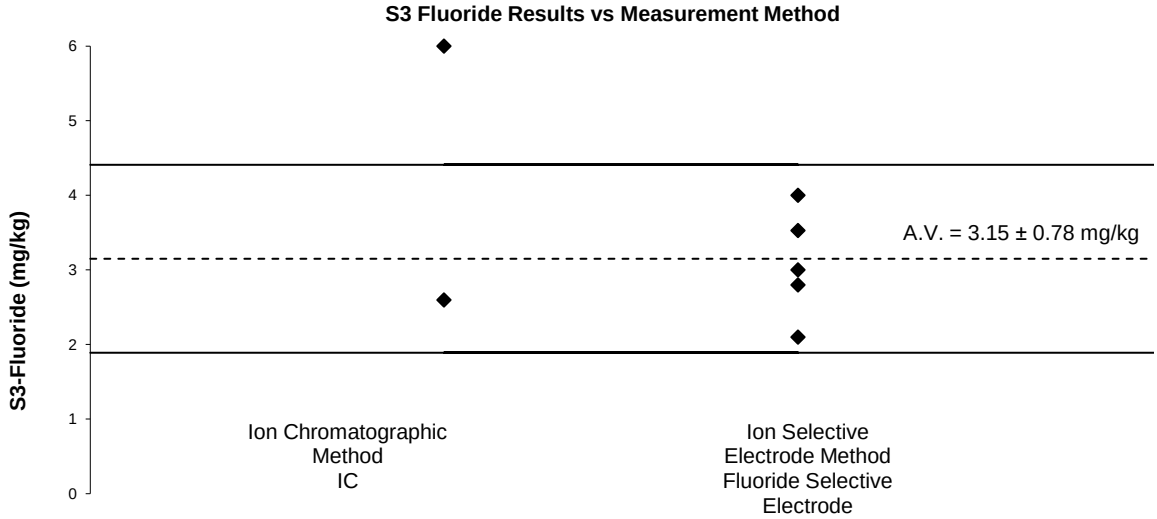


Figure 72 S3-Fluoride Results vs. Measurement Method

The high fluoride results from IC measurements may be explained by interferences from simple organic acids, bromates and chlorates found in soil samples.

Iodide Only two participants reported results for iodide in S3, both used ion chromatographic method.

Orthophosphate-P Participants used a wide variety of measurement methods and instrumental techniques (Figure 73). Ascorbic acid colorimetric method was the most popular method used by participants for the measurement of orthophosphate-P.

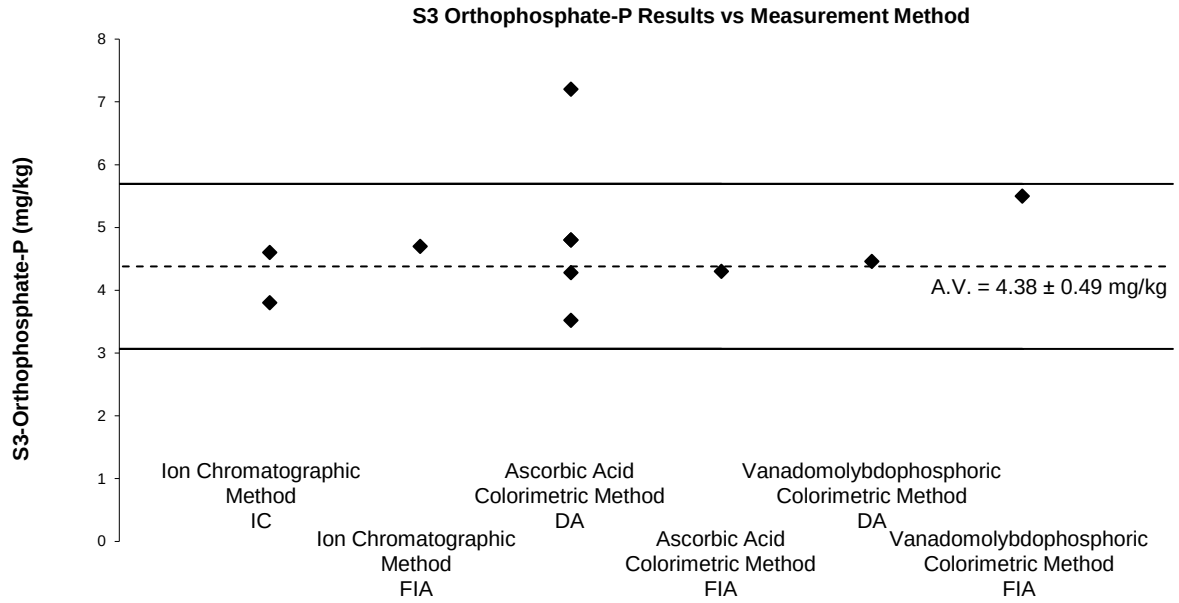


Figure 73 S3-Orthophosphate-P Results vs. Method

Sulphate Plots of participants' results versus the instrumental technique used are presented in Figure 74. Although most of the S in soil samples is from sulphate compounds, false positive results can be produced when this is measured by ICP-OES: this technique measures total S and not only S from sulphate compounds.

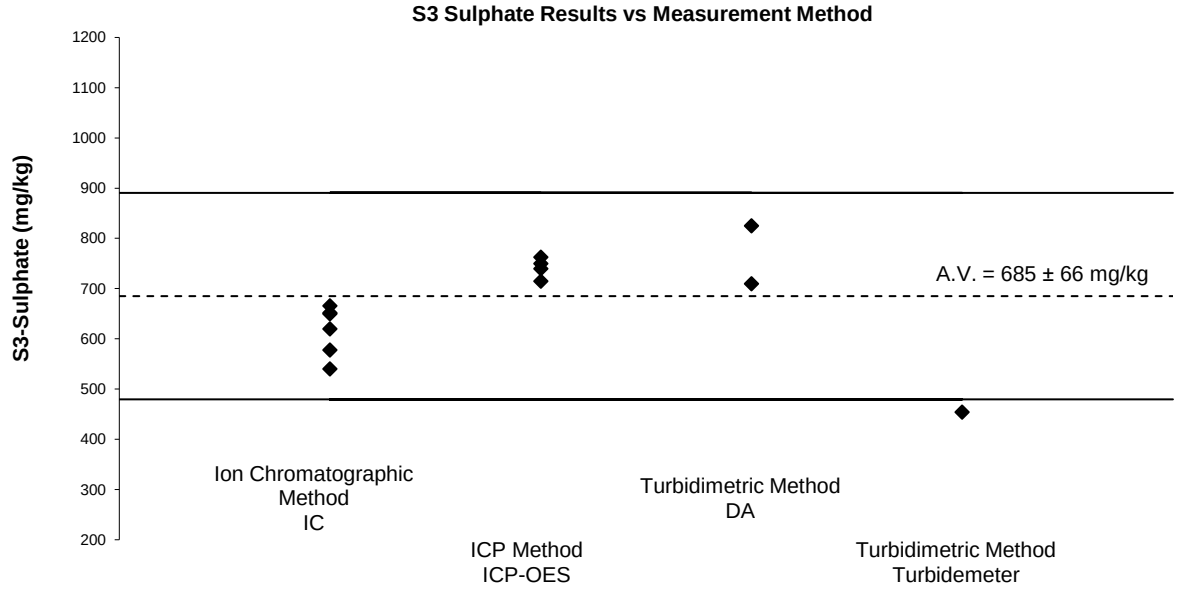


Figure 74 S3-Sulphate Results vs. Measurement Method and Instrumental Technique

7.10 Comparison with Previous NMI Proficiency Tests Studies of Metals in Soil

AQA 21-14 is the twenty-ninth NMI proficiency test of metals in soil. For most of the analytes the same fixed target standard deviation was used in the present study as in the previous studies of metals in soil. This allowed a comparison of participants' performance (z-score) over time and provided a benchmark for progressive improvement.

Participants' performance in the measurement of inorganic analytes in soil over time is presented in Figure 75. On average, participants' performance has remained fairly consistent over time.

Over time laboratories should expect at least 95% of its scores to lay within the range $|z| \leq 2.0$. Scores in the range $2.0 < |z| < 3.0$ occasionally can occur, however these should be interpreted in conjunction with the other scores obtained by that laboratory. For example, a trend of z-scores on one side of the zero line are an indication of method or laboratory bias.

Individual performance history reports are emailed to each participant at the end of the study; the consideration of z-scores for an analyte over time provides much more useful information than a single z-score.

7.11 Reference Materials and Certified Reference Materials

Participants reported whether control samples (spiked samples, certified reference materials-CRMs or matrix specific reference materials-RMs) had been used (Table 73).

Table 73 Control Samples Used by Participants

Lab. Code	Description of Control Samples
1	CRM
2	CRM
3	CRM
4	CRM
5	SS
6	RM – AGAL 12, In House AG reference
7	RM
8	CRM – Choice Analytical CRMs
9	CRM – ASPAC 7098 and ASPAC 6052
10	SS
11	Trace Metals - Sandy Loam 10. Lot# LRAA7890
12	CRM – SQC014: Nutrients in Soil for TKN and Ammonia as N
13	CRM – CRM036
14	CRM – PACS2 Marine Sediment
15	SS – Novachem SQC001S
16	SS
17	AGAL 12 & LOAM B
18	CRM – ICV 1, ICV 3, AGAL 10, AGAL 12, CRM540
19	RM – VHG-SL1-50g LOT#711217475
20	CRM – AGAL-10
23	AGAL 10 / AGAL 12
25	CRM
26	Agal-12 Biosoil

Lab. Code	Description of Control Samples
27	RM
28	CRM
29	AGAL 10 & AGAL 12
30	RM – AQA 20-13 S1,S2 and In house QC soil samples

Matrix matched control samples taken through all steps of the analytical process, are most valuable quality control tools for assessing the methods' performance.

