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National Measurement Institute

Proficiency Test Report AQA 20-02 Metals, Nutrients and Exchangeable Bases in Soil

May 2020

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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 and collaborators 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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1 SUMMARY

This report presents the results of the proficiency test AQA 20-02, metals, nutrients and exchangeable bases in soil. The study focused on the measurement of the following acid extractable elements: Ag, Al, As, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, S, Sb, Se, Sn, Sr, Tl, U, V and Zn. Measurement of total P, P buffer index (with Colwell P)- PBI_{+ColP}, calcium chloride-extractable B, total carbon (TC), total organic carbon (TOC), total nitrogen (TN), Colwell P, Colwell K, EC, pH of 1:5 soil / 0.01 M $CaCl_2$ extract, exchangeable bases (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}) - 1M NH_4Cl extract and moisture content was also included in the program.

The sample set consisted of one dried soil sample, one moist soil sample and one agricultural soil sample.

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

30 laboratories enrolled and reported 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 956 results, 883 (92%) returned a satisfactory score of $|z| \leq 2$.

Of 956 E_n-scores, 796 (83%) were satisfactory with $|E_n| \leq 1$.

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

The tests that presented the most analytical difficulty to participating laboratories were: Sb, B and Li.

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

Despite different matrices, analytes and analyte concentrations, on average participants' performance remained consistent.

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

Of 1039 numerical results, 988 were reported with an expanded measurement uncertainty. An example of estimating measurement uncertainty using only proficiency testing data is given in Appendix 3.

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

Surplus test samples from this study are available for sale.

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 interlaboratory 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;
- allergens in food;
- controlled drug assay; and
- folic acid in flour.

AQA 20-02 is the 26th 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 the determination of inorganic analytes in soil;
- 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 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 fifty-seven tests were selected from those for which an investigation level is published in the Guidelines 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 submitted results.

The timetable of the study was:

Invitations issued:	20 January 2020
Samples dispatched:	17 February 2020
Results due:	16 March 2020
Interim report issued:	18 March 2020

3.3 Test Material Specification

Three samples were provided for analysis:

Sample S1 was 25 g of dried soil;

Sample S2 was 30 g of moist 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 elements in S2 and S3 with the exception of calcium chloride-extractable B, Colwell P, EC, pH, sulphur and total phosphorus as the same preparation procedure was followed in previous studies.[1] The results from the partial homogeneity testing for these samples are reported in the present study as the homogeneity value.

A full homogeneity test was conducted for Sample S1. Sample S1 was demonstrated to be sufficiently homogeneous for the evaluation of participants' performance.

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 for 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 test samples were stored at ambient temperature prior to dispatch.

The samples were dispatched by courier on 17 February 2020.

The following items were packaged with the samples:

- a covering letter which included a description of the test samples and instructions for participants; and
- a form to confirm the receipt and condition of 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.

- Sample S2, the moist soil sample, should be thoroughly mixed before removing a test portion. To avoid loss of moisture, do not leave the sample uncovered.
- For Sample S3 for the determination of calcium chloride- extractable B, exchangeable bases (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}) - 1M NH_4Cl extract and of P buffer index (with Colwell P)- $PBI_{+ColP,}$ participants are asked to use the methods defined by Rayment, G.E. and David, J. L in "Soil Chemical Methods-Australasia".
- For S1 report results for acid extractable elements on as received basis in units of mg/kg.
- For S2 report results for moisture content in % (g/100g). For acid extractable elements in S2 results are to be reported on dry weight bases (corrected for moisture content) and in units of mg/kg.
- For S3 report results on as received basis in units of (cmol(+)/kg) for exchangeable bases (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}) - 1M NH_4Cl extract. Except for EC, for all the other tests, report results on as received basis in units of mg/kg. EC results are to be reported in units of µS/cm.

SAMPLE S1		SAMPLE S2		SAMPLE S3	
Test acid extractable	Appx Conc. Range (as received basis) mg/kg	Test acid extractable	Appx Conc. Range (dry weight basis) mg/kg	Test	Appx. Conc Range (as received basis) mg/kg
As	5-100	Ag	1-20	Ca (acid extractable)	250-5000
B	5-100	Al	500-10000	Calcium chloride –extractable B[1]	Not Available
Be	0.5-10	As	5-100	Colwell P	50-1000
Cd	0.5-10	Ba	50-1000	Colwell K	50-1000
Cr	25-500	Bi	5-100	EC	>500µS/cm
Cu	25-500	Cd	1-20	Exchangeable Ca-1MNH_4Cl extract[2]	>2.5 cmol(+)/kg
Hg	0.1-4	Co	25-500	Exchangeable Mg-1MNH_4Cl extract[2]	>0.5 cmol(+)/kg
Mn	50-1000	Cr	5-100	Exchangeable Na-1MNH_4Cl extract[2]	>0.15 cmol(+)/kg
Mo	5-100	Cu	25-500	Exchangeable K-1MNH_4Cl extract[2]	>0.15 cmol(+)/kg
Ni	25-500	Hg	0.5-10	Fe (acid extractable)	500-10000
Pb	5-100	Li	1-20	K (acid extractable)	50-1250
Sb	5-100	Ni	25-500	Mg (acid extractable)	50-1250
Se	5-100	Pb	50-1000	Na (acid extractable)	25-500
Sn	5-100	Se	5-100	P (acid extractable)	50-1250
V	5-100	Tl	1-20	P (total)	50-1250
Zn	25-500	U	0.5-10	P buffer index (with Colwell P)- PBI_{+ColP}[3]	50-1000
		V	25-500	pH of 1:5soil/0.01M$CaCl_2$ extract	Not Available
		Zn	50-1000	S (acid extractable)	10-200
		Moisture Content	5-40%	Sr (acid extractable)	5-100
				Total Carbon	>15000
				Total Organic Carbon	>15000
				Total Nitrogen	250-5000

[1]Method 12C, [2]Method 15A1, [3]Method 9I2 as defined by Rayment, G.E. and David, J. L in "Soil Chemical Methods-Australasia".

- Report results as you would report to a client.
- Please send us all the requested details regarding the test method.
- Return the completed results sheet by 16 March 2020.

3.9 Interim Report

An interim report was emailed to participants on 18 March 2020.

4 PARTICIPANT LABORATORY INFORMATION

4.1 Test Method Summaries

Summaries of test methods are transcribed in Tables 1 to 10. The instruments and settings reported by participants are presented in Appendix 5.

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
1*	3051	0.5	175	4.5	10					
2*	USEPA 3050	3	85	120	10	5	10		6	
4	USEPA3050/6010/6020/200.7/200.8	2	90 - 98	90	3	3				
5*	US-EPA Method 200.2	1	95	50	2	2				10 mL H_2O
6	APHA 3030E	1	40	4	5	1				
7	EPA Method 3050B Acid Digestion of Sediments, Sludges and Soils	0.5	85	240	5	5				
8	200.2 Revision 2.8	1	95 ± 5	60	2	10			2	
9	USEPA 6020 and USEPA 6010	0.5	95	120	2	3			2	
11		1	95-100	120	3	3				
12	EPA3051A	0.5	180	20	9	3				
13	US EPA 200.8	1	95	45	2.5	2.5				
14	US EPA 3050	2	100	60	4	12				4 mL H2O (bulked to 40 mL at end)
15	In House S6 referencing APHA 3125	0.4	120	60	2.5	7.5				
16	EPA (Environmental Protection Agency) 1994 Method 200.8		109	60	800	400				1200
17	USEPA3050/6010/6020/200.7/200.8	2	90-98	120	3	3				
18			95	120	2	6				
19	USEPA 200.2	1	95	60			2	10	2	
20	USEPA3050/6010/6020/200.7/200.8	1	90-98	120	3	3				
21	USEPA method 200.2 Revision 2.8	1	95	60			2	10	2	
23*	USEPA. “Method 3050: Acid Digestion of Sediments, Sludges, and Soils,”	2	95	60	10	30				
25	EPA3050B, 6020B	2	90-95	60	4	12				
26	USEPA 3051A (Modification)	1	170	15			8	2		

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
28	S1: Method EPA 200.2 & EPA 7471B (for Mercury analysis)									
27	US EPA 3050B	0.5	95	120	7.5	5			1.5	
29*	US EPA Methods 3050B, 3051A and 6020B	2	100	60	4	12				
30	US EPA 3051	0.1-0.2	180	20	1	3				

* See Additional Information for Methodology in Table 2

Table 2 Additional Information for Acid Extractable Elements

Lab. Code	Additional Information
1	For S2: We obtained poor reproducible results for aluminium and bismuth so decided not to report these elements
2	Instrument for Hg: Cetac Hg Analyser
23	S3: Sulphur is consistently above the range provided.
29	For S2: Ran dried samples, results reported on dry weight

Table 3 Methodology for Total Carbon

Lab. Code	Method Reference	Test Method	Measurement Technique	Additional Information
4	Walkley-Black or Combustion	High Temperature Oxidation	Titration or NDIR	
7	Iso 10694-1995	High Temperature Oxidation	IR detector	
8		High Temperature Oxidation	Eltra CS2000	
10	Total Carbon (6B2b) and TOC (6B3)	High Temperature Oxidation	IR-Leco	
11	APHA 5310 B	High Temperature Oxidation	1200	
15	In house S4a	High Temperature Oxidation	LECO	
17	Combustion	High Temperature Oxidation	NDIR	
20	Walkley-Black or Combustion	High Temperature Oxidation	Titration or NDIR	
21	AS 1289.4.1.1	High Temperature Oxidation		
23	APHA, 22nd Edition (2012), Method 5310 B High-Temperature Combustion Method.	High Temperature Oxidation	Infrared	
26	Rayment & Lyons,2011, "Soil Chemical Methods-Australasia" 6B2b	High Temperature Oxidation	Infrared and thermal conductivity detectors	Sample heated to 425ºC to remove organic carbon which was determined by difference.

Table 4 Methodology for Total Organic Carbon

Lab. Code	Method Reference	Test Method	Measurement Technique	Additional Information
2		Chemical Oxidation	DA	No Ag_2SO_4 Added
4	Walkley-Black or Combustion	High Temperature Oxidation	NDIR	
7	Iso 10694-1995	High Temperature Oxidation		
8		High Temperature Oxidation	Eltra CS2000	
10	Total Carbon (6B2b) and TOC (6B3)	High Temperature Oxidation	Leco	Sample was Fizz test with 4 M HCl and no Fizzing observed. Therefore no acid treatment was carried for TOC
11	APHA 5310 B	High Temperature Oxidation		
13		Chemical Oxidation (No Ag_2SO_4 Added)	Rayment et al, Walkey Black / FAS Titration	
15	In house S4a	High Temperature Oxidation	LECO	TOC - sample digested with sulfurous acid prior to analysis on LECO
17	Combustion	High Temperature Oxidation	NDIR	
20	Walkley-Black or Combustion	High Temperature Oxidation	Titration or NDIR	
21	AS 1289.4.1.1	Chemical Oxidation (Ag_2SO_4 Added)	Walkely & Black Method	
23	APHA Standard Methods for the Examination of Water and Waste Water, 22nd Edition (2012), Method 5310 B High-Temperature Combustion Method.	High Temperature Oxidation	Infrared	
26	Rayment & Lyons,2011, "Soil Chemical Methods-Australasia" 6B2b	High Temperature Oxidation	Infrared detector	Sample heated to 425°C to remove organic carbon which was determined by difference.

Table 5 Methodology for Colwell P and Colwell K

Lab. Code	Method Reference	Sample Mass (g)	Extraction Solution 0.5 M $NaHCO_3$ Volume (mL)	Shake time (hours)	Final Dilution Factor (Colwell K)	Final Dilution Factor (Colwell P)	Measurement Technique (Colwell K))	Measurement Technique (Colwell P)
2	Rayment and Lyons 9B1	1	100	16				DA 880 nm
8	Rayment & Lyons 9B1 & 18A1	1	100	16	100	100	ICP-OES 404.721nm, 766.491nm	UV-Vis 882 nm

Table 5 Methodology for Colwell P and Colwell K (continued)

Lab. Code	Method Reference	Sample Mass (g)	Extraction Solution 0.5 M $NaHCO_3$ Volume (mL)	Shake time (hours)	Final Dilution Factor (Colwell K)	Final Dilution Factor (Colwell P)	Measurement Technique (Colwell K))	Measurement Technique (Colwell P)
10								FIA
11		0.5	50	16			ICPAES	ICPAES
15	Colwell P 9B2, Colwell K 18A1	0.4	40	16	3280	328	ICPMS 31 m/z	FIA
20	Rayment and Lyons	1	100	16	100	100	ICP-OES-RV 766 nm	DA
26	Rayment and Lyons 9 B2	1	100	16			ICP-OES 766.491 nm	UV-Vis 882 nm

Table 6 Methodology for P Buffer Index – PBI_{+ColP}

Lab. Code	Method Reference	Sample Mass (g)	Extraction Solution (P equilibrating Solution) Volume (mL)	Shake time (hours)	Instrument	Final Dilution Factor	Wavelength (nm) / Absorbance (nm)
15	9I2b	2	20	16	ICP-OES	10	213.617
20	Rayment and Lyons	7	70	17	DA	10	
26		5	50	17	UV-Vis	10	882

Table 7 Methodology for Total P

Lab. Code	Method
2	Total P by Kjeldahl digestion and DA
8	Total P by APHA 4500 Norg-D with Jirka modification followed by DA finish
13	Total P by Kjeldalh digestion and DA
19	Persulfate digestion followed by FIA
21	APHA 4500 - Norg. A &D, with Jirka modification analysed by DA.
26	Rayment & Lyons,2011, "Soil Chemical Methods-Australasia" Method 7A2a; Used digest from 7A2a, UV-Vis measurement at 882nm

Table 8 Methodology for Calcium Chloride Extractable B

Lab. Code	Method Reference	Sample Mass (g)	Extraction Solution (0.01 M $CaCl_2$) Volume (mL)	Reflux Time (min)	Instrument	Final Dilution Factor	Wavelength (nm) / Absorbance (nm)
8		10	20	10	ICP-OES	2	249.773nm
15	12C2	10	20	10	ICP-OES	2	208.889
17	Rayment and Lyons	10	20	30			
20	Rayment and Lyons	10	20	30	ICP-OES-RV	2	

Table 9 Methodology for Total Nitrogen

Lab. Code	Method Reference	Test Method	Measurement Method	Instrument	Additional Information
2	ASTM D2216-98	Digestion $TN=TKN+NO_x$	Colorimetric – salicylate method	DA	
7	AOAC 990.03	Combustion	Dumas – High temperature combustion	LECO	
8	APHA 22nd edition 4500 Norg A & D with Jirka Modification-Jirka et al. (1976) and the appropriate Discrete Analyser method.	Digestion $TN=TKN+NO_x$	Colorimentric – phenate method	DA	
10		Combustion	Dumas – High temperature combustion	LECO	
11	APHA, Methods 4500-Norg B and C.	Digestion Distillation $TN=TKN+NO_x$		Manual Analysis	
13	APHA 4500-NORG D / US EPA 351.2	Digestion $TN=TKN+NO_x$	Colorimetric – salicylate method	DA	NO2-N by DA,NO3-N by IC, NOx by calc.
15	In house S4a - Dumas combustion	Combustion	Dumas – High temperature combustion	LECO	
17	APHA 4500 Norg TKN + NOX water extraction	Combustion	Dumas – High temperature combustion	NA	Combustion Chemiluminescence
19	APHA, 4500-P J. & 4500-N C.	Digestion		FIA	
20	APHA 4500 Norg or TN by Furnace Chemiluminescence	Digestion $TN=TKN+NO_x$	Colorimetric – salicylate method	DA	
21	APHA 4500 -NOrg. A & D,	Digestion	Colorimetric – salicylate method	DA	
23	American Public Health Association (APHA) - Standard Methods for the Examination of Water and Wastewater, Method 4500-Norg D Block Digestion and Flow injection Analysis	Digestion $TN=TKN+NO_x$	Colorimetric – salicylate method	FIA	
26	Rayment & Lyons,2011, "Soil Chemical Methods-Australasia" Method 7A2a	Digestion TN=TKN	Colorimetric – salicylate method	Technicon Colorimeter SCIC	

Table 10 Methodology for Exchangeable Bases

Lab. Code	Method Reference*	Sample Mass (g)	Shake time (hrs)	Extraction Solution	Extraction Solution Vol. (mL)	Additional Information
2	Rayment and Lyons 15D3 & 15N1	5	1	1M NH_4Cl	100	
4	15A1	2.5	2	1M NH_4Cl	50	
6	15A1	5	1	1M NH_4Cl	100	
8	15A1	2.5	1	1M NH_4Cl	50	
10	15A1	22	1	1M NH_4Cl	40	
11	15A1	2	2	1M NH_4Cl	40	
12*	15A1 .	2.5	1	1M NH_4Cl	50	CEC was not corrected by soluble Na salt according to 15A1, however soluble Na does dominate the NH4Cl extraction therefore bring large positive bias
15	15A1	1	1	1M NH_4Cl	20	
17	15A1	2.5	2	1M NH_4Cl	50	
19	ED007	2.5	1	1M NH_4Cl	50	
20	15A1	2.5	2	1M NH_4Cl	50	
21	15A1	2.5	1	1M NH_4Cl	50	
23	Rayment, GE & Lyons, DJ 2011 Method 15B1 and 15B2 In 'Soil Chemical Methods' CSIRO,Melbourne, Australia	5	1	1M NH_4Cl	100	
26	15A1	2	1	1M NH_4Cl	40	

*15A1 as defined by Rayment, G.E. and David, J. L. in "Soil Chemical Methods-Australasia"

4.2 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	Standard deviation of replicate analyses multiplied by 2 or 3			
2	Top Down - precision and estimates of the method and laboratory bias	Duplicate Analysis Instrument Calibration	CRM Instrument Calibration	NATA Technical Note 33
3	Top Down - precision and estimates of the method and laboratory bias	Control Samples - CRM	CRM	ISO/GUM
4	Top Down - precision and estimates of the method and laboratory bias	Control Samples - SS	Recoveries of SS	NATA Technical Note 33
5	Standard deviation of replicate analyses multiplied by 2 or 3	Control Samples - CRM Duplicate Analysis	CRM Instrument Calibration	Eurachem/CITAC Guide
6	Standard deviation of replicate analyses multiplied by 2 or 3	Control Samples - CRM Duplicate Analysis	CRM	ISO/GUM
7	Top Down - precision and estimates of the method and laboratory bias	Control Samples Duplicate Analysis	Laboratory Bias from PT Studies	NATA Technical Note 33
8	Top Down - precision and estimates of the method and laboratory bias	Control Samples - CRM Duplicate Analysis	Instrument Calibration	Eurachem/CITAC Guide
9	Bottom Up (ISO/GUM, fish bone/ cause and effect diagram)	Control Samples - CRM Duplicate Analysis Instrument Calibration	CRM Instrument Calibration	Eurachem/CITAC Guide
10	Top Down - reproducibility (standard deviation) from PT studies used directly	Control Samples - CRM Duplicate Analysis Instrument Calibration	Laboratory Bias from PT Studies	NATA Technical Note 33
11	Top Down - precision and estimates of the method and laboratory bias	Control Samples - CRM Duplicate Analysis	CRM Variation in Sample Moisture Content Recoveries of SS	Nordtest Report TR537
12	Standard deviation of replicate analyses multiplied by 2 or 3	Duplicate Analysis	Laboratory Bias from PT Studies	NMI Uncertainty Course
13	Professional judgement	Control Samples - RM	CRM Recoveries of SS	NATA Technical Note 33

Table 11 Basis of Uncertainty Estimate (continued)

Lab. Code	Approach to Estimating MU	Information Sources for MU Estimation[a]		Guide Document for Estimating MU
		Precision	Method Bias	
14	Top Down - reproducibility (standard deviation) from PT studies used directly	Control Samples - CRM Instrument Calibration	CRM Recoveries of SS	ISO/GUM
15	Top Down - precision and estimates of the method and laboratory bias	Control Samples - RM Duplicate Analysis	Standard Purity Instrument Calibration	Nordtest Report TR537
16	Standard deviation of replicate analyses multiplied by 2 or 3	Control Samples - RM Duplicate Analysis	Recoveries of SS	
17	Top Down - precision and estimates of the method and laboratory bias	Control Samples	Recoveries of SS	NATA Technical Note 33
18	Bottom Up (ISO/GUM, fish bone/ cause and effect diagram)	Control Samples - CRM Duplicate Analysis Instrument Calibration		ISO/GUM
19*	Top Down - precision and estimates of the method and laboratory bias	Control Samples - RM Duplicate Analysis Instrument Calibration	CRM Laboratory Bias from PT Studies Instrument Calibration	NATA Technical Note 33
20	Top Down - precision and estimates of the method and laboratory bias	Control Samples	Recoveries of SS	NATA Technical Note 33
21	Top Down - precision and estimates of the method and laboratory bias	Control Samples	CRM	Eurachem/CITAC Guide
22	Top Down - precision and estimates of the method and laboratory bias	Duplicate Analysis	CRM	NATA Technical Note 33
23	Top Down - precision and estimates of the method and laboratory bias	Control Samples - CRM Duplicate Analysis Instrument Calibration	CRM Recoveries of SS Instrument Calibration	
24	Professional judgement	Duplicate Analysis	CRM Recoveries of SS Instrument Calibration	Eurachem/CITAC Guide

Table 11 Basis of Uncertainty Estimate (continued)

Lab. Code	Approach to Estimating MU	Information Sources for MU Estimation[a]		Guide Document for Estimating MU
		Precision	Method Bias	
25*	See 'Additional Information' section below	Control Samples - RM Duplicate Analysis Instrument Calibration	CRM Instrument Calibration	See 'Additional Information' section below
26	Top Down - precision and estimates of the method and laboratory bias	Control Samples - CRM Duplicate Analysis	CRM	NMI Uncertainty Course
27*	Top Down - precision and estimates of the method and laboratory bias	Control Samples - CRM Duplicate Analysis	CRM Recoveries of SS	other please type
28	Top Down - precision and estimates of the method and laboratory bias	Control Samples - RM	CRM Recoveries of SS	Eurachem/CITAC Guide
29*	Top Down - precision and estimates of the method and laboratory bias	Control Samples - CRM Duplicate Analysis Instrument Calibration	CRM Laboratory Bias from PT Studies Instrument Calibration	ASTM E2554-13
30	Standard deviation of replicate analyses multiplied by 2 or 3	Standard deviation from PT studies only		Eurachem/CITAC Guide
		Duplicate Analysis	Laboratory Bias from PT Studies	

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

Table 12 Additional Information for Measurement Uncertainty

Lab. Code	Additional Information
19	Macro MU Calculation Pack based on QC Data
25	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
27	Top Down approach, John Eames
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

4.3 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. There were no participants' comments regarding this study.

There were no comments from participants on this study.

5 PRESENTATION OF RESULTS AND STATISTICAL ANALYSIS

5.1 Results Summary

Participant results are listed in Tables 13 to 69 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 58.

An example chart with interpretation guide is shown in Figure 1.

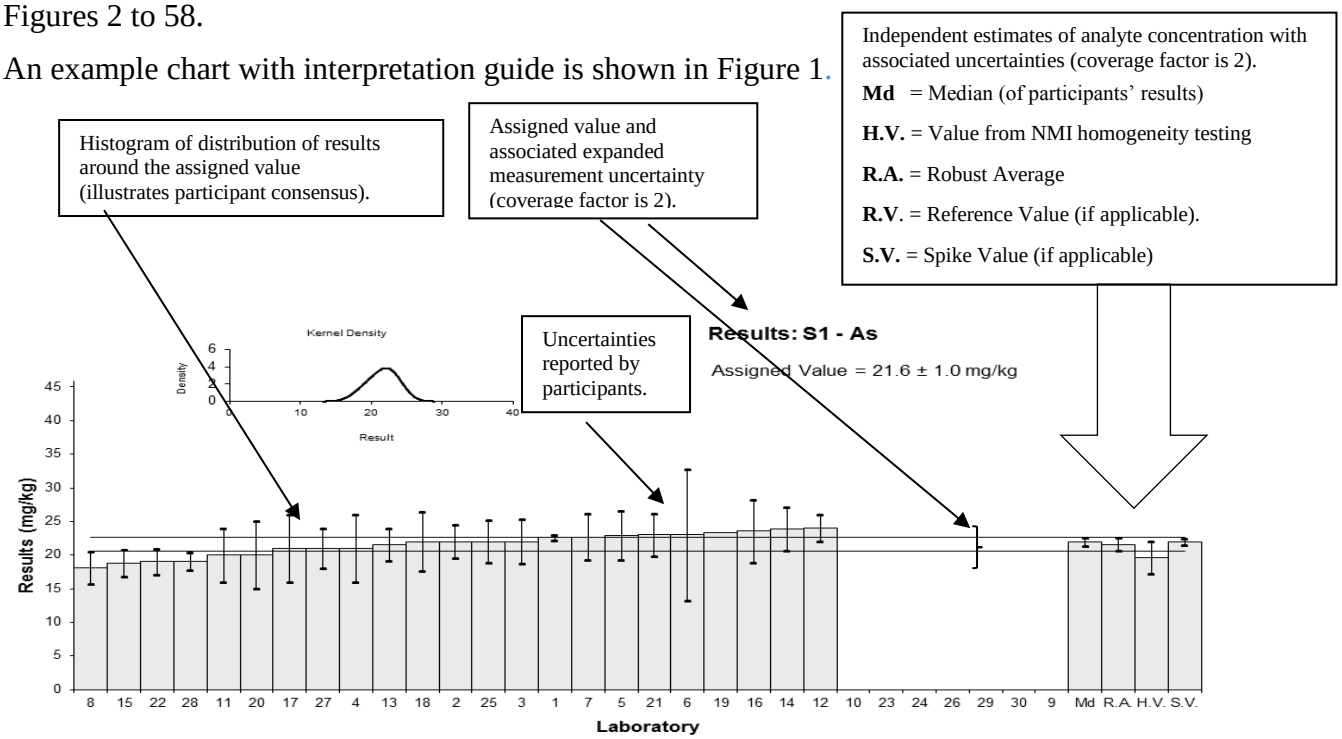


Figure 1 Guide to Presentation of Results

5.2 Assigned Value

An example of the 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 assigned values were the robust average of participants' results; the expanded uncertainties were estimated from the associated robust standard deviations.

5.3 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, ISO 13528:2015(E)'.[6]

5.4 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]

5.5 Target Standard Deviation

The target standard deviation (σ) is the product of the assigned value *(X)* and the performance coefficient of variation (PCV) as presented in Equation 1. This value is used for calculation of participant z-score and provides scaling for laboratory deviation from the assigned value.

$$\sigma = (X) * PCV \qquad \text{Equation 1}$$

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] By setting a fixed and realistic value for the PCV, the participants' performance does not depend on other participants' performance and can be compared from study to study and against achievable performance.

5.6 z-Score

An example of z-score calculation using data from the present study is given in Appendix 2. For each participants' result a z-score is calculated according to Equation 2 below:

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

where:

z is z-score
χ is participants' result
X is the study assigned value
σ is the target standard deviation from Equation 1

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

- $|z| \leq 2$ is satisfactory;
- $2 < |z| < 3$ is questionable;
- $|z| \geq 3$ is unsatisfactory.

5.7 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:

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

where:

E_n is E_n-score
χ is a participants 'result
X is the assigned value
U_χ is the expanded uncertainty of the participants' result
U_X is the expanded uncertainty of the assigned value

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

- $|E_n| \leq 1$ is satisfactory;
- $|E_n| > 1$ is unsatisfactory.

5.8 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 13

Sample Details

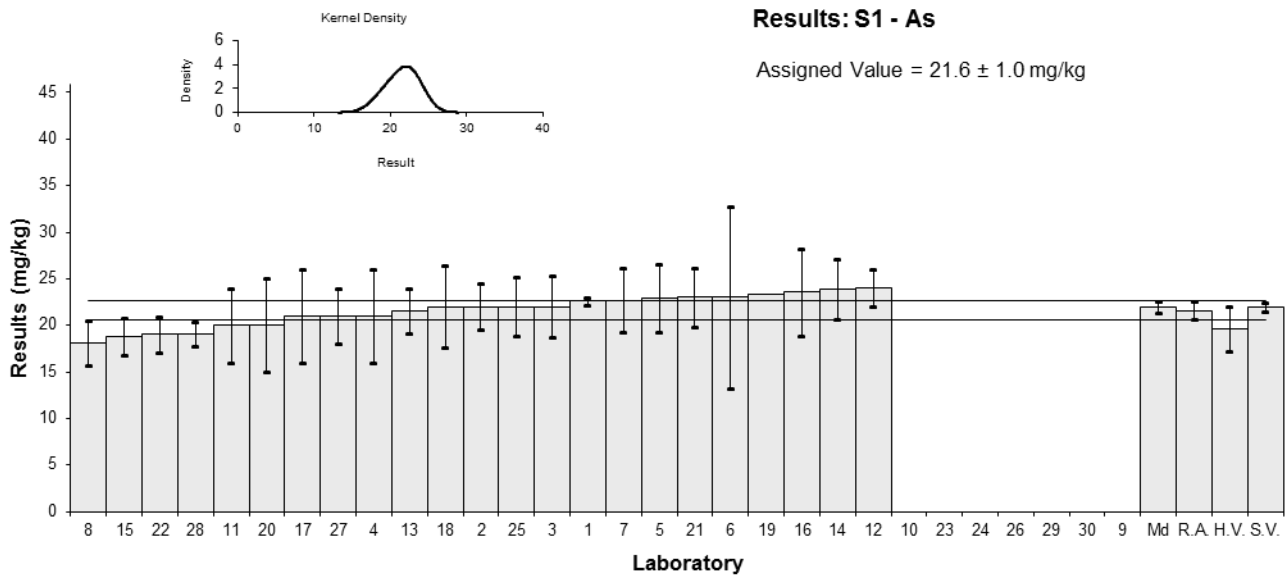
Sample No.	S1
Matrix.	Soil
Analyte.	As
Units	mg/kg

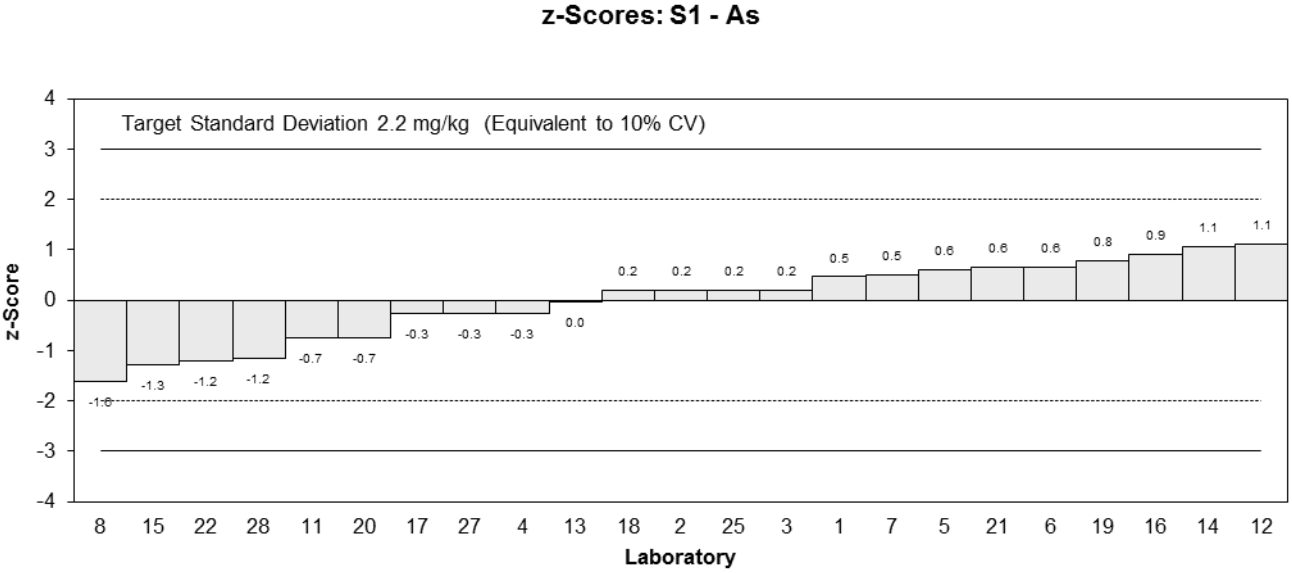
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	22.6	0.4	0.46	0.93
2	22	2.5	0.19	0.15
3	22	3.3	0.19	0.12
4	21	5	-0.28	-0.12
5	22.9	3.7	0.60	0.34
6	23.0	9.77	0.65	0.14
7	22.7	3.4	0.51	0.31
8	18.1	2.35	-1.62	-1.37
9	NT	NT		
10	NT	NT		
11	20	4	-0.74	-0.39
12	24	2	1.11	1.07
13	21.5	2.4	-0.05	-0.04
14	23.9	3.19	1.06	0.69
15	18.8	2.0	-1.30	-1.25
16	23.55	4.71	0.90	0.40
17	21	5	-0.28	-0.12
18	22	4.4	0.19	0.09
19	23.3	NR	0.79	1.70
20	20	5	-0.74	-0.31
21	23.0	3.12	0.65	0.43
22	19	1.9	-1.20	-1.21
23	NT	NT		
24	NT	NT		
25	22	3.2	0.19	0.12
26	NT	NT		
27	21	3	-0.28	-0.19
28	19.100	1.284	-1.16	-1.54
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value	21.6	1.0
Spike	22.0	0.5
Homogeneity Value	19.6	2.4
Robust Average	21.6	1.0
Median	22.0	0.6
Mean	21.6	
N	23	
Max.	24	
Min.	18.1	
Robust SD	1.9	
Robust CV	8.8%	


Kernel Density
Density
Result
Results: S1 - As
Assigned Value = 21.6 ± 1.0 mg/kg
Results (mg/kg)
Laboratory
8 15 22 28 11 20 17 27 4 13 18 2 25 3 1 7 5 21 6 19 16 14 12 10 23 24 26 29 30 9 Md R.A. H.V. S.V.


z-Scores: S1 - As
Target Standard Deviation 2.2 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
8 15 22 28 11 20 17 27 4 13 18 2 25 3 1 7 5 21 6 19 16 14 12

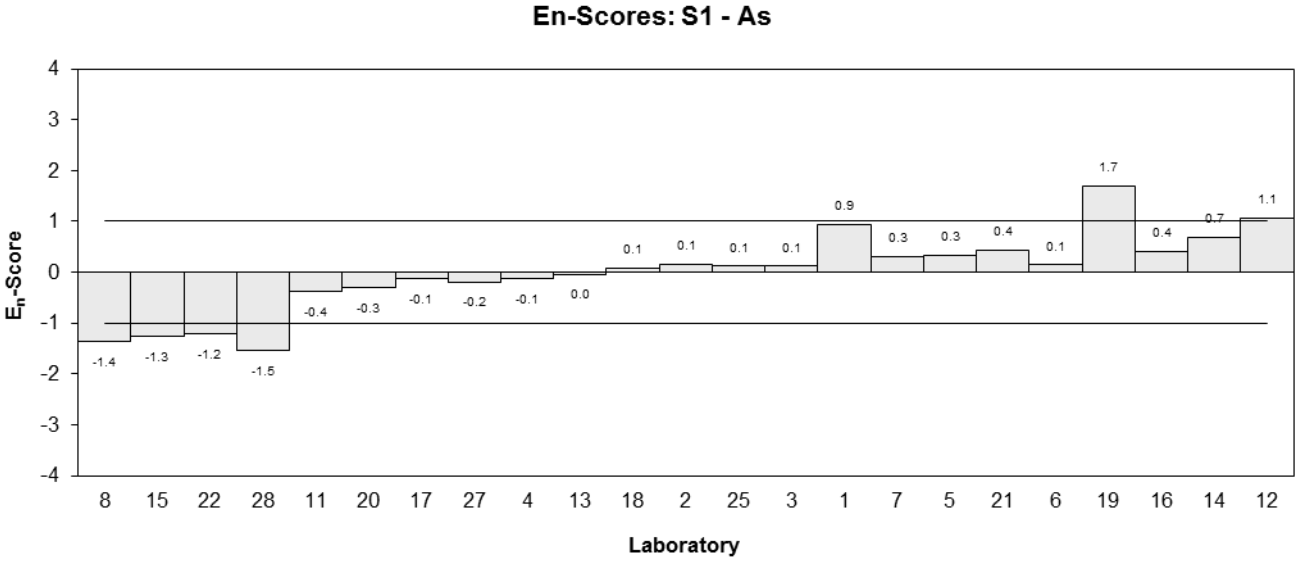

En-Scores: S1 - As
En-Score
Laboratory
8 15 22 28 11 20 17 27 4 13 18 2 25 3 1 7 5 21 6 19 16 14 12

Figure 2

Table 14

Sample Details

Sample No.	S1
Matrix.	Soil
Analyte.	B
Units	mg/kg

Participant Results

Lab Code	Result	Uncertainty
1	NT	NT
2	7.8	2.1
3	22	5.5
4	17	3
5	<20	3.6
6	NR	NR
7	18.1	2.7
8	<50	0.9
9	NT	NT
10	NT	NT
11	17	3
12	31	2
13	34.4	7.1
14	11.7	2.30
15	17.5	2.5
16	17.08	3.42
17	14	3
18	13	2.6
19	<50	NR
20	14	3
21	<50	NR
22	12	2.4
23	NT	NT
24	NT	NT
25	25	4.1
26	NT	NT
27	15	3
28	NT	NT
29	NT	NT
30	NT	NT

Statistics

Assigned Value	Not Set	
Spike	25.0	0.5
Homogeneity Value	16.1	1.9
Robust Average	17.1	3.8
Median	17.0	2.8
Mean	17.9	
N	16	
Max.	34.4	
Min.	7.8	
Robust SD	6.1	
Robust CV	36%	

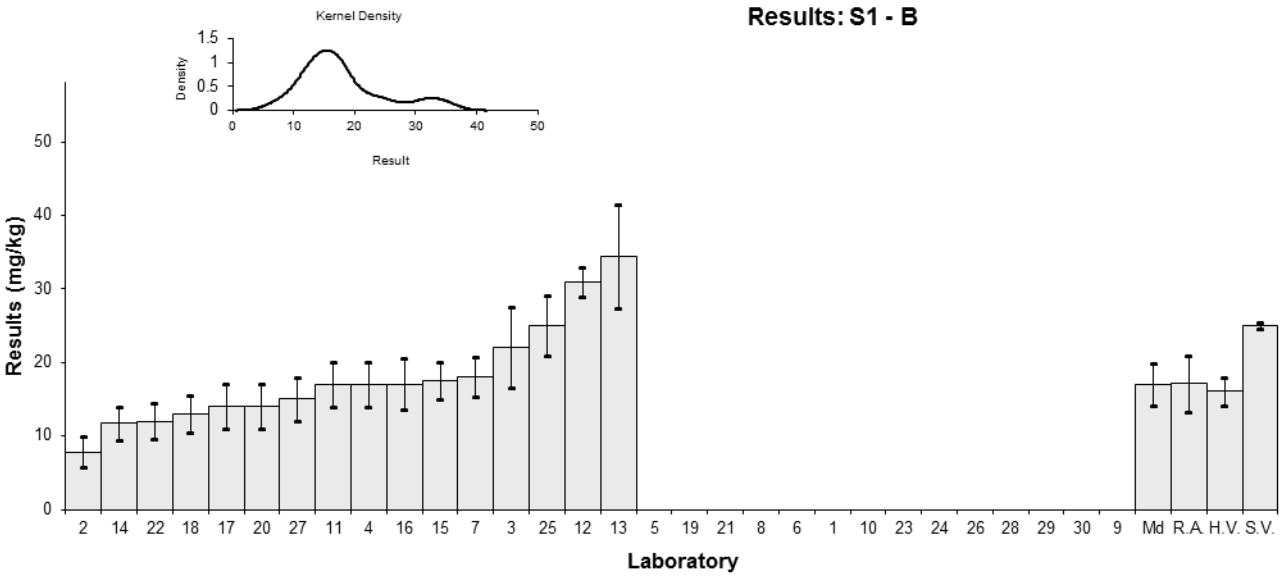

Results: S1 - B
Kernel Density
Density
Result
Results (mg/kg)
Laboratory
2 14 22 18 17 20 27 11 4 16 15 7 3 25 12 13 5 19 21 8 6 1 10 23 24 26 28 29 30 9 Md R.A. H.V. S.V.