Some laboratories reported using certified reference materials. These materials may not meet the internationally recognised definition of a Certified Reference Material:

> ***' a reference material****, accompanied by documentation issued by an authoritative body and providing one or more specified property values with associated uncertainties and traceabilities, using valid procedures'*[27]

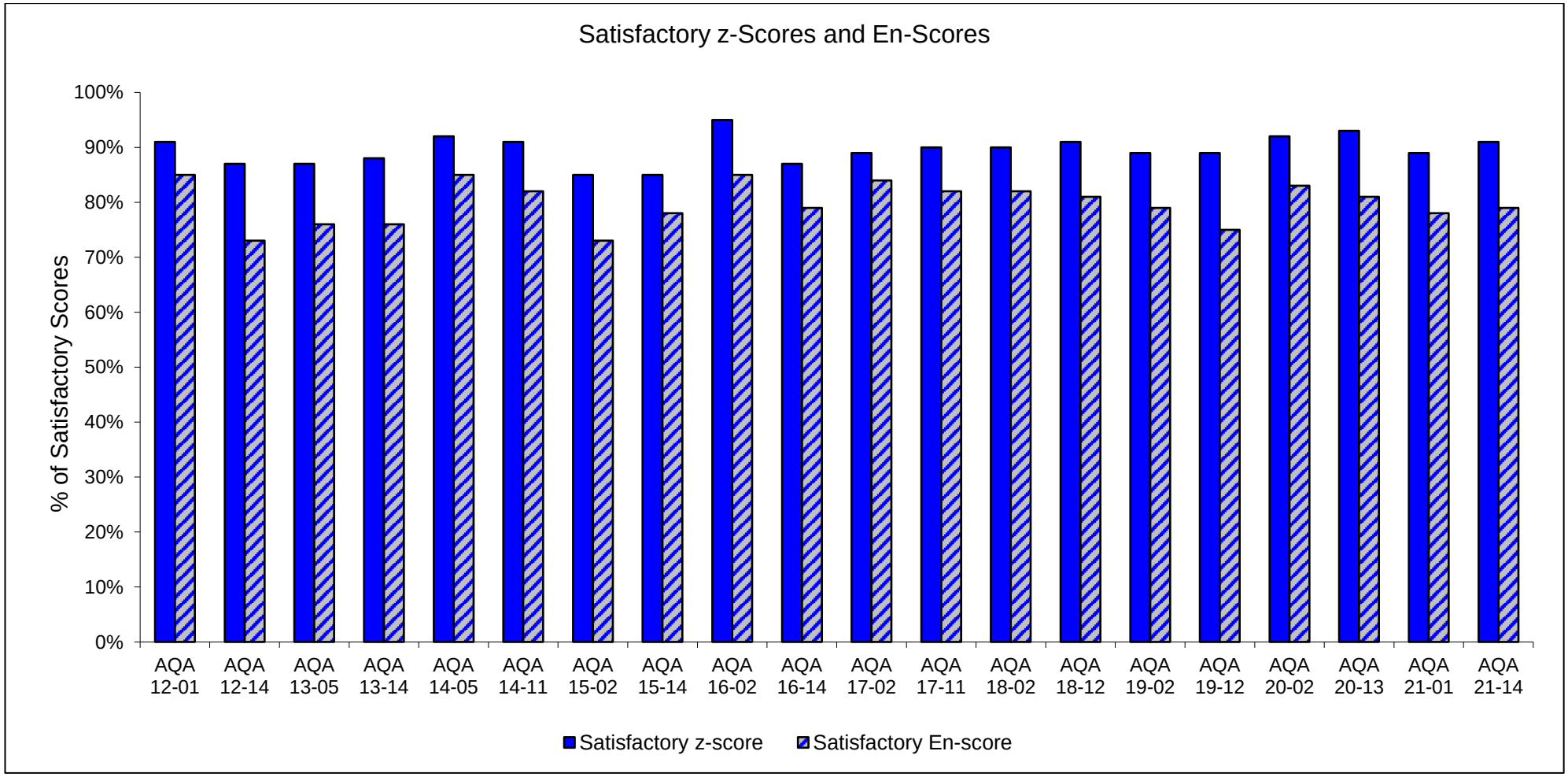


Figure 75 Participants' Performance over Time

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APPENDIX 1 - SAMPLE PREPARATION, ANALYSIS AND HOMOGENEITY TESTING

Sample Preparation

Samples S1 was sediment material. This sample was previously distributed as sample S2 for AQA 19-12. The preparation procedure of this sample is provided in the report for AQA 19-12.

Samples S2 was a soil sample fortified for 17 elements, dried, ground, and passed through a 350 µm sieve. The fortified soil was further mixed and divided into portions of 25 g each.

Sample S3 was an agricultural soil material dried, ground, passed through a 350 µm sieve and further mixed and divided into portions of 75 g each.

Sample Analysis and Homogeneity Testing

The same preparation procedure as in previous NMI PT studies for inorganic analytes in soil was followed for Samples S1, S2 and S3. Partial homogeneity testing was conducted for the elements of interest with the exception of Sb and Rb in S2 and EC, pH, 2M KCl extractable nitrate-N and S in S3. Three bottles were analysed in duplicate and the average of these results was reported as the homogeneity value. Measurements were made under repeatability conditions in random order.

Sample Analysis for Acid Extractable Elements

A test portion of approximately 0.5 g of soil was weighed into a 50 mL graduated polypropylene centrifuge tube. The sample was digested using 3 mL of concentrated nitric acid and 3 mL of concentrated hydrochloric acid on a hot block at 95°C ± 5°C. After digestion, each sample was diluted to 40 mL with Milli-Q water and then further diluted as necessary.

The measurement instrument was calibrated using external standards for targeted analytes. A set of quality control samples consisting of blanks, blank matrix spike, and matrix matched reference materials, duplicates and sample matrix spikes, was carried through the same set of procedures and analysed at the same time as the samples. A summary of the instrument conditions used and the ion/wavelength monitored for each analyte is given in Table 74.

Table 74 Instrumental Technique used for Acid Extractable Elements

Analyte	Instrument	Internal Standard	Reaction/ Collision Cell	Cell Mode/Gas	S1/2 Final Dilution Factor	S3 Final Dilution Factor	Ion (m/z)/ Wavelength (nm)
Ag	ICP-MS	Rh	ORS	He	800	NA	107 m/z
Al	ICP-MS	Rh	NA	NA	800	NA	27 m/z
As	ICP-MS	Rh	ORS	He	800	NA	75 m/z
B	ICP-MS	Rh	NA	NA	800	NA	11 m/z
Ba	ICP-MS	Rh	ORS	He	800	NA	137 m/z
Be	ICP-MS	Rh	NA	NA	800	NA	9 m/z
Bi	ICP-MS	Ir	NA	He	800	NA	209 m/z
Ca	ICP-MS	Rh	ORS	He	NA	800	43 m/z
Cd	ICP-MS	Rh	NA	NA	800	NA	111 m/z
Co	ICP-MS	Rh	ORS	He	800	NA	59 m/z
Cr	ICP-MS	Rh	ORS	He	800	NA	52 m/z
Cs	ICP-MS	Rh	ORS	He	800	NA	113 m/z
Cu	ICP-MS	Rh	ORS	He	800	NA	65 m/z
Fe	ICP-MS	Rh	NA	NA	NA	800	56 m/z
Ga	ICP-MS	Rh	ORS	He	800	NA	71 m/z
Hg	ICP-MS	Rh	NA	NA	800	NA	201 m/z
K	ICP-MS	Rh	ORS	He	NA	800	39 m/z

Analyte	Instrument	Internal Standard	Reaction/ Collision Cell	Cell Mode/Gas	S1/2 Final Dilution Factor	S3 Final Dilution Factor	Ion (m/z)/ Wavelength (nm)
La	ICP-MS	Rh	ORS	He	800	NA	139 m/z
Li	ICP-MS	Rh	ORS	He	800	NA	7 m/z
Mg	ICP-MS	Rh	ORS	He	NA	800	24 m/z
Mn	ICP-MS	Rh	ORS	He	800	NA	55 m/z
Mo	ICP-MS	Rh	ORS	He	800	NA	95 m/z
Na	ICP-MS	Rh	ORS	He	NA	800	23 m/z
Ni	ICP-MS	Rh	ORS	He	800	NA	60 m/z
P	ICP-MS	Rh	ORS	HEHe	NA	800	31 m/z
Pb	ICP-MS	Ir	NA	NA	800	NA	Average of 206, 207, 208 m/z
Se	ICP-MS	Rh	ORS	HEHe	800	NA	78 m/z
Sn	ICP-MS	Rh	NA	NA	800	NA	118 m/z
Sr	ICP-MS	Rh	ORS	He	NA	800	88 m/z
Th	ICP-MS	Ir	ORS	He	800	NA	232 m/z
Tl	ICP-MS	Ir	ORS	He	800	NA	205 m/z
U	ICP-MS	Ir	NA	NA	800	NA	238 m/z
V	ICP-MS	Rh	ORS	He	800	NA	51 m/z
Zn	ICP-MS	Rh	ORS	He	800	NA	66 m/z

Sample Analysis for Water Soluble Anions

A test portion of 10 g was weighed into a 50 mL polypropylene container. The container was then filled with deionised water. The suspension was shaken, at room temperature for 1 h, centrifuged, and filtered through 0.45 µm filter. A summary of the measurement methods and instrumental techniques is presented in Table 75.

Table 75 Summary of the Measurement Methods and Instrumental Techniques used by NMI

Anion	Measurement Method	Instrument
Total Kjeldahl Nitrogen	Titrimetric Method	Manual Analysis
Water Soluble Bromide	Ion Chromatographic Method	IC
Water Soluble Chloride	Ion Chromatographic Method	IC
Water Soluble Fluoride	Ion Selective Electrode Method	IC
Water Soluble Orthophosphate-P	Colorimetric, Ascorbic Acid Reduction	DA
Water Soluble Sulphate	Ion Chromatographic Method	IC

APPENDIX 2 - ASSIGNED VALUE, Z-SCORE AND E_N SCORE CALCULATION

The assigned value was calculated as the robust average using the procedure described in 'ISO13528:2015(E), Statistical methods for use in proficiency testing by inter-laboratory comparisons – Annex C'.[6] The uncertainty was estimated as:

$$u_{rob\ av} = 1.25 * S_{rob\ av} / \sqrt{p} \qquad \text{Equation 4}$$

where:

$u_{rob\ av}$ robust average standard uncertainty
$S_{rob\ av}$ robust average standard deviation
p number of results

The expanded uncertainty ($U_{rob\ av}$) is the standard uncertainty multiplied by a coverage factor of 2 at approximately 95% confidence level.

A worked example is set out below in Table 76.

Table 76 Uncertainty of Assigned Value for As in Sample S1

No. results (p)	21
Robust Average	20.9 mg/kg
$S_{rob\ av}$	1.9 mg/kg
$u_{rob\ av}$	0.51 mg/kg
k	2
$U_{rob\ av}$	1.0 mg/kg

The assigned value for **As** in Sample S1 is **20.9 ± 1.0 mg/kg**.

z-Score and E_n-score

For each participant's result a z-score and E_n-score are calculated according to Equation 1 and Equation 2 respectively (see page 15).

A worked example is set out below in Table 77.

Table 77 z-Score and E_n-score for As Result Reported by Laboratory 1 in S1

As Result mg/kg	Assigned Value mg/kg	Set Target Standard Deviation	z-Score	E_n-Score
21 ± 3.15	20.9 ± 1.0	10% as CV or 0.10x20.9 = =2.1 mg/kg	$z = \frac{(21 - 20.9)}{2.1}$ z = 0.05	$En = \frac{(21 - 20.9)}{\sqrt{3.15^2 + 1.0^2}}$ E_n=0.03

APPENDIX 3 - USING PT DATA FOR UNCERTAINTY ESTIMATION

When a laboratory has successfully participated in at least 6 proficiency testing studies, the standard deviation from proficiency testing studies can also be used to estimate the uncertainty of their measurement results.[10, 12] An example is given. Between 2009 and 2021 NMI carried out 24 proficiency tests of metals in soil. These studies involved analyses of acid-extractable elements at low and high levels in dried soil, moist soil, biosoil, sediment and sludge.

Laboratory X submitted results for As in all of these PTs. All reported results returned satisfactory z-scores. This data can usefully be separated into two ranges of results 0.5 to 10 mg/kg and 10 to 100 mg/kg (Tables 78 and 79).

Taking the average of the robust CV over these PT samples for each concentration range gives estimates of the relative standard uncertainty of 12% and 9.4% respectively. Using a coverage factor of two gives relative expanded uncertainties of 25% and 19% respectively, at a level of confidence of approximately 95%.

Table 78 Laboratory X Reported Results for As at 0.5 to 10 mg/kg Level.

Study No.	Sample	Laboratory result mg/kg	Assigned value* mg/kg	Robust CV of all results (%)	Number of Results
AQA 09-13	S1 - Biosoil	4.091	3.64	16	11
	S2 - Soil	4.29	4.57	15	12
AQA 11-01	S1 - Biosoil	3.54	3.57	19.7	18
AQA 13-05	S1 - Soil	9.22	9.21	14	22
AQA 14-11	S1 - Sediment	7.91	7.37	11.8	21
AQA 15-02	S1 - Moist Sludge	8.29	7.02	13	22
	S2 - Moist Sludge	7.42	7.02	11.3	17
AQA 15-14	S1 - Sediment	10	9.95	6.7	17
	S2 - Soil	4.53	4.47	6.4	14
AQA 16-02	S2 - Clay	2.67	2.11	14	20
AQA 16-14	S1 - Soil	6.03	5.61	20	17
AQA 17-02	S2 - Soil	3.71	3.76	10	13
AQA 18-02	S1 - Compost	2.22	2.73	11	17
AQA 19-02	S1 - Soil	2.83	2.65	11	24
AQA 19-12	S1 - Soil	2.32	2.12	16	16
AQA 20-13	S1 - Biosoil	2.85	3.29	11	17
AQA 21-01	S1 – Sediment	7.02	6.26	6.9	18
AQA 21-01	S2 – Moist Sludge	3.99	3.58	12.6	13
Average				12.1**	

*Expanded uncertainty at approximately 95% confidence. ** The mean value of Robust CV was used.

Table 79 Laboratory X Reported Results for As at 10 to 100 mg/kg Level.

Study No.	Sample	Laboratory result mg/kg	Assigned value* mg/kg	Robust CV of all results (%)	Number of Results
AQA 10-12	S1 - Soil	16.6	14.4	8.5	19
AQA 11-12	S1 - Moist Sludge	25	21.6	15	13
AQA 12-01	S1 - Sediment	18.4	17.3	8.1	21
AQA 12-14	S2 - Soil	16.6	14.8	11	20
AQA 13-14	S1 - Sandy Soil	16.6	15.1	10.4	21
AQA 14-05	S1 - Soil	13.2	12.3	7.8	25
AQA 17-11	S1 - Sediment	18.1	17.4	11	22
AQA 18-12	S2 - Soil	10.4	9.6	8	20
AQA 19-12	S2 - Sediment	21	19.9	9	19
AQA 20-02	S1 - Soil	18.8	21.6	8.8	23
AQA 20-02	S2 - Moist Soil	16.5	17.8	6.7	24
AQA 21-14	S1 - Sediment	19.5	20.9	8.9	21
Average				9.4**	

*Expanded uncertainty at approximately 95% confidence. ** The mean value of Robust CV was used.

Table 80 sets out the expanded uncertainty for results of the measurement of As in soil, biosoil, clay, sediment, sludge, sandy soil, moist soil, compost and agricultural soil over the ranges 0.5 to 10 mg/kg and 10 to 100 mg/kg.

Table 80 Uncertainty of As Results Estimated Using PT Data.

Results mg/kg	Uncertainty mg/kg
1.00	0.25
5.0	1.3
20.0	3.8
75	15

The estimates of 25% and 19% relative passes the test of being reasonable, and the analysis of the 30 different PT samples over twelve years can be assumed to include all the relevant uncertainty components (different matrices, operators, reagents, calibrators etc.), and so complies with ISO 17025:2018.[8]

APPENDIX 4 - INSTRUMENT DETAILS

Table 81 Instrument Conditions Ag

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Indium				NA	
2	NA	NA	NA	NA	NA	NA	NA
3						NA	
4	ICP-OES-RV					NA	328.068
5	ICP-MS	Rh	CRI	He	500	NA	107
6	ICP-MS	Rh	NA	NA	625	NA	109
7	NA	NA	NA	NA	NA	NA	NA
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	NA	328.069nm
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	103	ORS	He	50		107
11						NA	
12	NA	NA	NA	NA	NA	NA	NA
13	ICP-MS	In	NA		1000	NA	107
14	NA	NA	NA	NA	NA	NA	NA
15	ICP-MS	In	ORS	He	0.1	NA	107
16	ICP-OES-AV	NA	NA		1	NA	328.068
17	ICP-OES-AV	Yttrium			250	NA	328.068
18	ICP-MS	Rh	ORS	He	500	NA	107
19	ICP-MS	Y 89	KED		NA	NA	107
20						NA	
21	ICP-MS		CRI	He		NA	
22	ICP-MS	Rh	ORS	He	800	NA	107
23	NA	NA	NA	NA	NA	NA	NA
24	NA	NA	NA	NA	NA	NA	NA
25	ICP-OES-AV	Lu	NA	NA	100	NA	328.068
26	ICP-MS	Rh	NA	standard mode	400	NA	109
27	ICP-MS	Rh	NA		NA	250	
28						NA	
29	ICP-MS	Rh	ORS	He	500	NA	107
30	ICP-MS/MS	Rh103	ORS	O2	4000	NA	Ag 107/107(m/z)

Table 82 Instrument Conditions Al

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV	Scandium				NA	
2						NA	
3						NA	
4	NA	NA	NA	NA	NA	NA	NA
5	ICP-MS	Sc	CRI	He	500	NA	27
6	ICP-MS	Sc	KED	He	625	NA	27
7	ICP-OES-AV	Eu	NA	NA	50	NA	237
8	ICP-OES	Eu & Cs	NA	NA	50	NA	236.707, 308.215, 396.15nm
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	72		standard mode	50		27
11	ICP-MS	Rhodium	KED	He	1000	NA	26.982
12	NA	NA	NA	NA	NA	NA	NA
13	ICP-OES-AV-buffer	Y			100	NA	394.401
14	NA	NA	NA	NA	NA	NA	NA
15	ICP-OES-AV	Lu			0.1	NA	237.312
16	ICP-OES-AV	NA	NA		10	NA	396.152
17	ICP-OES-RV	Yttrium			250	NA	396.153
18	ICP-MS	Sc	ORS	He	500	NA	27
19	ICP-MS	Sc-2 45	KED		1000	NA	27
20						NA	
21	ICP-OES-AV					NA	
22	NA	NA	NA	NA	NA	NA	NA
23	ICP-MS	Yes				NA	27
24						NA	
25	NA	NA	NA	NA	NA	NA	NA
26	ICP-MS	Sc	NA	standard mode	2000	NA	27
27	ICP-MS	Sc	NA		NA	250	
28	NA	NA	NA	NA	NA	NA	NA
29	ICP-MS	Sc	ORS	He	5000	NA	27
30	ICP-OES-AV	In 303.936	NA	NA	80	NA	Al 237.312

Table 83 Instrument Conditions As

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Indium				NA	
2						NA	
3						NA	
4	NA	NA	NA	NA	NA	NA	NA
5	ICP-MS	Rh	CRI	He	500	NA	75
6	ICP-MS	Ge	KED	He	625	NA	75
7	ICP-MS	Sc	ORS	He	50	NA	75
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	NA	188.89nm
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	72	ORS	He	50		75
11	ICP-MS	Rhodium	KED	He	1000	NA	74.922
12	NA	NA	NA	NA	NA	NA	NA
13	ICP-OES-AV-buffer	Y			100	NA	188.979
14	NA	NA	NA	NA	NA	NA	NA
15	ICP-MS	Ge	ORS	He	0.1	NA	75
16	ICP-OES-AV	NA	NA		1	NA	188.98
17	ICP-OES-AV	Yttrium			250	NA	188.979
18	ICP-MS	Y	ORS	He	500	NA	75
19	ICP-MS	Ge-1 72	KED		10	NA	75
20						NA	
21	ICP-MS		CRI	He		NA	
22	NA	NA	NA	NA	NA	NA	NA
23	ICP-MS	Yes	KED	He		NA	75
24						NA	
25	NA	NA	NA	NA	NA	NA	NA
26	ICP-MS	Rh	KED	He	1000	NA	75
27	ICP-MS	Rh	UC	He	250	250	
28	NA	NA	NA	NA	NA	NA	NA
29	ICP-MS	Rh	ORS	He	500	NA	75
30	ICP-OES-AV	In 303.936	NA	NA	80	NA	As 188.980