Figure 3

Table 15

Sample Details

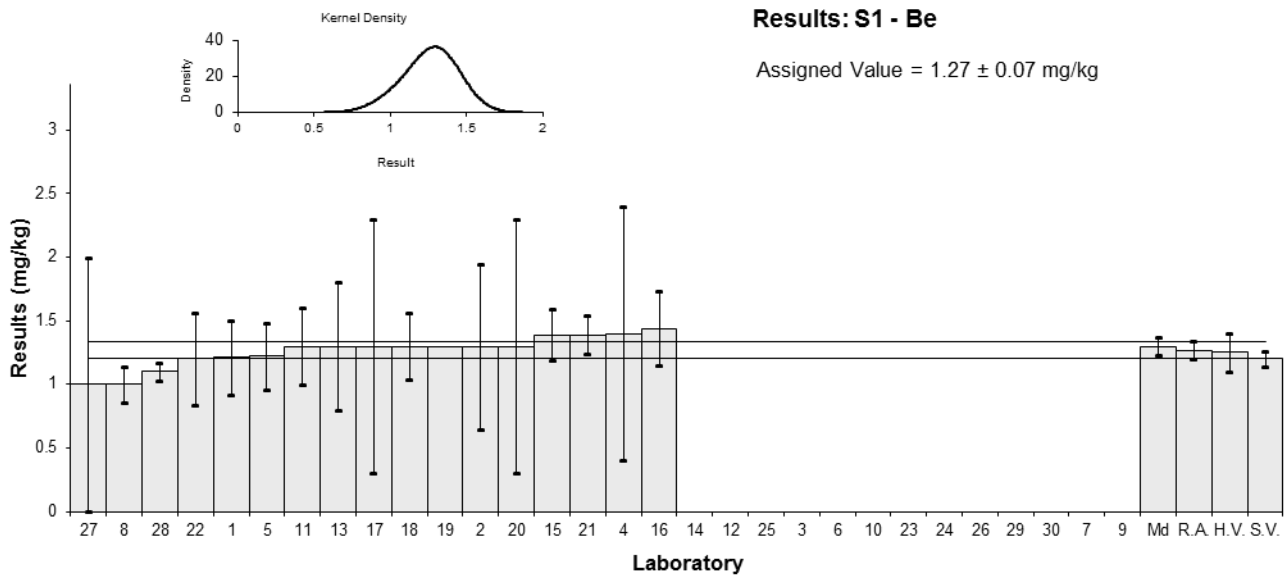
Sample No.	S1
Matrix.	Soil
Analyte.	Be
Units	mg/kg

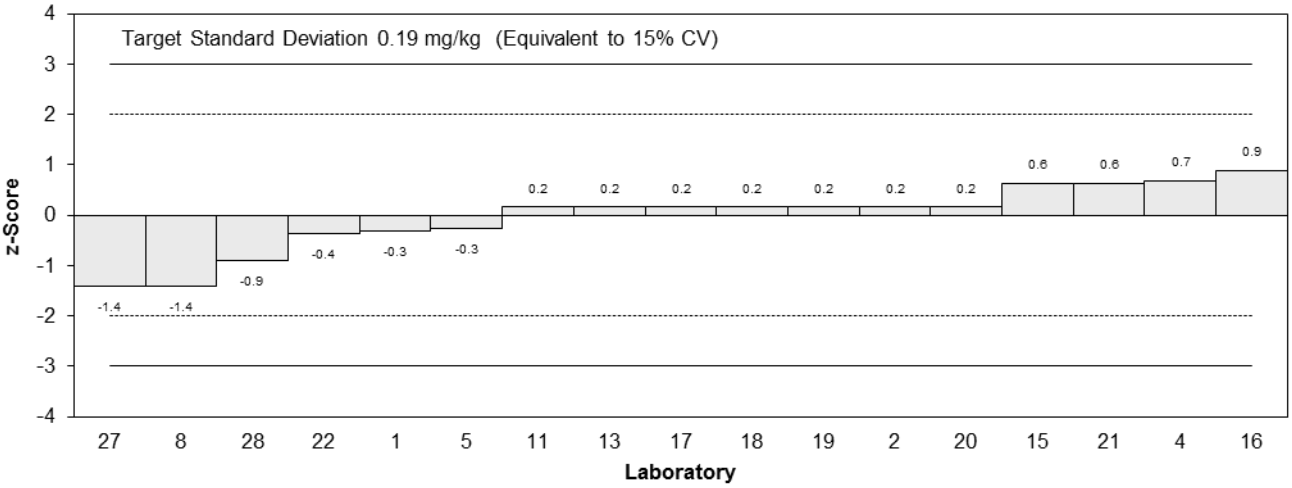
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	1.21	0.29	-0.31	-0.20
2	1.3	0.65	0.16	0.05
3	<5	<1.3		
4	1.4	1	0.68	0.13
5	1.22	0.26	-0.26	-0.19
6	NR	NR		
7	NT	NT		
8	1.0	0.14	-1.42	-1.72
9	NT	NT		
10	NT	NT		
11	1.3	0.3	0.16	0.10
12	<2	0.2		
13	1.30	0.50	0.16	0.06
14	< 2	NR		
15	1.39	0.2	0.63	0.57
16	1.44	0.29	0.89	0.57
17	1.3	1	0.16	0.03
18	1.3	.26	0.16	0.11
19	1.3	NR	0.16	0.43
20	1.3	1	0.16	0.03
21	1.39	0.15	0.63	0.72
22	1.2	0.36	-0.37	-0.19
23	NT	NT		
24	NT	NT		
25	<2	0.4		
26	NT	NT		
27	1	1	-1.42	-0.27
28	1.100	0.073	-0.89	-1.68
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value	1.27	0.07
Spike	1.20	0.06
Homogeneity Value	1.25	0.15
Robust Average	1.27	0.07
Median	1.30	0.07
Mean	1.26	
N	17	
Max.	1.44	
Min.	1	
Robust SD	0.12	
Robust CV	9.4%	


Kernel Density
Density
Result
Results: S1 - Be
Assigned Value = 1.27 ± 0.07 mg/kg
Results (mg/kg)
Laboratory
27 8 28 22 1 5 11 13 17 18 19 2 20 15 21 4 16 14 12 25 3 6 10 23 24 26 29 30 7 9 Md R.A. H.V. S.V.


z-Scores: S1 - Be
Target Standard Deviation 0.19 mg/kg (Equivalent to 15% CV)
z-Score
Laboratory
27 8 28 22 1 5 11 13 17 18 19 2 20 15 21 4 16
-1.4 -1.4 -0.9 -0.4 -0.3 -0.3 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.6 0.6 0.7 0.9

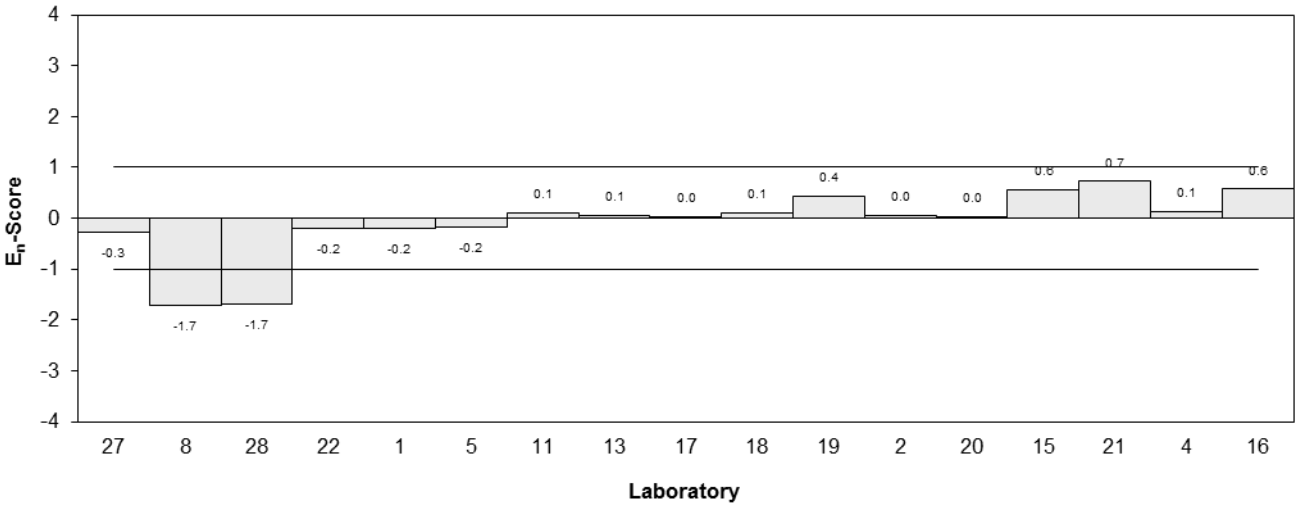

En-Scores: S1 - Be
En-Score
Laboratory
27 8 28 22 1 5 11 13 17 18 19 2 20 15 21 4 16
-0.3 -1.7 -1.7 -0.2 -0.2 -0.2 0.1 0.1 0.0 0.1 0.4 0.0 0.0 0.6 0.7 0.1 0.6

Figure 4

Table 16

Sample Details

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

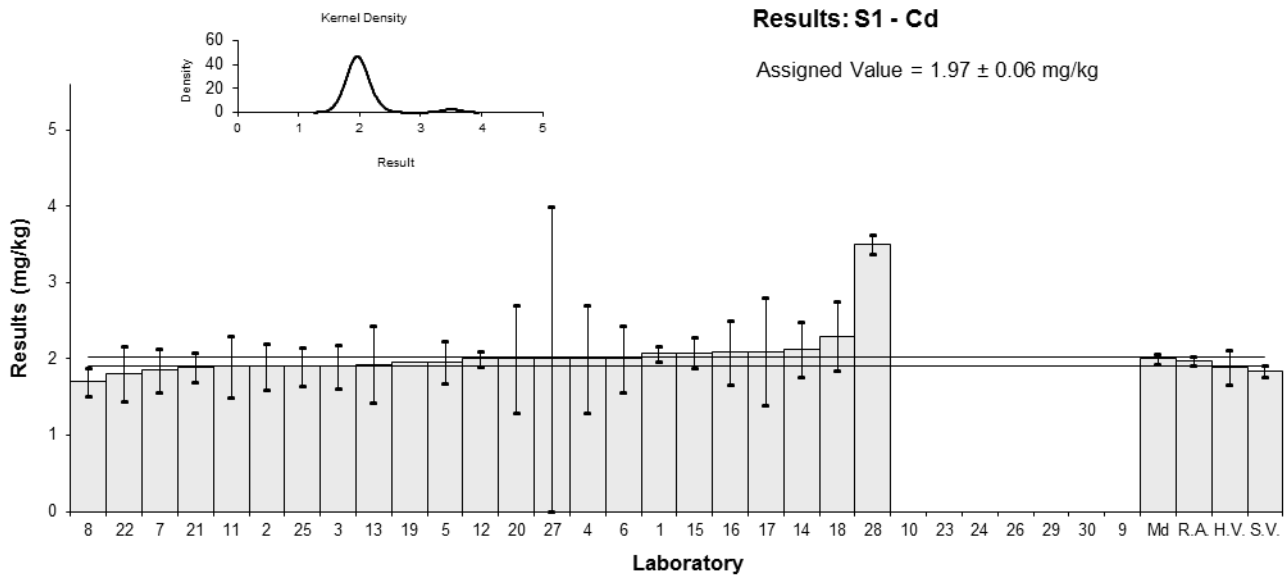
Participant Results

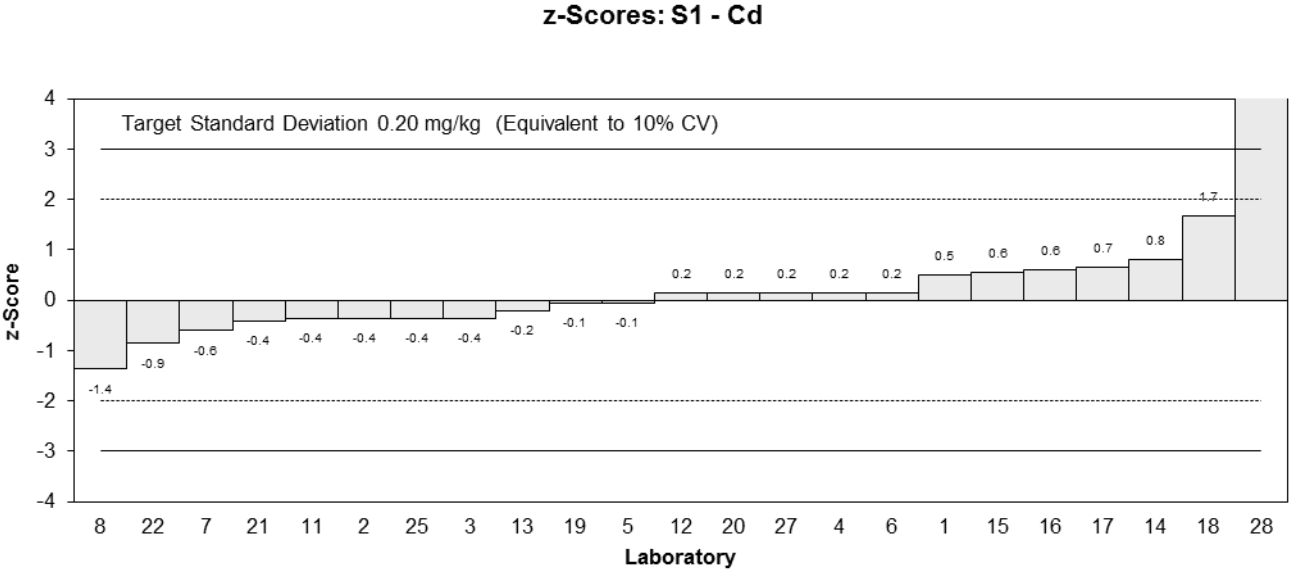
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	2.07	0.10	0.51	0.86
2	1.9	0.3	-0.36	-0.23
3	1.9	0.29	-0.36	-0.24
4	2.0	0.7	0.15	0.04
5	1.96	0.28	-0.05	-0.03
6	2.0	0.44	0.15	0.07
7	1.85	0.28	-0.61	-0.42
8	1.7	0.18	-1.37	-1.42
9	NT	NT		
10	NT	NT		
11	1.9	0.4	-0.36	-0.17
12	2.0	0.1	0.15	0.26
13	1.93	0.50	-0.20	-0.08
14	2.13	0.361	0.81	0.44
15	2.08	0.2	0.56	0.53
16	2.09	0.42	0.61	0.28
17	2.1	0.7	0.66	0.19
18	2.3	0.46	1.68	0.71
19	1.96	NR	-0.05	-0.17
20	2.0	0.7	0.15	0.04
21	1.89	0.19	-0.41	-0.40
22	1.8	0.36	-0.86	-0.47
23	NT	NT		
24	NT	NT		
25	1.9	0.25	-0.36	-0.27
26	NT	NT		
27	2	2	0.15	0.01
28	3.500	0.124	7.77	11.11
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value*	1.97	0.06
Spike	1.84	0.07
Homogeneity Value	1.89	0.23
Robust Average	1.98	0.06
Median	2.00	0.06
Mean	2.04	
N	23	
Max.	3.5	
Min.	1.7	
Robust SD	0.12	
Robust CV	6.1%	

*Robust Average excluding Laboratory 28


Kernel Density
Density
Result
Results: S1 - Cd
Assigned Value = 1.97 ± 0.06 mg/kg
Results (mg/kg)
Laboratory
8 22 7 21 11 2 25 3 13 19 5 12 20 27 4 6 1 15 16 17 14 18 28 10 23 24 26 29 30 9 Md R.A. H.V. S.V.


z-Scores: S1 - Cd
Target Standard Deviation 0.20 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
8 22 7 21 11 2 25 3 13 19 5 12 20 27 4 6 1 15 16 17 14 18 28

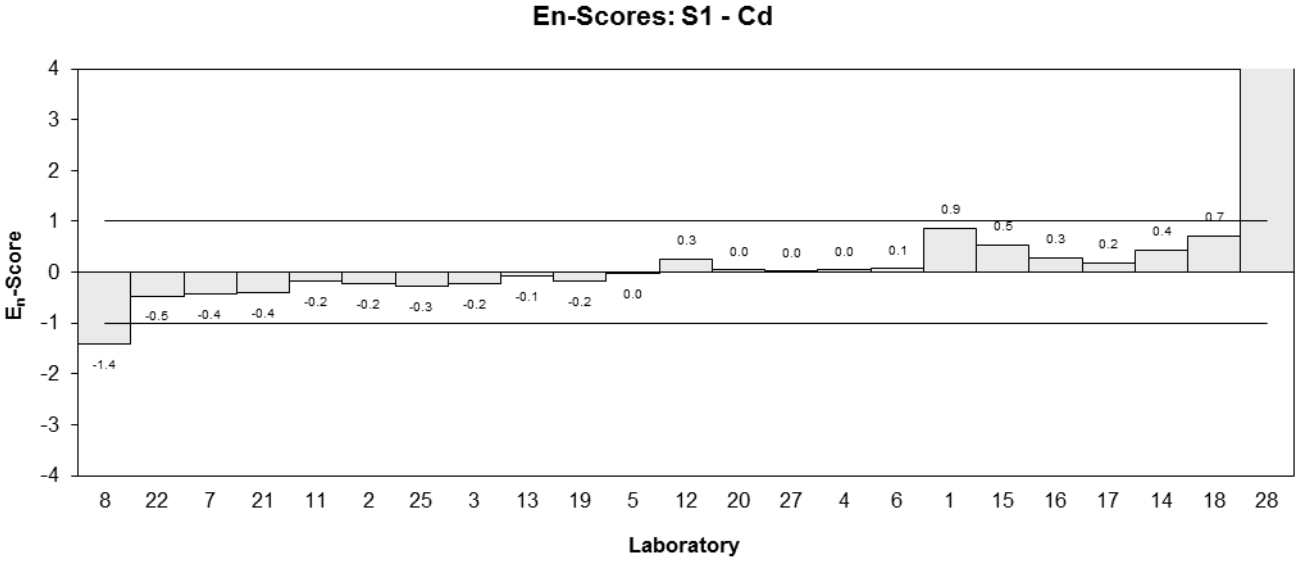

En-Scores: S1 - Cd
En-Score
Laboratory
8 22 7 21 11 2 25 3 13 19 5 12 20 27 4 6 1 15 16 17 14 18 28

Figure 5

Table 17

Sample Details

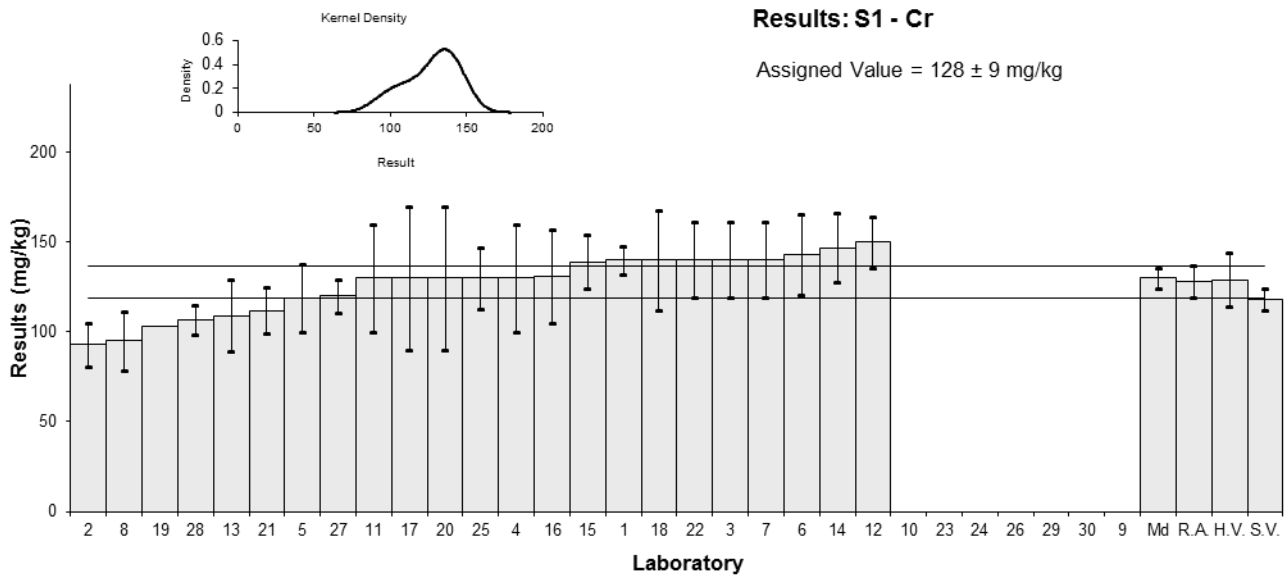
Sample No.	S1
Matrix.	Soil
Analyte.	Cr
Units	mg/kg

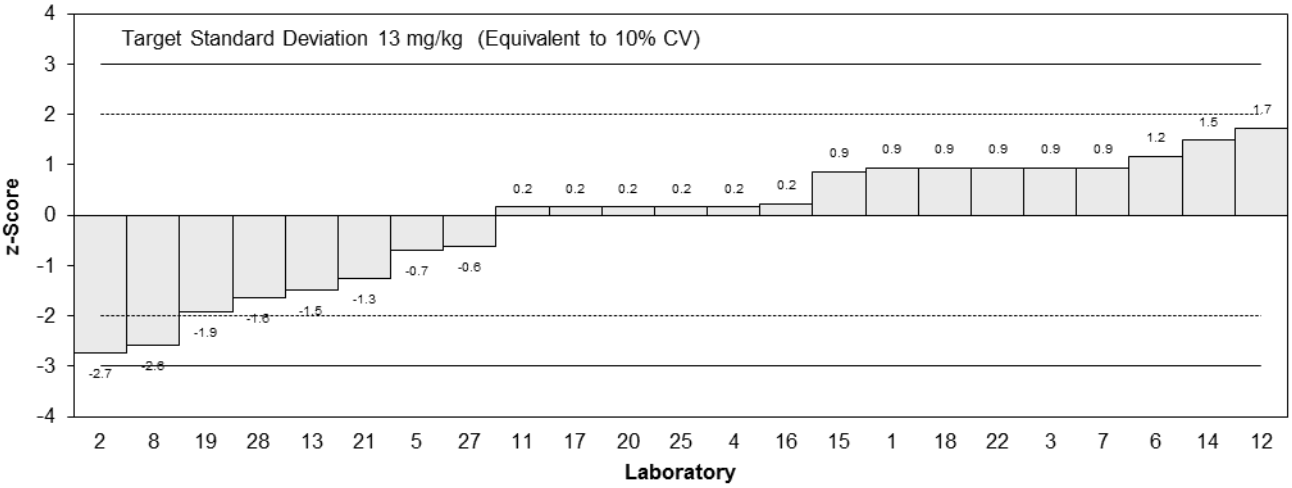
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	140	7.7	0.94	1.01
2	93	12	-2.73	-2.33
3	140	21	0.94	0.53
4	130	30	0.16	0.06
5	119	19	-0.70	-0.43
6	143	22.6	1.17	0.62
7	140	21	0.94	0.53
8	95	16.5	-2.58	-1.76
9	NT	NT		
10	NT	NT		
11	130	30	0.16	0.06
12	150	14	1.72	1.32
13	109	20	-1.48	-0.87
14	147	19.47	1.48	0.89
15	139	15	0.86	0.63
16	130.91	26.18	0.23	0.11
17	130	40	0.16	0.05
18	140	28	0.94	0.41
19	103.3	NR	-1.93	-2.74
20	130	40	0.16	0.05
21	112	12.9	-1.25	-1.02
22	140	21	0.94	0.53
23	NT	NT		
24	NT	NT		
25	130	17.3	0.16	0.10
26	NT	NT		
27	120	9	-0.62	-0.63
28	107.000	8.175	-1.64	-1.73
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value	128	9
Spike	118	6
Homogeneity Value	129	15
Robust Average	128	9
Median	130	6
Mean	127	
N	23	
Max.	150	
Min.	93	
Robust SD	17	
Robust CV	13%	


Kernel Density
Density
Result
Results: S1 - Cr
Assigned Value = 128 ± 9 mg/kg
Results (mg/kg)
Laboratory
2 8 19 28 13 21 5 27 11 17 20 25 4 16 15 1 18 22 3 7 6 14 12 10 23 24 26 29 30 9 Md R.A. H.V. S.V.


z-Scores: S1 - Cr
Target Standard Deviation 13 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
2 8 19 28 13 21 5 27 11 17 20 25 4 16 15 1 18 22 3 7 6 14 12

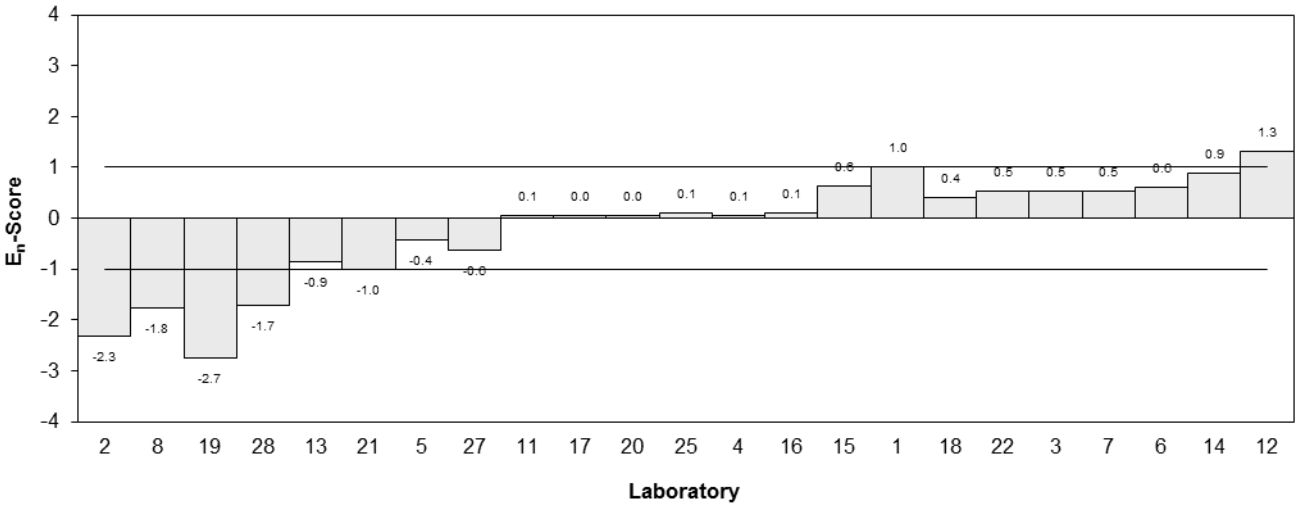

En-Scores: S1 - Cr
En-Score
Laboratory
2 8 19 28 13 21 5 27 11 17 20 25 4 16 15 1 18 22 3 7 6 14 12

Figure 6

Table 18

Sample Details

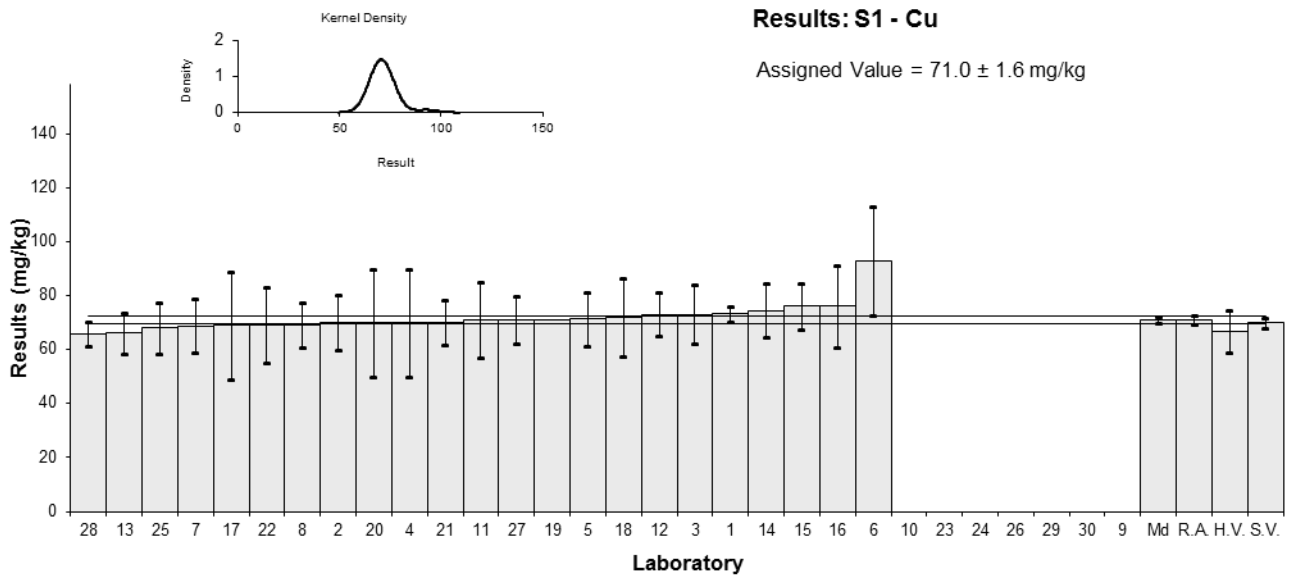
Sample No.	S1
Matrix.	Soil
Analyte.	Cu
Units	mg/kg

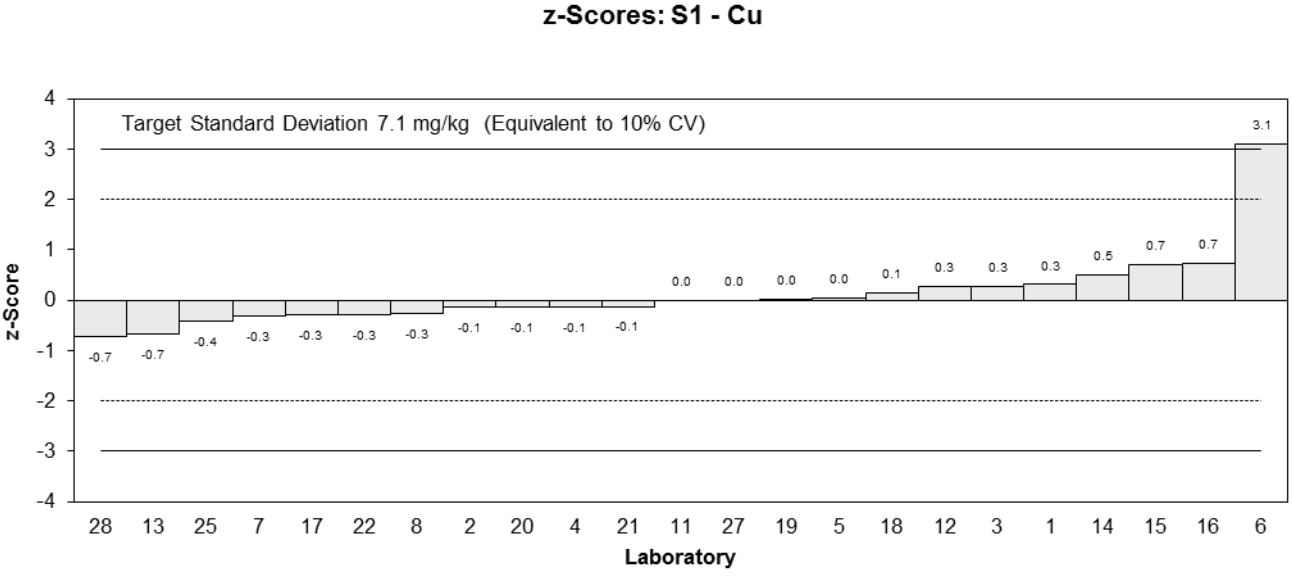
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	73.2	2.9	0.31	0.66
2	70	10.08	-0.14	-0.10
3	73	11	0.28	0.18
4	70	20	-0.14	-0.05
5	71.3	9.8	0.04	0.03
6	93.0	20.1	3.10	1.09
7	68.8	10	-0.31	-0.22
8	69.1	8.48	-0.27	-0.22
9	NT	NT		
10	NT	NT		
11	71	14	0.00	0.00
12	73	8	0.28	0.25
13	66.2	7.6	-0.68	-0.62
14	74.5	9.87	0.49	0.35
15	76.0	8.5	0.70	0.58
16	76.15	15.23	0.73	0.34
17	69	20	-0.28	-0.10
18	72	14.4	0.14	0.07
19	71.14	NR	0.02	0.09
20	70	20	-0.14	-0.05
21	70.1	8.41	-0.13	-0.11
22	69	14	-0.28	-0.14
23	NT	NT		
24	NT	NT		
25	68	9.6	-0.42	-0.31
26	NT	NT		
27	71	9	0.00	0.00
28	65.800	4.310	-0.73	-1.13
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value	71.0	1.6
Spike	70.0	1.9
Homogeneity Value	66.7	8.0
Robust Average	71.0	1.6
Median	71.0	1.3
Mean	71.8	
N	23	
Max.	93	
Min.	65.8	
Robust SD	3.1	
Robust CV	4.4%	


Kernel Density
Density
Result
Results: S1 - Cu
Assigned Value = 71.0 ± 1.6 mg/kg
Results (mg/kg)
Laboratory
28 13 25 7 17 22 8 2 20 4 21 11 27 19 5 18 12 3 1 14 15 16 6 10 23 24 26 29 30 9 Md R.A. H.V. S.V.


z-Scores: S1 - Cu
Target Standard Deviation 7.1 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
28 13 25 7 17 22 8 2 20 4 21 11 27 19 5 18 12 3 1 14 15 16 6

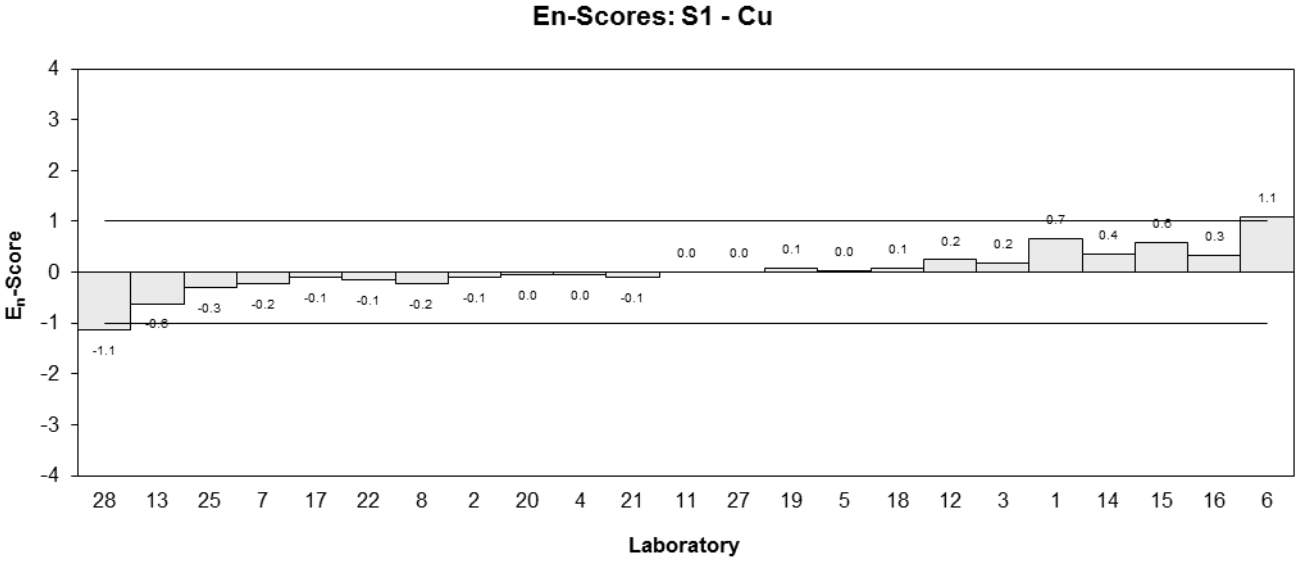

En-Scores: S1 - Cu
En-Score
Laboratory
28 13 25 7 17 22 8 2 20 4 21 11 27 19 5 18 12 3 1 14 15 16 6

Figure 7

Table 19

Sample Details

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

Participant Results

Lab Code	Result	Uncertainty
1	0.11	0.01
2	0.14	0.07
3	0.2	0.04
4	0.11	0.1
5	0.131	0.068
6	NR	NR
7	0.13	0.02
8	0.1	0.01
9	NT	NT
10	NT	NT
11	<0.2	NR
12	<0.2	0.04
13	0.151	0.03
14	0.137	0.018
15	0.17	0.04
16	0.14	0.03
17	0.1	0.1
18	0.11	0.022
19	0.12	NR
20	0.12	0.1
21	0.14	0.01
22	<1.0	NR
23	NT	NT
24	NT	NT
25	0.13	0.017
26	NT	NT
27	0.11	0.03
28	0.170	0.029
29	NT	NT
30	NT	NT

Statistics

Assigned Value	Not Set	
Spike	0.413	0.010
Homogeneity Value	0.171	0.040
Robust Average	0.131	0.014
Median	0.130	0.014
Mean	0.133	
N	19	
Max.	0.2	
Min.	0.1	
Robust SD	0.025	
Robust CV	19%	

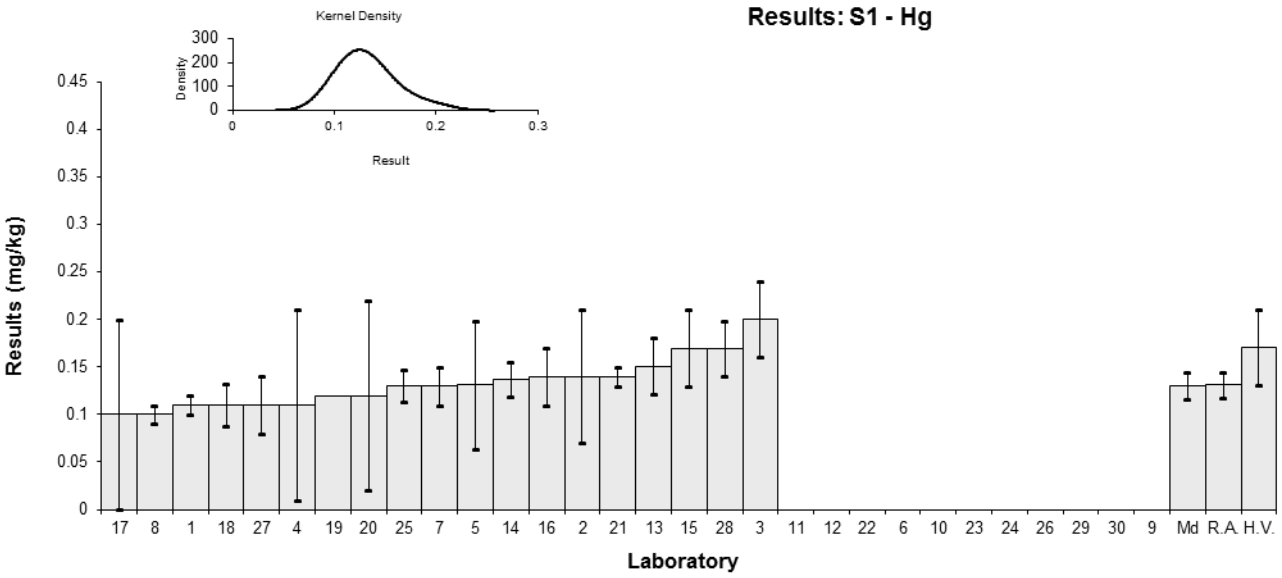

Results: S1 - Hg
Kernel Density
Density
Result
Results (mg/kg)
Laboratory
17 8 1 18 27 4 19 20 25 7 5 14 16 2 21 13 15 28 3 11 12 22 6 10 23 24 26 29 30 9 Md R.A. H.V.

Figure 8

Table 20

Sample Details

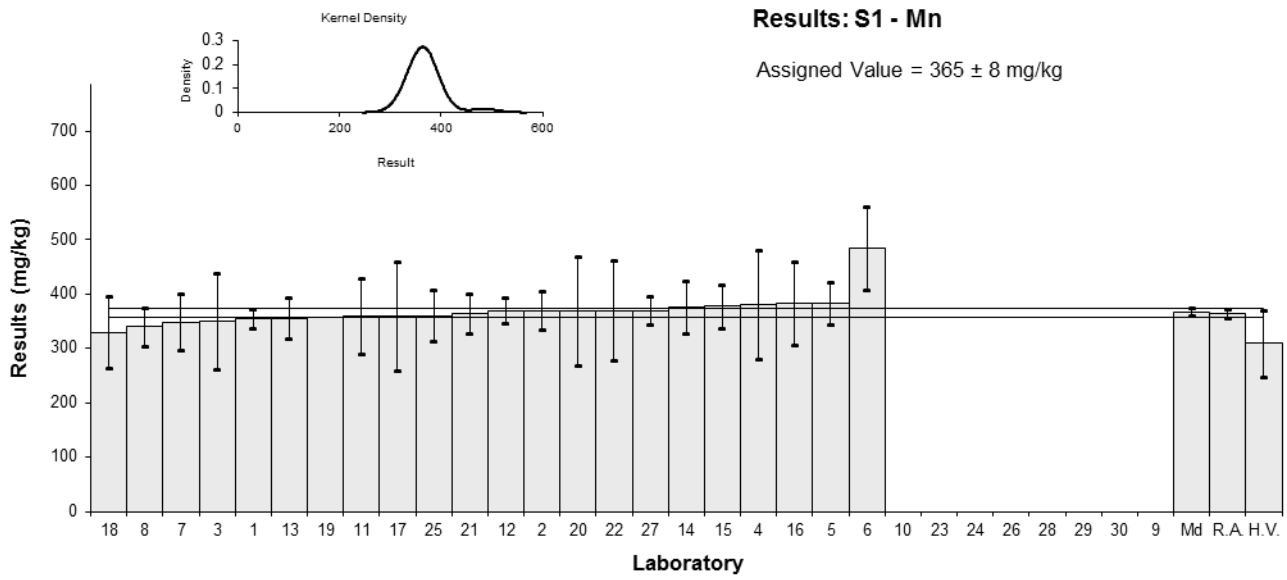
Sample No.	S1
Matrix.	Soil
Analyte.	Mn
Units	mg/kg

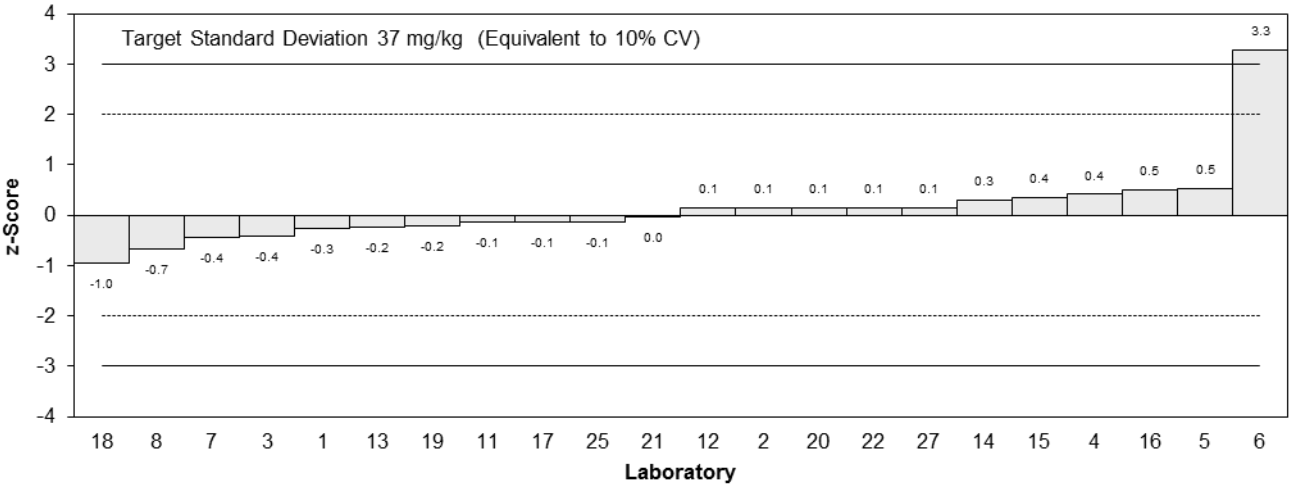
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	355	18	-0.27	-0.51
2	370	36	0.14	0.14
3	350	88	-0.41	-0.17
4	380	100	0.41	0.15
5	384	39	0.52	0.48
6	485	76.5	3.29	1.56
7	349	52	-0.44	-0.30
8	340	34.8	-0.68	-0.70
9	NT	NT		
10	NT	NT		
11	360	70	-0.14	-0.07
12	370	24	0.14	0.20
13	356	38	-0.25	-0.23
14	376	49.0	0.30	0.22
15	378	40	0.36	0.32
16	383.55	76.71	0.51	0.24
17	360	100	-0.14	-0.05
18	330	66	-0.96	-0.53
19	357	NR	-0.22	-1.00
20	370	100	0.14	0.05
21	364	36.01	-0.03	-0.03
22	370	92	0.14	0.05
23	NT	NT		
24	NT	NT		
25	360	47.3	-0.14	-0.10
26	NT	NT		
27	370	25	0.14	0.19
28	NT	NT		
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value	365	8
Spike	Not Spiked	
Homogeneity Value	309	62
Robust Average	365	8
Median	367	7
Mean	369	
N	22	
Max.	485	
Min.	330	
Robust SD	15	
Robust CV	4.1%	


Kernel Density
Density
Result
Results: S1 - Mn
Assigned Value = 365 ± 8 mg/kg
Results (mg/kg)
Laboratory
18 8 7 3 1 13 19 11 17 25 21 12 2 20 22 27 14 15 4 16 5 6 10 23 24 26 28 29 30 9 Md R.A. H.V.


z-Scores: S1 - Mn
Target Standard Deviation 37 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
18 8 7 3 1 13 19 11 17 25 21 12 2 20 22 27 14 15 4 16 5 6

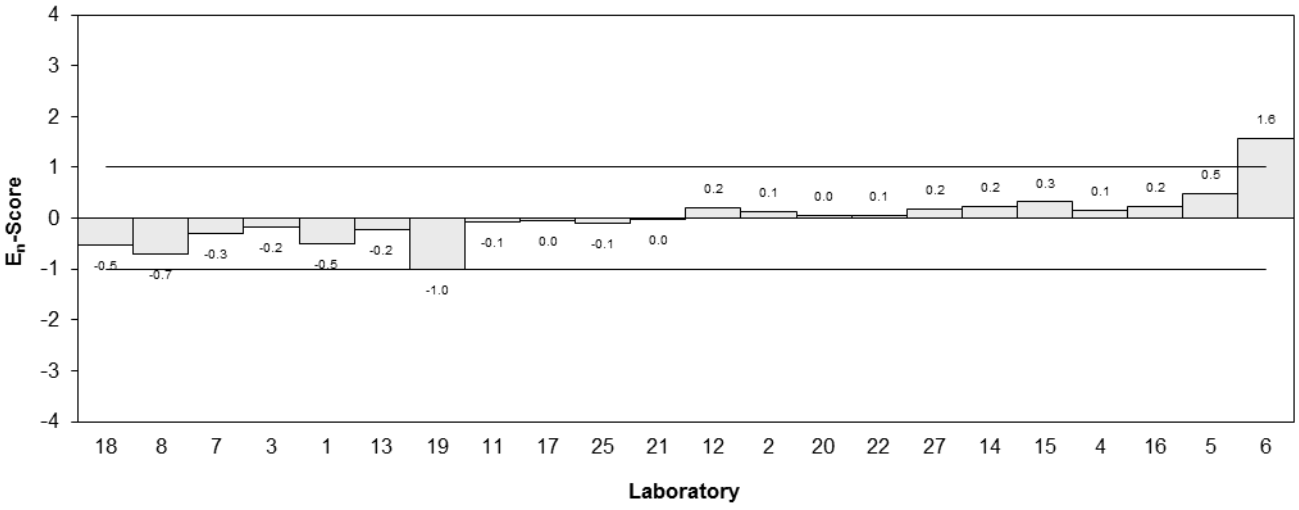

En-Scores: S1 - Mn
En-Score
Laboratory
18 8 7 3 1 13 19 11 17 25 21 12 2 20 22 27 14 15 4 16 5 6

Figure 9

Table 21

Sample Details

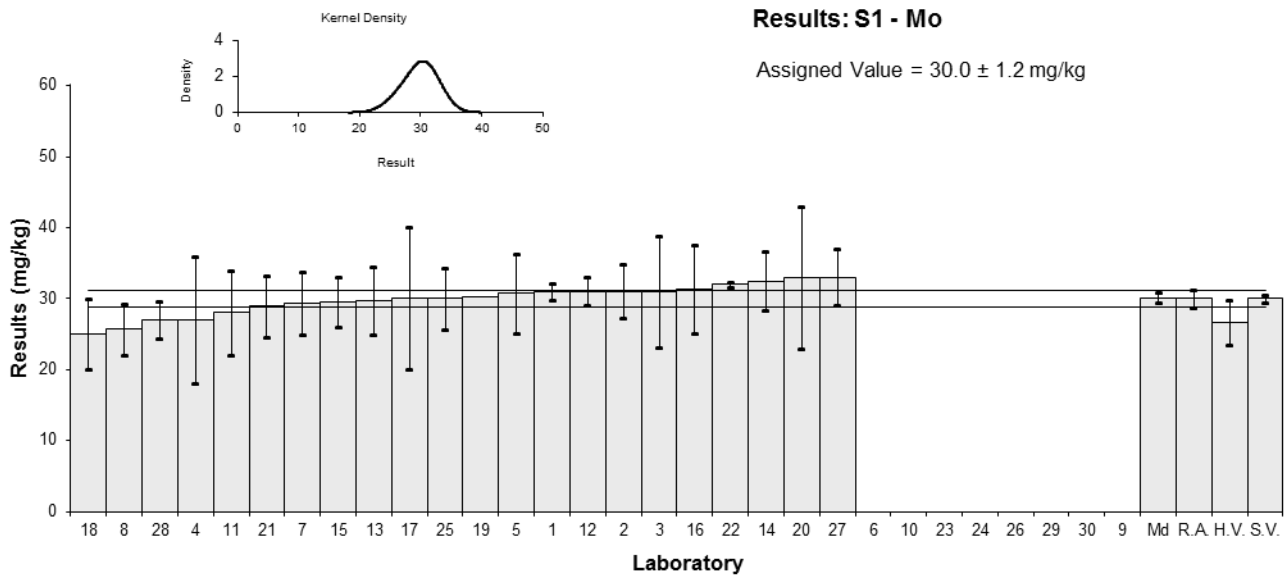
Sample No.	S1
Matrix.	Soil
Analyte.	Mo
Units	mg/kg

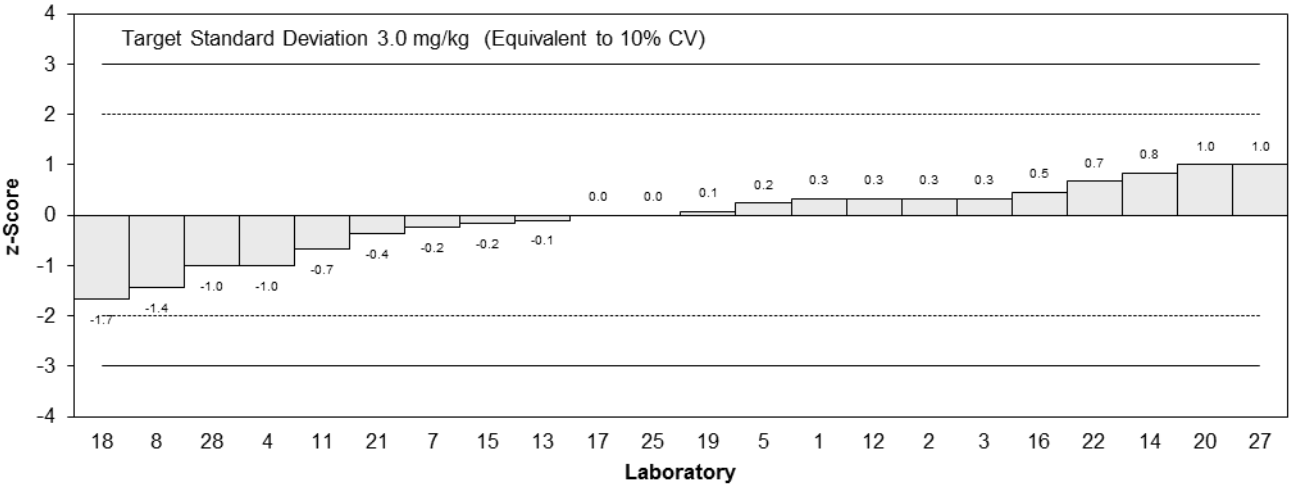
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	31.0	1.2	0.33	0.59
2	31	3.8	0.33	0.25
3	31	7.8	0.33	0.13
4	27	9	-1.00	-0.33
5	30.7	5.6	0.23	0.12
6	NR	NR		
7	29.3	4.4	-0.23	-0.15
8	25.7	3.62	-1.43	-1.13
9	NT	NT		
10	NT	NT		
11	28	6	-0.67	-0.33
12	31	2	0.33	0.43
13	29.7	4.8	-0.10	-0.06
14	32.5	4.20	0.83	0.57
15	29.5	3.5	-0.17	-0.14
16	31.35	6.27	0.45	0.21
17	30	10	0.00	0.00
18	25	5	-1.67	-0.97
19	30.22	NR	0.07	0.18
20	33	10	1.00	0.30
21	28.9	4.34	-0.37	-0.24
22	32	0.32	0.67	1.61
23	NT	NT		
24	NT	NT		
25	30	4.3	0.00	0.00
26	NT	NT		
27	33	4	1.00	0.72
28	27.000	2.600	-1.00	-1.05
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value	30.0	1.2
Spike	30.0	0.6
Homogeneity Value	26.6	3.2
Robust Average	30.0	1.2
Median	30.1	0.7
Mean	29.9	
N	22	
Max.	33	
Min.	25	
Robust SD	2.2	
Robust CV	7.3%	


Kernel Density
Density
Result
Results: S1 - Mo
Assigned Value = 30.0 ± 1.2 mg/kg
Results (mg/kg)
Laboratory
18 8 28 4 11 21 7 15 13 17 25 19 5 1 12 2 3 16 22 14 20 27 6 10 23 24 26 29 30 9 Md R.A. H.V. S.V.


z-Scores: S1 - Mo
Target Standard Deviation 3.0 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
18 8 28 4 11 21 7 15 13 17 25 19 5 1 12 2 3 16 22 14 20 27
-1.7 -1.4 -1.0 -1.0 -0.7 -0.4 -0.2 -0.2 -0.1 0.0 0.0 0.1 0.2 0.3 0.3 0.3 0.3 0.5 0.7 0.8 1.0 1.0

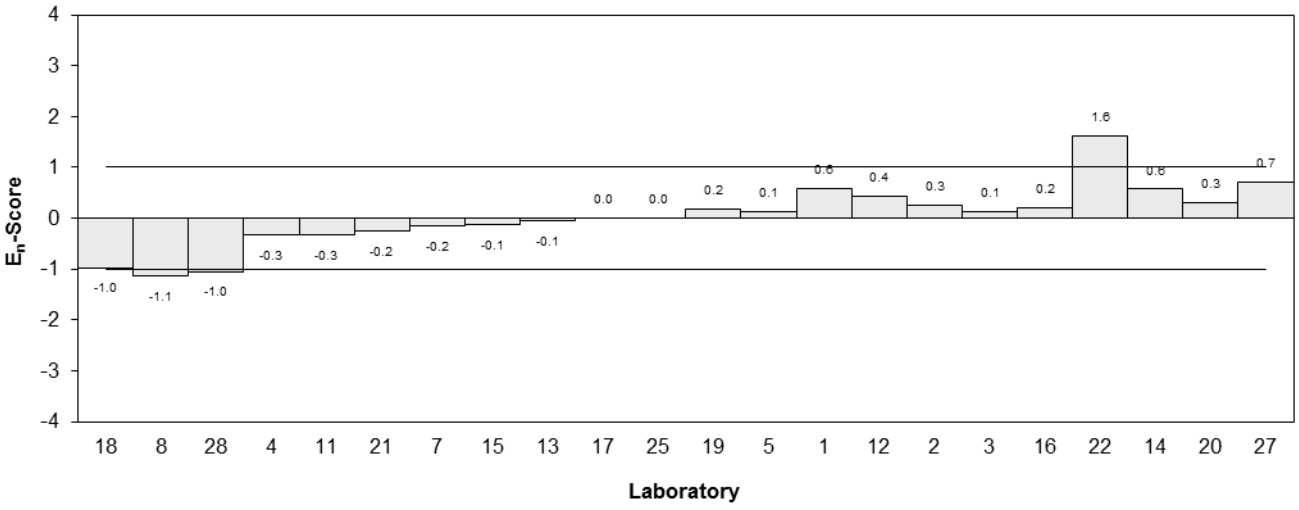

En-Scores: S1 - Mo
En-Score
Laboratory
18 8 28 4 11 21 7 15 13 17 25 19 5 1 12 2 3 16 22 14 20 27
-1.0 -1.1 -1.0 -0.3 -0.3 -0.2 -0.2 -0.1 -0.1 0.0 0.0 0.2 0.1 0.6 0.4 0.3 0.1 0.2 1.6 0.6 0.3 0.7

Figure 10

Table 22

Sample Details

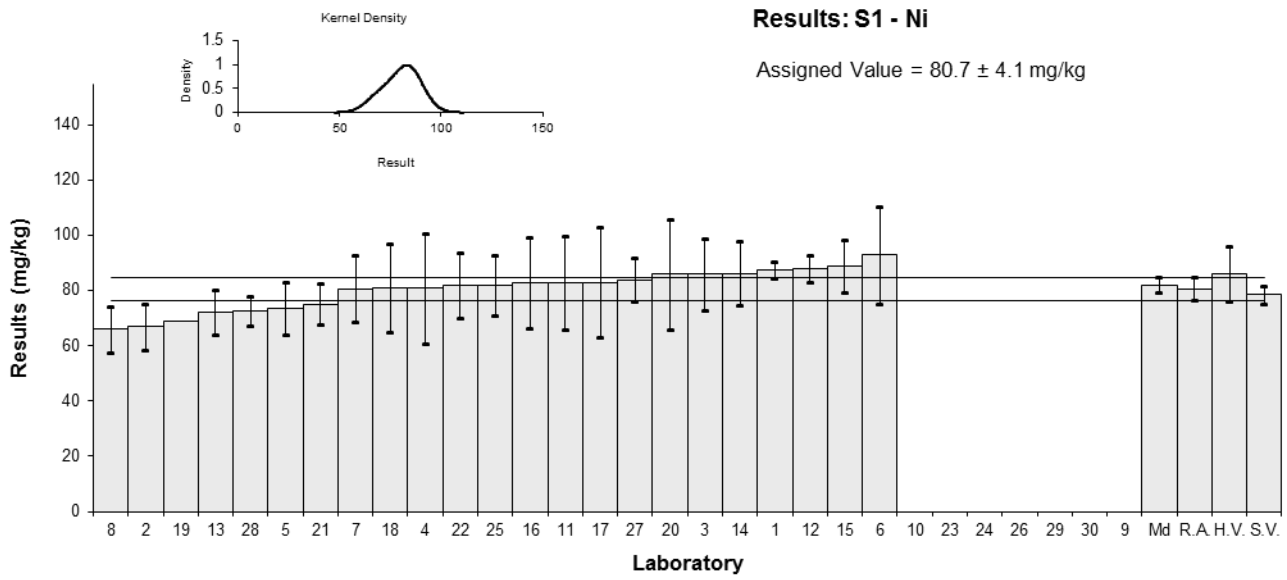
Sample No.	S1
Matrix.	Soil
Analyte.	Ni
Units	mg/kg

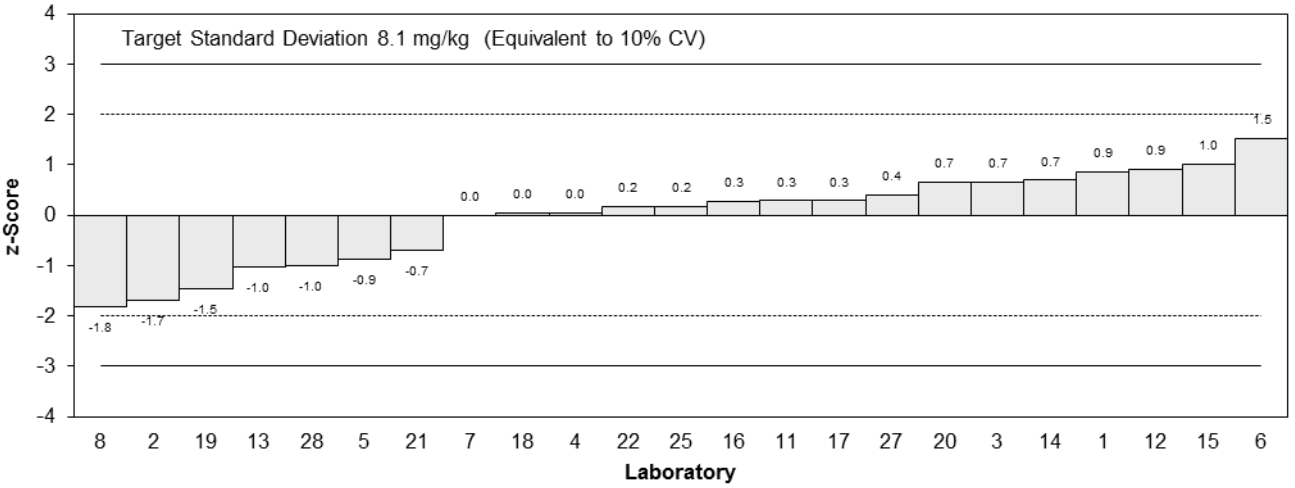
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	87.6	2.9	0.86	1.37
2	67	8.3	-1.70	-1.48
3	86	13	0.66	0.39
4	81	20	0.04	0.01
5	73.7	9.6	-0.87	-0.67
6	93.0	17.6	1.52	0.68
7	80.7	12	0.00	0.00
8	66	8.2	-1.82	-1.60
9	NT	NT		
10	NT	NT		
11	83	17	0.29	0.13
12	88	5	0.90	1.13
13	72.3	8	-1.04	-0.93
14	86.3	11.7	0.69	0.45
15	88.9	9.5	1.02	0.79
16	82.85	16.57	0.27	0.13
17	83	20	0.29	0.11
18	81	16.2	0.04	0.02
19	68.88	NR	-1.46	-2.88
20	86	20	0.66	0.26
21	75.1	7.42	-0.69	-0.66
22	82	12	0.16	0.10
23	NT	NT		
24	NT	NT		
25	82	11	0.16	0.11
26	NT	NT		
27	84	8	0.41	0.37
28	72.600	5.213	-1.00	-1.22
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value	80.7	4.1
Spike	78.5	3.2
Homogeneity Value	86	10
Robust Average	80.7	4.1
Median	82.0	2.8
Mean	80.5	
N	23	
Max.	93	
Min.	66	
Robust SD	7.9	
Robust CV	9.8%	


Kernel Density
Density
Result
Results: S1 - Ni
Assigned Value = 80.7 ± 4.1 mg/kg
Results (mg/kg)
Laboratory
8 2 19 13 28 5 21 7 18 4 22 25 16 11 17 27 20 3 14 1 12 15 6 10 23 24 26 29 30 9 Md R.A. H.V. S.V.


z-Scores: S1 - Ni
Target Standard Deviation 8.1 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
8 2 19 13 28 5 21 7 18 4 22 25 16 11 17 27 20 3 14 1 12 15 6

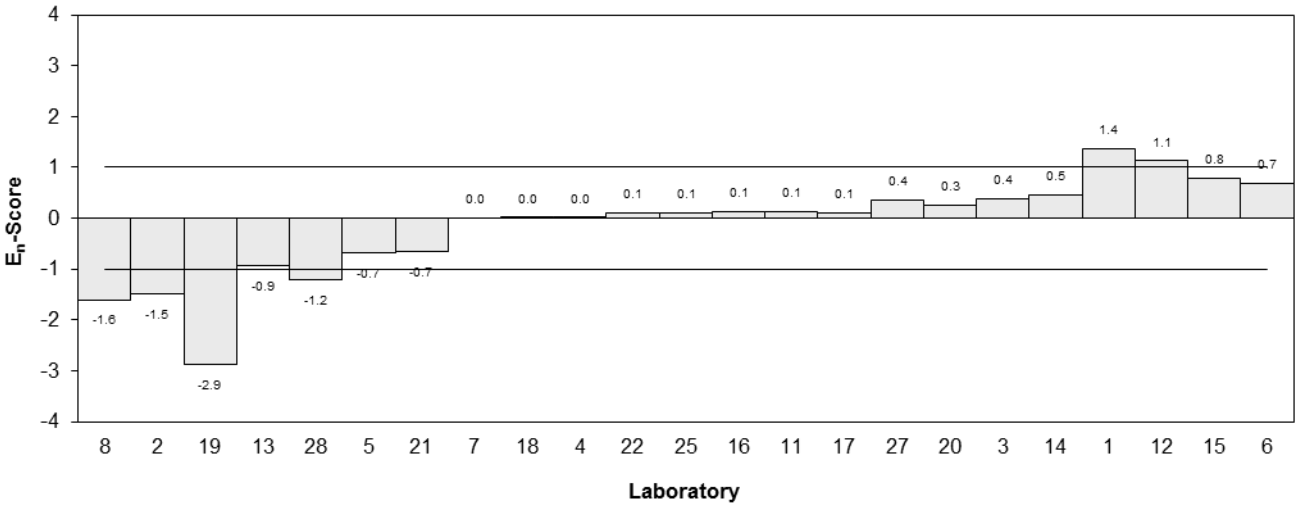

En-Scores: S1 - Ni
En-Score
Laboratory
8 2 19 13 28 5 21 7 18 4 22 25 16 11 17 27 20 3 14 1 12 15 6

Figure 11

Table 23

Sample Details

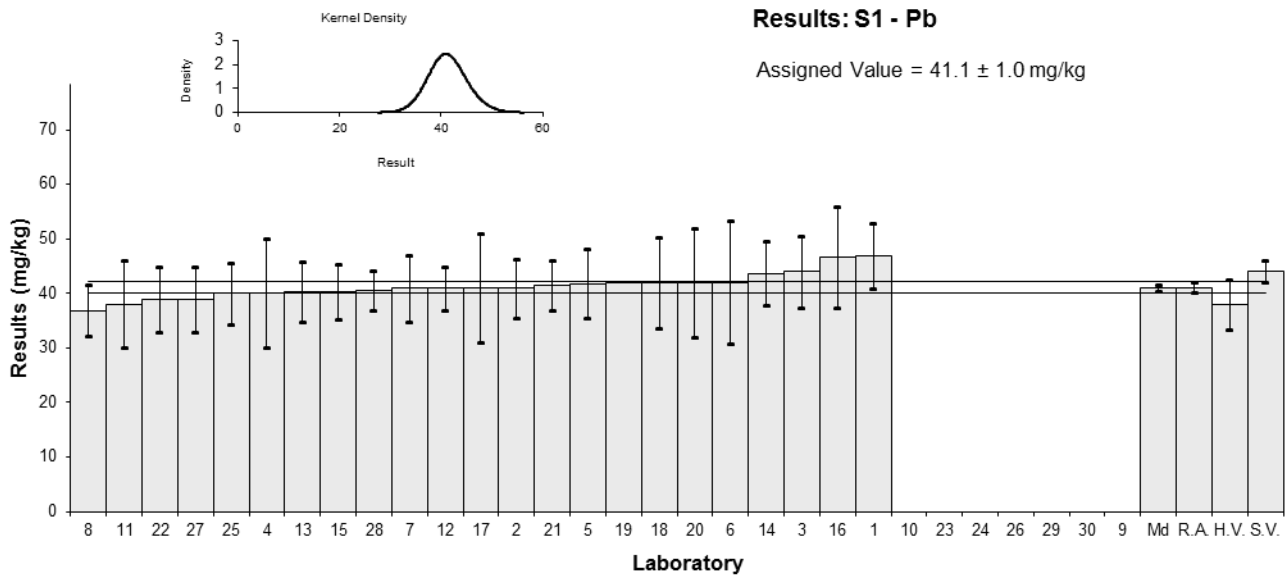
Sample No.	S1
Matrix.	Soil
Analyte.	Pb
Units	mg/kg

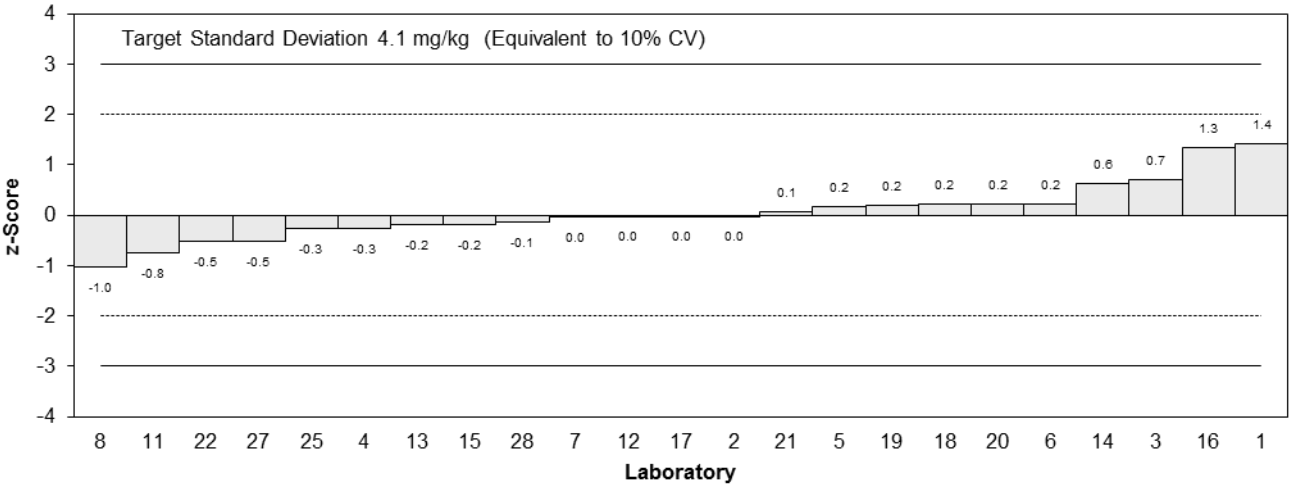
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	46.9	6	1.41	0.95
2	41	5.4	-0.02	-0.02
3	44	6.6	0.71	0.43
4	40	10	-0.27	-0.11
5	41.8	6.3	0.17	0.11
6	42.0	11.3	0.22	0.08
7	40.9	6.1	-0.05	-0.03
8	36.9	4.67	-1.02	-0.88
9	NT	NT		
10	NT	NT		
11	38	8	-0.75	-0.38
12	41	4	-0.02	-0.02
13	40.3	5.6	-0.19	-0.14
14	43.7	5.89	0.63	0.44
15	40.3	5.0	-0.19	-0.16
16	46.64	9.33	1.35	0.59
17	41	10	-0.02	-0.01
18	42	8.4	0.22	0.11
19	41.90	NR	0.19	0.80
20	42	10	0.22	0.09
21	41.4	4.56	0.07	0.06
22	39	6	-0.51	-0.35
23	NT	NT		
24	NT	NT		
25	40	5.7	-0.27	-0.19
26	NT	NT		
27	39	6	-0.51	-0.35
28	40.500	3.645	-0.15	-0.16
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value	41.1	1.0
Spike	44.0	2.0
Homogeneity Value	37.9	4.6
Robust Average	41.1	1.0
Median	41.0	0.6
Mean	41.3	
N	23	
Max.	46.9	
Min.	36.9	
Robust SD	2.0	
Robust CV	4.9%	


Kernel Density
Density
Result
Results: S1 - Pb
Assigned Value = 41.1 ± 1.0 mg/kg
Results (mg/kg)
Laboratory
8 11 22 27 25 4 13 15 28 7 12 17 2 21 5 19 18 20 6 14 3 16 1 10 23 24 26 29 30 9 Md R.A. H.V. S.V.


z-Scores: S1 - Pb
Target Standard Deviation 4.1 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
8 11 22 27 25 4 13 15 28 7 12 17 2 21 5 19 18 20 6 14 3 16 1
-1.0 -0.8 -0.5 -0.5 -0.3 -0.3 -0.2 -0.2 -0.1 0.0 0.0 0.0 0.0 0.1 0.2 0.2 0.2 0.2 0.2 0.6 0.7 1.3 1.4

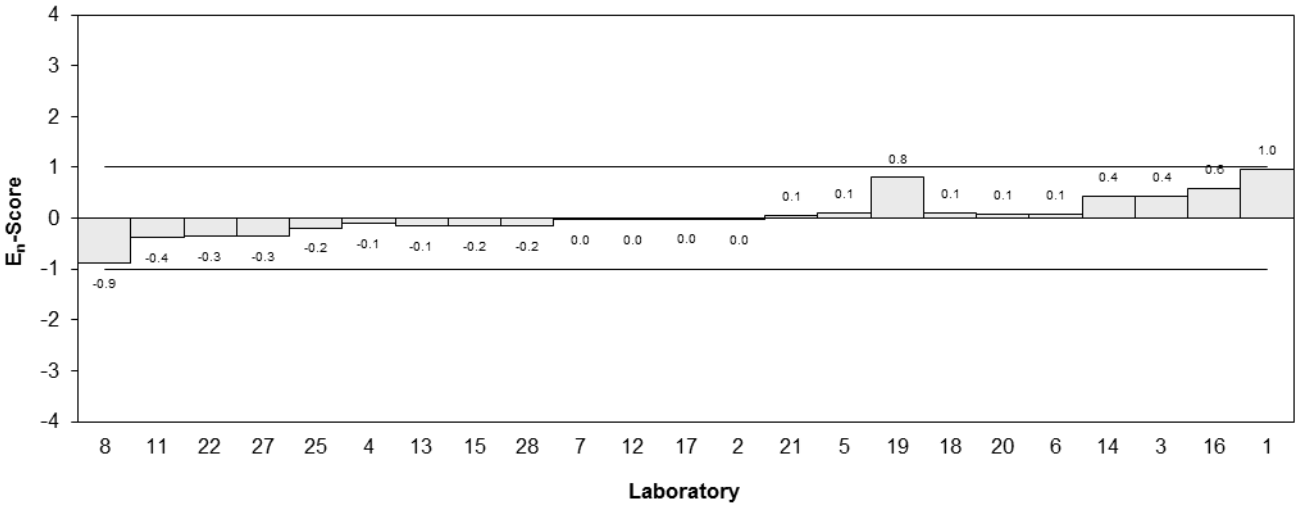

En-Scores: S1 - Pb
En-Score
Laboratory
8 11 22 27 25 4 13 15 28 7 12 17 2 21 5 19 18 20 6 14 3 16 1
-0.9 -0.4 -0.3 -0.3 -0.2 -0.1 -0.1 -0.2 -0.2 0.0 0.0 0.0 0.0 0.1 0.1 0.8 0.1 0.1 0.1 0.4 0.4 0.6 1.0

Figure 12

Table 24

Sample Details

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

Participant Results

Lab Code	Result	Uncertainty
1	18.8	0.4
2	6	3
3	17	4.3
4	9.9	4
5	12.5	2.3
6	NR	NR
7	16.4	2.5
8	6.8	0.99
9	NT	NT
10	NT	NT
11	10	2
12	19	3
13	13.4	3.0
14	17.8	1.99
15	NT	NT
16	13.79	2.76
17	13	4
18	18	3.6
19	8.50	NR
20	10	4
21	8.89	2.61
22	NT	NT
23	NT	NT
24	NT	NT
25	18	2.3
26	NT	NT
27	NT	NT
28	NT	NT
29	NT	NT
30	NT	NT

Statistics

Assigned Value	Not Set	
Spike	20.0	0.4
Homogeneity Value	11.0	1.3
Robust Average	13.2	2.9
Median	13.2	3.0
Mean	13.2	
N	18	
Max.	19	
Min.	6	
Robust SD	4.9	
Robust CV	37%	

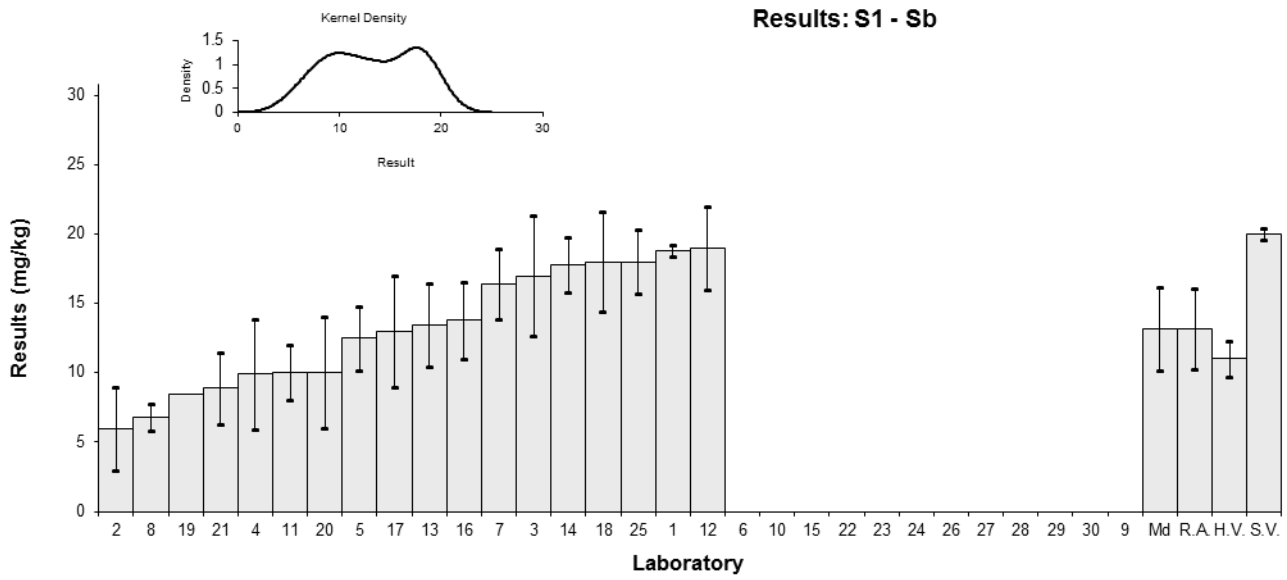

Results: S1 - Sb
Kernel Density
Density
Result
Results (mg/kg)
Laboratory
2 8 19 21 4 11 20 5 17 13 16 7 3 14 18 25 1 12 6 10 15 22 23 24 26 27 28 29 30 9 Md R.A. H.V. S.V.

Figure 13

Table 25

Sample Details

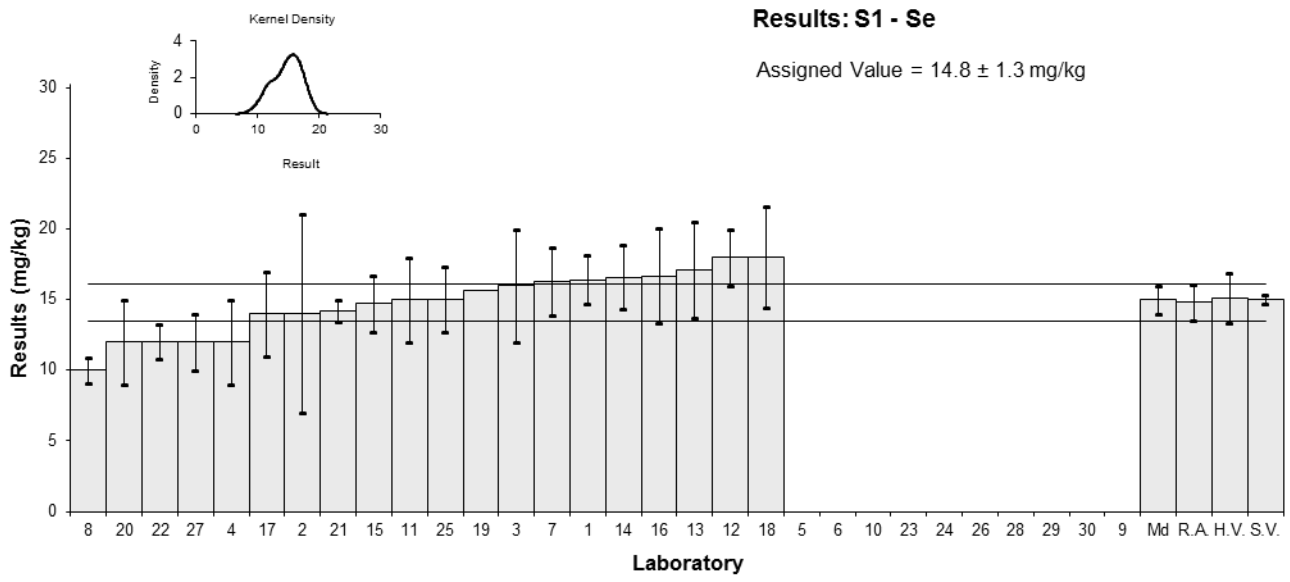
Sample No.	S1
Matrix.	Soil
Analyte.	Se
Units	mg/kg

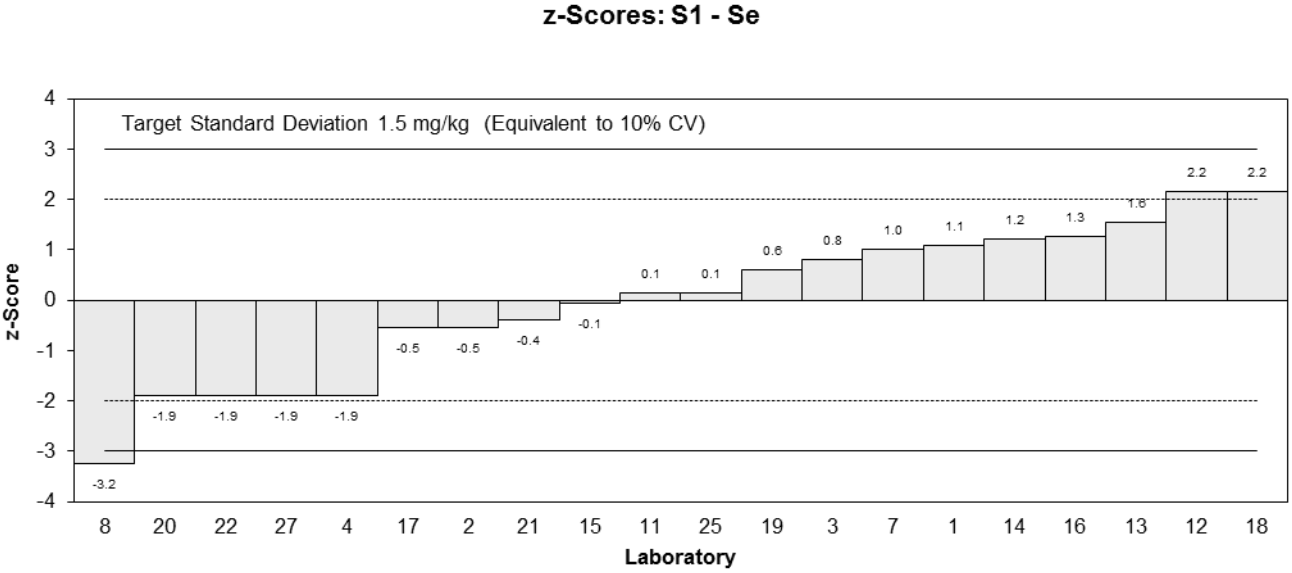
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	16.4	1.7	1.08	0.75
2	14	7	-0.54	-0.11
3	16	4	0.81	0.29
4	12	3	-1.89	-0.86
5	<20	14		
6	NR	NR		
7	16.3	2.4	1.01	0.55
8	10	0.9	-3.24	-3.04
9	NT	NT		
10	NT	NT		
11	15	3	0.14	0.06
12	18	2	2.16	1.34
13	17.1	3.4	1.55	0.63
14	16.6	2.23	1.22	0.70
15	14.7	2.0	-0.07	-0.04
16	16.68	3.34	1.27	0.52
17	14	3	-0.54	-0.24
18	18	3.6	2.16	0.84
19	15.68	NR	0.59	0.68
20	12	3	-1.89	-0.86
21	14.2	0.73	-0.41	-0.40
22	12	1.2	-1.89	-1.58
23	NT	NT		
24	NT	NT		
25	15	2.3	0.14	0.08
26	NT	NT		
27	12	2	-1.89	-1.17
28	NT	NT		
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value	14.8	1.3
Spike	15.0	0.3
Homogeneity Value	15.1	1.8
Robust Average	14.8	1.3
Median	15.0	1.0
Mean	14.8	
N	20	
Max.	18	
Min.	10	
Robust SD	2.4	
Robust CV	16%	


Kernel Density
Density
Result
Results: S1 - Se
Assigned Value = 14.8 ± 1.3 mg/kg
Results (mg/kg)
Laboratory
8 20 22 27 4 17 2 21 15 11 25 19 3 7 1 14 16 13 12 18 5 6 10 23 24 26 28 29 30 9 Md R.A. H.V. S.V.


z-Scores: S1 - Se
Target Standard Deviation 1.5 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
8 20 22 27 4 17 2 21 15 11 25 19 3 7 1 14 16 13 12 18
-3.2 -1.9 -1.9 -1.9 -1.9 -0.5 -0.5 -0.4 -0.1 0.1 0.1 0.6 0.8 1.0 1.1 1.2 1.3 1.6 2.2 2.2

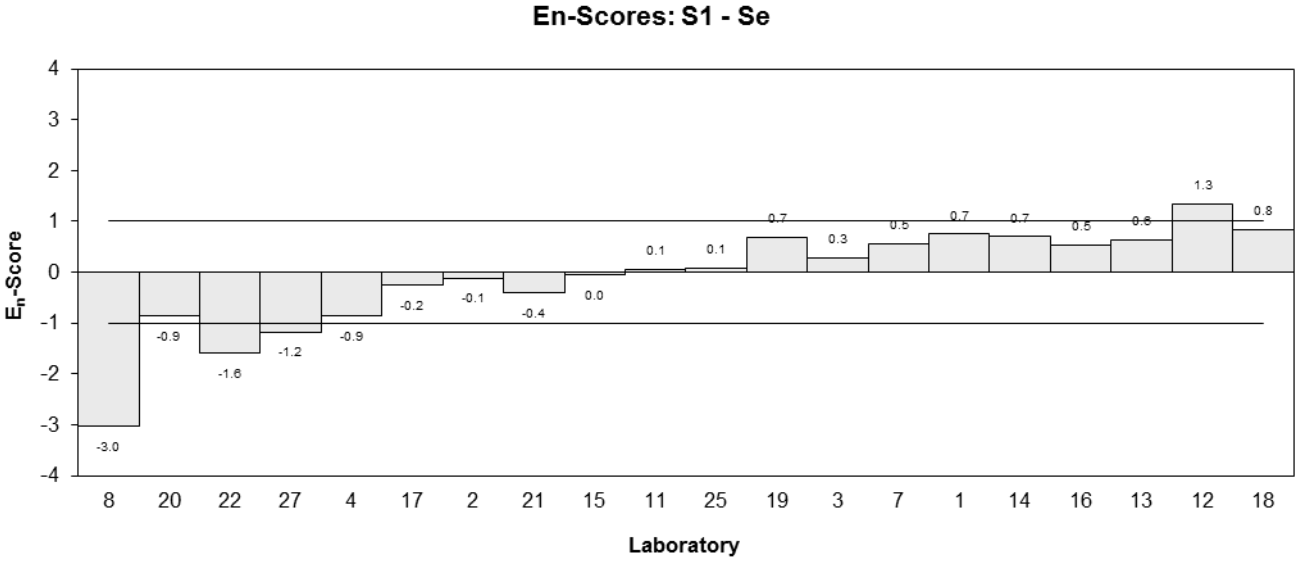

En-Scores: S1 - Se
En-Score
Laboratory
8 20 22 27 4 17 2 21 15 11 25 19 3 7 1 14 16 13 12 18
-3.0 -0.9 -1.6 -1.2 -0.9 -0.2 -0.1 -0.4 0.0 0.1 0.1 0.7 0.3 0.5 0.7 0.7 0.5 0.6 1.3 0.8

Figure 14

Table 26

Sample Details

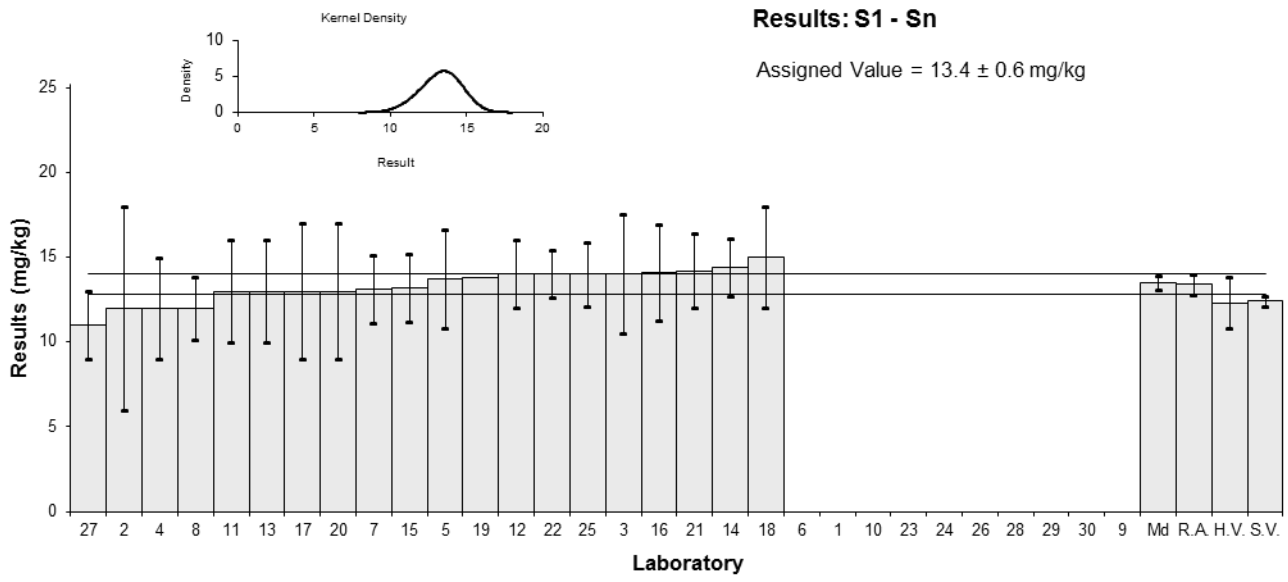
Sample No.	S1
Matrix.	Soil
Analyte.	Sn
Units	mg/kg

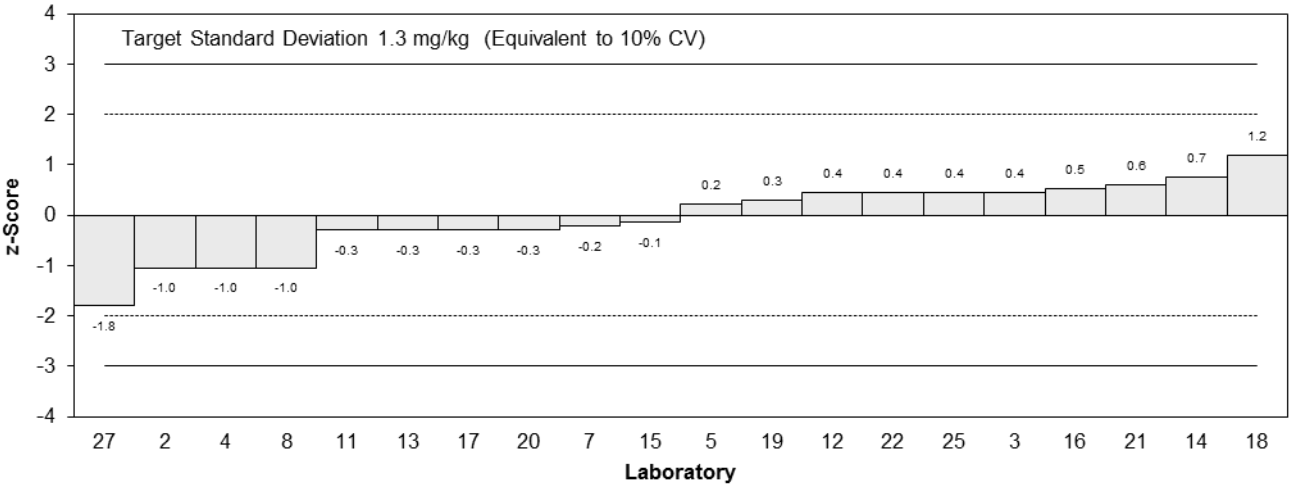
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	12	6	-1.04	-0.23
3	14	3.5	0.45	0.17
4	12	3	-1.04	-0.46
5	13.7	2.9	0.22	0.10
6	NR	NR		
7	13.1	2.0	-0.22	-0.14
8	12.0	1.87	-1.04	-0.71
9	NT	NT		
10	NT	NT		
11	13	3	-0.30	-0.13
12	14	2	0.45	0.29
13	13.0	3.0	-0.30	-0.13
14	14.4	1.70	0.75	0.55
15	13.2	2.0	-0.15	-0.10
16	14.10	2.82	0.52	0.24
17	13	4	-0.30	-0.10
18	15	3	1.19	0.52
19	13.80	NR	0.30	0.67
20	13	4	-0.30	-0.10
21	14.2	2.19	0.60	0.35
22	14	1.4	0.45	0.39
23	NT	NT		
24	NT	NT		
25	14	1.9	0.45	0.30
26	NT	NT		
27	11	2	-1.79	-1.15
28	NT	NT		
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value	13.4	0.6
Spike	12.4	0.3
Homogeneity Value	12.3	1.5
Robust Average	13.4	0.6
Median	13.5	0.4
Mean	13.3	
N	20	
Max.	15	
Min.	11	
Robust SD	1.0	
Robust CV	7.5%	