Table 84 Instrument Conditions B

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV	Scandium				NA	
2	NA	NA	NA	NA	NA	NA	NA
3						NA	
4	ICP-OES-RV					NA	249.772
5	ICP-MS	Sc	CRI	NA	500	NA	11
6	ICP-MS	Sc	NA	NA	625	NA	10
7	NA	NA	NA	NA	NA	NA	NA
8	ICP-OES	Eu & Cs	NA	NA	50	NA	249.773nm
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	89		standard mode	10		11
11						NA	
12	NA	NA	NA	NA	NA	NA	NA
13	ICP-OES-AV-buffer	Y			100	NA	208.957
14	NA	NA	NA	NA	NA	NA	NA
15	ICP-MS	Li6	NA	standard mode	0.1	NA	11
16	ICP-OES-AV	NA	NA		1	NA	249.772
17	ICP-OES-AV	Yttrium			250	NA	249.677
18	ICP-MS	Sc	ORS	He	500	NA	11
19	ICP-MS	Y 89	KED		10	NA	11
20						NA	
21	ICP-MS		CRI	He		NA	
22	ICP-MS	Rh	ORS	NA	800	NA	11
23	NA	NA	NA	NA	NA	NA	NA
24	NA	NA	NA	NA	NA	NA	NA
25	ICP-OES-AV	Lu	NA	NA	100	NA	249.678
26	ICP-MS	Sc	KED	He	400	NA	11
27	ICP-MS	Sc	NA		250	NA	
28						NA	
29	ICP-MS	Sc	ORS	He	500	NA	11
30	ICP-OES-AV	In 303.936	NA	NA	80	NA	B 249.678

Table 85 Instrument Conditions Ba

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV	Scandium				NA	
2	NA	NA	NA	NA	NA	NA	NA
3						NA	
4	ICP-OES-RV					NA	585.367
5	ICP-MS	Rh	CRI	He	500	NA	135
6	ICP-MS	Rh	NA	NA	625	NA	138
7	NA	NA	NA	NA	NA	NA	NA
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	NA	585.369nm
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	159	ORS	He	50		137
11						NA	
12	NA	NA	NA	NA	NA	NA	NA
13	ICP-OES-AV-buffer	Y			100	NA	455.403
14	NA	NA	NA	NA	NA	NA	NA
15	ICP-OES-AV	Lu			0.1	NA	455.403
16	ICP-OES-AV	NA	NA		10	NA	455.403
17	ICP-OES-AV	Yttrium			250	NA	249.677
18	ICP-MS	Rh	ORS	He	500	NA	135
19	ICP-MS	In-1 115	KED		10		138
20						NA	
21	ICP-MS		CRI	He		NA	
22	ICP-MS	Rh	ORS	He	800	NA	137
23	NA	NA	NA	NA	NA	NA	NA
24	NA	NA	NA	NA	NA	NA	NA
25	ICP-OES-AV	Lu	NA	NA	100	NA	455.403
26	ICP-MS	Tb	NA	standard mode	400	NA	137
27	ICP-MS	In	NA		250	250	
28						NA	
29	ICP-MS	Sc	ORS	He	500	NA	135
30	ICP-OES-AV	Eu 390.711	NA	NA	80	NA	Ba 455.403

Table 86 Instrument Conditions Be

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Indium				NA	
2	NA	NA	NA	NA	NA	NA	NA
3						NA	
4	ICP-OES-RV					NA	585.367
5	ICP-MS	Sc	CRI	NA	500	NA	9
6	ICP-MS	Sc	NA	NA	625	NA	9
7	NA	NA	NA	NA	NA	NA	NA
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	NA	313.042nm
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	72		standard mode	50		9
11						NA	
12	NA	NA	NA	NA	NA	NA	NA
13	ICP-MS	Sc	NA		1000	NA	9
14	NA	NA	NA	NA	NA	NA	NA
15	ICP-MS	Li6	ORS	He	0.1	NA	9
16	ICP-OES-AV	NA	NA		1	NA	234.861
17	ICP-OES-AV	Yttrium			250	NA	313.107
18	ICP-MS	Sc	ORS	He	500	NA	NA
19	ICP-MS	Sc-2 45	KED		10	NA	9
20						NA	
21						NA	
22	ICP-MS	Rh	ORS	NA	800	NA	9
23	NA	NA	NA	NA	NA	NA	NA
24	NA	NA	NA	NA	NA	NA	NA
25	ICP-OES-AV	Lu	NA	NA	100	NA	234.861
26	ICP-MS	Sc	NA	standard mode	400	NA	9
27	ICP-MS	Sc	NA		250	NA	
28						NA	
29	ICP-MS	Sc[No Gas]	ORS	He	500	NA	9
30	ICP-OES-AV	Lu307.760	NA	NA	80	NA	Be 313.107

Table 87 Instrument Conditions Bi

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1						NA	
2	NA	NA	NA	NA	NA	NA	NA
3						NA	
4	ICP-MS	Rh, Sc, Ir	ORC	He	NA	NA	209
5	ICP-MS	Lu	CRI	He	500	NA	209
6						NA	
7	NA	NA	NA	NA	NA	NA	NA
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	NA	209 m/z
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	159		standard mode	50		209
11						NA	
12	NA	NA	NA	NA	NA	NA	NA
13						NA	NT
14	NA	NA	NA	NA	NA	NA	NA
15	ICP-MS	Ir	ORS	He	0.1	NA	209
16						NA	
17	NA					NA	
18	ICP-MS	Lu	ORS	He	500	NA	209
19	NA	NA	NA	NA	NA	NA	NA
20						NA	
21						NA	
22	ICP-MS	Ir	ORS	He	800	NA	209
23	NA	NA	NA	NA	NA	NA	NA
24	NA	NA	NA	NA	NA	NA	NA
25	ICP-OES-AV	Lu	NA	NA	100	NA	NA
26	ICP-MS	Tb	NA	standard mode	400	NA	209
27	ICP-MS	Ir	NA		NA	250	
28						NA	
29	ICP-MS	Lu	ORS	He	500	NA	209
30	ICP-MS/MS	Ir 193	ORS	O2	4000	NA	Bi 209/209(m/z)

Table 88 Instrument Conditions Ca

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV	Scandium			NA		
2	NA	NA	NA	NA	NA		NA
3	NA	NA	NA	NA	NA	NA	NA
4	NA	NA	NA	NA	NA		NA
5	NA	NA	NA	NA	NA	NA	NA
6	ICP-MS	Sc	KED	He	NA	625	44
7	ICP-MS	Sc	ORS	He	NA	50	44
8	ICP-OES	Eu & Cs	NA	NA	NA	50	315.887, 370.602nm
9					NA		
10	ICP-MS	89	ORS	H2		10	40
11					NA		
12					NA		
13	ICP-OES-AV-buffer	Y			100		315.887
14					NA		
15	ICP-OES-RV	Lu			NA	0.1	422.673
16	AAS	NA	NA		NA	10	422.7
17	ICP-OES-RV	Yttrium			NA	250	315.887
18	NA	NA	NA	NA	NA	NA	NA
19	NA	NA	NA	NA	NA	NA	NA
20					NA		
21	ICP-MS		CRI	He	NA		
22	ICP-OES-RV	Y	NA	NA	NA	800	422.673
23	NA	NA	NA	NA	NA	NA	NA
24	NA	NA	NA	NA	NA	NA	NA
25	NA	NA	NA	NA	NA	100	NA
26	NA	NA	NA	NA	NA	NA	NA
27	NA	NA	NA	NA	NA	NA	NA
28	NA	NA	NA	NA	NA		NA
29	NA	NA	NA	NA	NA	500	NA
30	NA	NA	NA	NA	NA	NA	NA

Table 89 Instrument Conditions Cd

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Indium				NA	
2						NA	
3						NA	
4	ICP-OES-RV					NA	226.502
5	ICP-MS	Rh	CRI	He	500	NA	111
6	ICP-MS	Rh	NA	NA	625	NA	111
7	ICP-MS	Rh	ORS	He	50	NA	111
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	NA	226.502nm
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	103	ORS	He	50		111
11	ICP-MS	Rhodium	KED	He	1000	NA	110.904
12	NA	NA	NA	NA	NA	NA	NA
13	ICP-MS	In	NA		100	NA	111
14	NA	NA	NA	NA	NA	NA	NA
15	ICP-MS	In	ORS	He	0.1	NA	111
16	ICP-OES-AV	NA	NA		1	NA	226.502
17	ICP-OES-AV	Yttrium			250	NA	226.502
18	ICP-MS	Rh	DRC	He	500	NA	114
19	ICP-MS	In-1 115	KED		10		111
20						NA	
21	ICP-MS		CRI	He		NA	
22	ICP-MS	Rh	ORS	He	800	NA	111
23	ICP-MS	Yes	KED	He		NA	63
24						NA	
25	ICP-OES-AV	Lu	NA	NA	100	NA	228.802
26	ICP-MS	Rh	KED	He	1000/400	NA	111
27	ICP-MS	Rh	NA		250	250	
28						NA	
29	ICP-MS	Rh	ORS	He	500	NA	111
30	ICP-OES-AV	Lu219.556	NA	NA	80	NA	Cd 226.502