Kernel Density
Density
Result
Results: S1 - Sn
Assigned Value = 13.4 ± 0.6 mg/kg
Results (mg/kg)
Laboratory
27 2 4 8 11 13 17 20 7 15 5 19 12 22 25 3 16 21 14 18 6 1 10 23 24 26 28 29 30 9 Md R.A. H.V. S.V.


z-Scores: S1 - Sn
Target Standard Deviation 1.3 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
27 2 4 8 11 13 17 20 7 15 5 19 12 22 25 3 16 21 14 18
-1.8 -1.0 -1.0 -1.0 -0.3 -0.3 -0.3 -0.3 -0.2 -0.1 0.2 0.3 0.4 0.4 0.4 0.4 0.5 0.6 0.7 1.2

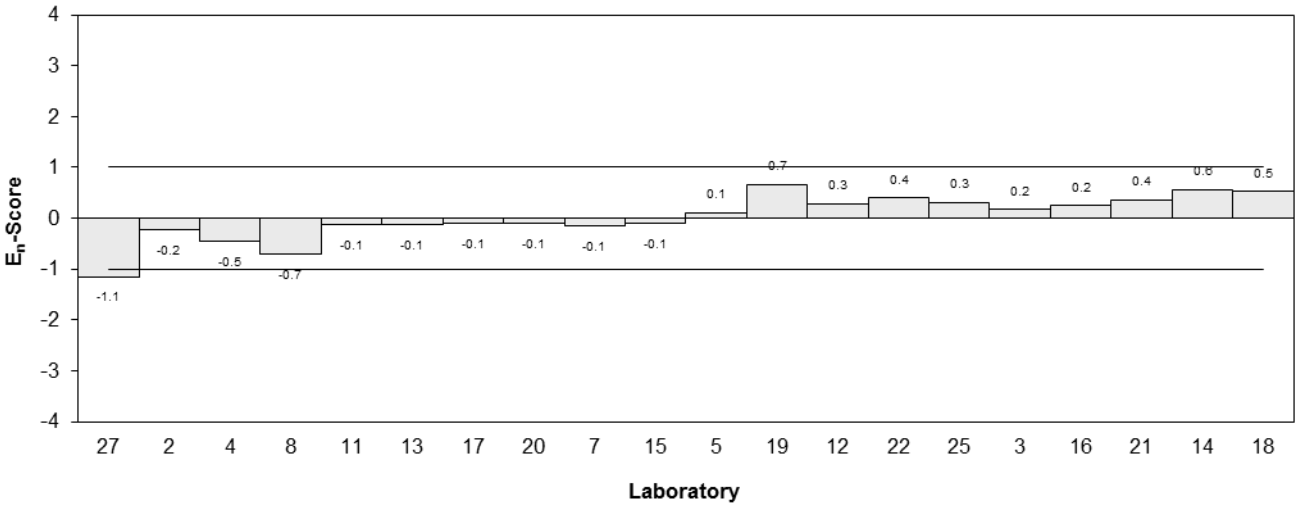

En-Scores: S1 - Sn
En-Score
Laboratory
27 2 4 8 11 13 17 20 7 15 5 19 12 22 25 3 16 21 14 18
-1.1 -0.2 -0.5 -0.7 -0.1 -0.1 -0.1 -0.1 -0.1 -0.1 0.1 0.7 0.3 0.4 0.3 0.2 0.2 0.4 0.6 0.5

Figure 15

Table 27

Sample Details

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

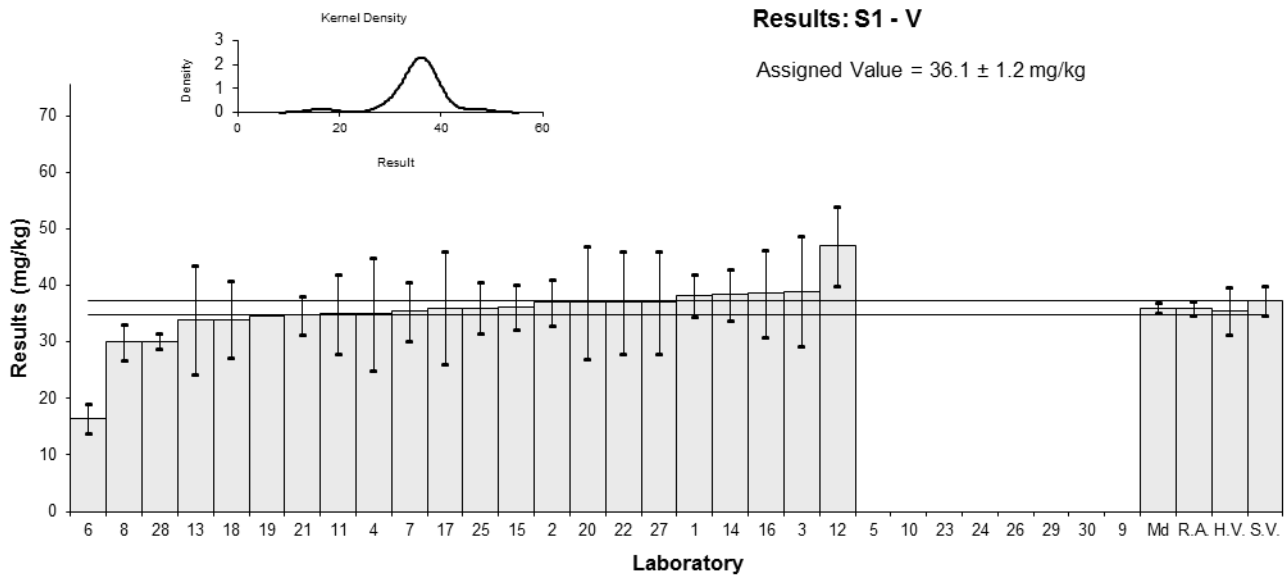
Participant Results

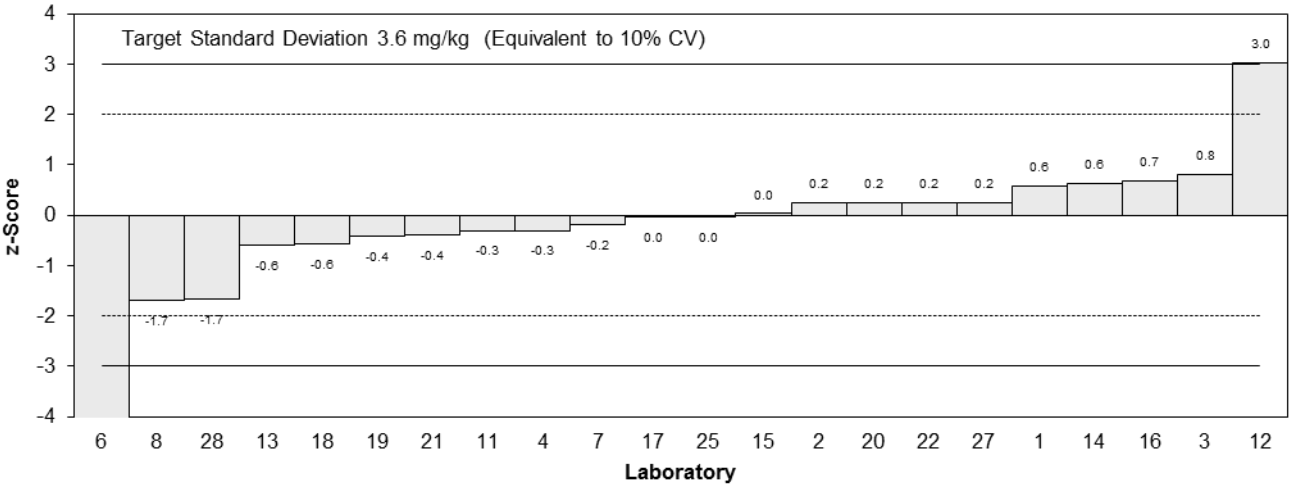
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	38.2	3.8	0.58	0.53
2	37	4.1	0.25	0.21
3	39	9.8	0.80	0.29
4	35	10	-0.30	-0.11
5	<100	67		
6	16.5	2.60	-5.43	-6.84
7	35.4	5.3	-0.19	-0.13
8	30	3.2	-1.69	-1.78
9	NT	NT		
10	NT	NT		
11	35	7	-0.30	-0.15
12	47	7	3.02	1.53
13	33.9	9.6	-0.61	-0.23
14	38.4	4.53	0.64	0.49
15	36.2	4.0	0.03	0.02
16	38.59	7.72	0.69	0.32
17	36	10	-0.03	-0.01
18	34	6.8	-0.58	-0.30
19	34.58	NR	-0.42	-1.27
20	37	10	0.25	0.09
21	34.7	3.38	-0.39	-0.39
22	37	9	0.25	0.10
23	NT	NT		
24	NT	NT		
25	36	4.5	-0.03	-0.02
26	NT	NT		
27	37	9	0.25	0.10
28	30.100	1.364	-1.66	-3.30
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value*	36.1	1.2
Spike	37.3	2.6
Homogeneity Value	35.5	4.3
Robust Average	35.9	1.3
Median	36.0	0.9
Mean	35.3	
N	22	
Max.	47	
Min.	16.5	
Robust SD	2.5	
Robust CV	7%	

*Robust Average excluding Laboratory 6


Kernel Density
Density
Result
Results: S1 - V
Assigned Value = 36.1 ± 1.2 mg/kg
Results (mg/kg)
Laboratory
6 8 28 13 18 19 21 11 4 7 17 25 15 2 20 22 27 1 14 16 3 12 5 10 23 24 26 29 30 9 Md R.A. H.V. S.V.


z-Scores: S1 - V
Target Standard Deviation 3.6 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
6 8 28 13 18 19 21 11 4 7 17 25 15 2 20 22 27 1 14 16 3 12
3.0
0.8
0.7
0.6
0.6
0.6
0.2
0.2
0.2
0.2
0.2
0.0
0.0
0.0
-0.2
-0.3
-0.3
-0.4
-0.4
-0.6
-0.6
-1.7
-1.7

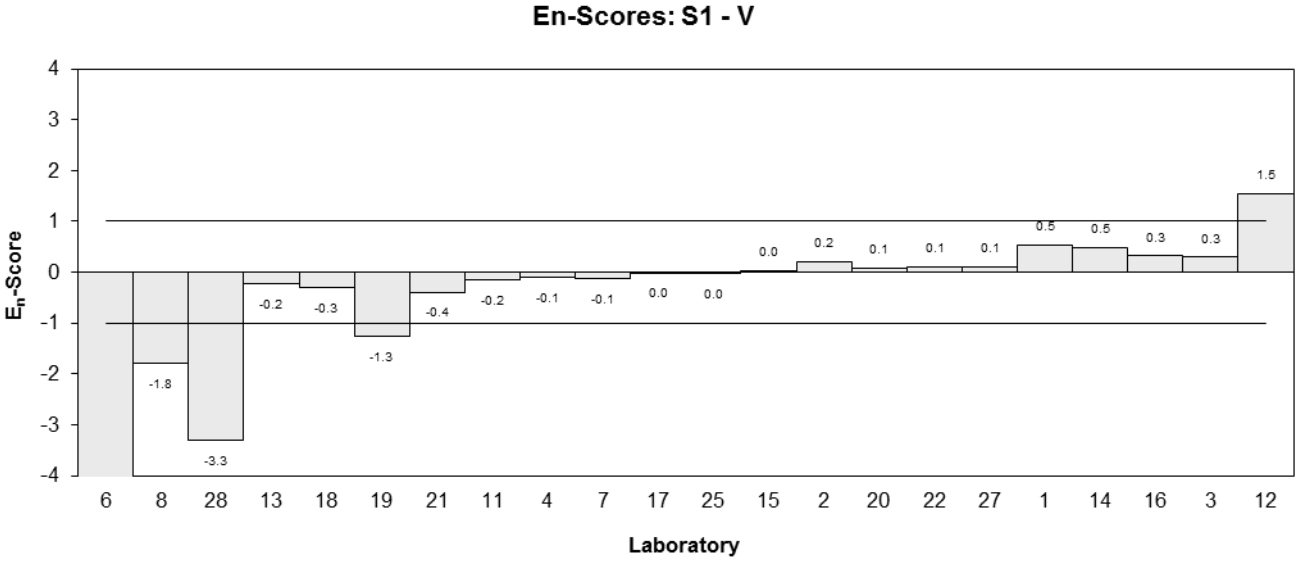

En-Scores: S1 - V
En-Score
Laboratory
6 8 28 13 18 19 21 11 4 7 17 25 15 2 20 22 27 1 14 16 3 12
1.5
0.5
0.5
0.3
0.3
0.2
0.1
0.1
0.1
0.0
0.0
0.0
-0.1
-0.1
-0.2
-0.4
-0.2
-0.3
-1.3
-1.8
-3.3

Figure 16

Table 28

Sample Details

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

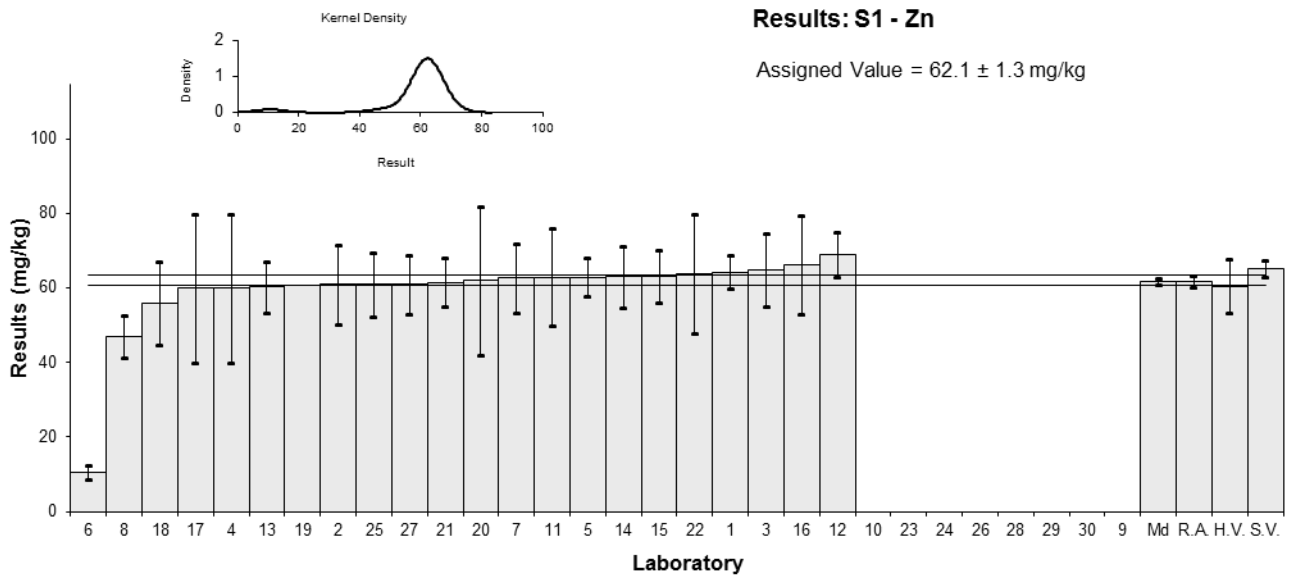
Participant Results

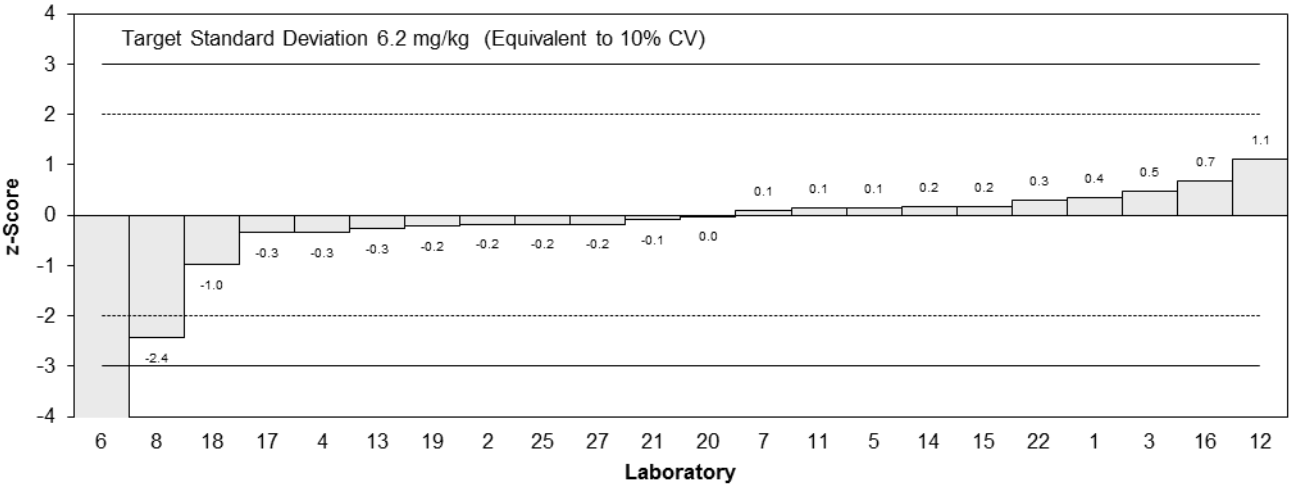
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	64.3	4.5	0.35	0.47
2	61	10.7	-0.18	-0.10
3	65	9.8	0.47	0.29
4	60	20	-0.34	-0.10
5	63.0	5.2	0.14	0.17
6	10.6	1.85	-8.29	-22.78
7	62.7	9.4	0.10	0.06
8	47.0	5.76	-2.43	-2.56
9	NT	NT		
10	NT	NT		
11	63	13	0.14	0.07
12	69	6	1.11	1.12
13	60.4	6.9	-0.27	-0.24
14	63.1	8.27	0.16	0.12
15	63.1	7.0	0.16	0.14
16	66.29	13.26	0.67	0.31
17	60	20	-0.34	-0.10
18	56	11.2	-0.98	-0.54
19	60.71	NR	-0.22	-1.07
20	62	20	-0.02	0.00
21	61.5	6.56	-0.10	-0.09
22	64	16	0.31	0.12
23	NT	NT		
24	NT	NT		
25	61	8.7	-0.18	-0.13
26	NT	NT		
27	61	8	-0.18	-0.14
28	NT	NT		
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value*	62.1	1.3
Spike	65.3	2.2
Homogeneity Value	60.6	7.3
Robust Average	61.9	1.5
Median	61.8	0.9
Mean	59.3	
N	22	
Max.	69	
Min.	10.6	
Robust SD	2.8	
Robust CV	4.5%	

*Robust Average excluding Laboratory 6


Kernel Density
Density
Result
Results: S1 - Zn
Assigned Value = 62.1 ± 1.3 mg/kg
Results (mg/kg)
Laboratory
6 8 18 17 4 13 19 2 25 27 21 20 7 11 5 14 15 22 1 3 16 12 10 23 24 26 28 29 30 9 Md R.A. H.V. S.V.


z-Scores: S1 - Zn
Target Standard Deviation 6.2 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
6 8 18 17 4 13 19 2 25 27 21 20 7 11 5 14 15 22 1 3 16 12

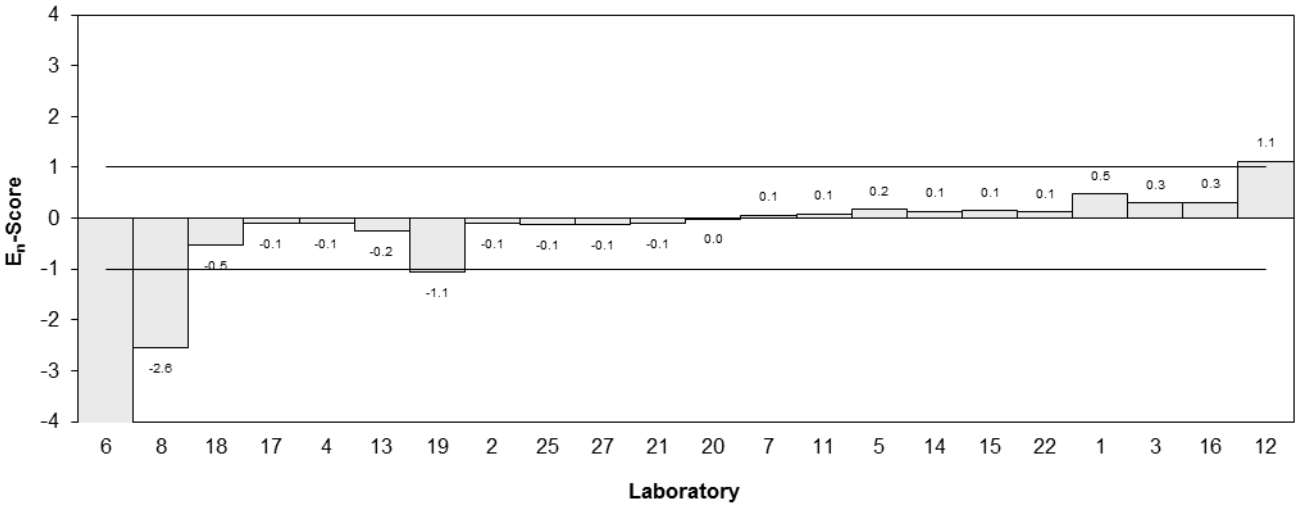

En-Scores: S1 - Zn
En-Score
Laboratory
6 8 18 17 4 13 19 2 25 27 21 20 7 11 5 14 15 22 1 3 16 12

Figure 17

Table 29

Sample Details

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

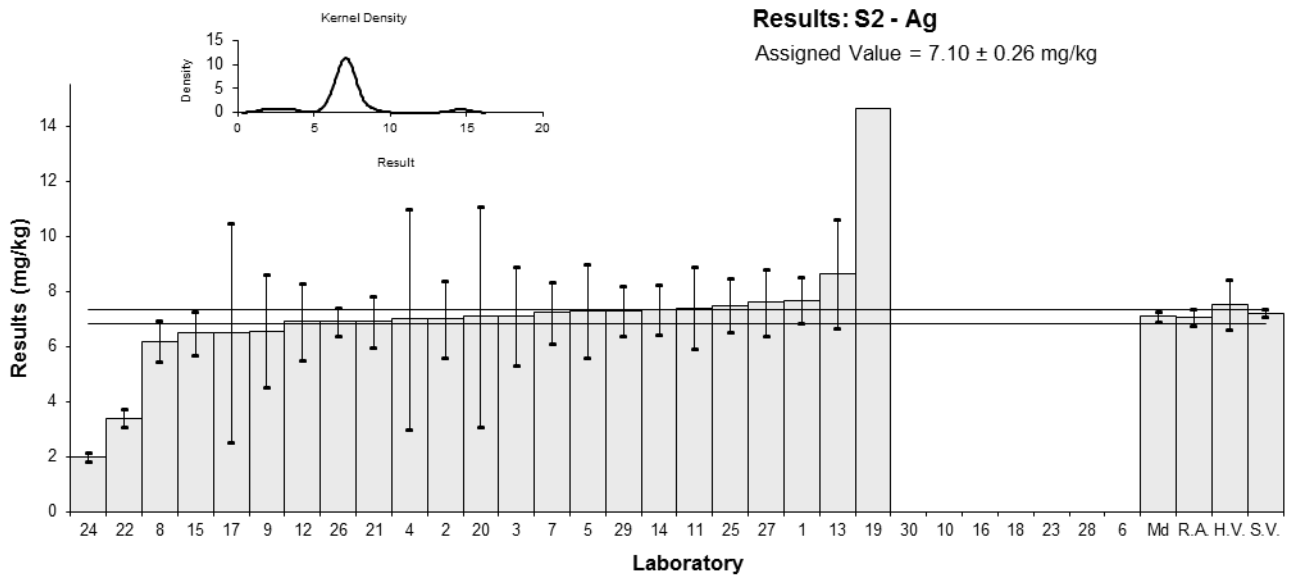
Participant Results

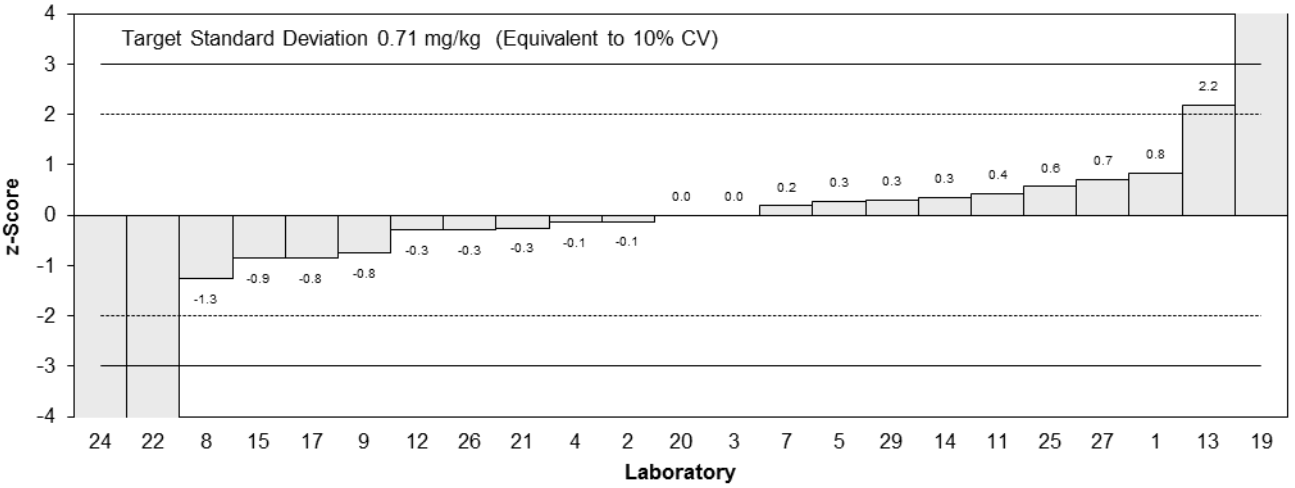
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	7.69	0.85	0.83	0.66
2	7.01	1.4	-0.13	-0.06
3	7.1	1.8	0.00	0.00
4	7.0	4	-0.14	-0.02
5	7.3	1.7	0.28	0.12
6	NT	NT		
7	7.23	1.1	0.18	0.12
8	6.2	0.73	-1.27	-1.16
9	6.56	2.06	-0.76	-0.26
10	NT	NT		
11	7.4	1.5	0.42	0.20
12	6.9	1.4	-0.28	-0.14
13	8.65	2.0	2.18	0.77
14	7.34	0.891	0.34	0.26
15	6.49	0.8	-0.86	-0.73
16	NT	NT		
17	6.5	4	-0.85	-0.15
18	NT	NT		
19	14.64	NR	10.62	29.00
20	7.1	4	0.00	0.00
21	6.92	0.93	-0.25	-0.19
22	3.4	0.34	-5.21	-8.64
23	NT	NT		
24	1.97	0.16	-7.23	-16.80
25	7.5	0.98	0.56	0.39
26	6.9	0.5	-0.28	-0.35
27	7.6	1.2	0.70	0.41
28	NT	NT		
29	7.31	0.914	0.30	0.22
30	NR	NR		

Statistics

Assigned Value*	7.10	0.26
Spike	7.22	0.15
Homogeneity Value	7.53	0.90
Robust Average	7.06	0.31
Median	7.10	0.19
Mean	7.07	
N	23	
Max.	14.64	
Min.	1.97	
Robust SD	0.60	
Robust CV	8.5%	

*Robust Average excluding Laboratories 19, 22 and 24


Kernel Density
Density
Result
Results: S2 - Ag
Assigned Value = 7.10 ± 0.26 mg/kg
Results (mg/kg)
Laboratory
24 22 8 15 17 9 12 26 21 4 2 20 3 7 5 29 14 11 25 27 1 13 19 30 10 16 18 23 28 6 Md R.A. H.V. S.V.


z-Scores: S2 - Ag
Target Standard Deviation 0.71 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
24 22 8 15 17 9 12 26 21 4 2 20 3 7 5 29 14 11 25 27 1 13 19

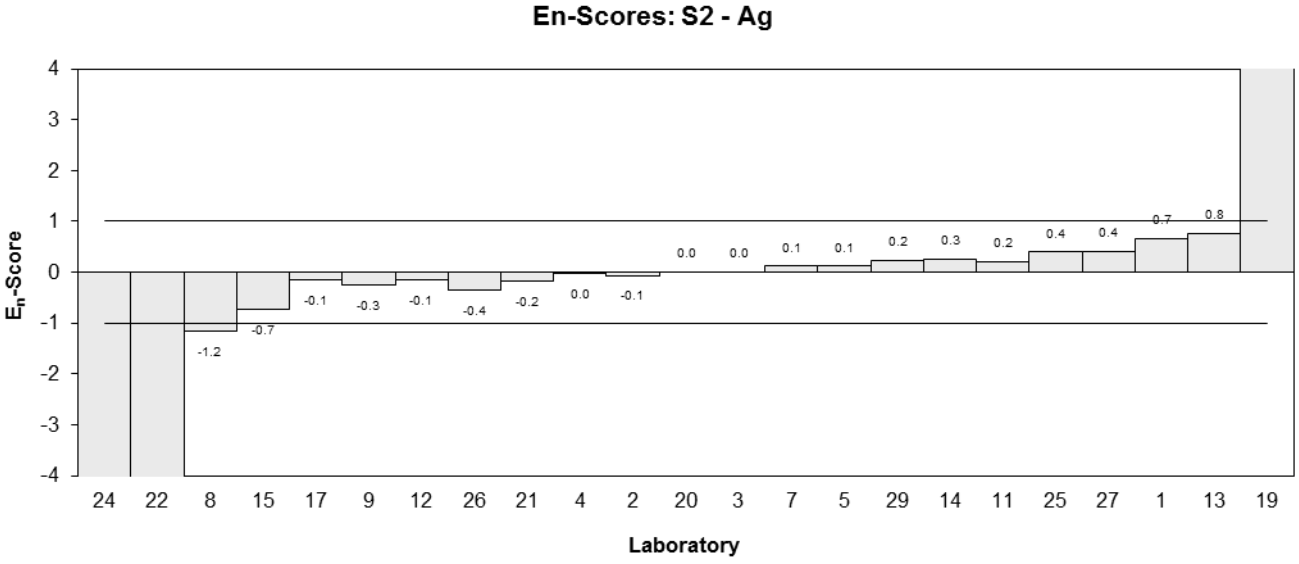

En-Scores: S2 - Ag
En-Score
Laboratory
24 22 8 15 17 9 12 26 21 4 2 20 3 7 5 29 14 11 25 27 1 13 19

Figure 18

Table 30

Sample Details

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

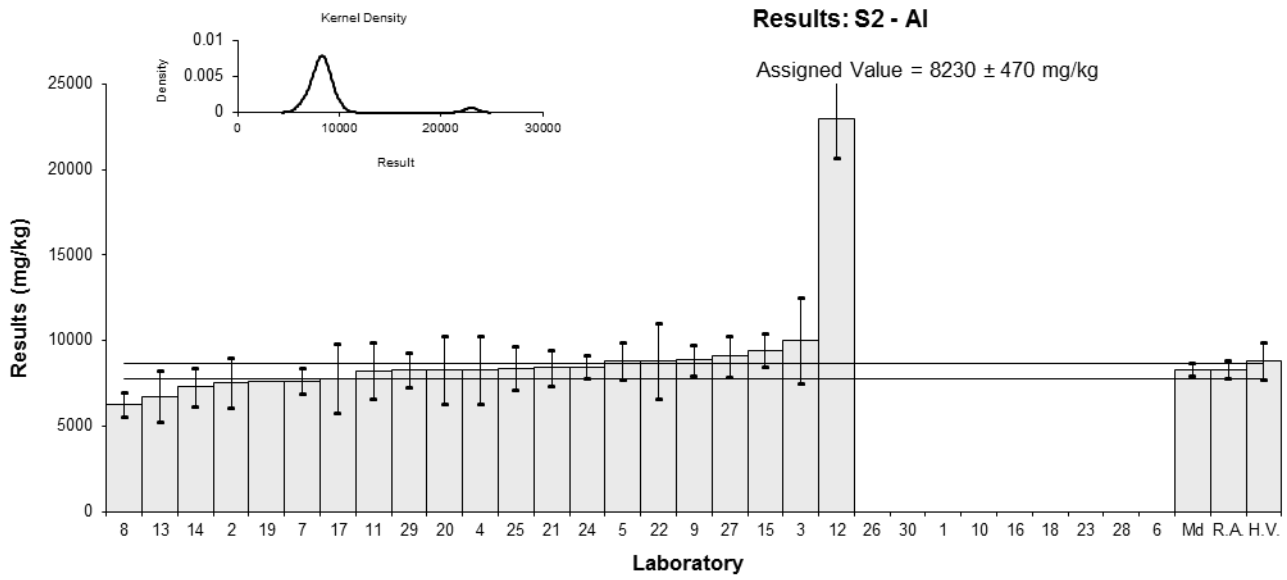
Participant Results

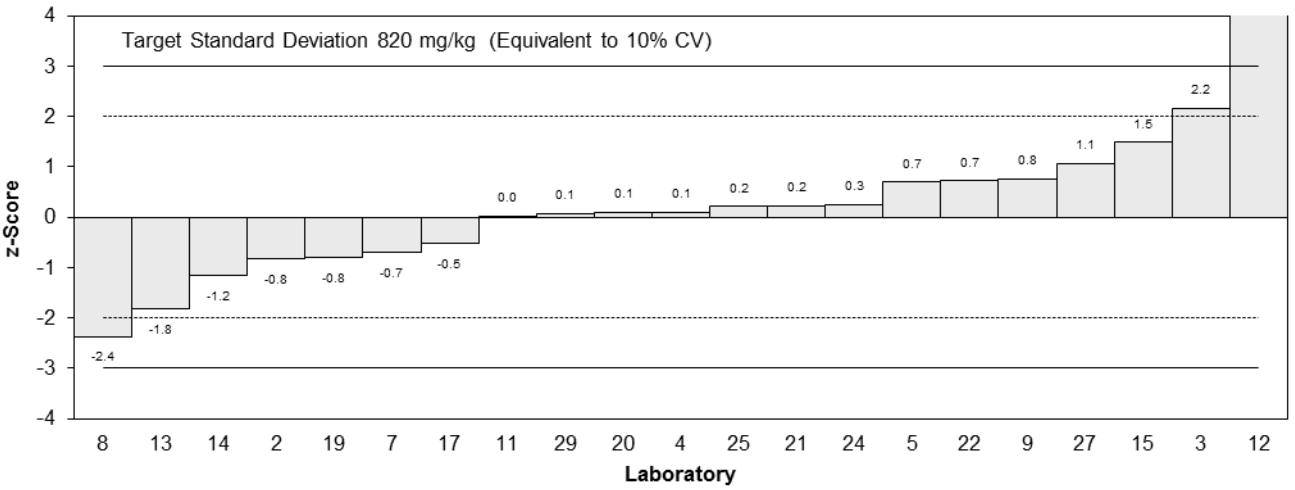
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	7543.04	1486	-0.83	-0.44
3	10000	2500	2.15	0.70
4	8300	2000	0.09	0.03
5	8800	1100	0.69	0.48
6	NT	NT		
7	7648	765	-0.71	-0.65
8	6280	723.3	-2.37	-2.26
9	8856	930	0.76	0.60
10	NT	NT		
11	8250	1650	0.02	0.01
12	23000	2300	17.95	6.29
13	6730	1500	-1.82	-0.95
14	7280	1100	-1.15	-0.79
15	9450	950	1.48	1.15
16	NT	NT		
17	7800	2000	-0.52	-0.21
18	NT	NT		
19	7577.1	NR	-0.79	-1.39
20	8300	2000	0.09	0.03
21	8410	1052	0.22	0.16
22	8820	2200	0.72	0.26
23	NT	NT		
24	8440	675	0.26	0.26
25	8400	1289	0.21	0.12
26	NR	NR		
27	9100	1200	1.06	0.68
28	NT	NT		
29	8280	1037	0.06	0.04
30	NR	NR		

Statistics

Assigned Value*	8230	470
Spike	Not Spiked	
Homogeneity Value	8830	1100
Robust Average	8310	510
Median	8300	380
Mean	8917	
N	21	
Max.	23000	
Min.	6280	
Robust SD	928	
Robust CV	11%	

*Robust Average excluding Laboratory 12


Kernel Density
Density
Result
Results: S2 - Al
Assigned Value = 8230 ± 470 mg/kg
Results (mg/kg)
Laboratory
8 13 14 2 19 7 17 11 29 20 4 25 21 24 5 22 9 27 15 3 12 26 30 1 10 16 18 23 28 6 Md R.A. H.V.


z-Scores: S2 - Al
Target Standard Deviation 820 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
8 13 14 2 19 7 17 11 29 20 4 25 21 24 5 22 9 27 15 3 12

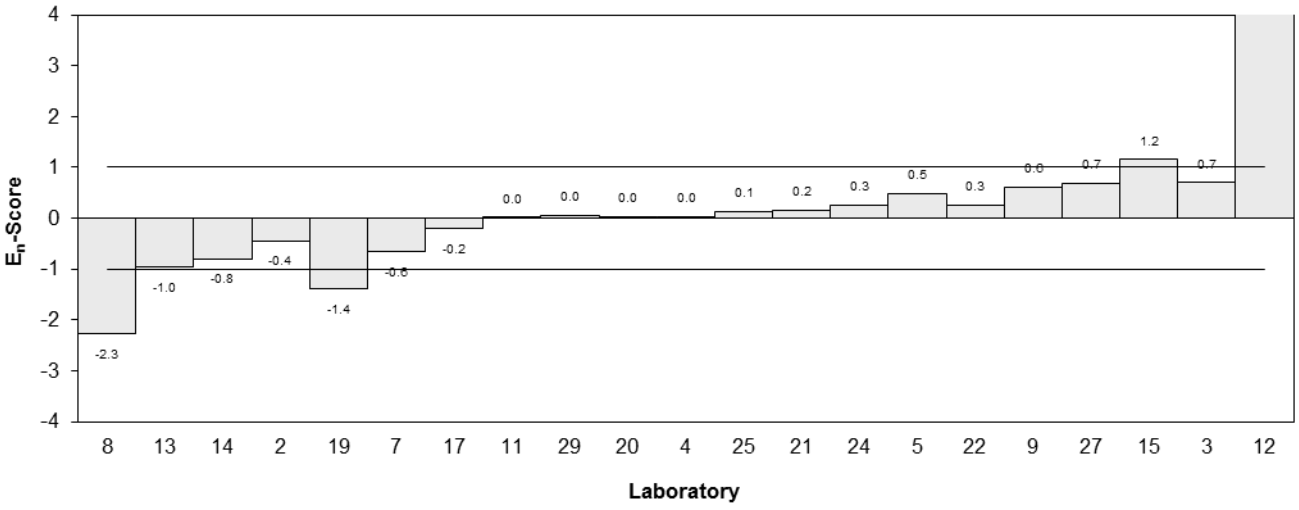

En-Scores: S2 - Al
En-Score
Laboratory
8 13 14 2 19 7 17 11 29 20 4 25 21 24 5 22 9 27 15 3 12

Figure 19

Table 31

Sample Details

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

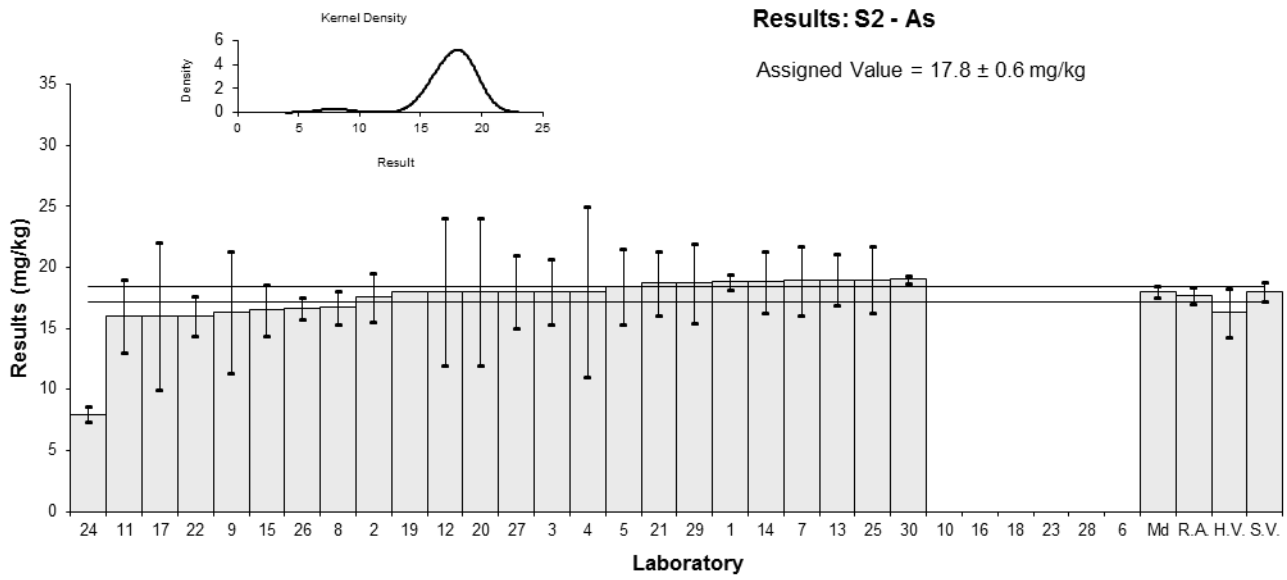
Participant Results

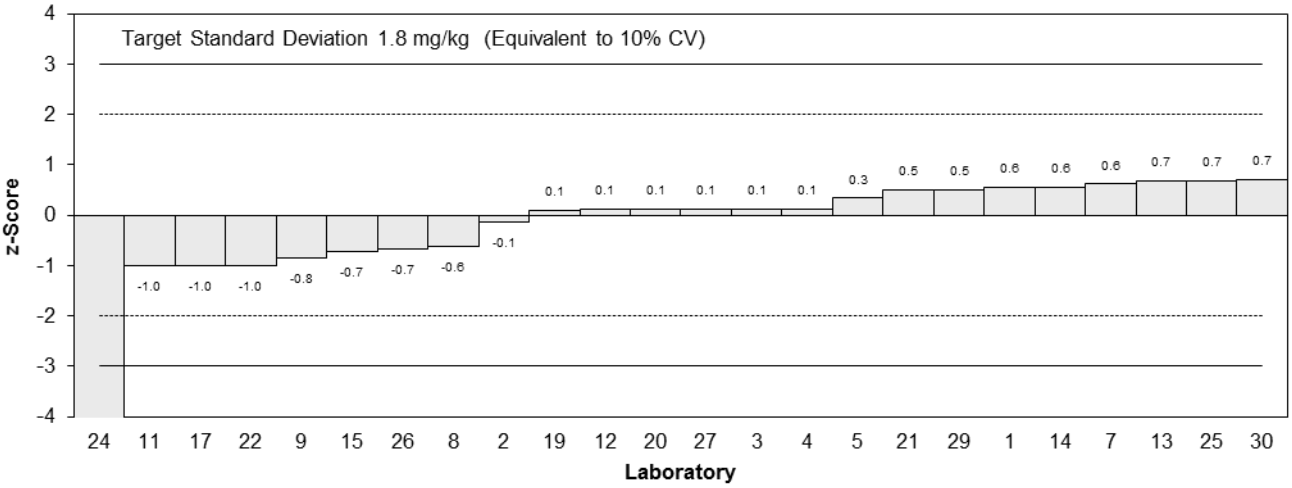
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	18.8	0.6	0.56	1.18
2	17.54	2	-0.15	-0.12
3	18	2.7	0.11	0.07
4	18	7	0.11	0.03
5	18.4	3.1	0.34	0.19
6	NT	NT		
7	18.9	2.8	0.62	0.38
8	16.7	1.40	-0.62	-0.72
9	16.3	5.0	-0.84	-0.30
10	NT	NT		
11	16	3	-1.01	-0.59
12	18	6	0.11	0.03
13	19.0	2.1	0.67	0.55
14	18.8	2.51	0.56	0.39
15	16.5	2.1	-0.73	-0.60
16	NT	NT		
17	16	6	-1.01	-0.30
18	NT	NT		
19	17.96	NR	0.09	0.27
20	18	6	0.11	0.03
21	18.7	2.6	0.51	0.34
22	16	1.6	-1.01	-1.05
23	NT	NT		
24	7.96	0.64	-5.53	-11.22
25	19	2.7	0.67	0.43
26	16.6	0.9	-0.67	-1.11
27	18	3	0.11	0.07
28	NT	NT		
29	18.7	3.29	0.51	0.27
30	19.04	0.30	0.70	1.85