Table 90 Instrument Conditions Co

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Indium				NA	
2						NA	
3						NA	
4	NA	NA	NA	NA	NA	NA	NA
5	ICP-MS	Sc	CRI	He	500	NA	59
6	ICP-MS	Ge	KED	He	625	NA	59
7	ICP-MS	Sc	ORS	He	50	NA	59
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	NA	228.616nm
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	103	ORS	He	50		59
11	ICP-MS	Rhodium	KED	He	1000	NA	58.933
12	NA	NA	NA	NA	NA	NA	NA
13	ICP-MS	Sc	KED	He	100	NA	59
14	NA	NA	NA	NA	NA	NA	NA
15	ICP-MS	Ge	ORS	He	0.1	NA	59
16	ICP-OES-AV	NA	NA		1	NA	231.16
17	ICP-OES-AV	Yttrium			250	NA	228.616
18	ICP-MS	Sc	ORS	He	500	NA	59
19	ICP-MS	Sc 45	KED		10		59
20						NA	
21	ICP-MS		CRI	He		NA	
22	NA	NA	NA	NA	NA	NA	NA
23	ICP-MS	Yes	KED	He		NA	59
24						NA	
25	NA	NA	NA	NA	NA	NA	NA
26	ICP-MS	Ga	KED	He	2000	NA	59
27	ICP-MS	Rh	UC	He	NA	250	
28	NA	NA	NA	NA	NA	NA	NA
29	ICP-MS	Sc	ORS	He	500	NA	59
30	ICP-OES-AV	Lu219.556	NA	NA	80	NA	Co 228.615

Table 91 Instrument Conditions Cr

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Indium				NA	
2						NA	
3						NA	
4	NA	NA	NA	NA	NA	NA	NA
5	ICP-MS	Sc	CRI	He	500	NA	52
6	ICP-MS	Sc	KED	He	625	NA	52
7	ICP-MS	Sc	ORS	He	50	NA	51
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	NA	267.716nm
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	72	ORS	He	50		52
11	ICP-MS	Rhodium	KED	He	1000	NA	51.941
12	NA	NA	NA	NA	NA	NA	NA
13	ICP-OES-AV-buffer	Y			100	NA	205.56
14	NA	NA	NA	NA	NA	NA	NA
15	ICP-OES-AV	Lu			0.1	NA	205.56
16	ICP-OES-AV	NA	NA		1	NA	283.563
17	ICP-OES-AV	Yttrium			250	NA	267.716
18	ICP-MS	Sc	ORS	He	500	NA	52
19	ICP-MS	Sc 45	KED		10		52
20						NA	
21	ICP-MS		CRI	He		NA	
22	NA	NA	NA	NA	NA	NA	NA
23	ICP-MS	Yes	KED	He		NA	52
24						NA	
25	NA	NA	NA	NA	NA	NA	NA
26	ICP-MS	Sc	KED	He	1000	NA	52
27	ICP-MS	Sc	UC	He	250	250	
28	NA	NA	NA	NA	NA	NA	NA
29	ICP-MS	Sc	ORS	He	500	NA	63
30	ICP-MS/MS	Sc 45/61	ORS	O2	1600	NA	Cr 52/52(m/z)

Table 92 Instrument Conditions Cs

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1						NA	
2	NA	NA	NA	NA	NA	NA	NA
3						NA	
4	ICP-MS	Rh, Sc, Ir	ORS	He	NA	NA	
5	NA	NA	NA	NA	NA	NA	NA
6						NA	
7	NA	NA	NA	NA	NA	NA	NA
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	NA	133 m/z
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	159	ORS	He	50		133
11						NA	
12	NA	NA	NA	NA	NA	NA	NA
13						NA	NT
14	NA	NA	NA	NA	NA	NA	NA
15						NA	
16						NA	
17	NA					NA	
18	NA	NA	NA	NA	NA	NA	NA
19	NA	NA	NA	NA	NA		NA
20						NA	
21						NA	
22	ICP-MS	Rh	ORS	He	800	NA	133
23	NA	NA	NA	NA	NA	NA	NA
24	NA	NA	NA	NA	NA	NA	NA
25	ICP-OES-AV	Lu	NA	NA	100	NA	NA
26	ICP-MS	Tb	NA	standard mode	400	NA	133
27	ICP-MS	Rh	NA	He	NA	250	
28						NA	
29	NA	NA	NA	NA	500	NA	NA
30	NA	NA	NA	NA	NA	NA	NA

Table 93 Instrument Conditions Cu

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Indium				NA	
2						NA	
3						NA	
4	NA	NA	NA	NA	NA	NA	NA
5	ICP-MS	Sc	CRI	He	500	NA	63
6	ICP-MS	Ge	KED	He	625	NA	63
7	ICP-MS	Sc	ORS	He	50	NA	63
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	NA	327.395nm
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	103	ORS	He	50		63
11	ICP-MS	Rhodium	KED	He	1000	NA	62.93
12	NA	NA	NA	NA	NA	NA	NA
13	ICP-OES-AV-buffer	Y			100	NA	324.752
14	NA	NA	NA	NA	NA	NA	NA
15	ICP-OES-AV	Lu			0.1	NA	324.754
16	ICP-OES-AV	NA	NA		1	NA	324.754
17	ICP-OES-AV	Yttrium			250	NA	324.752
18	ICP-MS	Sc	ORS	He	500	NA	63
19	ICP-MS	Sc 45	KED		10	NA	63
20						NA	
21	ICP-MS		CRI	He		NA	
22	NA	NA	NA	NA	NA	NA	NA
23	ICP-MS	Yes	KED	He		NA	63
24						NA	
25	NA	NA	NA	NA	NA	NA	NA
26	ICP-MS	Ga	KED	He	1000	NA	63
27	ICP-MS	Ga	UC	He	250	250	
28	NA	NA	NA	NA	NA	NA	NA
29	ICP-MS	Sc	ORS	He	500	NA	52
30	ICP-OES-AV	In 303.936	NA	NA	80	NA	Cu 327.395

Table 94 Instrument Conditions Fe

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV	Scandium			NA		
2	NA	NA	NA	NA	NA		NA
3	NA	NA	NA	NA	NA	NA	NA
4	NA	NA	NA	NA	NA		NA
5	ICP-MS	Sc	CRI	He	NA	500	56
6	ICP-MS	Sc	KED	He	NA	625	56
7	ICP-MS	Sc	ORS	He	NA	50	56
8	ICP-OES	Eu & Cs	NA	NA	NA	50	238.204, 258.588, 259.940nm
9					NA		
10	ICP-MS	103	ORS	H2	NA	50	56
11	ICP-MS	Rhodium	KED	He	NA	1000	55.935
12					NA		
13	ICP-OES-AV-buffer	Y			100		239.562
14					NA		
15	ICP-OES-AV	Lu			NA	0.1	259.94
16	ICP-OES-AV	NA	NA		NA	10	238.204
17	ICP-OES-RV	Yttrium			NA	250	259.939
18	ICP-MS	Sc	ORS	He	NA	500	56
19	NA	NA	NA	NA	NA	NA	NA
20					NA		
21	ICP-OES-AV				NA		
22	ICP-OES-RV	Y	NA	NA	NA	800	238.204
23	NA	NA	NA	NA	NA	NA	NA
24	NA	NA	NA	NA	NA	NA	NA
25	NA	NA	NA	NA	NA	100	NA
26	NA	NA	NA	NA	NA	NA	NA
27	NA	NA	NA	NA	NA	NA	NA
28	NA	NA	NA	NA	NA		NA
29	ICP-MS	Sc	ORS	He	NA	5000	56
30	NA	NA	NA	NA	NA	NA	NA

Table 95 Instrument Conditions Ga

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1						NA	
2	NA	NA	NA	NA	NA	NA	NA
3						NA	
4	ICP-MS	Rh, Sc, Ir	ORS	He	NA	NA	71
5	NA	NA	NA	NA	NA	NA	NA
6						NA	
7	NA	NA	NA	NA	NA	NA	NA
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	NA	71 m/z
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	NT					
11						NA	
12	NA	NA	NA	NA	NA	NA	NA
13						NA	NT
14	NA	NA	NA	NA	NA	NA	NA
15						NA	
16						NA	
17	NA					NA	
18	NA	NA	NA	NA	NA	NA	NA
19	NA	NA	NA	NA	NA	NA	NA
20						NA	
21						NA	
22	ICP-MS	Rh	ORS	He	800	NA	71
23	NA	NA	NA	NA	NA	NA	NA
24	NA	NA	NA	NA	NA	NA	NA
25	ICP-OES-AV	Lu	NA	NA	100	NA	NA
26	NA	NA	NA	NA	NA	NA	NA
27	NA	NA	NA		NA	NA	
28						NA	
29	NA	NA	NA	NA	NA	NA	NA
30	NA	NA	NA	NA	NA	NA	NA

Table 96 Instrument Conditions Hg

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	CVAAS					NA	
2						NA	
3						NA	
4						NA	
5	ICP-MS	Lu	CRI	He	500	NA	201
6	ICP-MS	Ir	NA	NA	625	NA	201
7	CVAAS	NA	NA	NA	50	NA	453
8	FIMS-AAS	NA	NA	NA	50	NA	253.7nm
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	193		standard mode	50		202
11	ICP-MS	Iridium	KED	He	1000	NA	201.971
12	NA	NA	NA	NA	NA	NA	NA
13	CVAAS					NA	253.7
14	NA	NA	NA	NA	NA	NA	NA
15	CVAFS				0.1	NA	253.7
16	Cold Vapour FIMS	NA			1	NA	253.7
17	CVAAS	Yttrium			250	NA	253.7
18	ICP-MS	Lu	ORS	He	500	NA	201
19	ICP-MS	Ir 193	KED		100	NA	202
20	FIMS					NA	253.7
21	ICP-MS		CRI	He		NA	
22	ICP-MS	Ir	ORS	He	800	NA	201
23	ICP-MS	Yes				NA	202
24						NA	
25	ICP-OES-AV	Lu	NA	NA	100	NA	NA
26	ICP-MS	Tb	NA	standard mode	1000/400	NA	201
27	ICP-MS	Ir	NA		250	250	
28						NA	
29	ICP-MS	Lu	ORS	He	500	NA	202
30	ICP-MS/MS	Ir 193	ORS	O2	4000	NA	Hg 202/202(m/z)