Statistics

Assigned Value*	17.8	0.6
Spike	18.0	0.8
Homogeneity Value	16.3	2.0
Robust Average	17.7	0.7
Median	18.0	0.5
Mean	17.4	
N	24	
Max.	19.04	
Min.	7.96	
Robust SD	1.3	
Robust CV	7.3%	

*Robust Average excluding Laboratory 24


Kernel Density
Density
Result
Results: S2 - As
Assigned Value = 17.8 ± 0.6 mg/kg
Results (mg/kg)
Laboratory
24 11 17 22 9 15 26 8 2 19 12 20 27 3 4 5 21 29 1 14 7 13 25 30 10 16 18 23 28 6 Md R.A. H.V. S.V.


z-Scores: S2 - As
Target Standard Deviation 1.8 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
24 11 17 22 9 15 26 8 2 19 12 20 27 3 4 5 21 29 1 14 7 13 25 30

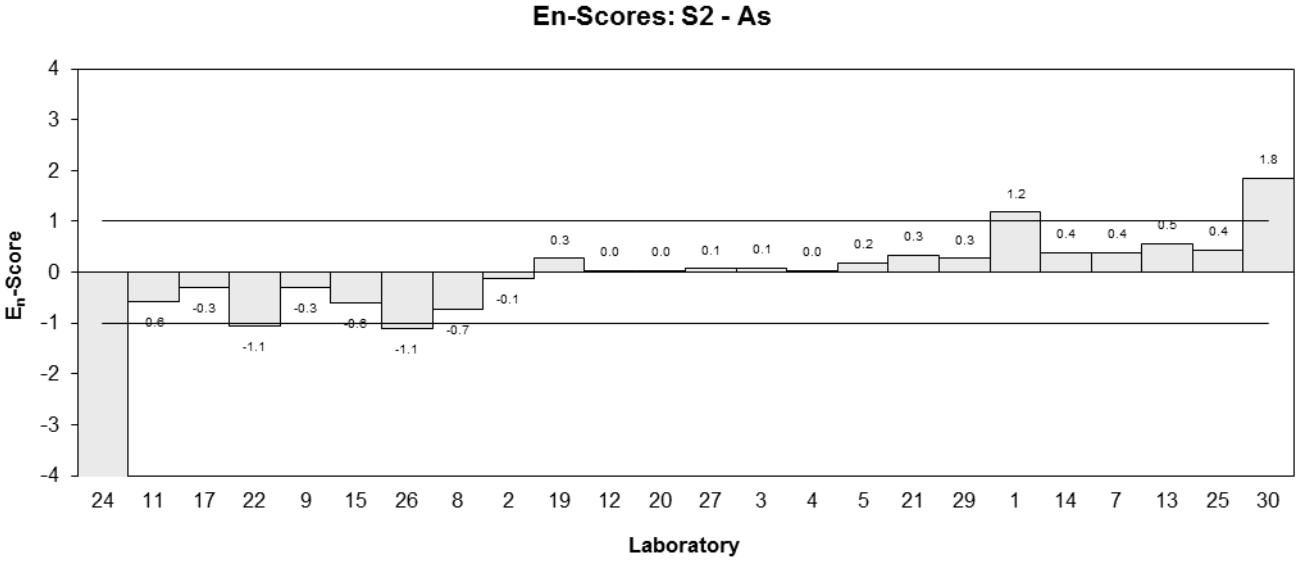

En-Scores: S2 - As
En-Score
Laboratory
24 11 17 22 9 15 26 8 2 19 12 20 27 3 4 5 21 29 1 14 7 13 25 30

Figure 20

Table 32

Sample Details

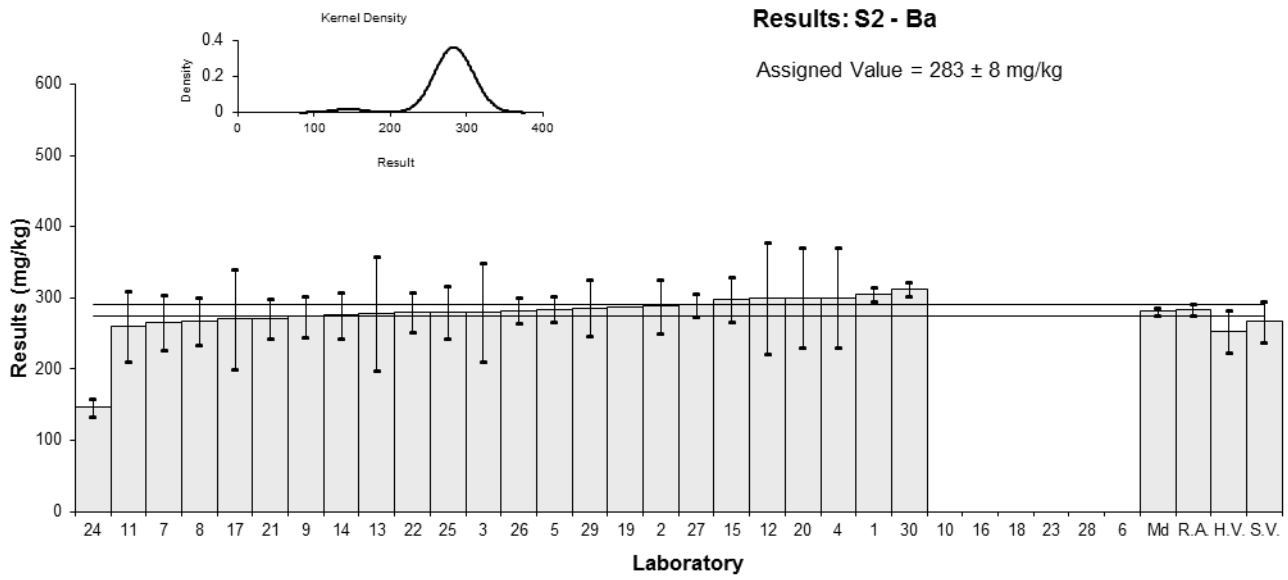
Sample No.	S2
Matrix.	Soil
Analyte.	Ba
Units	mg/kg

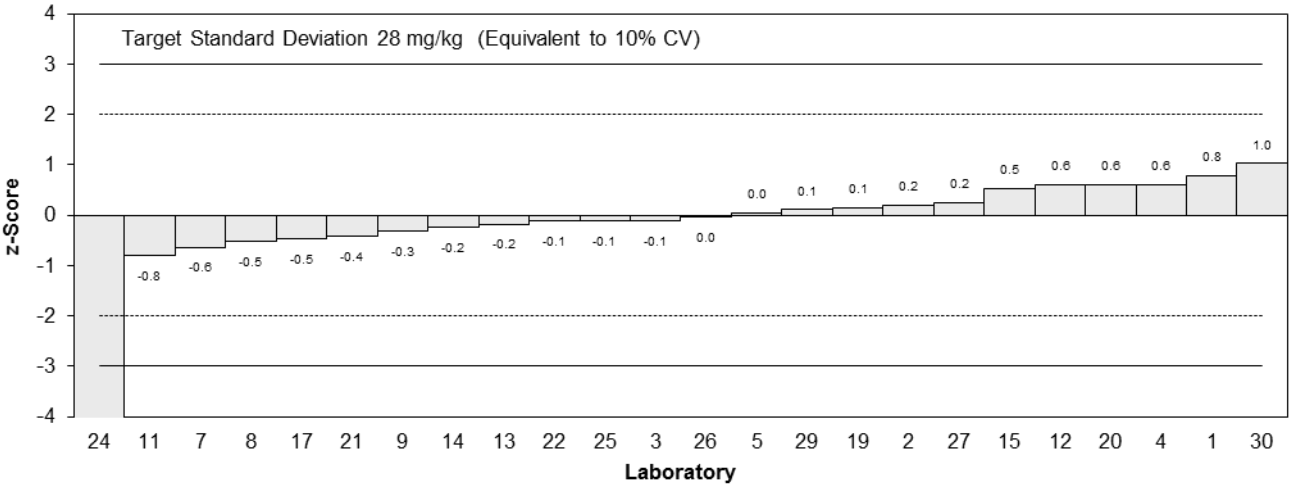
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	305	9.9	0.78	1.73
2	288.71	37.8	0.20	0.15
3	280	70	-0.11	-0.04
4	300	70	0.60	0.24
5	284	18	0.04	0.05
6	NT	NT		
7	265	39	-0.64	-0.45
8	268	33.3	-0.53	-0.44
9	274	29	-0.32	-0.30
10	NT	NT		
11	260	50	-0.81	-0.45
12	300	78	0.60	0.22
13	278	80	-0.18	-0.06
14	276	32.6	-0.25	-0.21
15	298	32	0.53	0.45
16	NT	NT		
17	270	70	-0.46	-0.18
18	NT	NT		
19	287.11	NR	0.15	0.51
20	300	70	0.60	0.24
21	271	27.6	-0.42	-0.42
22	280	28	-0.11	-0.10
23	NT	NT		
24	146	12	-4.84	-9.50
25	280	37	-0.11	-0.08
26	282	18	-0.04	-0.05
27	290	16	0.25	0.39
28	NT	NT		
29	286	39.5	0.11	0.07
30	312	10.24	1.02	2.23

Statistics

Assigned Value	283	8
Spike	267	29
Homogeneity Value	253	30
Robust Average	283	8
Median	281	6
Mean	278	
N	24	
Max.	312	
Min.	146	
Robust SD	16	
Robust CV	5.7%	


Kernel Density
Density
Result
Results: S2 - Ba
Assigned Value = 283 ± 8 mg/kg
Results (mg/kg)
Laboratory
24 11 7 8 17 21 9 14 13 22 25 3 26 5 29 19 2 27 15 12 20 4 1 30 10 16 18 23 28 6 Md R.A. H.V. S.V.


z-Scores: S2 - Ba
Target Standard Deviation 28 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
24 11 7 8 17 21 9 14 13 22 25 3 26 5 29 19 2 27 15 12 20 4 1 30
-0.8 -0.6 -0.5 -0.5 -0.4 -0.3 -0.2 -0.2 -0.1 -0.1 -0.1 0.0 0.0 0.1 0.1 0.2 0.2 0.5 0.6 0.6 0.6 0.8 1.0

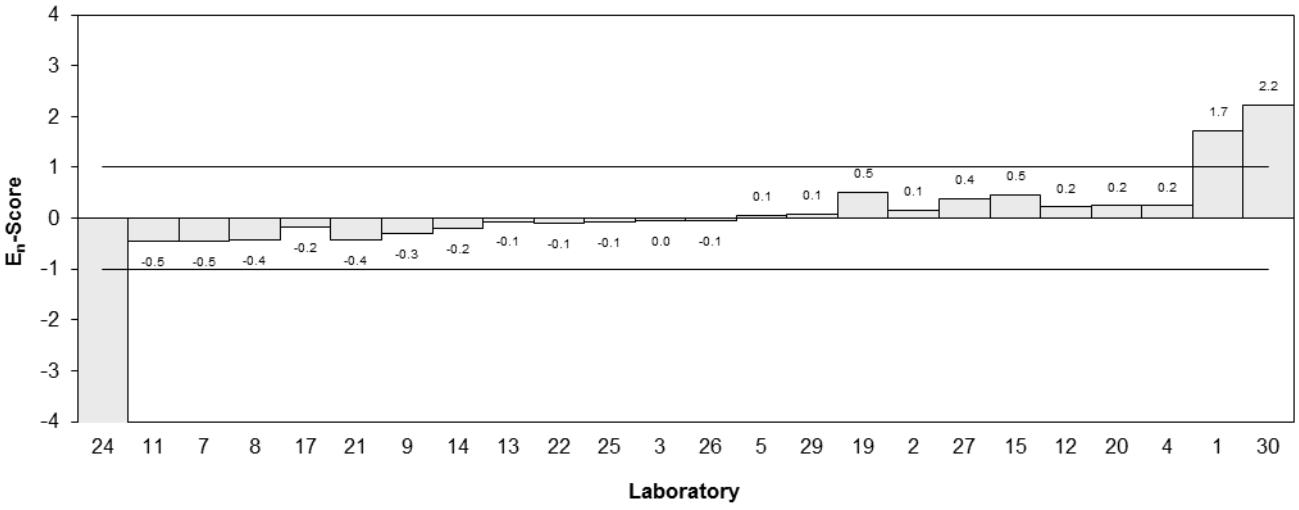

En-Scores: S2 - Ba
En-Score
Laboratory
24 11 7 8 17 21 9 14 13 22 25 3 26 5 29 19 2 27 15 12 20 4 1 30
-0.5 -0.5 -0.4 -0.2 -0.4 -0.3 -0.2 -0.1 -0.1 -0.1 0.0 -0.1 0.1 0.1 0.5 0.1 0.4 0.5 0.2 0.2 0.2 1.7 2.2

Figure 21

Table 33

Sample Details

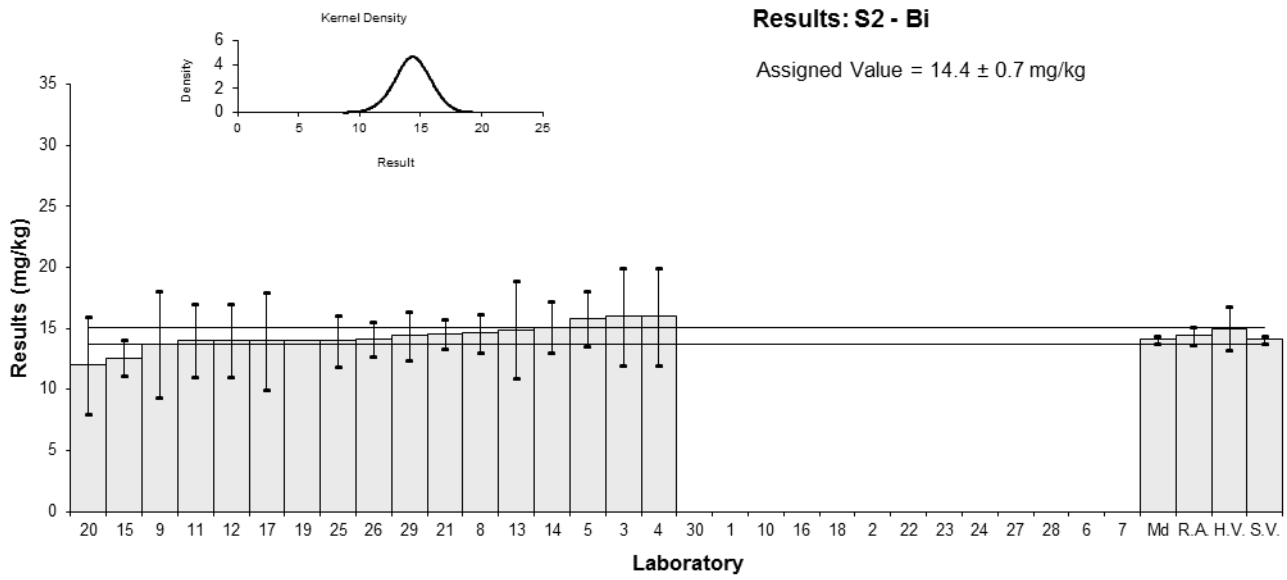
Sample No.	S2
Matrix.	Soil
Analyte.	Bi
Units	mg/kg

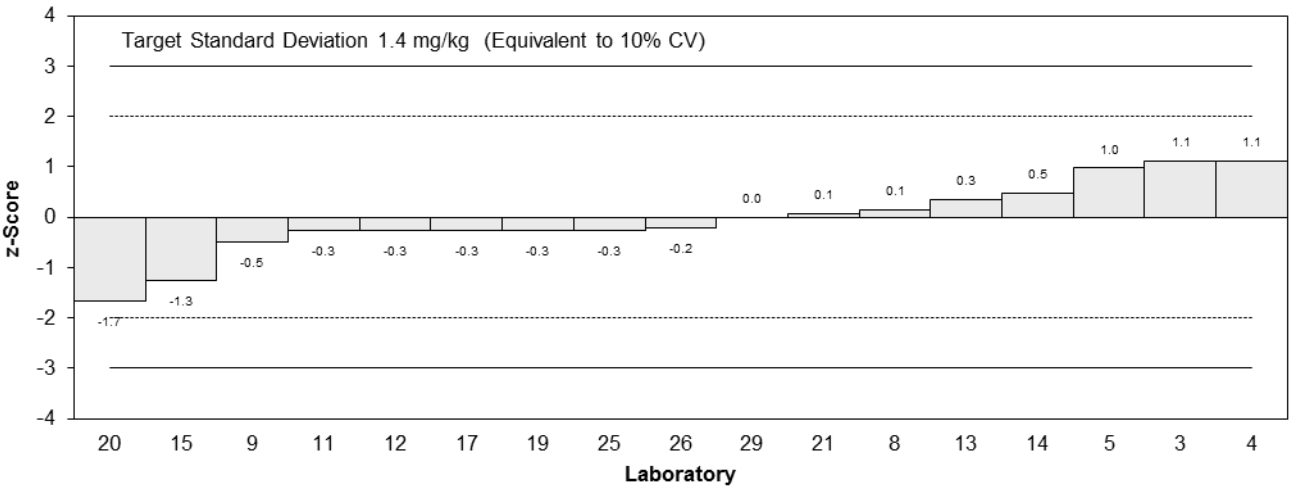
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	NT	NT		
3	16	4	1.11	0.39
4	16	4	1.11	0.39
5	15.8	2.3	0.97	0.58
6	NT	NT		
7	NT	NT		
8	14.6	1.55	0.14	0.12
9	13.7	4.4	-0.49	-0.16
10	NT	NT		
11	14	3	-0.28	-0.13
12	14	3	-0.28	-0.13
13	14.9	4.0	0.35	0.12
14	15.1	2.13	0.49	0.31
15	12.6	1.5	-1.25	-1.09
16	NT	NT		
17	14	4	-0.28	-0.10
18	NT	NT		
19	14	NR	-0.28	-0.57
20	12	4	-1.67	-0.59
21	14.5	1.2	0.07	0.07
22	NT	NT		
23	NT	NT		
24	NT	NT		
25	14	2.1	-0.28	-0.18
26	14.1	1.4	-0.21	-0.19
27	NT	NT		
28	NT	NT		
29	14.4	1.97	0.00	0.00
30	NR	NR		

Statistics

Assigned Value	14.4	0.7
Spike	14.1	0.3
Homogeneity Value	15.0	1.8
Robust Average	14.4	0.7
Median	14.1	0.3
Mean	14.3	
N	17	
Max.	16	
Min.	12	
Robust SD	1.1	
Robust CV	7.6%	


Kernel Density
Density
Result
Results: S2 - Bi
Assigned Value = 14.4 ± 0.7 mg/kg
Results (mg/kg)
Laboratory
20 15 9 11 12 17 19 25 26 29 21 8 13 14 5 3 4 30 1 10 16 18 2 22 23 24 27 28 6 7 Md R.A. H.V. S.V.


z-Scores: S2 - Bi
Target Standard Deviation 1.4 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
20 15 9 11 12 17 19 25 26 29 21 8 13 14 5 3 4
-1.7 -1.3 -0.5 -0.3 -0.3 -0.3 -0.3 -0.3 -0.2 0.0 0.1 0.1 0.3 0.5 1.0 1.1 1.1

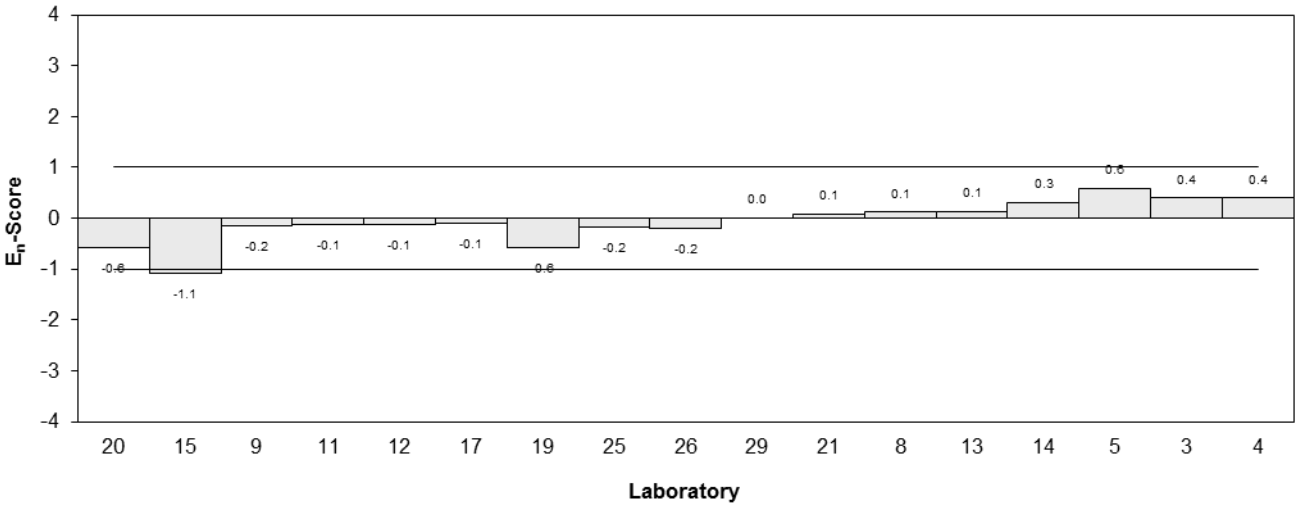

En-Scores: S2 - Bi
En-Score
Laboratory
20 15 9 11 12 17 19 25 26 29 21 8 13 14 5 3 4
-0.6 -1.1 -0.2 -0.1 -0.1 -0.1 -0.6 -0.2 -0.2 0.0 0.1 0.1 0.1 0.3 0.6 0.4 0.4

Figure 22

Table 34

Sample Details

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

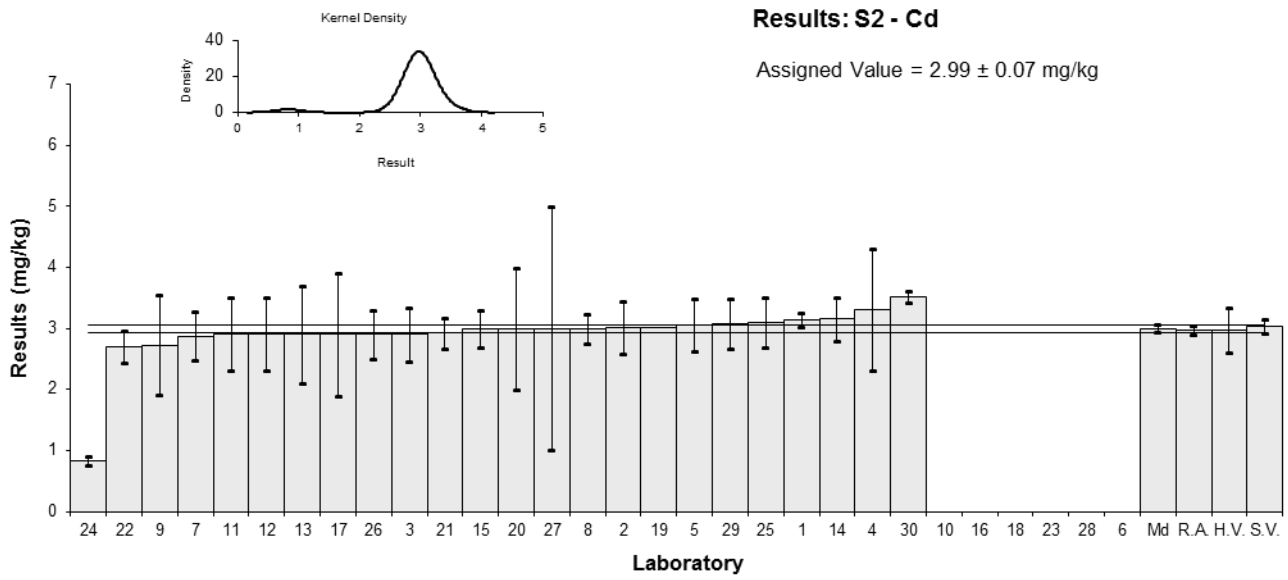
Participant Results

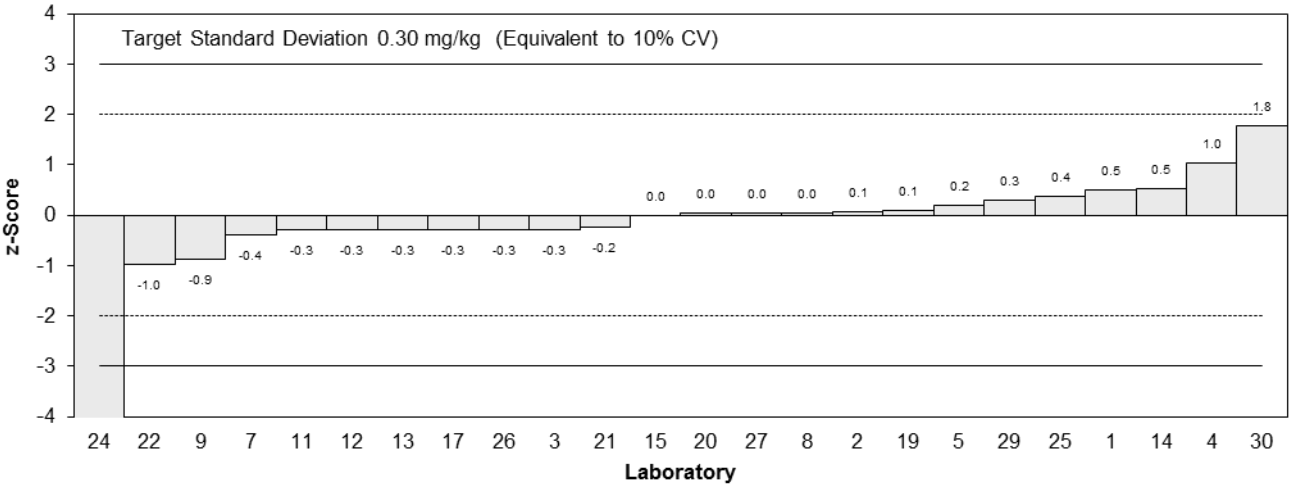
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	3.14	0.11	0.50	1.15
2	3.01	0.43	0.07	0.05
3	2.9	0.44	-0.30	-0.20
4	3.3	1.0	1.04	0.31
5	3.05	0.43	0.20	0.14
6	NT	NT		
7	2.87	0.4	-0.40	-0.30
8	3.0	0.24	0.03	0.04
9	2.73	0.82	-0.87	-0.32
10	NT	NT		
11	2.9	0.6	-0.30	-0.15
12	2.9	0.6	-0.30	-0.15
13	2.90	0.80	-0.30	-0.11
14	3.15	0.36	0.54	0.44
15	2.99	0.3	0.00	0.00
16	NT	NT		
17	2.9	1	-0.30	-0.09
18	NT	NT		
19	3.02	NR	0.10	0.43
20	3.0	1	0.03	0.01
21	2.92	0.26	-0.23	-0.26
22	2.7	0.27	-0.97	-1.04
23	NT	NT		
24	0.83	0.07	-7.22	-21.82
25	3.1	0.41	0.37	0.26
26	2.9	0.4	-0.30	-0.22
27	3	2	0.03	0.00
28	NT	NT		
29	3.08	0.41	0.30	0.22
30	3.52	0.09	1.77	4.65

Statistics

Assigned Value*	2.99	0.07
Spike	3.03	0.12
Homogeneity Value	2.97	0.36
Robust Average	2.97	0.07
Median	3.00	0.06
Mean	2.91	
N	24	
Max.	3.52	
Min.	0.83	
Robust SD	0.15	
Robust CV	5.1%	

*Robust Average excluding Laboratory 24


Kernel Density
Density
Result
Results: S2 - Cd
Assigned Value = 2.99 ± 0.07 mg/kg
Results (mg/kg)
24 22 9 7 11 12 13 17 26 3 21 15 20 27 8 2 19 5 29 25 1 14 4 30 10 16 18 23 28 6 Md R.A. H.V. S.V.
Laboratory


z-Scores: S2 - Cd
Target Standard Deviation 0.30 mg/kg (Equivalent to 10% CV)
z-Score
24 22 9 7 11 12 13 17 26 3 21 15 20 27 8 2 19 5 29 25 1 14 4 30
Laboratory

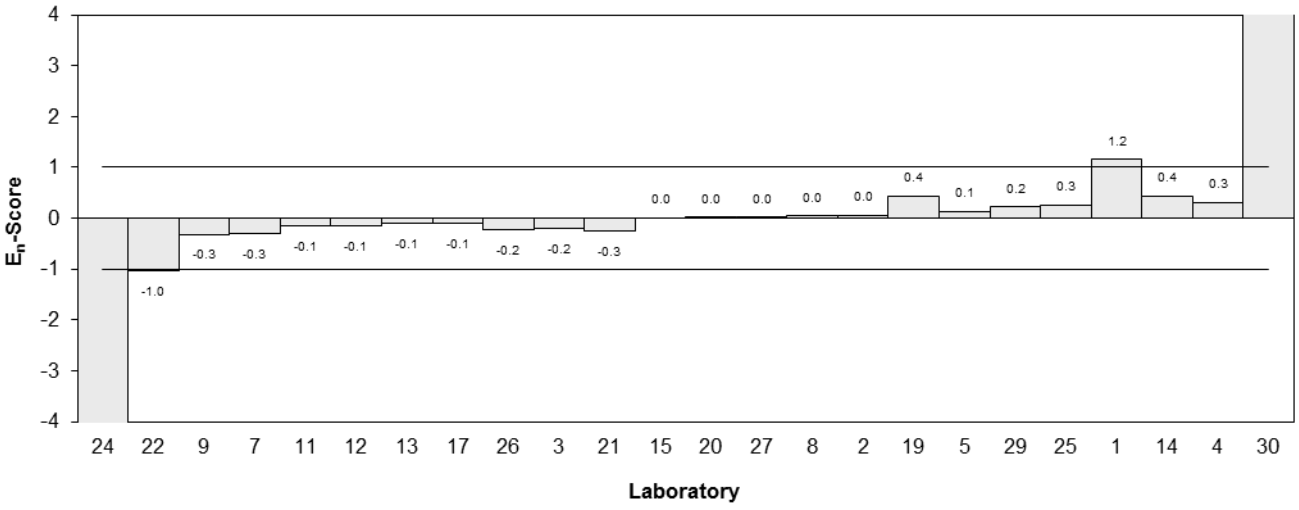

En-Scores: S2 - Cd
En-Score
24 22 9 7 11 12 13 17 26 3 21 15 20 27 8 2 19 5 29 25 1 14 4 30
Laboratory

Figure 23

Table 35

Sample Details

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

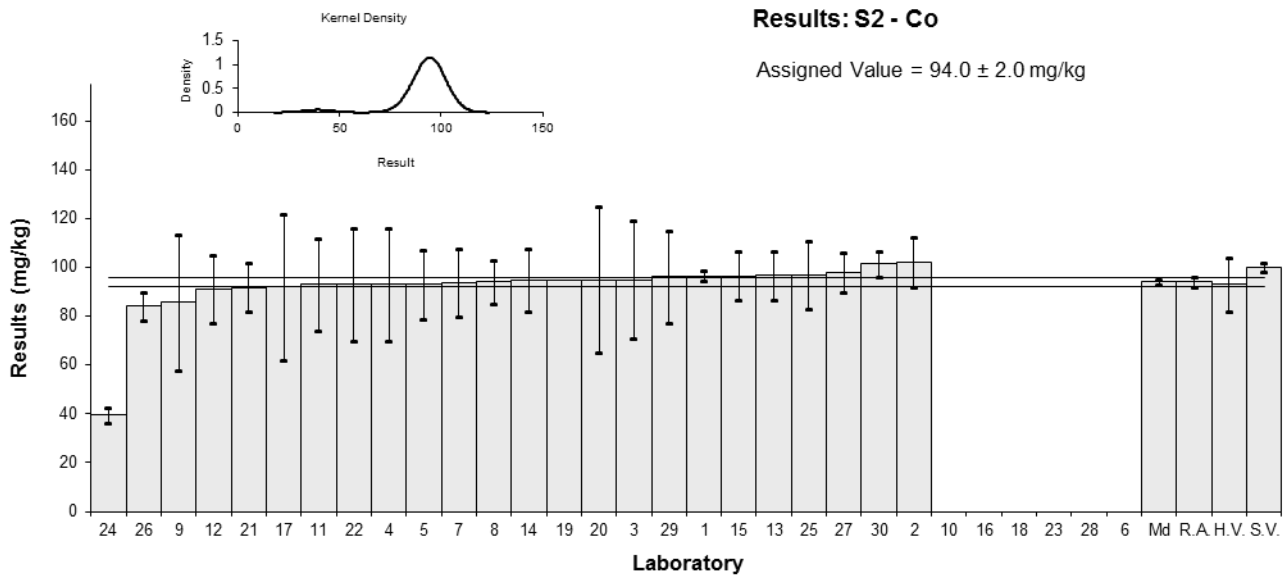
Participant Results

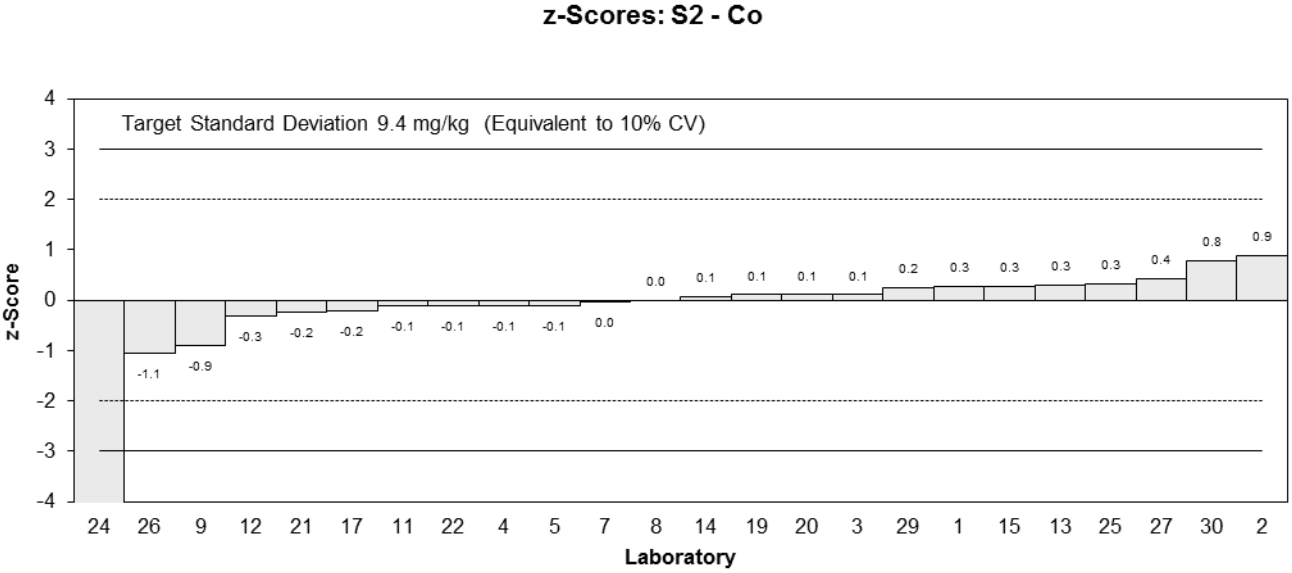
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	96.5	2.0	0.27	0.88
2	102.21	10.3	0.87	0.78
3	95	24	0.11	0.04
4	93	23	-0.11	-0.04
5	93	14	-0.11	-0.07
6	NT	NT		
7	93.7	14	-0.03	-0.02
8	94	8.9	0.00	0.00
9	85.6	27.7	-0.89	-0.30
10	NT	NT		
11	93	19	-0.11	-0.05
12	91	14	-0.32	-0.21
13	96.8	10	0.30	0.27
14	94.7	12.8	0.07	0.05
15	96.5	10	0.27	0.25
16	NT	NT		
17	92	30	-0.21	-0.07
18	NT	NT		
19	95.0	NR	0.11	0.50
20	95	30	0.11	0.03
21	91.7	10.01	-0.24	-0.23
22	93	23.2	-0.11	-0.04
23	NT	NT		
24	39.5	3.2	-5.80	-14.44
25	97	14	0.32	0.21
26	84	6	-1.06	-1.58
27	98	8	0.43	0.49
28	NT	NT		
29	96.3	18.9	0.24	0.12
30	101.4	5.12	0.79	1.35

Statistics

Assigned Value*	94.0	2.0
Spike	100.0	2.0
Homogeneity Value	93	11
Robust Average	94.0	2.0
Median	94.0	1.0
Mean	92.0	
N	24	
Max.	102.21	
Min.	39.5	
Robust SD	3.3	
Robust CV	3.5%	

*Robust Average excluding Laboratory 24


Kernel Density
Density
Result
Results: S2 - Co
Assigned Value = 94.0 ± 2.0 mg/kg
Results (mg/kg)
Laboratory
24 26 9 12 21 17 11 22 4 5 7 8 14 19 20 3 29 1 15 13 25 27 30 2 10 16 18 23 28 6 Md R.A. H.V. S.V.


z-Scores: S2 - Co
Target Standard Deviation 9.4 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
24 26 9 12 21 17 11 22 4 5 7 8 14 19 20 3 29 1 15 13 25 27 30 2

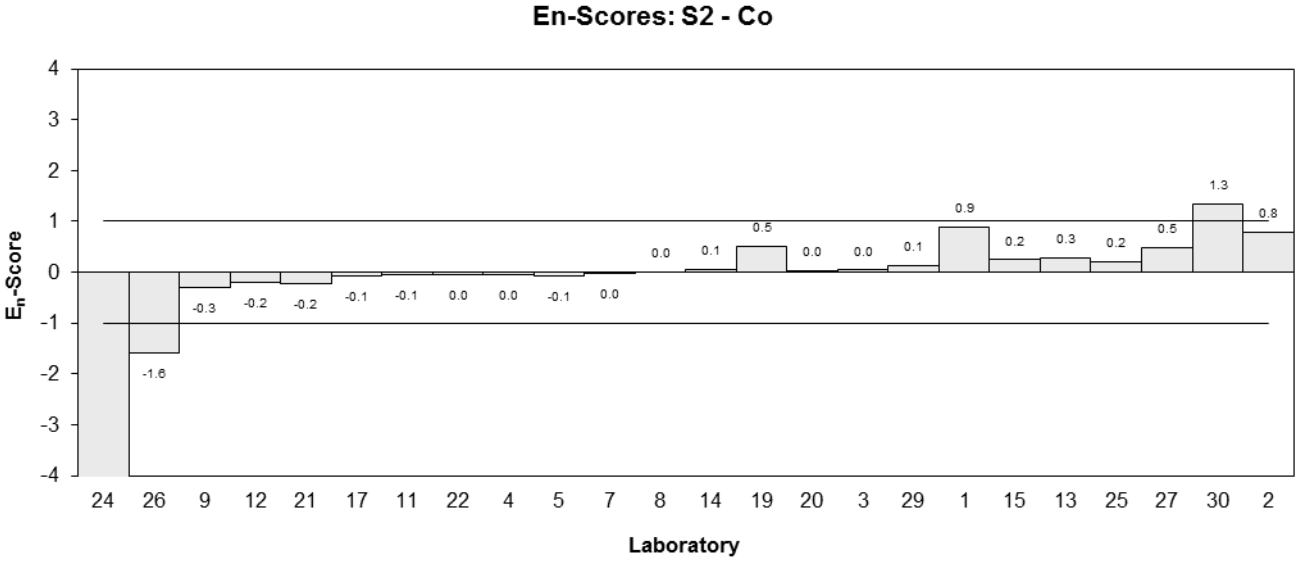

En-Scores: S2 - Co
En-Score
Laboratory
24 26 9 12 21 17 11 22 4 5 7 8 14 19 20 3 29 1 15 13 25 27 30 2

Figure 24

Table 36

Sample Details

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

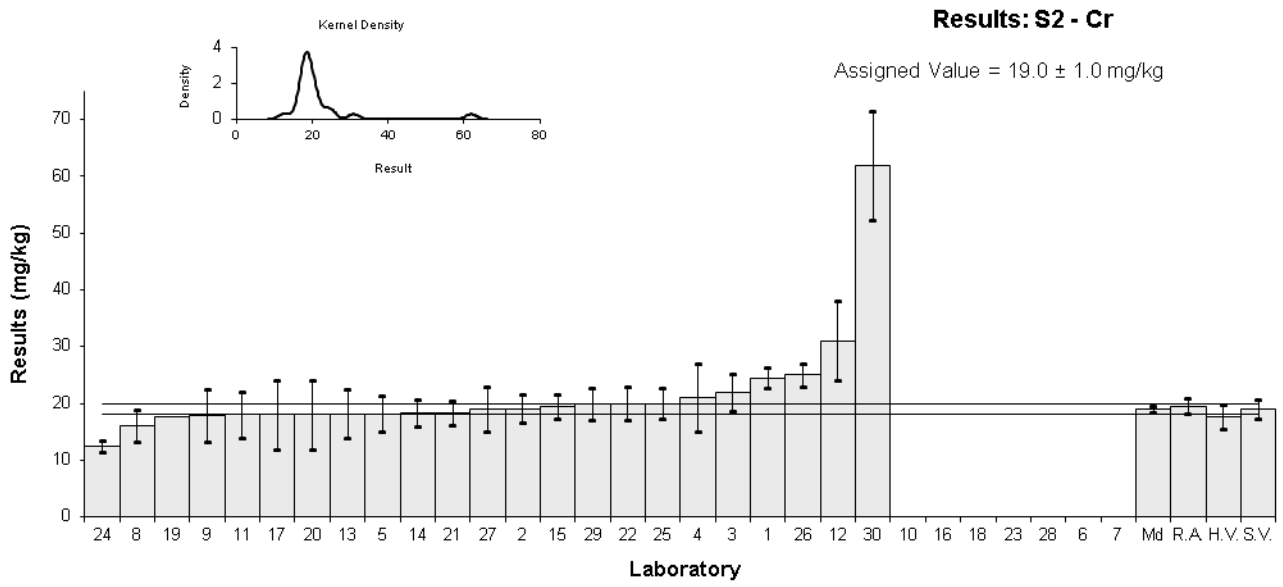
Participant Results

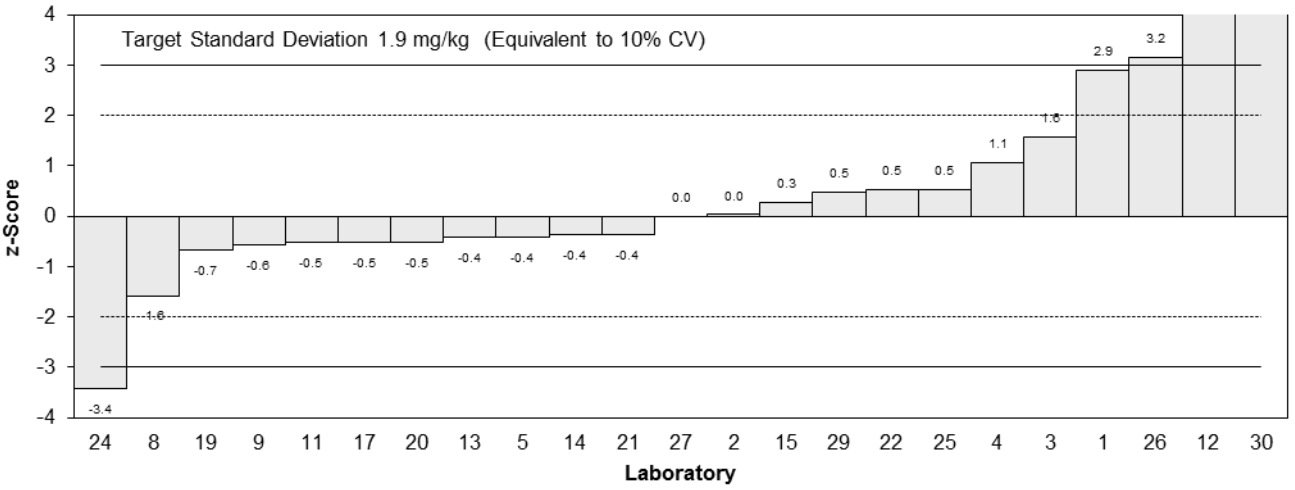
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	24.5	1.8	2.89	2.67
2	19.06	2.5	0.03	0.02
3	22	3.3	1.58	0.87
4	21	6	1.05	0.33
5	18.2	3.1	-0.42	-0.25
6	NT	NT		
7	NT	NT		
8	16	2.8	-1.58	-1.01
9	17.9	4.7	-0.58	-0.23
10	NT	NT		
11	18	4	-0.53	-0.24
12	31	7	6.32	1.70
13	18.2	4.2	-0.42	-0.19
14	18.3	2.42	-0.37	-0.27
15	19.5	2.2	0.26	0.21
16	NT	NT		
17	18	6	-0.53	-0.16
18	NT	NT		
19	17.70	NR	-0.68	-1.30
20	18	6	-0.53	-0.16
21	18.3	2.18	-0.37	-0.29
22	20	3.0	0.53	0.32
23	NT	NT		
24	12.5	1	-3.42	-4.60
25	20	2.7	0.53	0.35
26	25	2	3.16	2.68
27	19	4	0.00	0.00
28	NT	NT		
29	19.9	2.71	0.47	0.31
30	61.88	9.50	22.57	4.49