Table 97 Instrument Conditions K

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV	Scandium			NA		
2	NA	NA	NA	NA	NA		NA
3	NA	NA	NA	NA	NA	NA	NA
4	NA	NA	NA	NA	NA		NA
5	NA	NA	NA	NA	NA	NA	NA
6	ICP-MS	Sc	KED	He	NA	625	39
7	ICP-MS	Sc	ORS	NA	NA	50	39
8	ICP-OES	Eu & Cs	NA	NA	NA	50	404.721nm, 766.491nm
9					NA		
10	ICP-MS	89	ORS	H2		10	39
11					NA		
12					NA		
13	ICP-OES-AV-buffer	Y			100		766.49
14					NA		
15	ICP-OES-RV	Lu			NA	0.1	766.491
16	AAS	NA			NA	10	766.5
17	ICP-OES-RV	Yttrium			NA	250	766.49
18	NA	NA	NA	NA	NA	NA	NA
19	NA	NA	NA	NA	NA	NA	NA
20					NA		
21	ICP-OES-AV				NA		
22	ICP-OES-RV	Y	NA	NA	NA	800	766.491
23	NA	NA	NA	NA	NA	NA	NA
24	NA	NA	NA	NA	NA	NA	NA
25	NA	NA	NA	NA	NA	100	NA
26	NA	NA	NA	NA	NA	NA	NA
27	NA	NA	NA	NA	NA	NA	NA
28	NA	NA	NA	NA	NA		NA
29	NA	NA	NA	NA	NA	NA	NA
30	NA	NA	NA	NA	NA	NA	NA

Table 98 Instrument Conditions La

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1						NA	
2	NA	NA	NA	NA	NA	NA	NA
3						NA	
4	ICP-MS	Rh, Sc, Ir	ORS	He	NA	NA	139
5	NA	NA	NA	NA	NA	NA	NA
6						NA	
7	NA	NA	NA	NA	NA	NA	NA
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	NA	139 m/z
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	159	ORS	He	50		139
11						NA	
12	NA	NA	NA	NA	NA	NA	NA
13						NA	NT
14	NA	NA	NA	NA	NA	NA	NA
15	ICP-MS	In	ORS		0.1	NA	139
16						NA	
17	NA					NA	
18	NA	NA	NA	NA	NA	NA	NA
19	NA	NA	NA	NA	NA	NA	NA
20						NA	
21						NA	
22	ICP-MS	Rh	ORS	He	800	NA	139
23	NA	NA	NA	NA	NA	NA	NA
24	NA	NA	NA	NA	NA	NA	NA
25	ICP-OES-AV	Lu	NA	NA	100	NA	NA
26	ICP-MS	Tb	NA	standard mode	400	NA	139
27	ICP-MS	In	NA		NA	250	
28						NA	
29	NA	NA	NA	NA	NA	NA	NA
30	NA	NA	NA	NA	NA	NA	NA

Table 99 Instrument Conditions Li

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Indium				NA	
2	NA	NA	NA	NA	NA	NA	NA
3						NA	
4	ICP-MS	Rh, Sc, Ir	ORS	NA	NA	NA	7
5	ICP-MS	Sc	CRI	NA	500	NA	7
6	ICP-MS	Sc	NA	NA	625	NA	7
7	NA	NA	NA	NA	NA	NA	NA
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	NA	7 m/z
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	72	ORS	H2	50		7
11						NA	
12	NA	NA	NA	NA	NA	NA	NA
13	ICP-MS	Sc	NA		1000	NA	7
14	NA	NA	NA	NA	NA	NA	NA
15	ICP-MS	Li6	NA	standard mode	0.1	NA	7
16						NA	
17	ICP-OES-AV	Yttrium			250	NA	670.784
18	ICP-MS	Sc	ORS	He	500	NA	7
19	ICP-MS	Sc - 45	KED		10	NA	7
20						NA	
21	ICP-OES-AV					NA	
22	NA	NA	NA	NA	NA	NA	NA
23	NA	NA	NA	NA	NA	NA	NA
24	NA	NA	NA	NA	NA	NA	NA
25	ICP-OES-AV	Lu	NA	NA	100	NA	NA
26	ICP-MS	Sc	NA	standard mode	2000	NA	7
27	ICP-MS	Sc	NA		250	NA	
28						NA	
29	ICP-MS	Sc[No Gas]	ORS	He	500	NA	7
30	ICP-OES-AV	Cs672.328	NA	NA	80	NA	Li 670.783(nm)

Table 100 Instrument Conditions Mg

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV	Scandium			NA		
2	NA	NA	NA	NA	NA		NA
3	NA	NA	NA	NA	NA	NA	NA
4	NA	NA	NA	NA	NA		NA
5	NA	NA	NA	NA	NA	NA	NA
6	ICP-MS	Sc	KED	He	NA	625	25
7	ICP-MS	Sc	ORS	He	NA	50	24
8	ICP-OES	Eu & Cs	NA	NA	NA	50	383.829nm
9					NA		
10	ICP-MS	89	ORS	H2		10	24
11					NA		
12					NA		
13	ICP-OES-AV-buffer	Y			100		279.077
14					NA		
15	ICP-OES-RV	Lu			NA	0.1	285.213
16	AAS	NA	NA		NA	10	285.2
17	ICP-OES-RV	Yttrium			NA	250	279.077
18	NA	NA	NA	NA	NA	NA	NA
19	NA	NA	NA	NA	NA	NA	NA
20					NA		
21	ICP-OES-AV				NA		
22	ICP-OES-RV	Y	NA	NA	NA	800	279.078
23	NA	NA	NA	NA	NA	NA	NA
24	NA	NA	NA	NA	NA	NA	NA
25	NA	NA	NA	NA	NA	100	NA
26	NA	NA	NA	NA	NA	NA	NA
27	NA	NA	NA	NA	NA	NA	NA
28	NA	NA	NA	NA	NA		NA
29	NA	NA	NA	NA	NA	NA	NA
30	NA	NA	NA	NA	NA	NA	NA

Table 101 Instrument Conditions Mn

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Indium				NA	
2						NA	
3						NA	
4	NA	NA	NA	NA	NA	NA	NA
5	ICP-MS	Sc	CRI	He	500	NA	55
6	ICP-MS	Sc	KED	He	625	NA	55
7	ICP-MS	Sc	ORS	He	50	NA	55
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	NA	261.021nm
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	72		standard mode	50		55
11	ICP-MS	Rhodium	KED	He	1000	NA	54.938
12	NA	NA	NA	NA	NA	NA	NA
13	ICP-OES-AV-buffer	Y		He	100	NA	257.61
14	NA	NA	NA	NA	NA	NA	NA
15	ICP-OES-AV	Lu			0.1	NA	257.61
16	ICP-OES-AV	NA	NA		10	NA	294.921
17	ICP-OES-AV	Yttrium			250	NA	257.61
18	ICP-MS	Sc	ORS	He	500	NA	55
19	ICP-MS	Sc 45	KED		10	NA	55
20						NA	
21	ICP-MS		CRI	He		NA	
22	NA	NA	NA	NA	NA	NA	NA
23	ICP-MS	Yes				NA	55
24						NA	
25	NA	NA	NA	NA	NA	NA	NA
26	ICP-MS	Sc	KED	He	2000	NA	55
27	ICP-MS	Rh	UC	He	250	NA	
28	NA	NA	NA	NA	NA	NA	NA
29	ICP-MS	Sc	ORS	He	500	NA	55
30	ICP-OES-AV	Eu 271.700	NA	NA	80	NA	Mn 257.610

Table 102 Instrument Conditions Mo

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Indium				NA	
2						NA	
3						NA	
4	NA	NA	NA	NA	NA	NA	NA
5	ICP-MS	Rh	CRI	He	500	NA	95
6	ICP-MS	Rh	NA	NA	625	NA	95
7	ICP-MS	Rh	ORS	He	50	NA	95
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	NA	202.032nm
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	89	ORS	He	10		95
11						NA	
12	NA	NA	NA	NA	NA	NA	NA
13	ICP-MS	In	NA		1000	NA	95
14	NA	NA	NA	NA	NA	NA	NA
15	ICP-MS	Rh	ORS	He	0.1	NA	95
16	ICP-OES-AV	NA	NA		1	NA	202.032
17	ICP-OES-AV	Yttrium			250	NA	202.031
18	ICP-MS	Rh	ORS	He	500	NA	95
19	ICP-MS	Y 89	KED		NA		98
20						NA	
21	ICP-MS		CRI	He		NA	
22	NA	NA	NA	NA	NA	NA	NA
23	ICP-MS	Yes				NA	98
24						NA	
25	NA	NA	NA	NA	NA	NA	NA
26	ICP-MS	Rh	NA	standard mode	2000	NA	98
27	ICP-MS	Rh	UC	He	NA	250	
28	NA	NA	NA	NA	NA	NA	NA
29	ICP-MS	Rh	ORS	He	500	NA	95
30	ICP-MS/MS	Rh103	ORS	O2	4000	NA	Mo 95/95(m/z)

Table 103 Instrument Conditions Na

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV	Scandium			NA		
2	NA	NA	NA	NA	NA		NA
3	NA	NA	NA	NA	NA	NA	NA
4	NA	NA	NA	NA	NA		NA
5	NA	NA	NA	NA	NA	NA	NA
6	ICP-MS	Sc	KED	He	NA	625	23
7	ICP-MS	Sc	ORS	NA	NA	50	23
8	ICP-OES	Eu & Cs	NA	NA	NA	50	330.237, 589.592nm
9					NA		
10	ICP-MS	89	ORS	H2		5	23
11					NA		
12					NA		
13	ICP-OES-AV-buffer	Y			100		588.995
14					NA		
15	ICP-OES-RV	Y			NA	0.1	589.592
16	AAS	NA	NA		NA	1	589
17	ICP-OES-RV	Yttrium			NA	250	589.592
18	NA	NA	NA	NA	NA	NA	NA
19	NA	NA	NA	NA	NA	NA	NA
20	ICP-OES-RV				NA		589.592
21	ICP-OES-AV				NA		
22	ICP-OES-RV	Y	NA	NA	NA	800	589.592
23	NA	NA	NA	NA	NA	NA	NA
24	NA	NA	NA	NA	NA	NA	NA
25	NA	NA	NA	NA	NA	100	NA
26	NA	NA	NA	NA	NA	NA	NA
27	NA	N/A	NA	NA	NA	NA	NA
28	NA	NA	NA	NA	NA		NA
29	NA	NA	NA	NA	NA	NA	NA
30	NA	NA	NA	NA	NA	NA	NA