Statistics

Assigned Value*	19.0	1.0
Spike	19.0	1.8
Homogeneity Value	17.7	2.1
Robust Average	19.5	1.4
Median	19.0	0.6
Mean	21.5	
N	23	
Max.	61.88	
Min.	12.5	
Robust SD	2.6	
Robust CV	13%	

*Robust Average excluding Laboratories 12 and 30


Results: S2 - Cr
Assigned Value = 19.0 ± 1.0 mg/kg
Kernel Density
Density
Result
Results (mg/kg)
Laboratory
24 8 19 9 11 17 20 13 5 14 21 27 2 15 29 22 25 4 3 1 26 12 30 10 16 18 23 28 6 7 Md R.A. H.V. S.V.


z-Scores: S2 - Cr
Target Standard Deviation 1.9 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
24 8 19 9 11 17 20 13 5 14 21 27 2 15 29 22 25 4 3 1 26 12 30

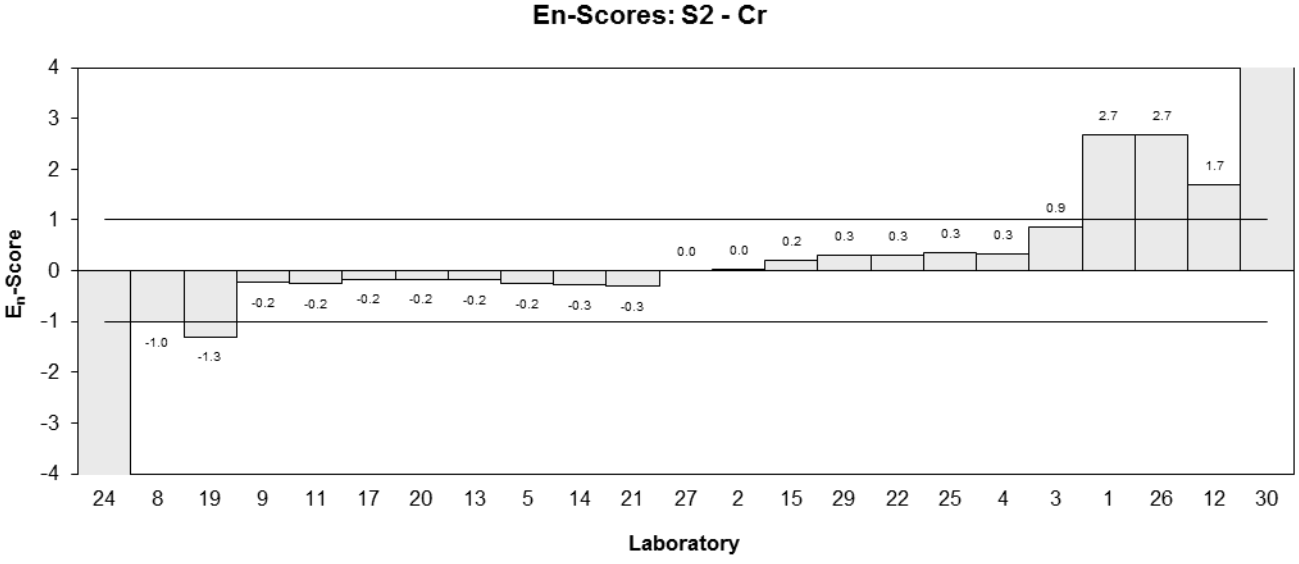

En-Scores: S2 - Cr
En-Score
Laboratory
24 8 19 9 11 17 20 13 5 14 21 27 2 15 29 22 25 4 3 1 26 12 30

Figure 25

Table 37

Sample Details

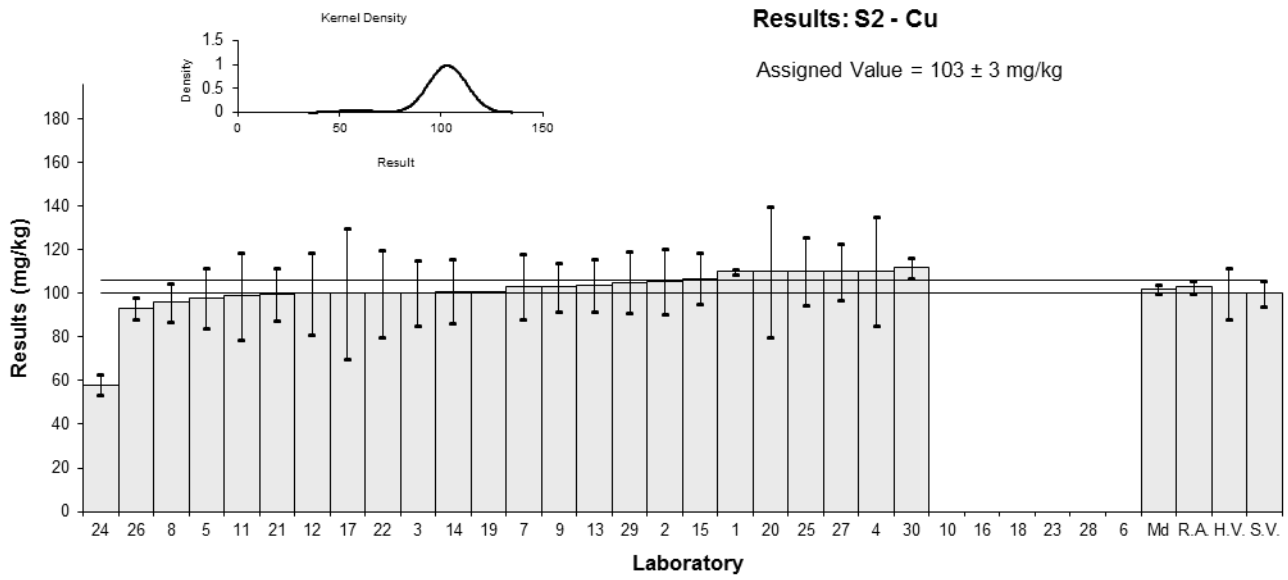
Sample No.	S2
Matrix.	Soil
Analyte.	Cu
Units	mg/kg

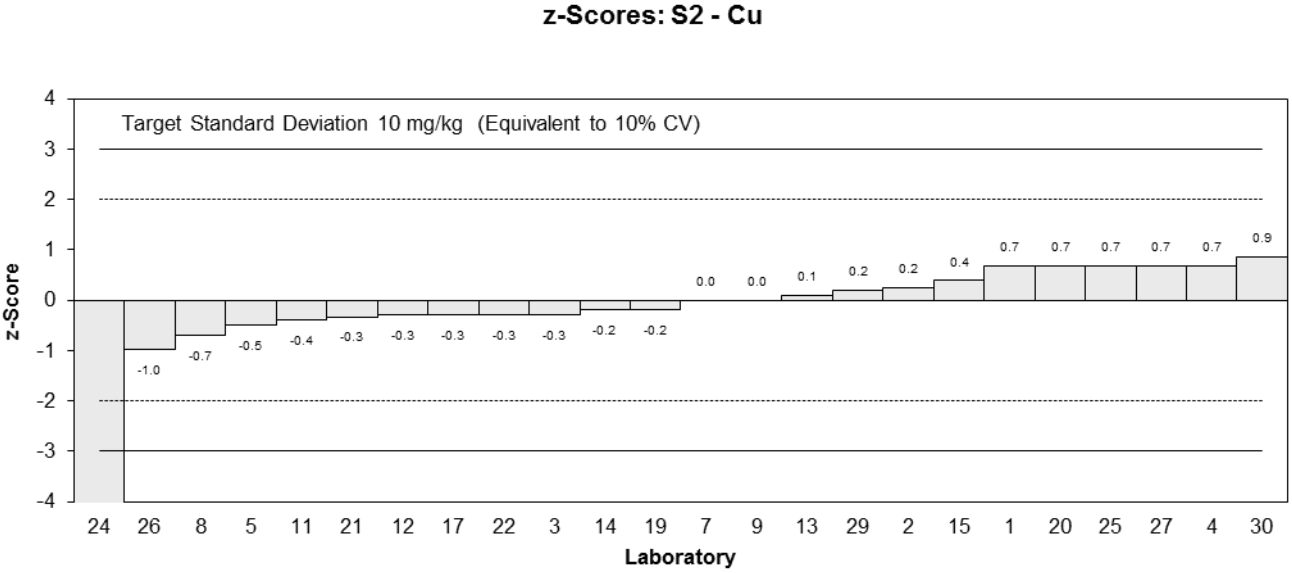
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	110	1	0.68	2.21
2	105.56	15.2	0.25	0.17
3	100	15	-0.29	-0.20
4	110	25	0.68	0.28
5	98	14	-0.49	-0.35
6	NT	NT		
7	103	15	0.00	0.00
8	95.9	8.98	-0.69	-0.75
9	103	11	0.00	0.00
10	NT	NT		
11	99	20	-0.39	-0.20
12	100	19	-0.29	-0.16
13	104	12	0.10	0.08
14	101	14.6	-0.19	-0.13
15	107	12	0.39	0.32
16	NT	NT		
17	100	30	-0.29	-0.10
18	NT	NT		
19	101.08	NR	-0.19	-0.64
20	110	30	0.68	0.23
21	99.6	11.92	-0.33	-0.28
22	100	20	-0.29	-0.15
23	NT	NT		
24	58.2	4.7	-4.35	-8.03
25	110	15.6	0.68	0.44
26	93	5	-0.97	-1.71
27	110	13	0.68	0.52
28	NT	NT		
29	105	14.1	0.19	0.14
30	111.81	4.72	0.86	1.58

Statistics

Assigned Value	103	3
Spike	100	6
Homogeneity Value	100	12
Robust Average	103	3
Median	102	2
Mean	101	
N	24	
Max.	111.81	
Min.	58.2	
Robust SD	6.1	
Robust CV	5.9%	


Kernel Density
Density
Result
Results: S2 - Cu
Assigned Value = 103 ± 3 mg/kg
Results (mg/kg)
Laboratory
24 26 8 5 11 21 12 17 22 3 14 19 7 9 13 29 2 15 1 20 25 27 4 30 10 16 18 23 28 6 Md R.A. H.V. S.V.


z-Scores: S2 - Cu
Target Standard Deviation 10 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
24 26 8 5 11 21 12 17 22 3 14 19 7 9 13 29 2 15 1 20 25 27 4 30

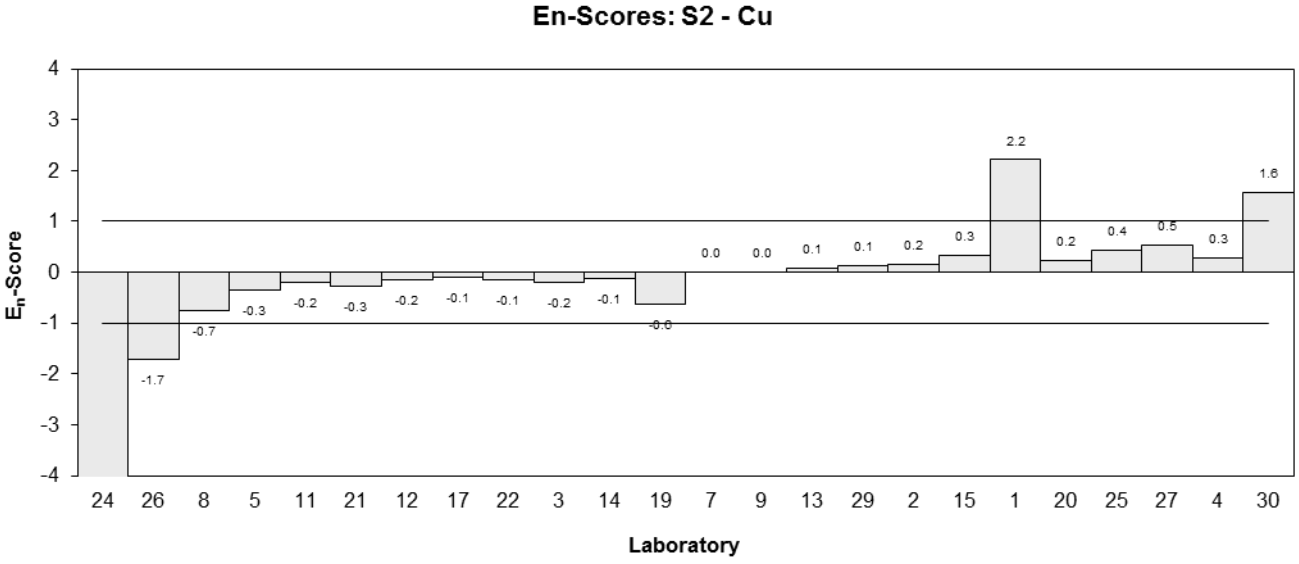

En-Scores: S2 - Cu
En-Score
Laboratory
24 26 8 5 11 21 12 17 22 3 14 19 7 9 13 29 2 15 1 20 25 27 4 30

Figure 26

Table 38

Sample Details

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

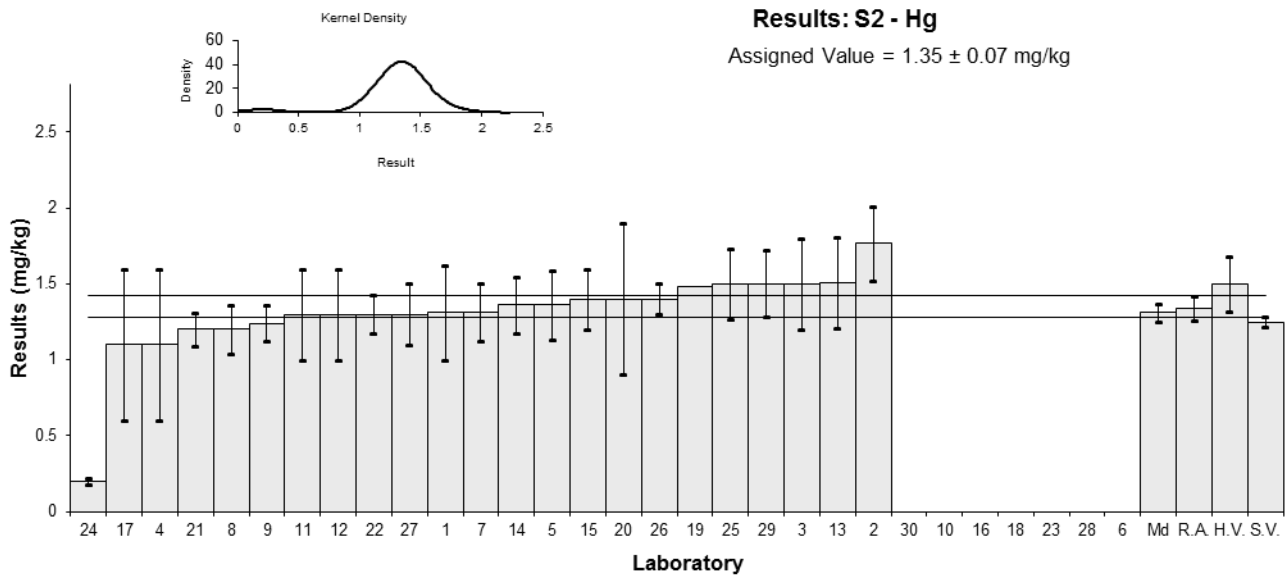
Participant Results

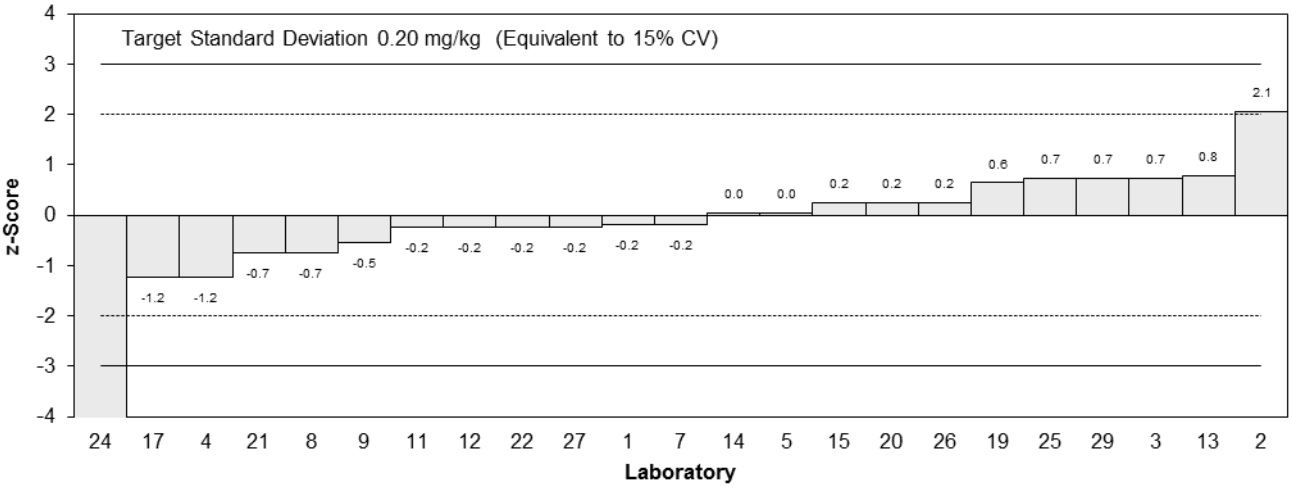
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	1.31	0.31	-0.20	-0.13
2	1.767	0.244	2.06	1.64
3	1.5	0.3	0.74	0.49
4	1.1	0.5	-1.23	-0.50
5	1.36	0.23	0.05	0.04
6	NT	NT		
7	1.31	0.19	-0.20	-0.20
8	1.2	0.16	-0.74	-0.86
9	1.24	0.12	-0.54	-0.79
10	NT	NT		
11	1.3	0.3	-0.25	-0.16
12	1.3	0.3	-0.25	-0.16
13	1.51	0.30	0.79	0.52
14	1.36	0.185	0.05	0.05
15	1.40	0.2	0.25	0.24
16	NT	NT		
17	1.1	0.5	-1.23	-0.50
18	NT	NT		
19	1.48	NR	0.64	1.86
20	1.4	0.5	0.25	0.10
21	1.20	0.11	-0.74	-1.15
22	1.3	0.13	-0.25	-0.34
23	NT	NT		
24	0.2	0.02	-5.68	-15.80
25	1.5	0.23	0.74	0.62
26	1.4	0.1	0.25	0.41
27	1.3	0.2	-0.25	-0.24
28	NT	NT		
29	1.50	0.22	0.74	0.65
30	NR	NR		

Statistics

Assigned Value*	1.35	0.07
Spike	1.25	0.03
Homogeneity Value	1.50	0.18
Robust Average	1.34	0.08
Median	1.31	0.06
Mean	1.31	
N	23	
Max.	1.767	
Min.	0.2	
Robust SD	0.16	
Robust CV	12%	

*Robust Average excluding Laboratory 24


Kernel Density
Density
Result
Results: S2 - Hg
Assigned Value = 1.35 ± 0.07 mg/kg
Results (mg/kg)
Laboratory
24 17 4 21 8 9 11 12 22 27 1 7 14 5 15 20 26 19 25 29 3 13 2 30 10 16 18 23 28 6 Md R.A. H.V. S.V.


z-Scores: S2 - Hg
Target Standard Deviation 0.20 mg/kg (Equivalent to 15% CV)
z-Score
Laboratory
24 17 4 21 8 9 11 12 22 27 1 7 14 5 15 20 26 19 25 29 3 13 2

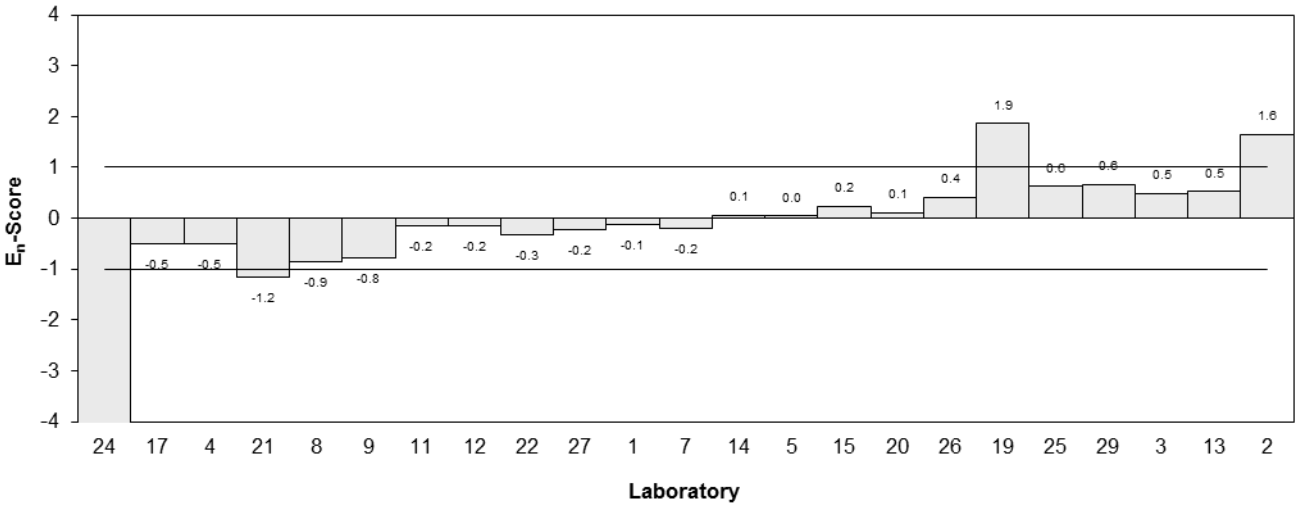

En-Scores: S2 - Hg
En-Score
Laboratory
24 17 4 21 8 9 11 12 22 27 1 7 14 5 15 20 26 19 25 29 3 13 2

Figure 27

Table 39

Sample Details

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

Participant Results

Lab Code	Result	Uncertainty
1	6.02	1.1
2	NT	NT
3	<5	<1.3
4	2.8	1.5
5	2.67	0.42
6	NT	NT
7	NT	NT
8	1.2	0.09
9	2.35	0.28
10	NT	NT
11	3.1	0.6
12	8.1	1.8
13	1.55	0.50
14	NT	NT
15	3.40	0.5
16	NT	NT
17	2.6	2
18	NT	NT
19	1.98	NR
20	2.8	2
21	2.1	0.21
22	1.8	0.18
23	NT	NT
24	4.81	0.38
25	<5	1
26	6.1	0.3
27	3	1
28	NT	NT
29	2.54	0.31
30	NR	NR

Statistics

Assigned Value	Not Set	
Spike	Not Spiked	
Homogeneity Value	3.17	0.38
Robust Average	3.00	0.83
Median	2.74	0.48
Mean	3.27	
N	18	
Max.	8.1	
Min.	1.2	
Robust SD	1.42	
Robust CV	47%	

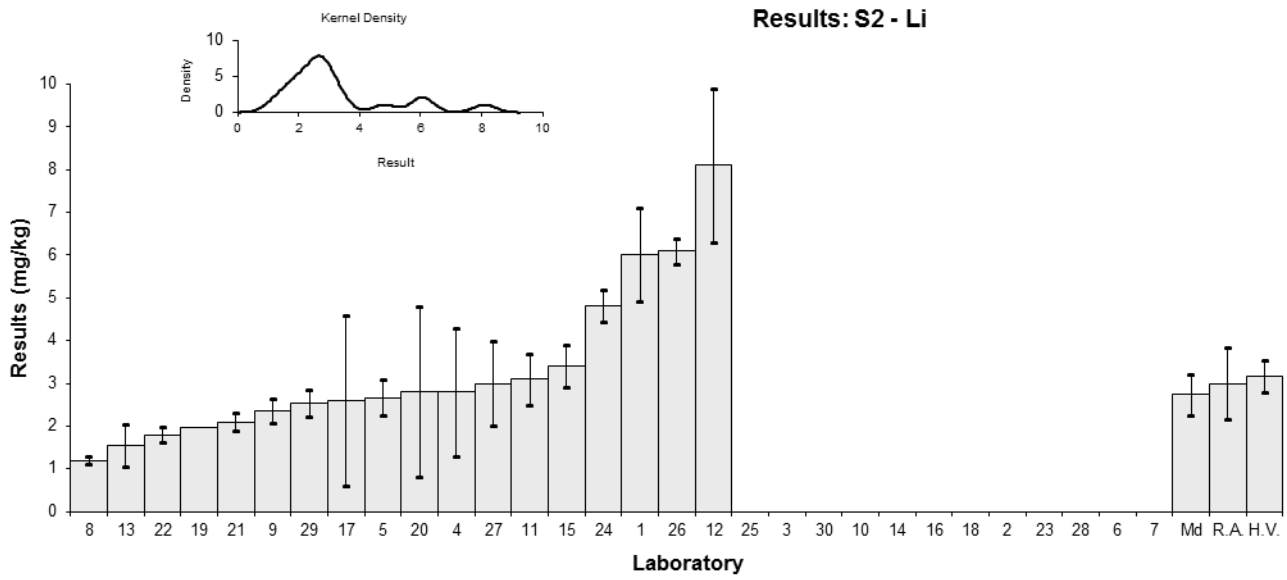

Results: S2 - Li
Kernel Density
Density
Result
Results (mg/kg)
Laboratory
8 13 22 19 21 9 29 17 5 20 4 27 11 15 24 1 26 12 25 3 30 10 14 16 18 2 23 28 6 7 Md R.A. H.V.

Figure 28

Table 40

Sample Details

Sample No.	S2
Matrix.	Soil
Analyte.	Moisture Content
Units	%

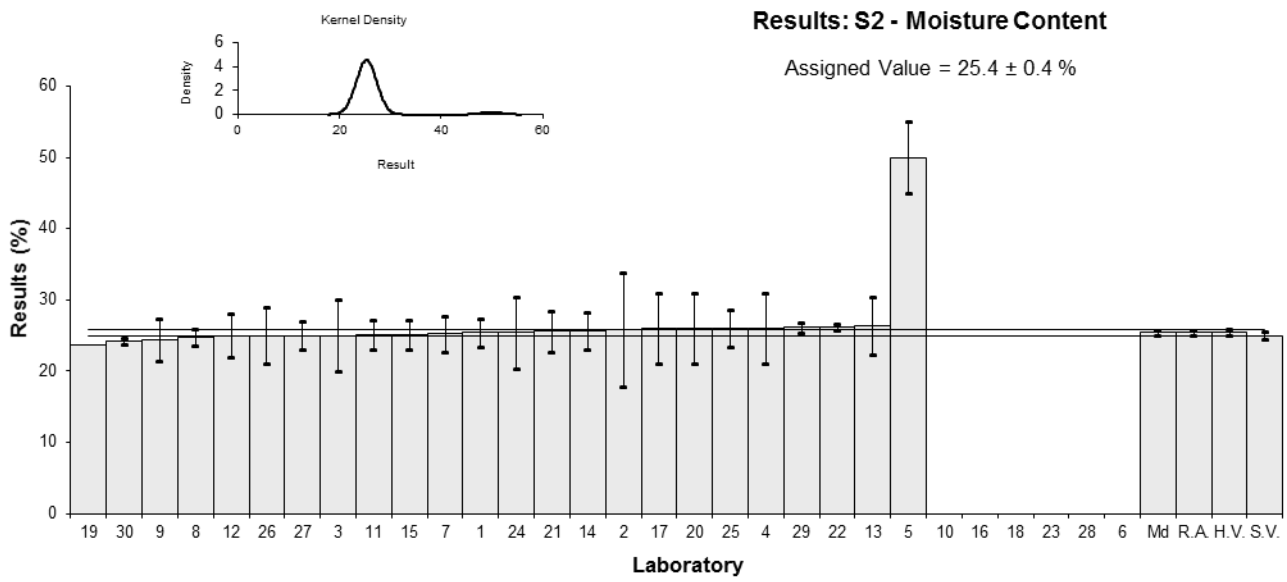
Participant Results

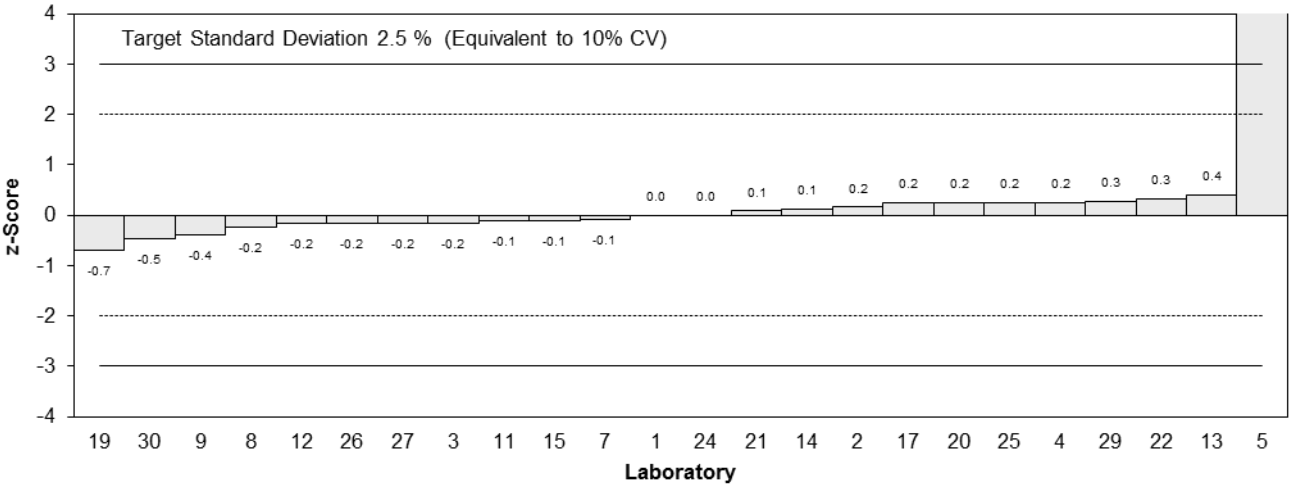
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	25.4	2	0.00	0.00
2	25.8	8	0.16	0.05
3	25	5	-0.16	-0.08
4	26	5	0.24	0.12
5	76.1	5.0	19.96	10.11
6	NT	NT		
7	25.2	2.5	-0.08	-0.08
8	24.8	1.14	-0.24	-0.50
9	24.4	2.9	-0.39	-0.34
10	NT	NT		
11	25.1	2	-0.12	-0.15
12	25	3	-0.16	-0.13
13	26.4	4.0	0.39	0.25
14	25.7	2.57	0.12	0.12
15	25.1	2.0	-0.12	-0.15
16	NT	NT		
17	26	5	0.24	0.12
18	NT	NT		
19	23.6	NR	-0.71	-4.50
20	26.0	5	0.24	0.12
21	25.6	2.92	0.08	0.07
22	26.2	0.5	0.31	1.25
23	NT	NT		
24	25.4	5	0.00	0.00
25	26	2.6	0.24	0.23
26	25	4	-0.16	-0.10
27	25	2	-0.16	-0.20
28	NT	NT		
29	26.1	0.71	0.28	0.86
30	24.2	0.4	-0.47	-2.12

Statistics

Assigned Value*	25.4	0.4
Spike	25.0	0.5
Homogeneity Value	25.5	0.5
Robust Average	25.4	0.4
Median	25.4	0.3
Mean	27.5	
N	24	
Max.	76.1	
Min.	23.6	
Robust SD	0.7	
Robust CV	2.8%	

*Robust Average excluding Laboratory 5


Kernel Density
Density
Result
Results: S2 - Moisture Content
Assigned Value = 25.4 ± 0.4 %
Results (%)
Laboratory
19 30 9 8 12 26 27 3 11 15 7 1 24 21 14 2 17 20 25 4 29 22 13 5 10 16 18 23 28 6 Md R.A. H.V. S.V.


z-Scores: S2 - Moisture Content
Target Standard Deviation 2.5 % (Equivalent to 10% CV)
z-Score
Laboratory
19 30 9 8 12 26 27 3 11 15 7 1 24 21 14 2 17 20 25 4 29 22 13 5
-0.7 -0.5 -0.4 -0.2 -0.2 -0.2 -0.2 -0.2 -0.1 -0.1 -0.1 0.0 0.0 0.1 0.1 0.2 0.2 0.2 0.2 0.2 0.3 0.3 0.4

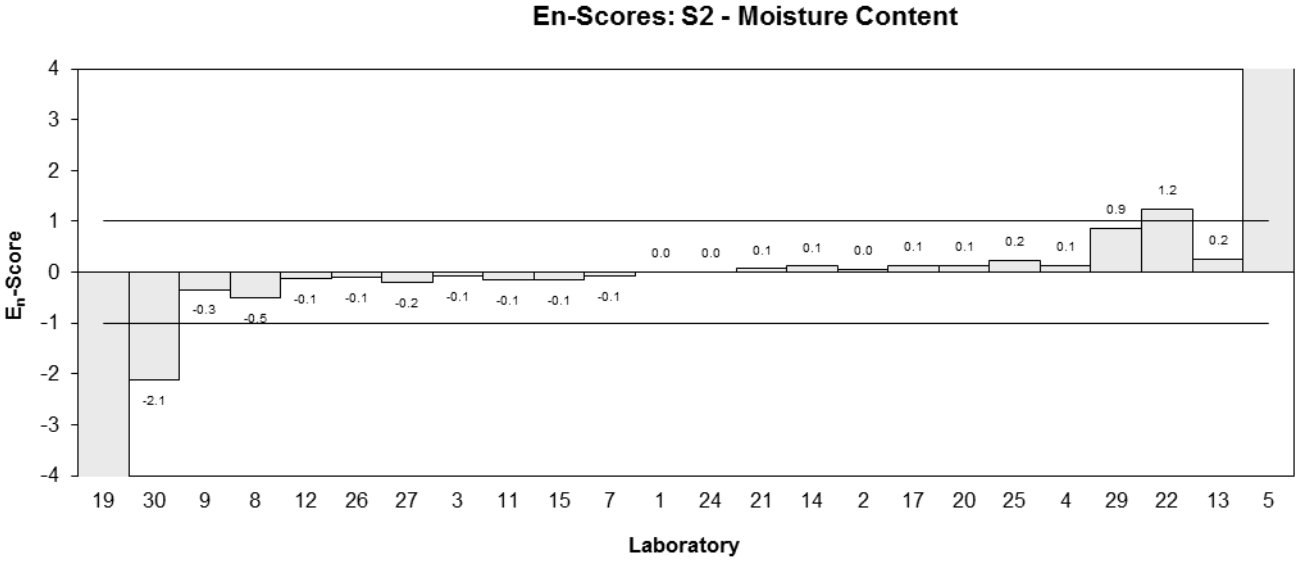

En-Scores: S2 - Moisture Content
En-Score
Laboratory
19 30 9 8 12 26 27 3 11 15 7 1 24 21 14 2 17 20 25 4 29 22 13 5
-2.1 -0.3 -0.5 -0.1 -0.1 -0.2 -0.1 -0.1 -0.1 -0.1 0.0 0.0 0.1 0.1 0.0 0.1 0.1 0.2 0.1 0.9 1.2 0.2

Figure 29

Table 41

Sample Details

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

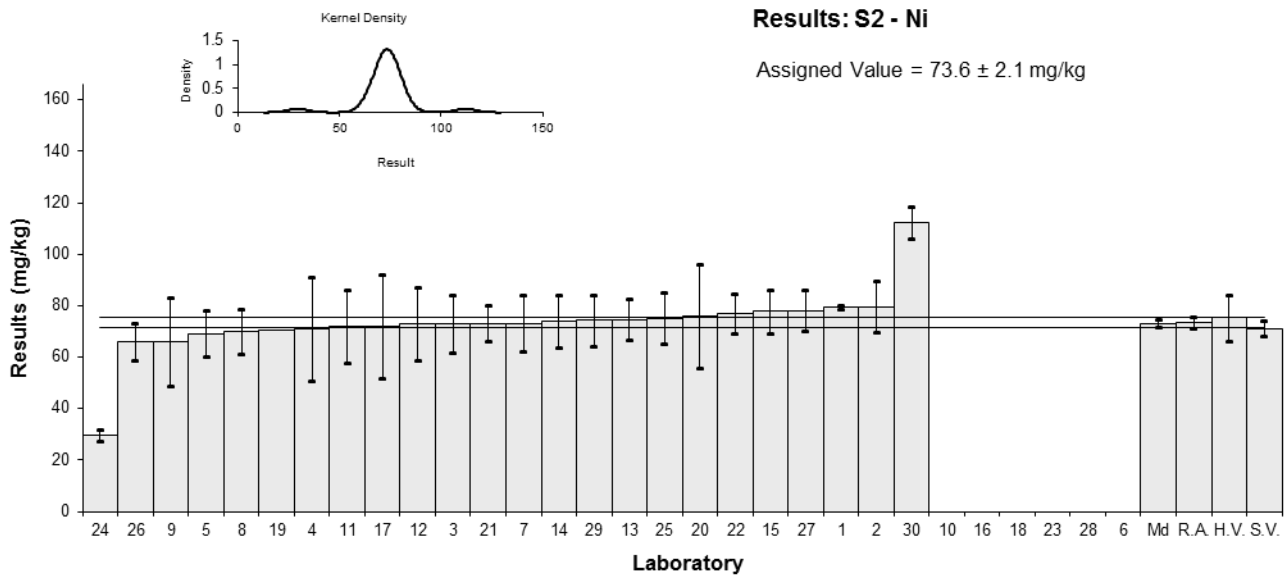
Participant Results

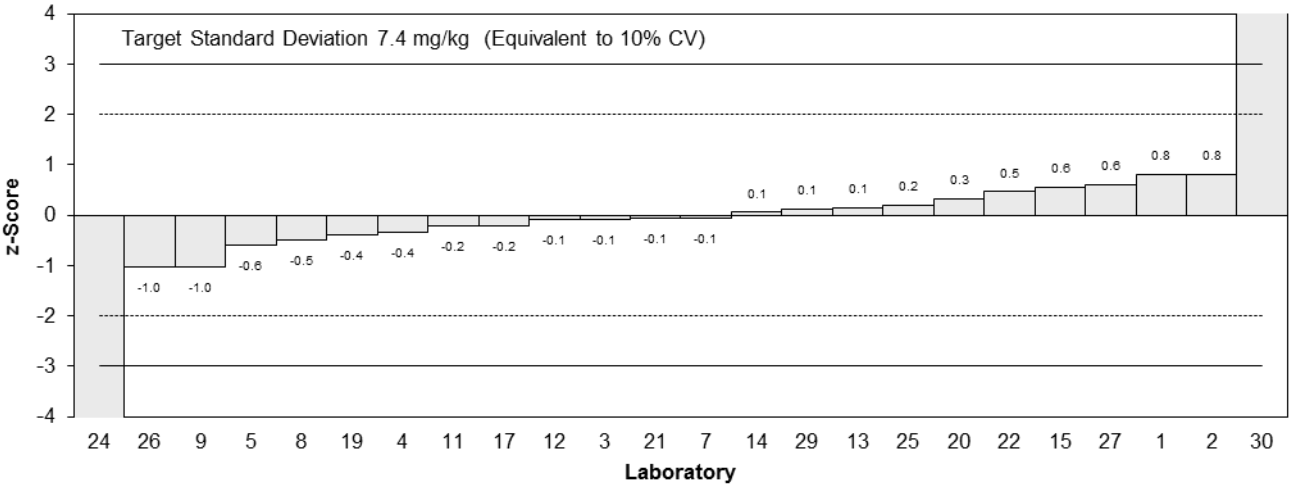
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	79.5	0.8	0.80	2.63
2	79.57	9.9	0.81	0.59
3	73	11	-0.08	-0.05
4	71	20	-0.35	-0.13
5	69.2	9.0	-0.60	-0.48
6	NT	NT		
7	73.2	11	-0.05	-0.04
8	70	8.7	-0.49	-0.40
9	66.0	17.0	-1.03	-0.44
10	NT	NT		
11	72	14	-0.22	-0.11
12	73	14	-0.08	-0.04
13	74.7	8.0	0.15	0.13
14	74.0	10.1	0.05	0.04
15	77.7	8.5	0.56	0.47
16	NT	NT		
17	72	20	-0.22	-0.08
18	NT	NT		
19	70.62	NR	-0.40	-1.42
20	76	20	0.33	0.12
21	73.2	7.18	-0.05	-0.05
22	77	7.7	0.46	0.43
23	NT	NT		
24	29.6	2.4	-5.98	-13.80
25	75	10	0.19	0.14
26	66	7	-1.03	-1.04
27	78	8	0.60	0.53
28	NT	NT		
29	74.4	10.0	0.11	0.08
30	112.36	6.23	5.27	5.90

Statistics

Assigned Value*	73.6	2.1
Spike	71.2	2.9
Homogeneity Value	75.3	9.0
Robust Average	73.5	2.3
Median	73.2	1.7
Mean	73.2	
N	24	
Max.	112.36	
Min.	29.6	
Robust SD	4.6	
Robust CV	6.3%	

*Robust Average excluding Laboratories 24 and 30


Kernel Density
Density
Result
Results: S2 - Ni
Assigned Value = 73.6 ± 2.1 mg/kg
Results (mg/kg)
Laboratory
24 26 9 5 8 19 4 11 17 12 3 21 7 14 29 13 25 20 22 15 27 1 2 30 10 16 18 23 28 6 Md R.A. H.V. S.V.


z-Scores: S2 - Ni
Target Standard Deviation 7.4 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
24 26 9 5 8 19 4 11 17 12 3 21 7 14 29 13 25 20 22 15 27 1 2 30

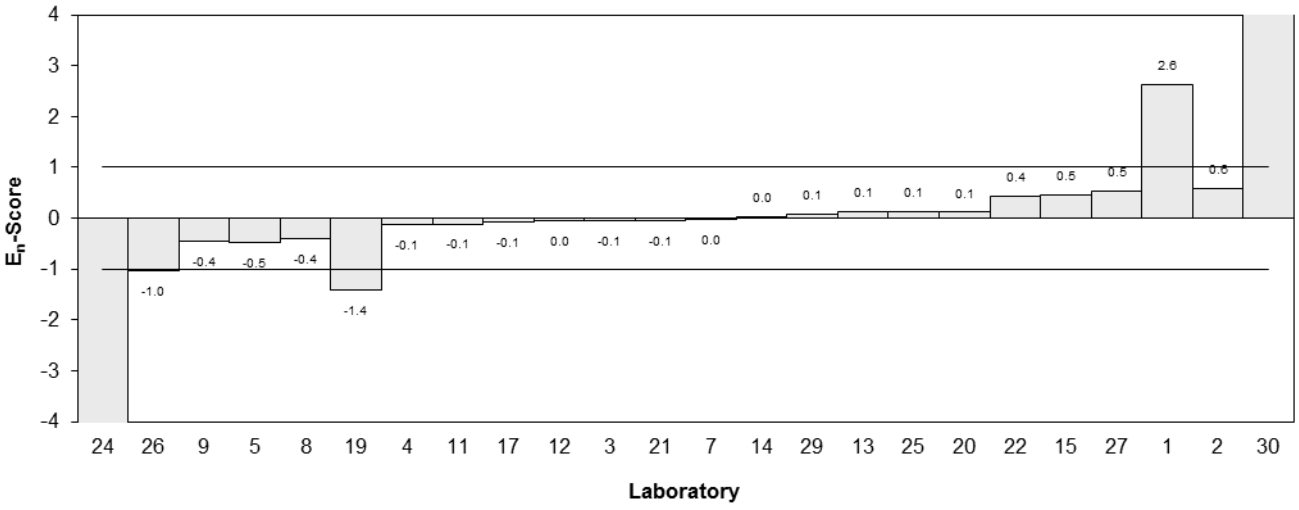

En-Scores: S2 - Ni
En-Score
Laboratory
24 26 9 5 8 19 4 11 17 12 3 21 7 14 29 13 25 20 22 15 27 1 2 30