Table 104 Instrument Conditions Ni

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Indium				NA	
2						NA	
3						NA	
4	ICP-OES-RV					NA	231.604
5	ICP-MS	Sc	CRI	He	500	NA	60
6	ICP-MS	Ge	KED	He	625	NA	60
7	ICP-MS	Sc	ORS	He	50	NA	60
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	NA	231.604nm
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	103	ORS	He	50		60
11	ICP-MS	Rhodium	KED	He	1000	NA	59.933
12	NA	NA	NA	NA	NA	NA	NA
13	ICP-OES-AV-buffer	Y			100	NA	231.604
14	NA	NA	NA	NA	NA	NA	NA
15	ICP-MS	Ge	ORS	He	0.1	NA	51
16	ICP-OES-AV	NA	NA		1	NA	231.604
17	ICP-OES-AV	Yttrium			250	NA	231.604
18	ICP-MS	Sc	ORS	He	500	NA	60
19	ICP-MS	Sc 45	KED		10	NA	60
20						NA	
21	ICP-MS		CRI	He		NA	
22	ICP-MS	Rh	ORS	He	800	NA	60
23	ICP-MS	Yes	KED	He		NA	60
24						NA	
25	ICP-OES-AV	Lu	NA	NA	100	NA	231.604
26	ICP-MS	Ga	KED	He	1000/400	NA	60
27	ICP-MS	Rh	UC	He	250	250	
28						NA	
29	ICP-MS	Sc	ORS	He	500	NA	60
30	ICP-OES-AV	Lu219.556	NA	NA	80	NA	Ni 231.604

Table 105 Instrument Conditions P

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1					NA		
2	NA	NA	NA	NA	NA		NA
3	NA	NA	NA	NA	NA	NA	NA
4	NA	NA	NA	NA	NA		NA
5	NA	NA	NA	NA	NA	NA	NA
6	ICP-MS	Sc	KED	He	NA	625	31
7	ICP-OES-AV	Eu	NA	NA	NA	50	186
8	ICP-OES	Eu & Cs	NA	NA	NA	50	185.827nm
9					NA		
10	ICP-MS	72	ORS	He		10	31
11					NA		
12					NA		
13	ICP-OES-AV-buffer	Y			100		178.221
14					NA		
15	ICP-OES-AV	Lu			NA	0.1	177.434
16	DA	NA	NA		NA	1	880
17	ICP-OES-AV	Yttrium			NA	250	178.221
18	ICP-MS	Sc	ORS	He	NA	500	31
19	NA	NA	NA	NA	NA	NA	NA
20					NA		
21	ICP-OES-AV				NA		
22	ICP-OES-AV	Y	NA	NA	NA	800	213.618
23	NA	NA	NA	NA	NA	NA	NA
24	NA	NA	NA	NA	NA	NA	NA
25	NA	NA	NA	NA	NA	100	NA
26	NA	NA	NA	NA	NA	NA	NA
27	NA	N/A	NA	NA	NA	NA	NA
28	NA	NA	NA	NA	NA		NA
29	NA	NA	NA	NA	NA	500	NA
30	NA	NA	NA	NA	NA	NA	NA

Table 106 Instrument Conditions Pb

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Indium				NA	
2						NA	
3						NA	
4	NA	NA	NA	NA	NA	NA	NA
5	ICP-MS	Lu	CRI	He	500	NA	208
6	ICP-MS	Ir	NA	NA	625	NA	206+207+208
7	ICP-MS	Ir	ORS	He	50	NA	208
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	NA	220.353nm
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	159		standard mode	50		208
11	ICP-MS	Iridium	KED	He	1000	NA	207.977
12	NA	NA	NA	NA	NA	NA	NA
13	ICP-OES-AV-buffer	Y			100	NA	220.353
14	NA	NA	NA	NA	NA	NA	NA
15	ICP-MS	Ir	ORS	He	0.1	NA	208
16	ICP-OES-AV	NA	NA		1	NA	220.353
17	ICP-OES-AV	Yttrium			250	NA	220.353
18	ICP-MS	Lu	ORS	He	500	NA	208
19	ICP-MS	Ir 193	KED		10	NA	208
20						NA	
21	ICP-MS		CRI	He		NA	
22	NA	NA	NA	NA	NA	NA	NA
23	ICP-MS	Yes				NA	208
24						NA	
25	NA	NA	NA	NA	NA	NA	NA
26	ICP-MS	Tb	KED	He	1000	NA	206+207+208
27	ICP-MS	Ir	NA		250	250	
28	NA	NA	NA	NA	NA	NA	NA
29	ICP-MS	Lu	ORS	He	500	NA	208
30	ICP-OES-AV	Eu271.70	NA	NA	80	NA	Pb 220.353

Table 107 Instrument Conditions Rb

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1						NA	
2	NA	NA	NA	NA	NA	NA	NA
3						NA	
4	ICP-MS					NA	
5	NA	NA	NA	NA	NA	NA	NA
6						NA	
7	NA	NA	NA	NA	NA	NA	NA
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	NA	85 m/z
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	89	ORS	He	50		85
11						NA	
12	NA	NA	NA	NA	NA	NA	NA
13						NA	NT
14	NA	NA	NA	NA	NA	NA	NA
15						NA	
16						NA	
17	NA					NA	
18	NA	NA	NA	NA	NA	NA	NA
19	NA				NA	NA	NA
20						NA	
21						NA	
22	NA	NA	NA	NA	NA	NA	NA
23	NA	NA	NA	NA	NA	NA	NA
24	NA	NA	NA	NA	NA	NA	NA
25	ICP-OES-AV	Lu	NA	NA	100	NA	NA
26	ICP-MS	Rh	NA	standard mode	400	NA	85
27	ICP-MS	Rh	NA		250	NA	
28						NA	
29	NA	NA	NA	NA	NA	NA	NA
30	NA	NA	NA	NA	NA	NA	NA

Table 108 Instrument Conditions S

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV	Scandium			NA		
2	NA	NA	NA	NA	NA		NA
3	NA	NA	NA	NA	NA	NA	NA
4	NA	NA	NA	NA	NA		NA
5	NA	NA	NA	NA	NA	NA	NA
6	ICP-OES-AV	Y	NA	NA	NA	62.5	181.975
7	ICP-OES-AV	Eu	NA	NA	NA	50	207
8	ICP-OES	Eu & Cs	NA	NA	NA	50	178.165,181.972nm
9					NA		
10	ICP-MS/MS	89-105	ORS	O2		50	32
11					NA		
12					NA		
13	ICP-OES-AV-buffer	Y			100		181.975
14					NA		
15	ICP-OES-AV	Lu			NA	0.1	181.972
16					NA		
17	ICP-OES-AV	Yttrium			NA	250	181.975
18	NA	NA	NA	NA	NA	NA	NA
19	NA	NA	NA	NA	NA	NA	NA
20					NA		
21	NA				NA		
22	ICP-OES-AV	Y	NA	NA	NA	800	181.972
23	NA	NA	NA	NA	NA	NA	NA
24	NA	NA	NA	NA	NA	NA	NA
25	NA	NA	NA	NA	NA	100	NA
26	NA	NA	NA	NA	NA	NA	NA
27	NA	NA	NA	NA	NA	NA	NA
28	NA	NA	NA	NA	NA		NA
29	NA	NA	NA	NA	NA	NA	NA
30	NA	NA	NA	NA	NA	NA	NA

Table 109 Instrument Conditions Sb

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Indium				NA	
2						NA	
3						NA	
4	ICP-OES-RV					NA	206.834
5	ICP-MS	Rh	CRI	He	500	NA	123
6	ICP-MS	Rh	NA	NA	625	NA	121
7	ICP-MS	Sc	ORS	He	50	NA	121
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	NA	206.834nm
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	193		standard mode	50		121
11						NA	
12	NA	NA	NA	NA	NA	NA	NA
13						NA	NT
14	NA	NA	NA	NA	NA	NA	NA
15	ICP-MS	In	ORS	He	0.1	NA	121
16	ICP-OES-AV	NA	NA		1	NA	206.834
17	ICP-OES-AV	Yttrium			250	NA	206.836
18	ICP-MS	Rh	ORS	He	500	NA	NA
19	NA	NA			NA	NA	NA
20						NA	
21	ICP-MS		CRI	He		NA	
22	ICP-MS	Rh	ORS	He	800	NA	121
23	ICP-MS	Yes				NA	121
24						NA	
25	ICP-OES-AV	Lu	NA	NA	100	NA	217.582
26	ICP-MS	Rh	NA	standard mode	400	NA	121
27	ICP-MS	Rh	NA		250	NA	
28						NA	
29	ICP-MS	Rh	ORS	He	500	NA	123
30	ICP-MS/MS	Rh103	ORS	O2	4000	NA	Sb 121/121(m/z)

Table 110 Instrument Conditions Se

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Indium				NA	
2						NA	
3						NA	
4	ICP-OES-RV					NA	196.026
5	ICP-MS	Sc	CRI	He	500	NA	78
6	ICP-MS	Rh	NA	NA	625	NA	82
7	ICP-MS	Sc	ORS	He	50	NA	78
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	NA	196.026nm
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	72	ORS	He	10		78
11						NA	
12	NA	NA	NA	NA	NA	NA	NA
13	ICP-MS	Ga	DRC	NH3	1000	NA	78
14	NA	NA	NA	NA	NA	NA	NA
15	ICP-MS	Ge	ORS	H2	0.1	NA	78
16	ICP-OES-AV	NA	NA		1	NA	196.026
17	ICP-OES-AV	Yttrium			250	NA	196.026
18	ICP-MS	Rh	ORS	H2	500	NA	78
19	ICP-MS	Ge-1 72	KED		10	NA	82
20	ICP-OES-AV					NA	196.026
21	ICP-MS		CRI	He		NA	
22	ICP-MS	Rh	ORS	HEHe	800	NA	78
23	ICP-MS		KED			NA	78
24						NA	
25	ICP-OES-AV	Lu	NA	NA	100	NA	196.026
26	ICP-MS	Te	NA	standard mode	2000/400	NA	82
27	ICP-MS	Rh	UC	He	250	250	
28						NA	
29	ICP-MS	Rh	ORS	H2	500	NA	78
30	ICP-MS/MS	Rh103	ORS	O2	4000	NA	Se 78/94(m/z)