Figure 30

Table 42

Sample Details

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

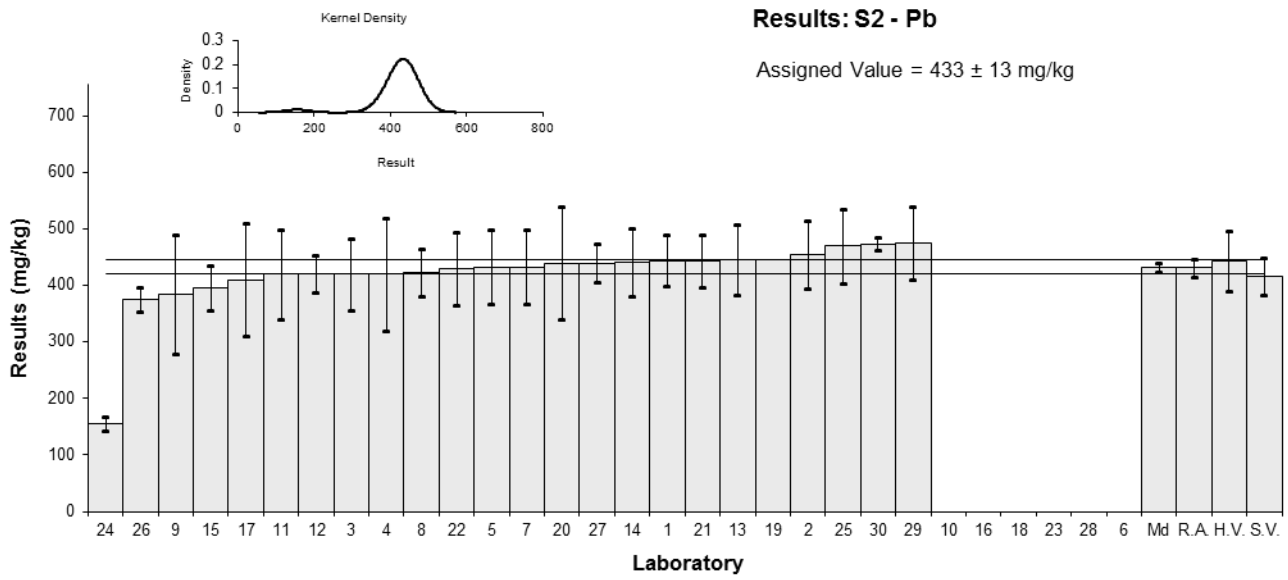
Participant Results

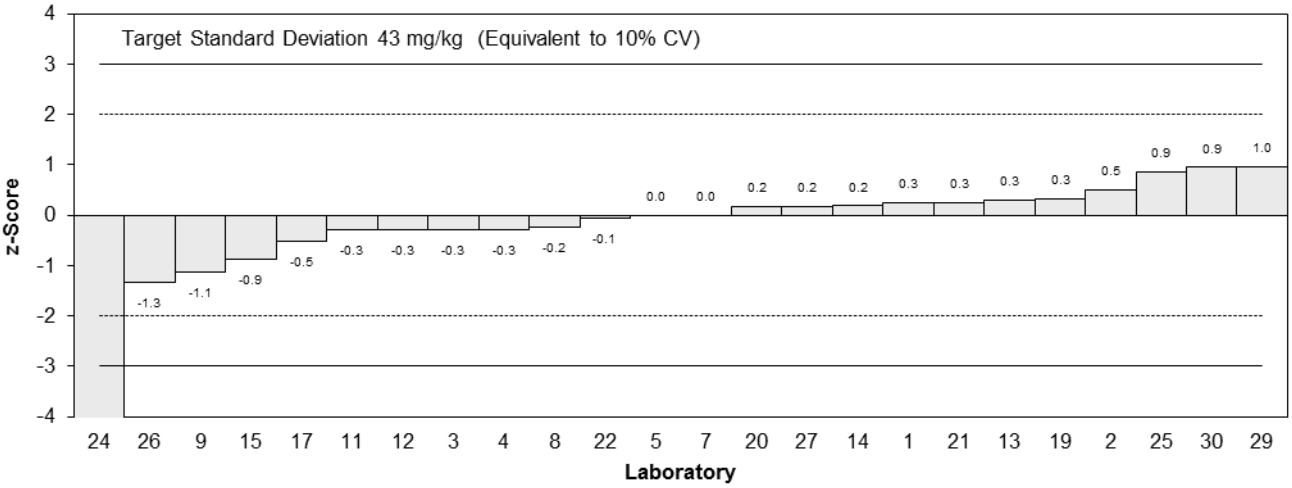
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	444	45	0.25	0.23
2	454.6	60.00	0.50	0.35
3	420	63	-0.30	-0.20
4	420	100	-0.30	-0.13
5	433	65	0.00	0.00
6	NT	NT		
7	433	65	0.00	0.00
8	423	41.6	-0.23	-0.23
9	384	106	-1.13	-0.46
10	NT	NT		
11	420	80	-0.30	-0.16
12	420	33	-0.30	-0.37
13	446	62	0.30	0.21
14	441	59.4	0.18	0.13
15	395	40	-0.88	-0.90
16	NT	NT		
17	410	100	-0.53	-0.23
18	NT	NT		
19	446.59	NR	0.31	1.05
20	440	100	0.16	0.07
21	444	46.36	0.25	0.23
22	430	64	-0.07	-0.05
23	NT	NT		
24	156	12	-6.40	-15.66
25	470	66.4	0.85	0.55
26	375	21	-1.34	-2.35
27	440	34	0.16	0.19
28	NT	NT		
29	475	65.1	0.97	0.63
30	473.95	11.12	0.95	2.39

Statistics

Assigned Value*	433	13
Spike	416	32
Homogeneity Value	443	53
Robust Average	431	15
Median	433	8
Mean	421	
N	24	
Max.	475	
Min.	156	
Robust SD	29	
Robust CV	6.7%	

*Robust Average excluding Laboratory 24


Kernel Density
Density
Result
Results: S2 - Pb
Assigned Value = 433 ± 13 mg/kg
Results (mg/kg)
Laboratory
24 26 9 15 17 11 12 3 4 8 22 5 7 20 27 14 1 21 13 19 2 25 30 29 10 16 18 23 28 6 Md R.A. H.V. S.V.


z-Scores: S2 - Pb
Target Standard Deviation 43 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
24 26 9 15 17 11 12 3 4 8 22 5 7 20 27 14 1 21 13 19 2 25 30 29
-1.3 -1.1 -0.9 -0.5 -0.3 -0.3 -0.3 -0.3 -0.2 -0.1 0.0 0.0 0.2 0.2 0.2 0.3 0.3 0.3 0.3 0.5 0.9 0.9 1.0

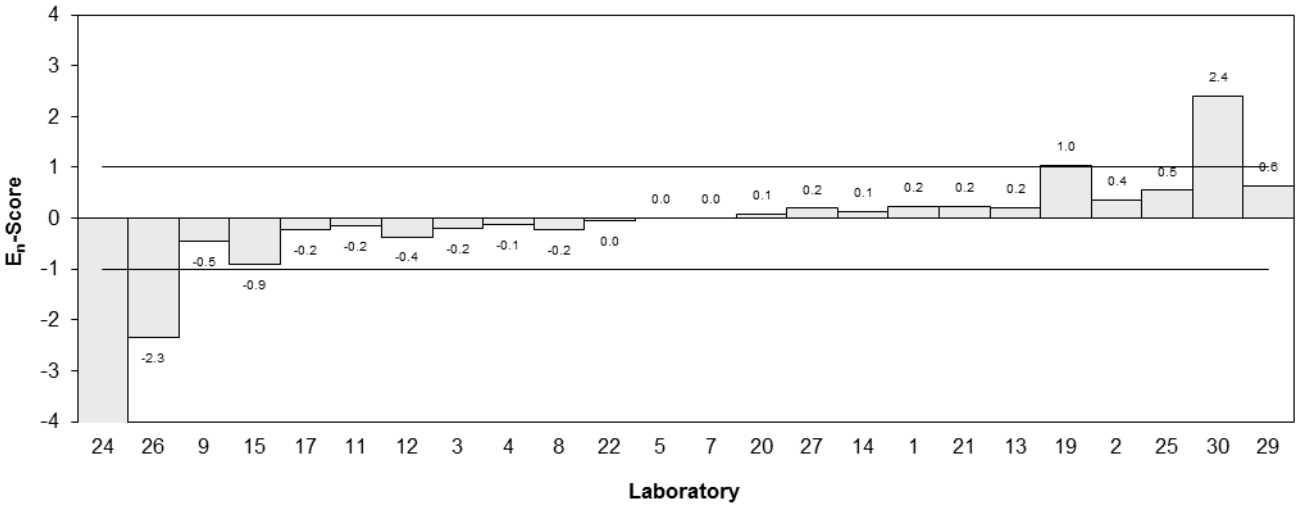

En-Scores: S2 - Pb
En-Score
Laboratory
24 26 9 15 17 11 12 3 4 8 22 5 7 20 27 14 1 21 13 19 2 25 30 29
-2.3 -0.5 -0.9 -0.2 -0.2 -0.4 -0.2 -0.1 -0.2 0.0 0.0 0.0 0.1 0.2 0.1 0.2 0.2 0.2 1.0 0.4 0.5 2.4 0.6

Figure 31

Table 43

Sample Details

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

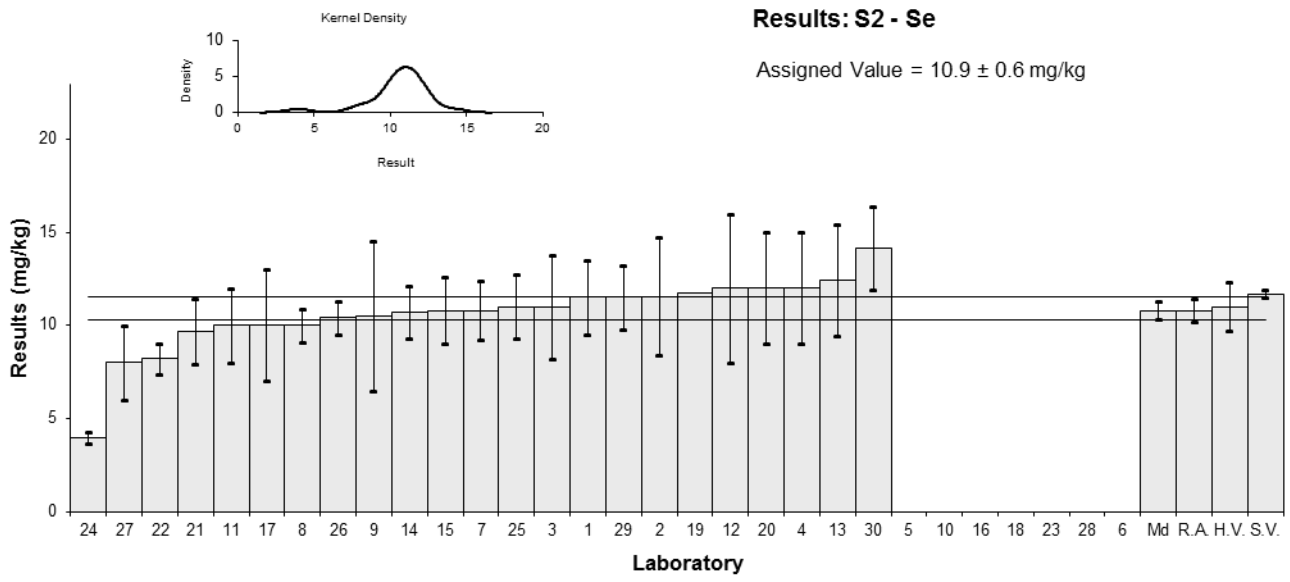
Participant Results

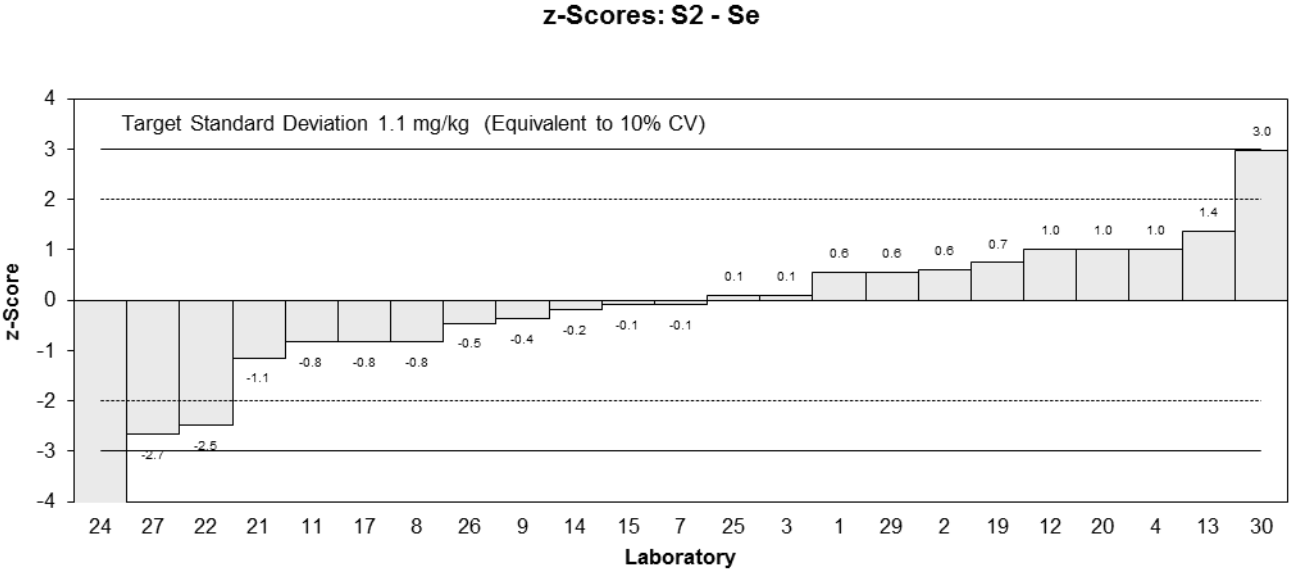
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	11.5	2.0	0.55	0.29
2	11.56	3.144	0.61	0.21
3	11	2.8	0.09	0.03
4	12	3	1.01	0.36
5	<20	14		
6	NT	NT		
7	10.8	1.6	-0.09	-0.06
8	10	0.9	-0.83	-0.83
9	10.5	4.0	-0.37	-0.10
10	NT	NT		
11	10	2	-0.83	-0.43
12	12	4	1.01	0.27
13	12.4	3	1.38	0.49
14	10.7	1.44	-0.18	-0.13
15	10.8	1.8	-0.09	-0.05
16	NT	NT		
17	10	3	-0.83	-0.29
18	NT	NT		
19	11.71	NR	0.74	1.35
20	12	3	1.01	0.36
21	9.65	1.75	-1.15	-0.68
22	8.2	0.82	-2.48	-2.66
23	NT	NT		
24	3.98	0.32	-6.35	-10.18
25	11	1.7	0.09	0.06
26	10.4	0.9	-0.46	-0.46
27	8	2	-2.66	-1.39
28	NT	NT		
29	11.5	1.73	0.55	0.33
30	14.15	2.24	2.98	1.40

Statistics

Assigned Value*	10.9	0.6
Spike	11.7	0.2
Homogeneity Value	11.0	1.3
Robust Average	10.8	0.6
Median	10.8	0.5
Mean	10.6	
N	23	
Max.	14.15	
Min.	3.98	
Robust SD	1.2	
Robust CV	11%	

*Robust Average excluding Laboratory 24


Kernel Density
Density
Result
Results: S2 - Se
Assigned Value = 10.9 ± 0.6 mg/kg
Results (mg/kg)
Laboratory
24 27 22 21 11 17 8 26 9 14 15 7 25 3 1 29 2 19 12 20 4 13 30 5 10 16 18 23 28 6 Md R.A. H.V. S.V.


z-Scores: S2 - Se
Target Standard Deviation 1.1 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
24 27 22 21 11 17 8 26 9 14 15 7 25 3 1 29 2 19 12 20 4 13 30

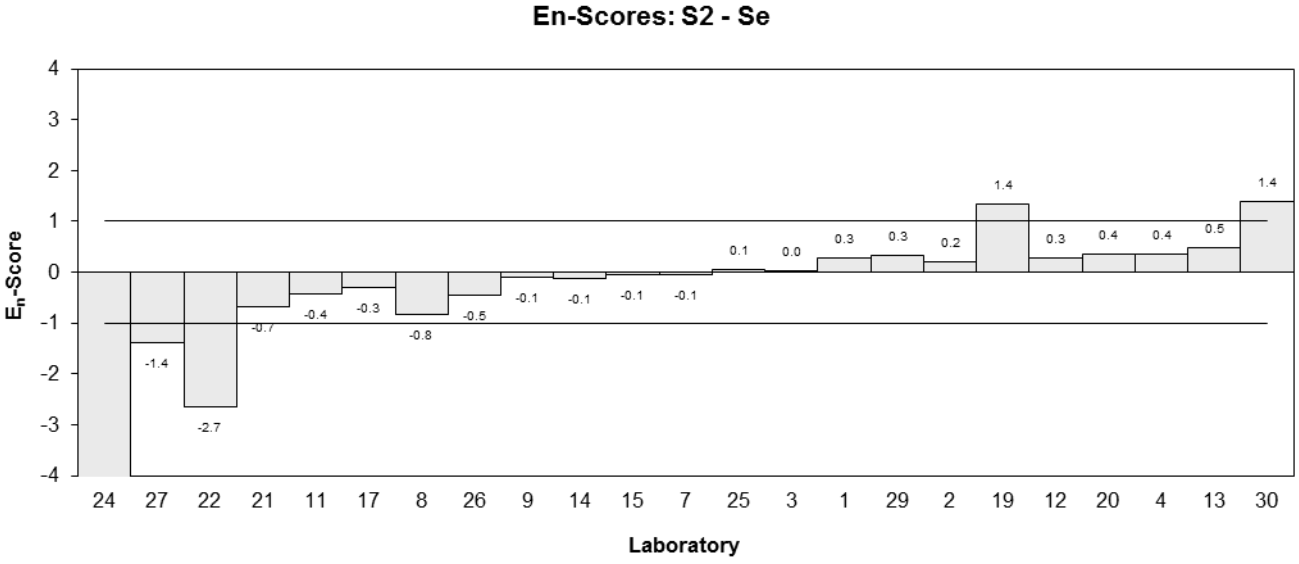

En-Scores: S2 - Se
En-Score
Laboratory
24 27 22 21 11 17 8 26 9 14 15 7 25 3 1 29 2 19 12 20 4 13 30

Figure 32

Table 44

Sample Details

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

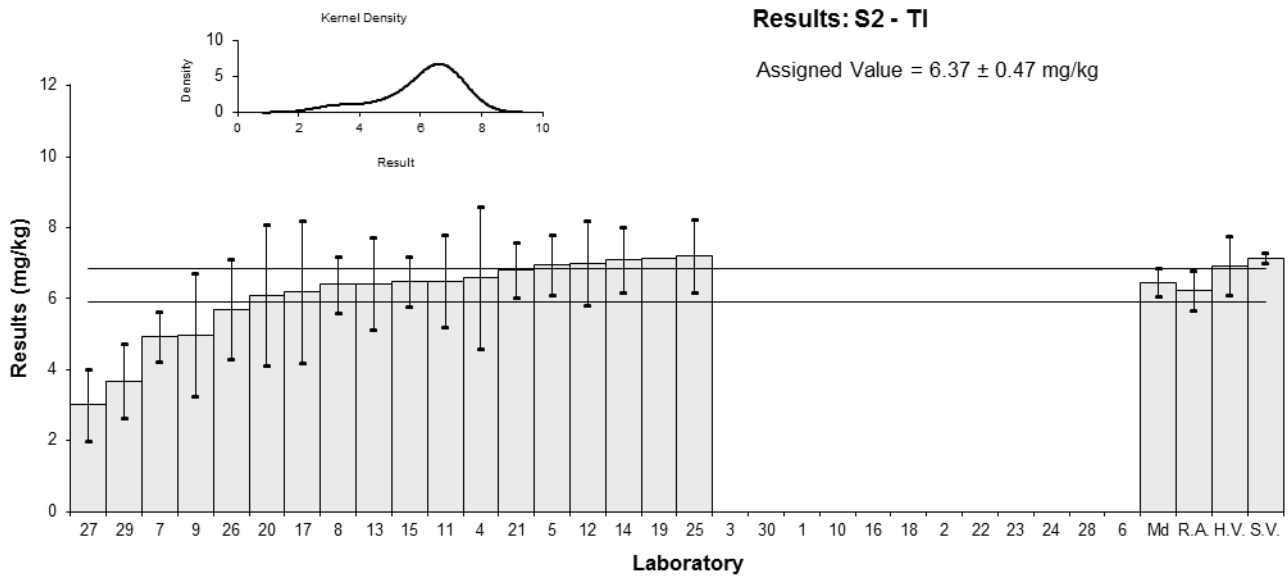
Participant Results

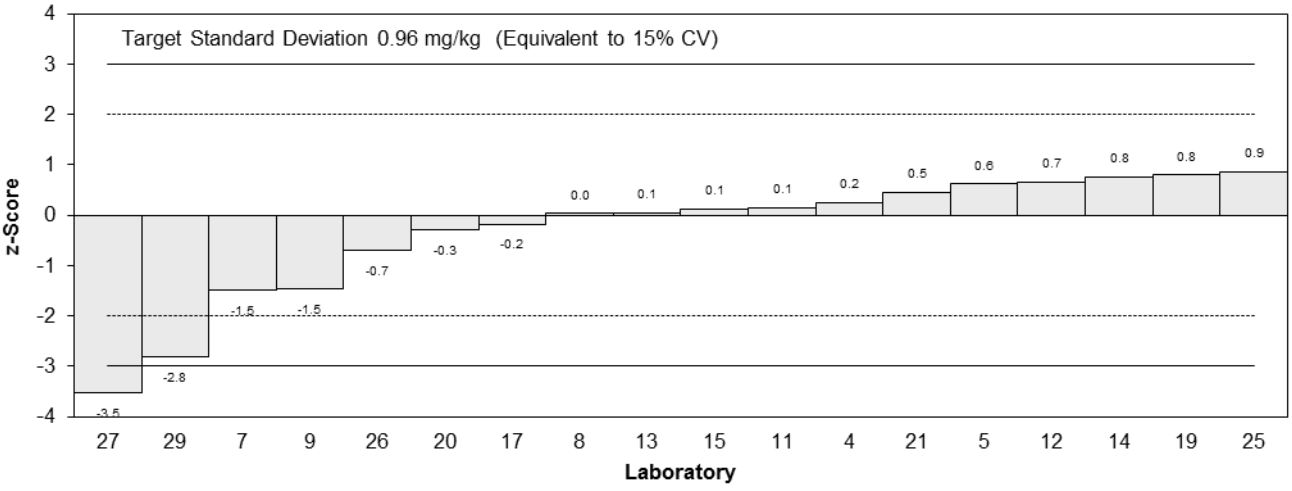
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	NT	NT		
3	<10	<2.5		
4	6.6	2	0.24	0.11
5	6.96	0.85	0.62	0.61
6	NT	NT		
7	4.94	0.7	-1.50	-1.70
8	6.4	0.79	0.03	0.03
9	4.98	1.73	-1.45	-0.78
10	NT	NT		
11	6.5	1.3	0.14	0.09
12	7.0	1.2	0.66	0.49
13	6.42	1.3	0.05	0.04
14	7.10	0.92	0.76	0.71
15	6.49	0.7	0.13	0.14
16	NT	NT		
17	6.2	2	-0.18	-0.08
18	NT	NT		
19	7.13	NR	0.80	1.62
20	6.1	2	-0.28	-0.13
21	6.8	0.78	0.45	0.47
22	NT	NT		
23	NT	NT		
24	NT	NT		
25	7.19	1.03	0.86	0.72
26	5.7	1.4	-0.70	-0.45
27	3	1	-3.53	-3.05
28	NT	NT		
29	3.67	1.05	-2.83	-2.35
30	NR	NR		

Statistics

Assigned Value*	6.37	0.47
Spike	7.14	0.14
Homogeneity Value	6.93	0.83
Robust Average	6.23	0.56
Median	6.46	0.39
Mean	6.07	
N	18	
Max.	7.19	
Min.	3	
Robust SD	0.95	
Robust CV	15%	

*Robust Average excluding Laboratory 27


Kernel Density
Density
Result
Results: S2 - Tl
Assigned Value = 6.37 ± 0.47 mg/kg
Results (mg/kg)
Laboratory
27 29 7 9 26 20 17 8 13 15 11 4 21 5 12 14 19 25 3 30 1 10 16 18 2 22 23 24 28 6 Md R.A. H.V. S.V.


z-Scores: S2 - Tl
Target Standard Deviation 0.96 mg/kg (Equivalent to 15% CV)
z-Score
Laboratory
27 29 7 9 26 20 17 8 13 15 11 4 21 5 12 14 19 25
-3.5 -2.8 -1.5 -1.5 -0.7 -0.3 -0.2 0.0 0.1 0.1 0.1 0.2 0.5 0.6 0.7 0.8 0.8 0.9

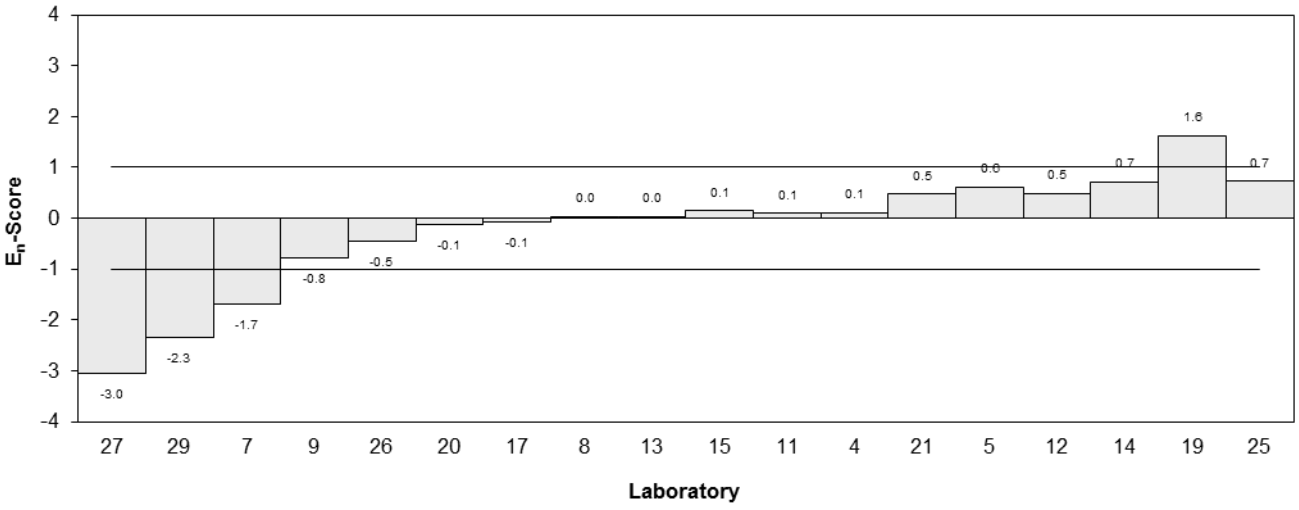

En-Scores: S2 - Tl
En-Score
Laboratory
27 29 7 9 26 20 17 8 13 15 11 4 21 5 12 14 19 25
-3.0 -2.3 -1.7 -0.8 -0.5 -0.1 -0.1 0.0 0.0 0.1 0.1 0.1 0.5 0.6 0.5 0.7 1.6 0.7

Figure 33

Table 45

Sample Details

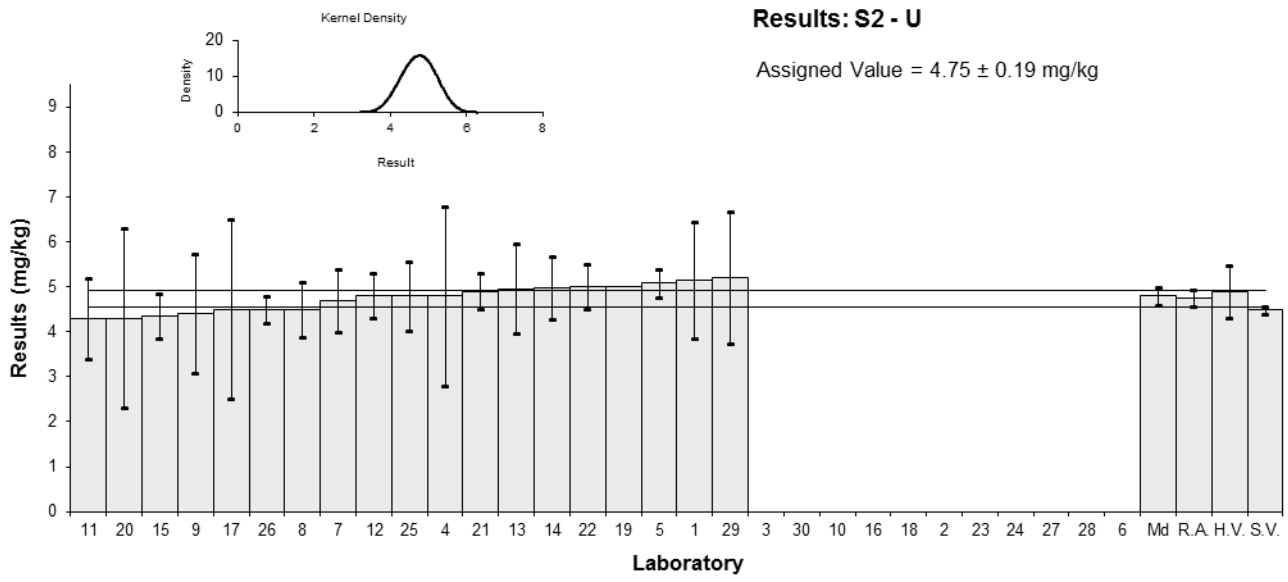
Sample No.	S2
Matrix.	Soil
Analyte.	U
Units	mg/kg

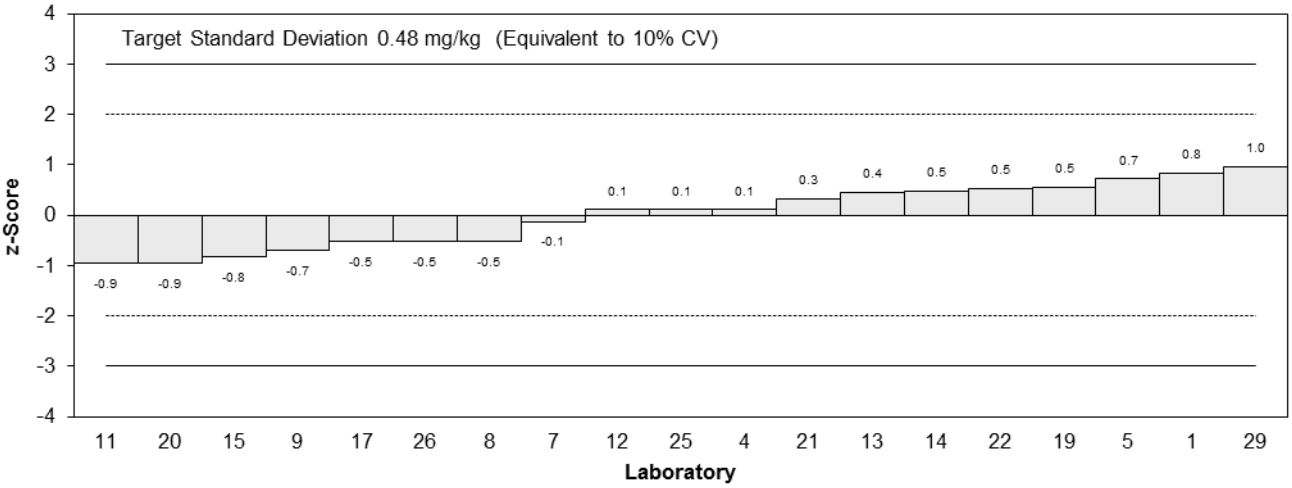
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	5.15	1.30	0.84	0.30
2	NT	NT		
3	<10	<2.5		
4	4.8	2	0.11	0.02
5	5.09	0.32	0.72	0.91
6	NT	NT		
7	4.69	0.7	-0.13	-0.08
8	4.5	0.61	-0.53	-0.39
9	4.42	1.33	-0.69	-0.25
10	NT	NT		
11	4.3	0.9	-0.95	-0.49
12	4.8	0.5	0.11	0.09
13	4.96	1.0	0.44	0.21
14	4.98	0.71	0.48	0.31
15	4.36	0.5	-0.82	-0.73
16	NT	NT		
17	4.5	2	-0.53	-0.12
18	NT	NT		
19	5.01	NR	0.55	1.37
20	4.3	2	-0.95	-0.22
21	4.9	0.40	0.32	0.34
22	5.0	0.5	0.53	0.47
23	NT	NT		
24	NT	NT		
25	4.8	0.78	0.11	0.06
26	4.5	0.3	-0.53	-0.70
27	NT	NT		
28	NT	NT		
29	5.21	1.48	0.97	0.31
30	NR	NR		

Statistics

Assigned Value	4.75	0.19
Spike	4.49	0.09
Homogeneity Value	4.90	0.59
Robust Average	4.75	0.19
Median	4.80	0.21
Mean	4.75	
N	19	
Max.	5.21	
Min.	4.3	
Robust SD	0.34	
Robust CV	7.2%	


Kernel Density
Density
Result
Results: S2 - U
Assigned Value = 4.75 ± 0.19 mg/kg
Results (mg/kg)
11 20 15 9 17 26 8 7 12 25 4 21 13 14 22 19 5 1 29 3 30 10 16 18 2 23 24 27 28 6 Md R.A. H.V. S.V.
Laboratory


z-Scores: S2 - U
Target Standard Deviation 0.48 mg/kg (Equivalent to 10% CV)
z-Score
-0.9 -0.9 -0.8 -0.7 -0.5 -0.5 -0.5 -0.1 0.1 0.1 0.1 0.3 0.4 0.5 0.5 0.5 0.7 0.8 1.0
11 20 15 9 17 26 8 7 12 25 4 21 13 14 22 19 5 1 29
Laboratory

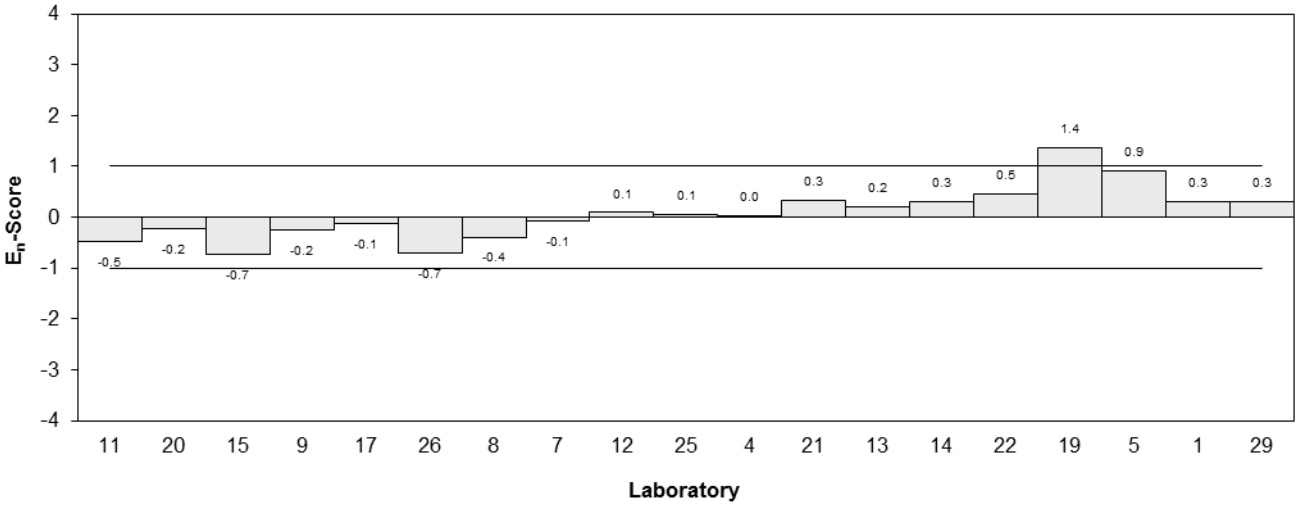

En-Scores: S2 - U
En-Score
-0.5 -0.2 -0.7 -0.2 -0.1 -0.7 -0.4 -0.1 0.1 0.1 0.0 0.3 0.2 0.3 0.5 1.4 0.9 0.3 0.3
11 20 15 9 17 26 8 7 12 25 4 21 13 14 22 19 5 1 29
Laboratory

Figure 34

Table 46

Sample Details

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

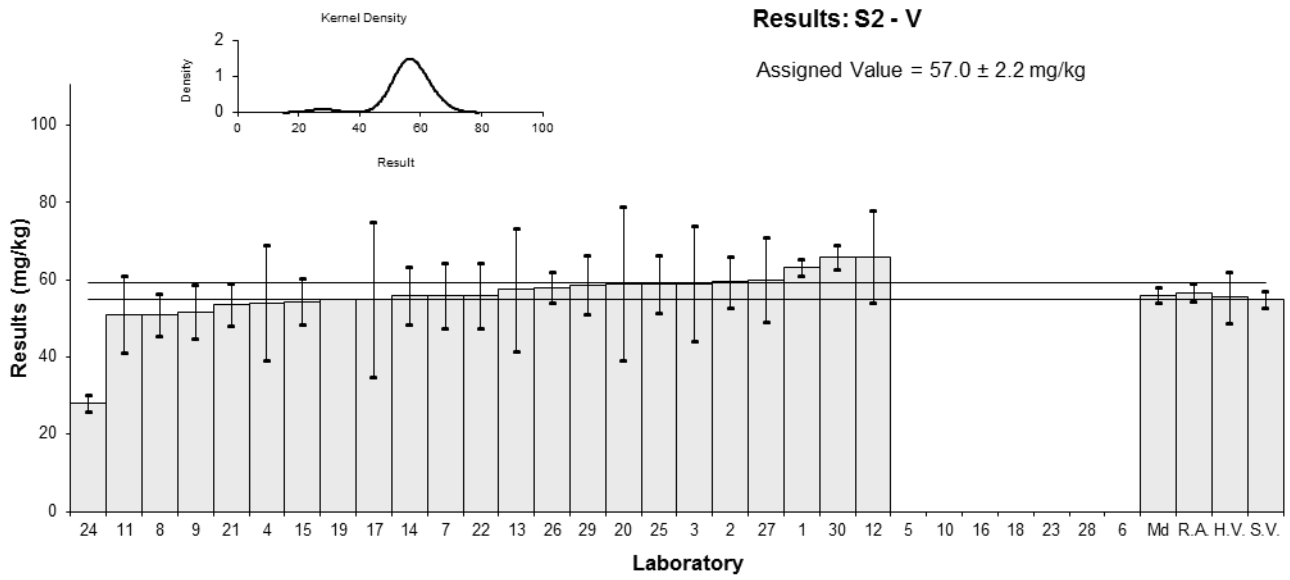
Participant Results

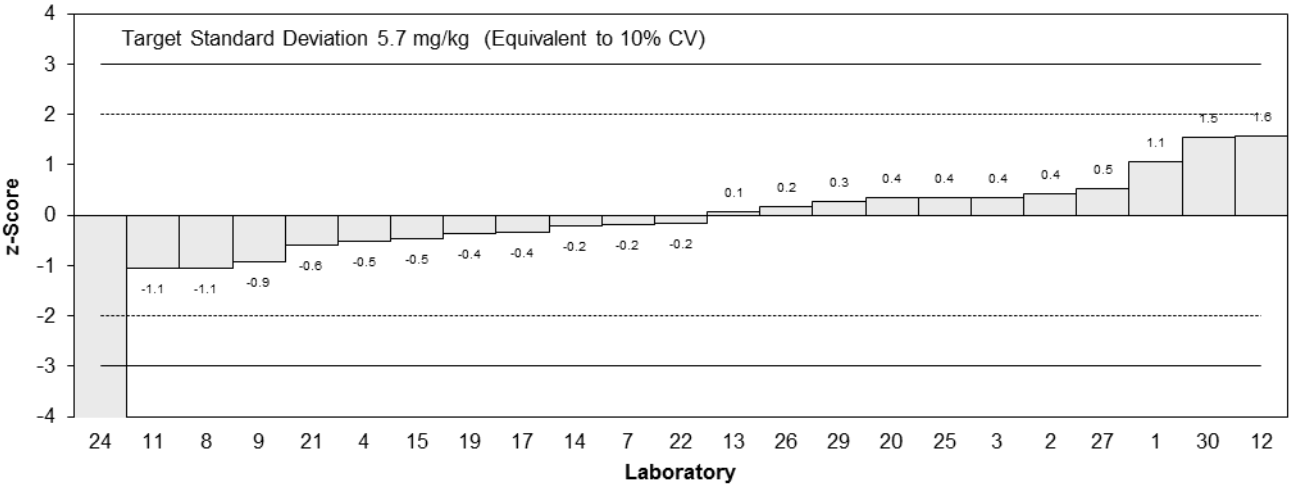
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	63.1	2.1	1.07	2.01
2	59.45	6.7	0.43	0.35
3	59	15	0.35	0.13
4	54	15	-0.53	-0.20
5	<100	67		
6	NT	NT		
7	55.98	8.4	-0.18	-0.12
8	51	5.4	-1.05	-1.03
9	51.7	6.9	-0.93	-0.73
10	NT	NT		
11	51	10	-1.05	-0.59
12	66	12	1.58	0.74
13	57.4	16	0.07	0.02
14	55.8	7.45	-0.21	-0.15
15	54.3	6.0	-0.47	-0.42
16	NT	NT		
17	55	20	-0.35	-0.10
18	NT	NT		
19	54.88	NR	-0.37	-0.96
20	59	20	0.35	0.10
21	53.6	5.34	-0.60	-0.59
22	56	8.4	-0.18	-0.12
23	NT	NT		
24	28.0	2.2	-5.09	-9.32
25	59	7.5	0.35	0.26
26	58	4	0.18	0.22
27	60	11	0.53	0.27
28	NT	NT		
29	58.6	7.66	0.28	0.20
30	65.83	3.11	1.55	2.32

Statistics

Assigned Value*	57.0	2.2
Spike	54.9	2.1
Homogeneity Value	55.5	6.7
Robust Average	56.7	2.3
Median	56.0	1.9
Mean	55.9	
N	23	
Max.	66	
Min.	28	
Robust SD	4.4	
Robust CV	7.8%	

*Robust Average excluding Laboratory 24


Kernel Density
Density
Result
Results: S2 - V
Assigned Value = 57.0 ± 2.2 mg/kg
Results (mg/kg)
Laboratory
24 11 8 9 21 4 15 19 17 14 7 22 13 26 29 20 25 3 2 27 1 30 12 5 10 16 18 23 28 6 Md R.A. H.V. S.V.


z-Scores: S2 - V
Target Standard Deviation 5.7 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
24 11 8 9 21 4 15 19 17 14 7 22 13 26 29 20 25 3 2 27 1 30 12

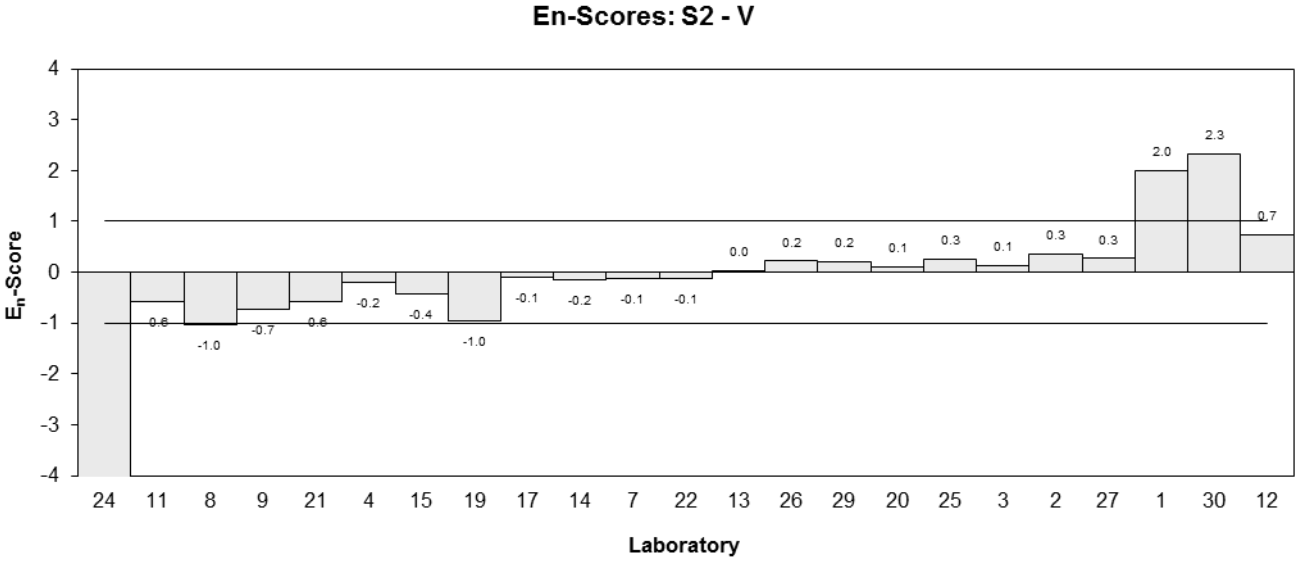

En-Scores: S2 - V
En-Score
Laboratory
24 11 8 9 21 4 15 19 17 14 7 22 13 26 29 20 25 3 2 27 1 30 12