Table 111 Instrument Conditions Sn

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV	Scandium				NA	
2	NA	NA	NA	NA	NA	NA	NA
3						NA	
4	ICP-OES-RV					NA	189.925
5	ICP-MS	Rh	CRI	He	500	NA	118
6						NA	
7	NA	NA	NA	NA	NA	NA	NA
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	NA	189.926nm
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	103	ORS	He	50		120
11						NA	
12	NA	NA	NA	NA	NA	NA	NA
13	ICP-OES-AV-buffer	Y			100	NA	189.927
14	NA	NA	NA	NA	NA	NA	NA
15	ICP-MS	In	ORS	He	0.1	NA	118
16	ICP-OES-AV	NA	NA		1	NA	189.925
17	ICP-OES-AV	Yttrium			250	NA	189.927
18	ICP-MS	Rh	ORS	He	500	NA	NA
19	ICP-MS	In-1 115	KED		1	NA	118
20						NA	
21						NA	
22	ICP-MS	Rh	ORS	He	800	NA	118
23	NA	NA	NA	NA	NA	NA	NA
24	NA	NA	NA	NA	NA	NA	NA
25	ICP-OES-AV	Lu	NA	NA	100	NA	NA
26	ICP-MS	Rh	NA	standard mode	400	NA	120
27	ICP-MS	Rh	NA		250	NA	
28						NA	
29	ICP-MS	Rh	ORS	He	500	NA	118
30	ICP-OES-AV	Lu219.556	NA	NA	80	NA	Sn 189.927

Table 112 Instrument Conditions Sr

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV	Scandium			NA		
2	NA	NA	NA	NA	NA		NA
3	NA	NA	NA	NA	NA	NA	NA
4	NA	NA	NA	NA	NA		NA
5	ICP-MS	Rh	CRI	He	NA	500	88
6	ICP-MS	Rh	NA	NA	NA	625	88
7	NA	NA	ORS	He	NA	50	88
8	ICP-OES	Eu & Cs	NA	NA	NA	50	430.545nm
9					NA		
10	ICP-MS	89	ORS	He		10	88
11					NA		
12					NA		
13	ICP-OES-AV-buffer	Y			100		407.771
14					NA		
15	ICP-OES-AV	Lu			NA	0.1	421.552
16	ICP-OES-AV	NA	NA		NA	1	407.771
17	ICP-OES-AV	Yttrium			NA	250	407.771
18	ICP-MS	Rh	ORS	He	NA	500	88
19	NA	NA	NA	NA	NA	NA	NA
20					NA		
21	ICP-OES-AV				NA		
22	ICP-OES-AV	Y	NA	NA	NA	800	430.544
23	NA	NA	NA	NA	NA	NA	NA
24	NA	NA	NA	NA	NA	NA	NA
25	NA	NA	NA	NA	NA	100	NA
26	NA	NA	NA	NA	NA	NA	NA
27	NA	N/A	NA	NA	NA	NA	NA
28	NA	NA	NA	NA	NA		NA
29	ICP-MS	Rh	ORS	He	NA	500	88
30	NA	NA	NA	NA	NA	NA	NA

Table 113 Instrument Conditions Th

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Indium				NA	
2						NA	
3						NA	
4	NA	NA	NA	NA	NA	NA	NA
5	NA	NA	NA	NA	NA	NA	NA
6	ICP-MS	Ir	NA	NA	625	NA	232
7	ICP-MS	Ir	ORS	He	50	NA	232
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	NA	232 m/z
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	NT					NA
11						NA	
12	NA	NA	NA	NA	NA	NA	NA
13						NA	NT
14	NA	NA	NA	NA	NA	NA	NA
15	ICP-MS	Ir	ORS	He	0.1	NA	232
16						NA	
17	NA					NA	
18	NA	NA	NA	NA	NA	NA	NA
19	NA				NA	NA	NA
20						NA	
21						NA	
22	NA	Ir	NA	NA	NA	NA	NA
23						NA	
24						NA	
25	NA	NA	NA	NA	NA	NA	NA
26	NA	NA	NA	NA	NA	NA	NA
27	NA	N/A	NA	NA	NA	NA	NA
28	NA	NA	NA	NA	NA	NA	NA
29	NA	NA	NA	NA	NA	NA	NA
30	ICP-MS/MS	Ir 193	ORS	He	4000	NA	Th 232/232(m/z)

Table 114 Instrument Conditions Tl

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Indium				NA	
2	NA	NA	NA	NA	NA	NA	NA
3						NA	
4	ICP-MS	Rh, Sc, Ir	ORS	He	NA	NA	205
5	ICP-MS	Lu	CRI	He	500	NA	205
6	ICP-MS	Ir	NA	NA	625	NA	205
7	NA	NA	NA	NA	NA	NA	NA
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	NA	203 m/z
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	159		standard mode	10		205
11						NA	
12	NA	NA	NA	NA	NA	NA	NA
13	ICP-MS	In			1000	NA	203
14	NA	NA	NA	NA	NA	NA	NA
15	ICP-MS	Ir	ORS	He	0.1	NA	205
16	ICP-OES-AV	NA	NA		1	NA	190.794
17	ICP-OES-AV	Yttrium			250	NA	190.801
18	ICP-MS	Lu	ORS	He	500	NA	205
19	NA				NA	NA	NA
20						NA	
21						NA	
22	ICP-MS	Ir	ORS	He	800	NA	205
23	NA	NA	NA	NA	NA	NA	NA
24	NA	NA	NA	NA	NA	NA	NA
25	ICP-OES-AV	Lu	NA	NA	100	NA	NA
26	ICP-MS	Tb	NA	standard mode	400	NA	205
27	ICP-MS	Ir	NA		NA	250	
28						NA	
29	ICP-MS	Lu	ORS	He	500	NA	205
30	ICP-MS/MS	Ir 193	ORS	O2	4000	NA	Tl 205/205(m/z)

Table 115 Instrument Conditions U

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Indium				NA	
2						NA	
3						NA	
4	NA	NA	NA	NA	NA	NA	NA
5	ICP-MS	Lu	CRI	He	500	NA	238
6	ICP-MS	Ir	NA	NA	625	NA	238
7	ICP-MS	Ir	ORS	He	50	NA	238
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	NA	238 m/z
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	159		standard mode	10		238
11						NA	
12	NA	NA	NA	NA	NA	NA	NA
13	ICP-MS	In			1000	NA	238
14	NA	NA	NA	NA	NA	NA	NA
15	ICP-MS	Ir	ORS	He	0.1	NA	238
16						NA	
17	NA					NA	
18	ICP-MS	Lu	ORS	He	500	NA	238
19	ICP-MS	Ir 193	KED		10		238
20						NA	
21	ICP-MS		CRI	He		NA	
22	NA	NA	NA	NA	NA	NA	NA
23						NA	
24						NA	
25	NA	NA	NA	NA	NA	NA	NA
26	ICP-MS	Tb	NA	standard mode	2000	NA	238
27	ICP-MS	Ir	NA		NA	250	
28	NA	NA	NA	NA	NA	NA	NA
29	ICP-MS	Lu	ORS	He	500	NA	238
30	ICP-MS/MS	Ir 193	ORS	He	4000	NA	U 238/238(m/z)

Table 116 Instrument Conditions V

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Indium				NA	
2						NA	
3						NA	
4	NA	NA	NA	NA	NA	NA	NA
5	ICP-MS	Sc	CRI	He	500	NA	51
6	ICP-MS	Sc	KED	He	625	NA	51
7	ICP-MS	Sc	ORS	He	50	NA	51
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	NA	311.837nm
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	72	ORS	He	50		51
11						NA	
12	NA	NA	NA	NA	NA	NA	NA
13	ICP-OES-AV-buffer	Y			100	NA	290.88
14	NA	NA	NA	NA	NA	NA	NA
15	ICP-MS	Ge	ORS	He	0.1	NA	51
16	ICP-OES-AV	NA	NA		1	NA	292.401
17	ICP-OES-AV	Yttrium			250	NA	292.402
18	ICP-MS	Sc	ORS	He	500	NA	51
19	ICP-MS	Sc 45	KED		10	NA	51
20						NA	
21						NA	
22	NA	NA	NA	NA	NA	NA	NA
23	ICP-MS	Yes	KED	He		NA	51
24						NA	
25	NA	NA	NA	NA	NA	NA	NA
26	ICP-MS	Sc	KED	He	2000	NA	51
27	ICP-MS	Sc	UC	He	250	NA	
28	NA	NA	NA	NA	NA	NA	NA
29	ICP-MS	Sc	ORS	He	500	NA	51
30	ICP-MS/MS	Sc 45/61	ORS	O2	4000	NA	V 51/67(m/z)

Table 117 Instrument Conditions Zn

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S2 Final Dilution Factor	S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV	Scandium				NA	
2						NA	
3						NA	
4	ICP-OES-RV					NA	206.2
5	ICP-MS	Sc	CRI	He	500	NA	66
6	ICP-MS	Ge	KED	He	625	NA	66
7	ICP-MS	Sc	ORS	He	50	NA	66
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	NA	206.2, 334.502nm
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	72	ORS	He	50		66
11	ICP-MS	Rhodium	KED	He	1000	NA	65.926
12	NA	NA	NA	NA	NA	NA	NA
13	ICP-OES-AV-buffer	Y			100	NA	206.2
14	NA	NA	NA	NA	NA	NA	NA
15	ICP-OES-AV	Lu			0.1	NA	206.2
16	ICP-OES-AV	NA	NA		1	206.2	
17	ICP-OES-AV	Yttrium			250	NA	206.200
18	ICP-MS	Sc	ORS	He	500	NA	66
19	ICP-MS	Sc 45	KED		10		66
20						NA	
21	ICP-OES-AV					NA	
22	ICP-MS	Rh	ORS	He	800	NA	66
23	ICP-MS	Yes	KED	He		NA	66
24						NA	
25	ICP-OES-AV	Lu	NA	NA	100	NA	213.857
26	ICP-MS	Ga	KED	He	1000/400	NA	66
27	ICP-MS	Rh	UC	He	250	250	
28						NA	
29	ICP-MS	Sc	ORS	He	500	NA	66
30	ICP-OES-AV	Lu219.556	NA	NA	80	NA	Zn 206.200

END OF REPORT