Figure 35

Table 47

Sample Details

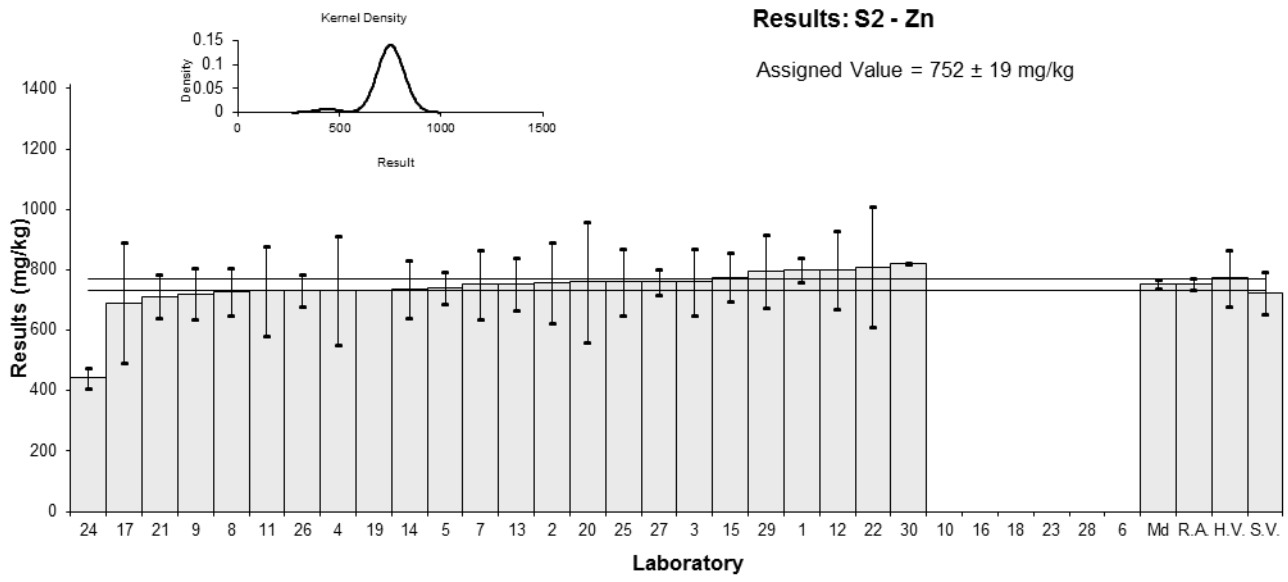
Sample No.	S2
Matrix.	Soil
Analyte.	Zn
Units	mg/kg

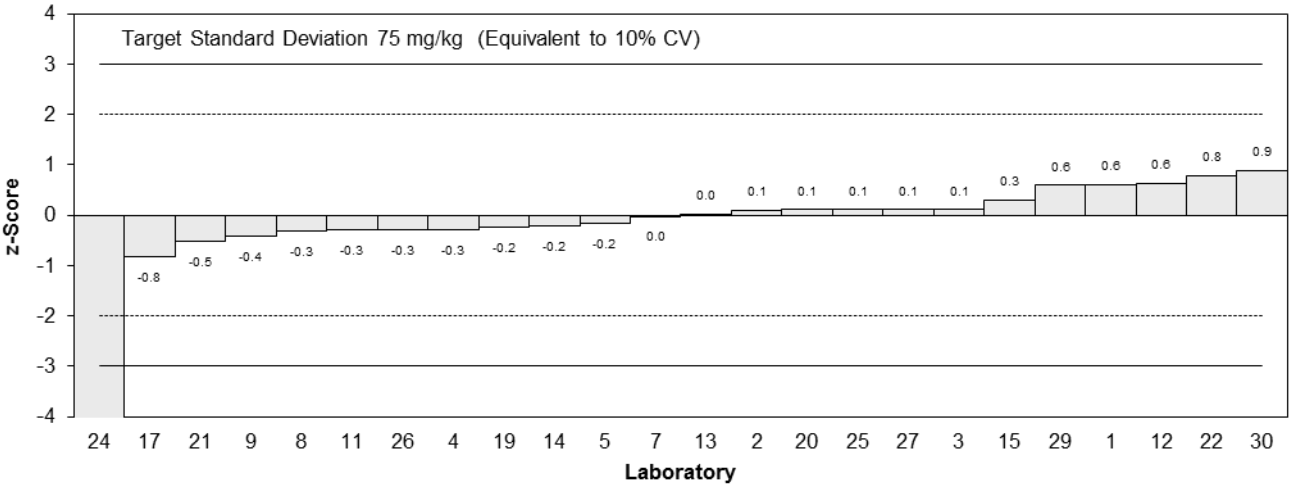
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	798	40	0.61	1.04
2	758.27	133	0.08	0.05
3	760	110	0.11	0.07
4	730	180	-0.29	-0.12
5	740	53	-0.16	-0.21
6	NT	NT		
7	751	113	-0.01	-0.01
8	728	78.3	-0.32	-0.30
9	721	85	-0.41	-0.36
10	NT	NT		
11	730	150	-0.29	-0.15
12	800	130	0.64	0.37
13	753	87	0.01	0.01
14	736	96.5	-0.21	-0.16
15	775	80	0.31	0.28
16	NT	NT		
17	690	200	-0.82	-0.31
18	NT	NT		
19	733.62	NR	-0.24	-0.97
20	760	200	0.11	0.04
21	712	72.1	-0.53	-0.54
22	810	200	0.77	0.29
23	NT	NT		
24	442	35	-4.12	-7.78
25	760	109	0.11	0.07
26	730	53	-0.29	-0.39
27	760	42	0.11	0.17
28	NT	NT		
29	796.3	120	0.59	0.36
30	819	2.32	0.89	3.50

Statistics

Assigned Value	752	19
Spike	724	71
Homogeneity Value	773	93
Robust Average	752	19
Median	752	14
Mean	741	
N	24	
Max.	819	
Min.	442	
Robust SD	38	
Robust CV	5.1%	


Kernel Density
Density
Result
Results: S2 - Zn
Assigned Value = 752 ± 19 mg/kg
Results (mg/kg)
Laboratory
24 17 21 9 8 11 26 4 19 14 5 7 13 2 20 25 27 3 15 29 1 12 22 30 10 16 18 23 28 6 Md R.A. H.V. S.V.


z-Scores: S2 - Zn
Target Standard Deviation 75 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
24 17 21 9 8 11 26 4 19 14 5 7 13 2 20 25 27 3 15 29 1 12 22 30

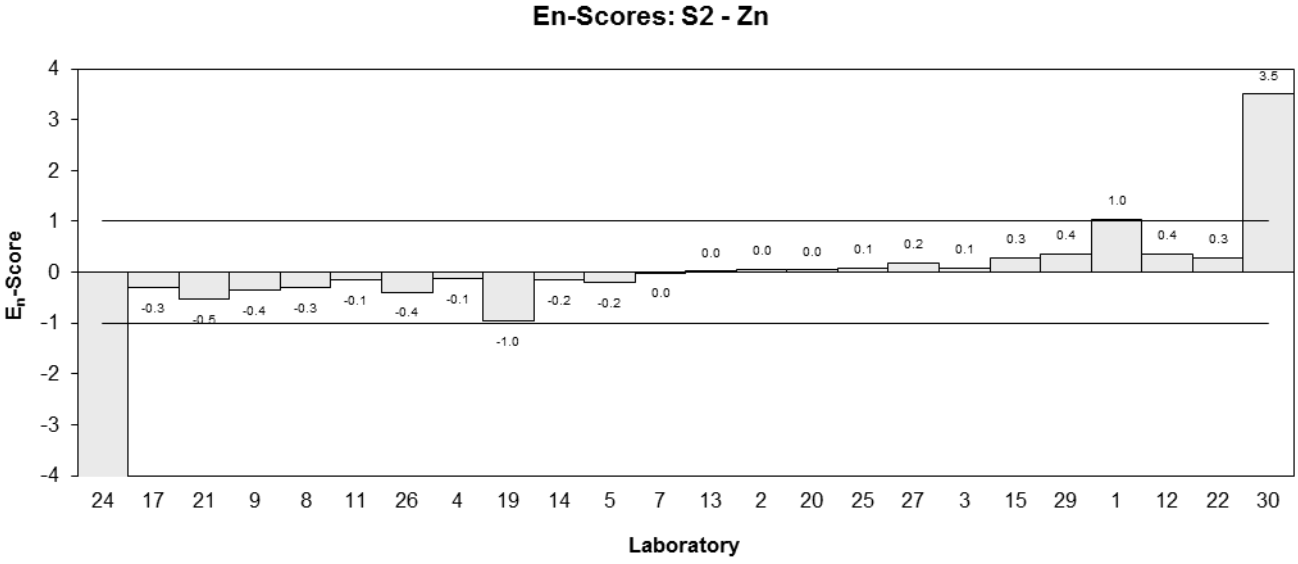

En-Scores: S2 - Zn
En-Score
Laboratory
24 17 21 9 8 11 26 4 19 14 5 7 13 2 20 25 27 3 15 29 1 12 22 30

Figure 36

Table 48

Sample Details

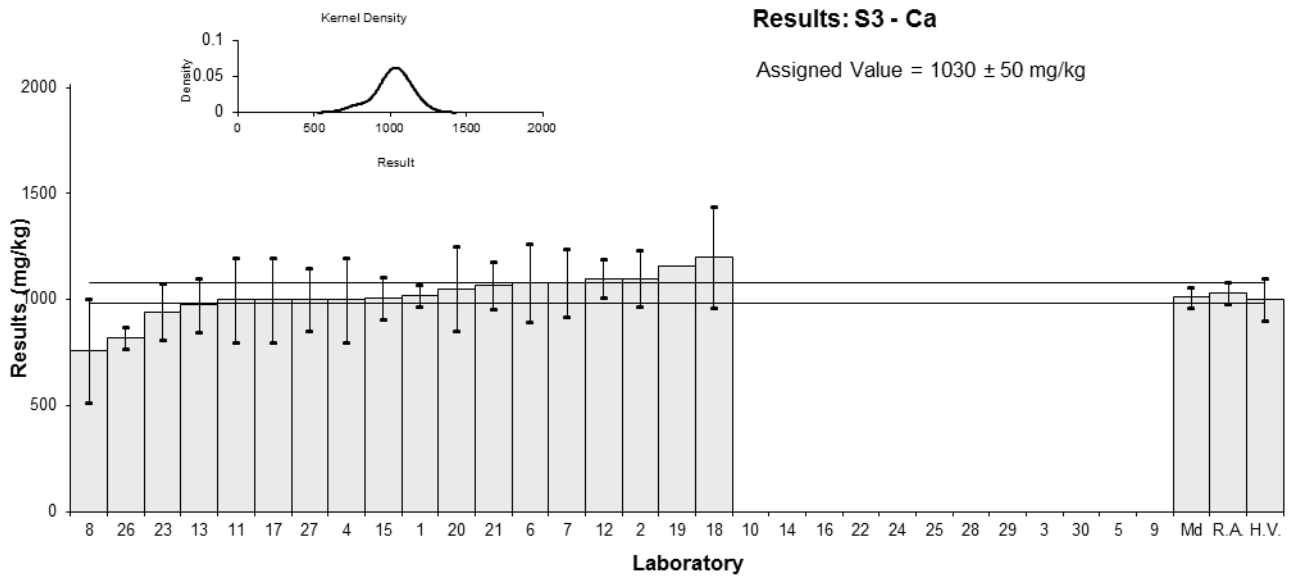
Sample No.	S3
Matrix.	Soil
Analyte.	Ca
Units	mg/kg

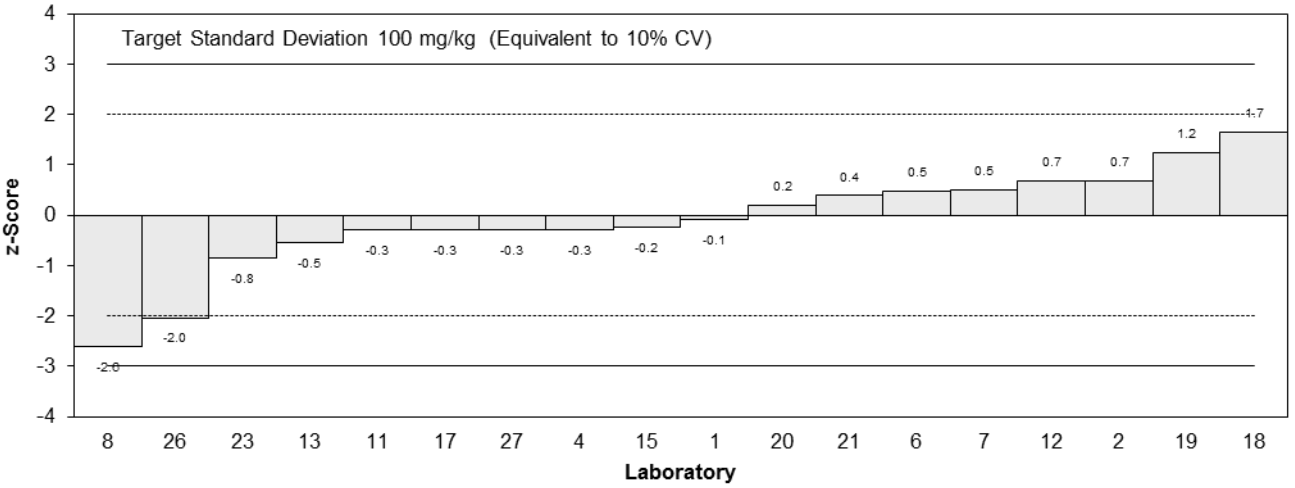
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	1020	50	-0.10	-0.14
2	1100	135	0.68	0.49
3	NT	NT		
4	1000	200	-0.29	-0.15
5	NT	NT		
6	1080	185	0.49	0.26
7	1082	160	0.50	0.31
8	760	243.2	-2.62	-1.09
9	NT	NT		
10	NR	NR		
11	1000	200	-0.29	-0.15
12	1100	93	0.68	0.66
13	974	125	-0.54	-0.42
14	NT	NT		
15	1005	100	-0.24	-0.22
16	NT	NT		
17	1000	200	-0.29	-0.15
18	1200	240	1.65	0.69
19	1158.6	NR	1.25	2.57
20	1050	200	0.19	0.10
21	1070	111.8	0.39	0.33
22	NT	NT		
23	943	132	-0.84	-0.62
24	NT	NT		
25	NT	NT		
26	820	50	-2.04	-2.97
27	1000	150	-0.29	-0.19
28	NT	NT		
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value	1030	50
Spike	Not Spiked	
Homogeneity Value	1000	100
Robust Average	1030	50
Median	1010	50
Mean	1020	
N	18	
Max.	1200	
Min.	760	
Robust SD	87	
Robust CV	8.4%	


Kernel Density
Density
Result
Results: S3 - Ca
Assigned Value = 1030 ± 50 mg/kg
Results (mg/kg)
Laboratory
8 26 23 13 11 17 27 4 15 1 20 21 6 7 12 2 19 18 10 14 16 22 24 25 28 29 3 30 5 9 Md R.A. H.V.


z-Scores: S3 - Ca
Target Standard Deviation 100 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
8 26 23 13 11 17 27 4 15 1 20 21 6 7 12 2 19 18

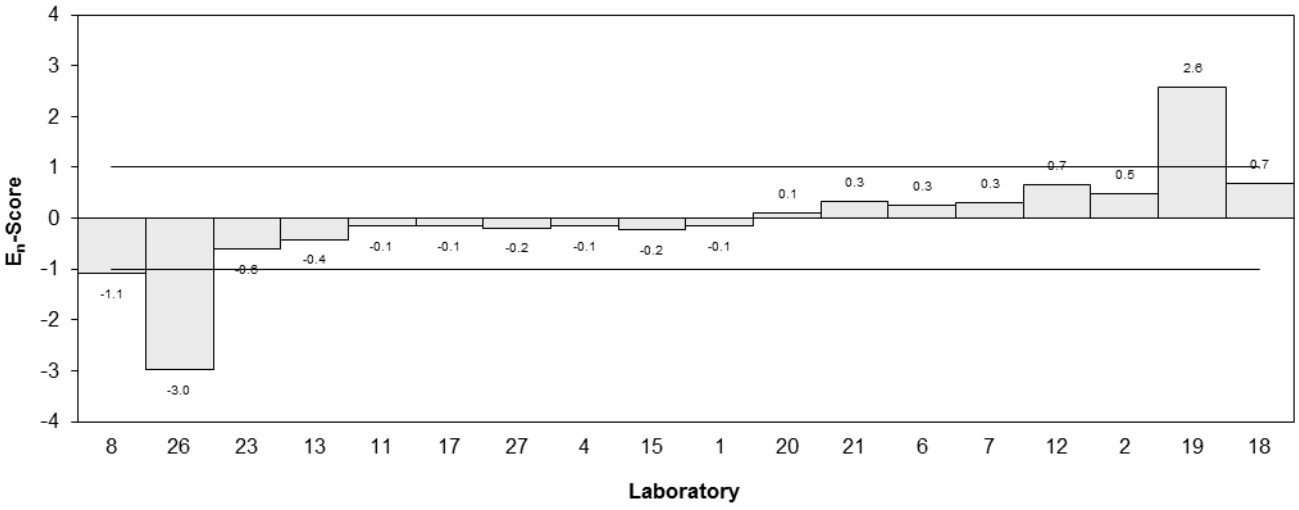

En-Scores: S3 - Ca
En-Score
Laboratory
8 26 23 13 11 17 27 4 15 1 20 21 6 7 12 2 19 18

Figure 37

Table 49

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	Colwell K
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	NR	NR
7	NT	NT
8	152	45.9
9	NT	NT
10	NR	NR
11	106	21
12	NT	NT
13	NT	NT
14	NT	NT
15	126	15
16	NT	NT
17	NT	NT
18	NT	NT
19	NR	NR
20	220	70
21	NT	NT
22	NT	NT
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	Not Spiked	
Homogeneity Value	160	19
Robust Average	151	70
Median	139	54
Mean	151	
N	4	
Max.	220	
Min.	106	
Robust SD	56	
Robust CV	37%	

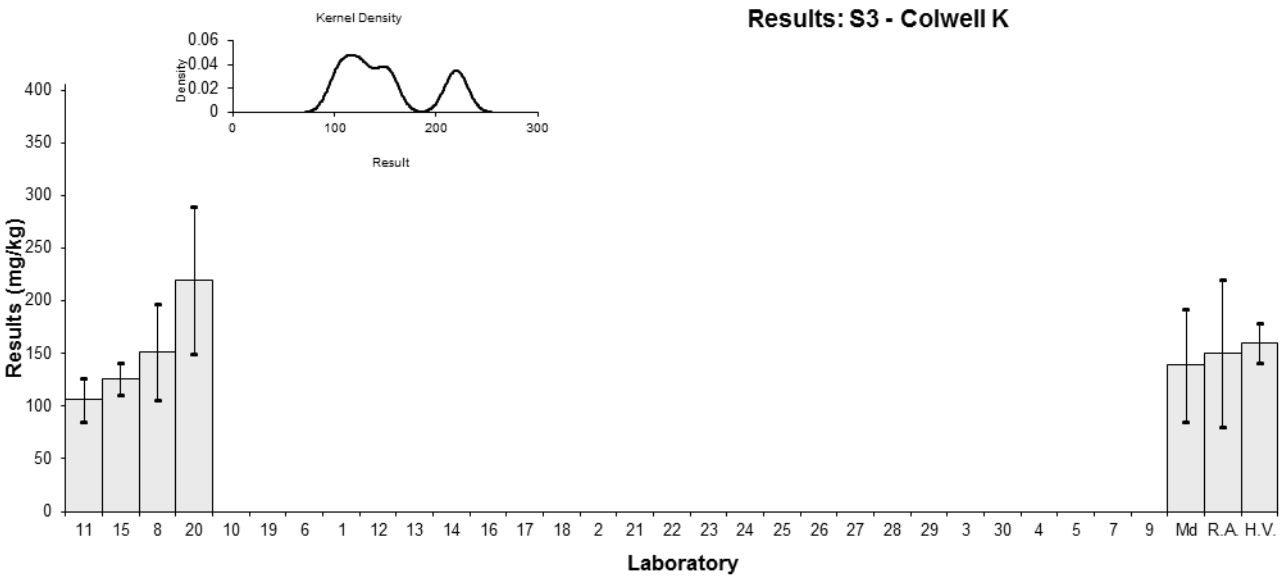

Results: S3 - Colwell K
Kernel Density
Density
0.06
0.04
0.02
0
0
100
200
300
Result
Results (mg/kg)
400
350
300
250
200
150
100
50
0
11 15 8 20 10 19 6 1 12 13 14 16 17 18 2 21 22 23 24 25 26 27 28 29 3 30 4 5 7 9 Md R.A. H.V.
Laboratory

Figure 38

Table 50

Sample Details

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

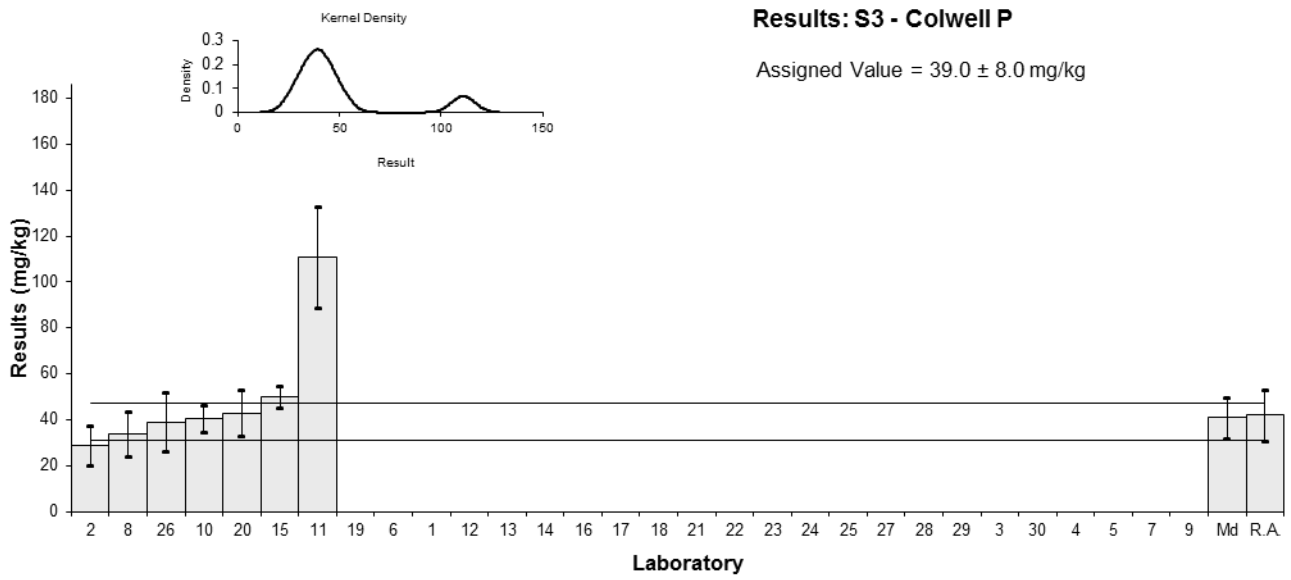
Participant Results

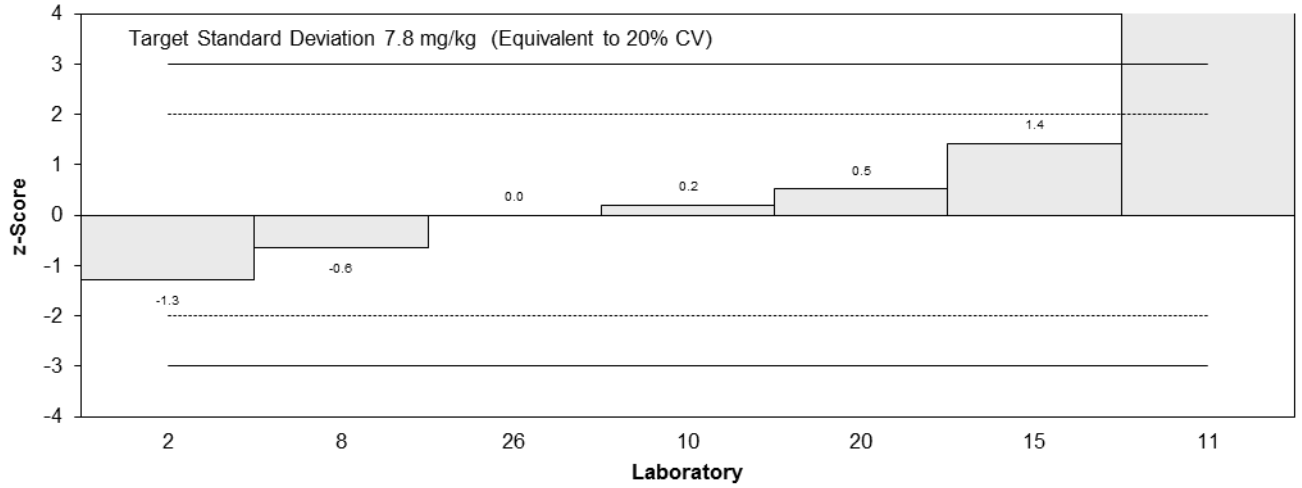
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	29	8.7	-1.28	-0.85
3	NT	NT		
4	NT	NT		
5	NT	NT		
6	NR	NR		
7	NT	NT		
8	34	9.7	-0.64	-0.40
9	NT	NT		
10	40.5	6	0.19	0.15
11	111	22	9.23	3.08
12	NT	NT		
13	NT	NT		
14	NT	NT		
15	50	5	1.41	1.17
16	NT	NT		
17	NT	NT		
18	NT	NT		
19	NR	NR		
20	43	10	0.51	0.31
21	NT	NT		
22	NT	NT		
23	NT	NT		
24	NT	NT		
25	NT	NT		
26	39	13	0.00	0.00
27	NT	NT		
28	NT	NT		
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value*	39.0	8.0
Spike	Not Spiked	
Robust Average	42	11
Median	41.0	9.0
Mean	49.5	
N	7	
Max.	111	
Min.	29	
Robust SD	11.3	
Robust CV	27%	

*Robust Average excluding Laboratory 11


Kernel Density
Density
Result
Results: S3 - Colwell P
Assigned Value = 39.0 ± 8.0 mg/kg
Results (mg/kg)
Laboratory
2 8 26 10 20 15 11 19 6 1 12 13 14 16 17 18 21 22 23 24 25 27 28 29 3 30 4 5 7 9 Md R.A.


z-Scores: S3 - Colwell P
Target Standard Deviation 7.8 mg/kg (Equivalent to 20% CV)
z-Score
Laboratory
2 8 26 10 20 15 11
-1.3
-0.6
0.0
0.2
0.5
1.4

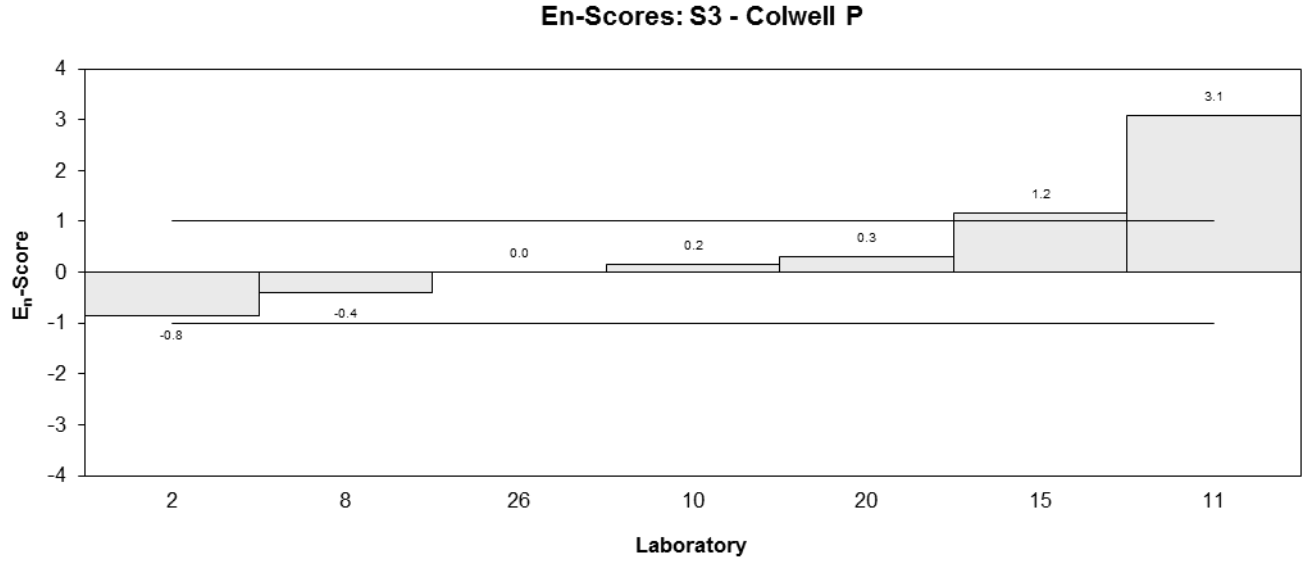

En-Scores: S3 - Colwell P
En-Score
Laboratory
2 8 26 10 20 15 11
-0.8
-0.4
0.0
0.2
0.3
1.2
3.1

Figure 39

Table 51

Sample Details

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

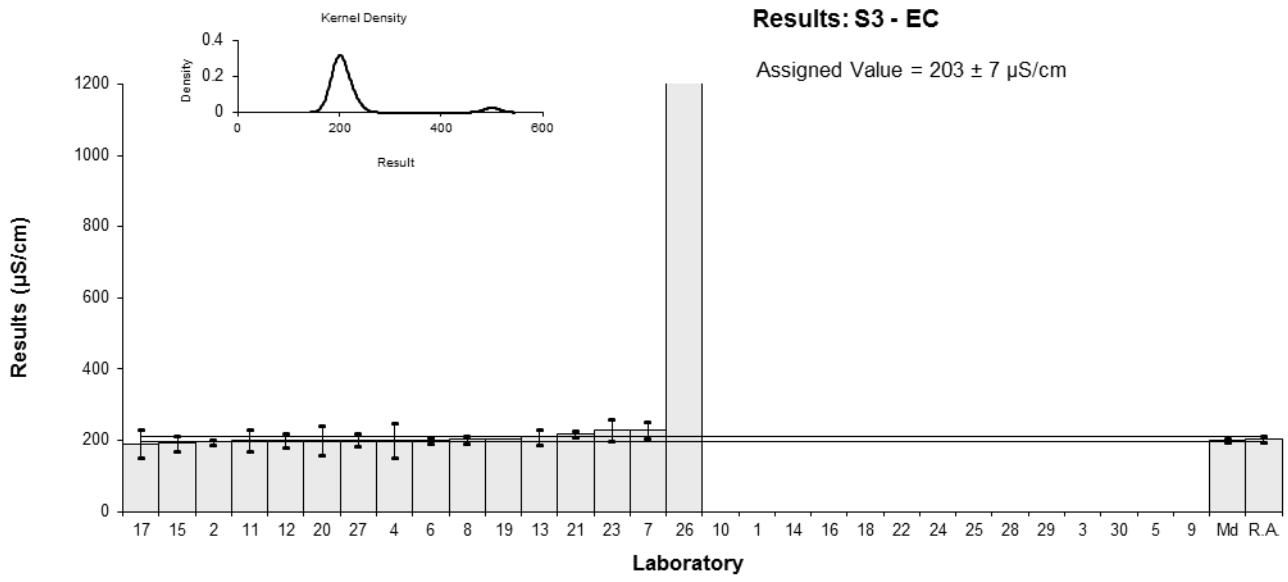
Participant Results

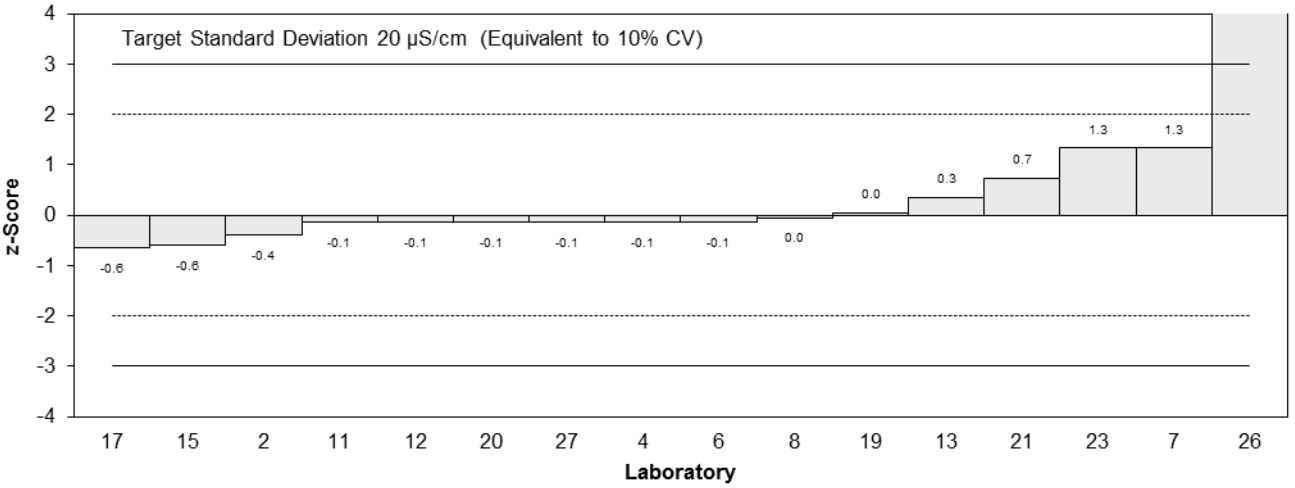
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	195	8.4	-0.39	-0.73
3	NT	NT		
4	200	50	-0.15	-0.06
5	NT	NT		
6	200	8	-0.15	-0.28
7	230	23	1.33	1.12
8	202	10.3	-0.05	-0.08
9	NT	NT		
10	NR	NR		
11	200	30	-0.15	-0.10
12	200	20	-0.15	-0.14
13	210	21	0.34	0.32
14	NT	NT		
15	191	20	-0.59	-0.57
16	NT	NT		
17	190	40	-0.64	-0.32
18	NT	NT		
19	204	NR	0.05	0.14
20	200	40	-0.15	-0.07
21	218	9.34	0.74	1.29
22	NT	NT		
23	230	30.8	1.33	0.85
24	NT	NT		
25	NT	NT		
26	1900	190	83.60	8.93
27	200	18	-0.15	-0.16
28	NT	NT		
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value*	203	7
Spike	Not Spiked	
Robust Average	205	9
Median	200	4
Mean	311	
N	16	
Max.	1900	
Min.	190	
Robust SD	14	
Robust CV	6.8%	

*Robust Average excluding Laboratory 26


Kernel Density
Density
Result
Results: S3 - EC
Assigned Value = 203 ± 7 µS/cm
Results (µS/cm)
Laboratory
17 15 2 11 12 20 27 4 6 8 19 13 21 23 7 26 10 1 14 16 18 22 24 25 28 29 3 30 5 9 Md R.A.


z-Scores: S3 - EC
Target Standard Deviation 20 µS/cm (Equivalent to 10% CV)
z-Score
Laboratory
17 15 2 11 12 20 27 4 6 8 19 13 21 23 7 26

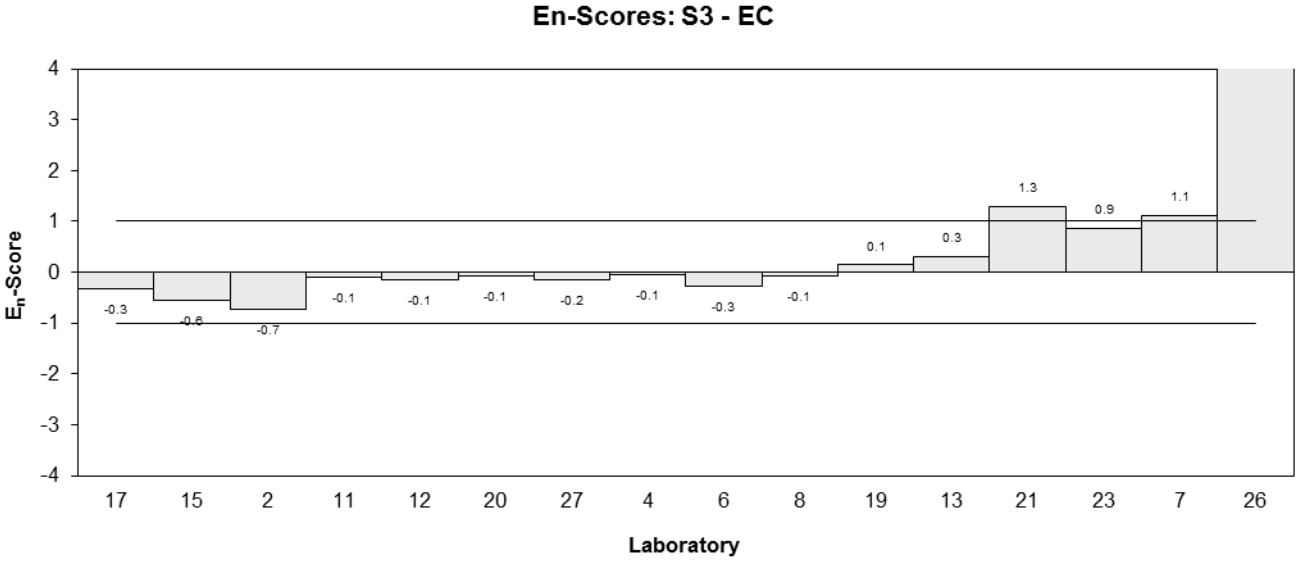

En-Scores: S3 - EC
En-Score
Laboratory
17 15 2 11 12 20 27 4 6 8 19 13 21 23 7 26

Figure 40

Table 52

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	Exchangeable Ca
Units	cmol(+)/kg

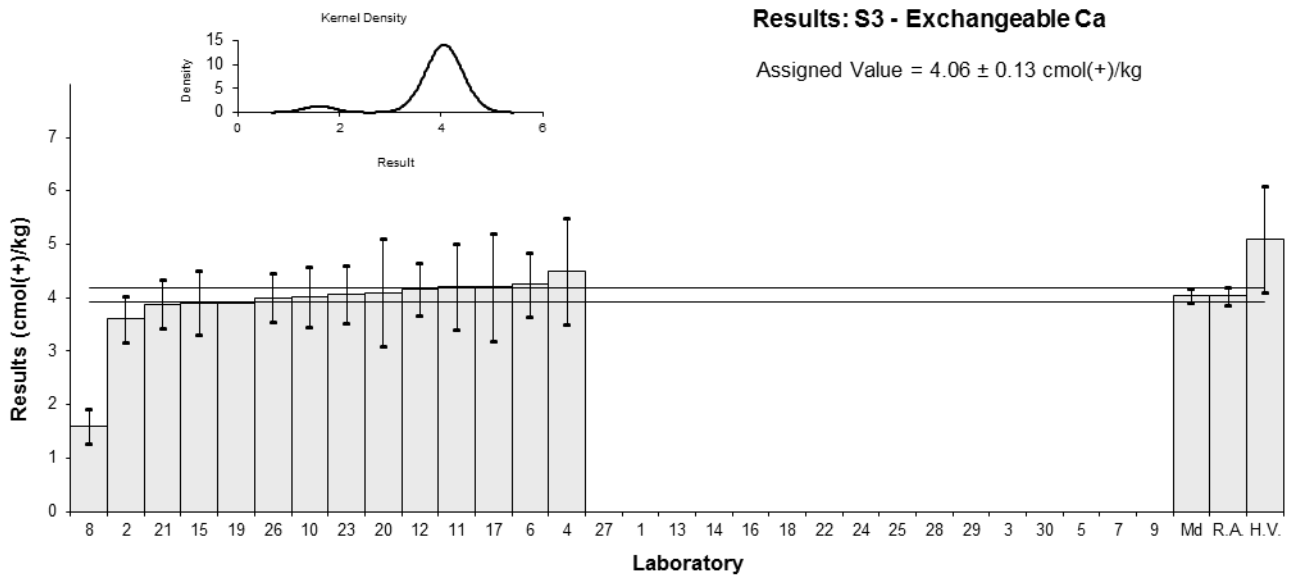
Participant Results

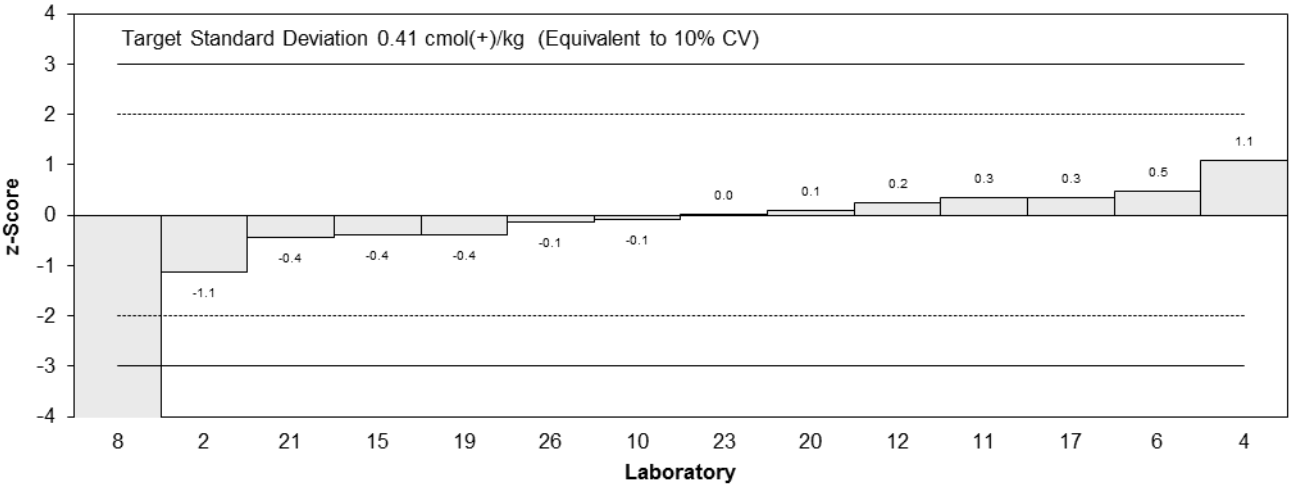
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	3.6	0.44	-1.13	-1.00
3	NT	NT		
4	4.5	1	1.08	0.44
5	NT	NT		
6	4.25	0.6	0.47	0.31
7	NT	NT		
8	1.6	0.32	-6.06	-7.12
9	NT	NT		
10	4.02	0.56	-0.10	-0.07
11	4.2	0.8	0.34	0.17
12	4.16	0.5	0.25	0.19
13	NT	NT		
14	NT	NT		
15	3.9	0.6	-0.39	-0.26
16	NT	NT		
17	4.2	1	0.34	0.14
18	NT	NT		
19	3.9	NR	-0.39	-1.23
20	4.1	1	0.10	0.04
21	3.88	0.46	-0.44	-0.38
22	NT	NT		
23	4.07	0.545	0.02	0.02
24	NT	NT		
25	NT	NT		
26	4	0.46	-0.15	-0.13
27	NR	NR		
28	NT	NT		
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value*	4.06	0.13
Spike	Not Spiked	
Homogeneity Value	5.10	1.00
Robust Average	4.03	0.16
Median	4.05	0.13
Mean	3.88	
N	14	
Max.	4.5	
Min.	1.6	
Robust SD	0.24	
Robust CV	6%	

*Robust Average excluding Laboratory 8


Kernel Density
Density
Result
Results: S3 - Exchangeable Ca
Assigned Value = 4.06 ± 0.13 cmol(+)/kg
Results (cmol(+)/kg)
8 2 21 15 19 26 10 23 20 12 11 17 6 4 27 1 13 14 16 18 22 24 25 28 29 3 30 5 7 9 Md R.A. H.V.
Laboratory


z-Scores: S3 - Exchangeable Ca
Target Standard Deviation 0.41 cmol(+)/kg (Equivalent to 10% CV)
z-Score
-1.1 -0.4 -0.4 -0.4 -0.1 -0.1 0.0 0.1 0.2 0.3 0.3 0.5 1.1
8 2 21 15 19 26 10 23 20 12 11 17 6 4
Laboratory

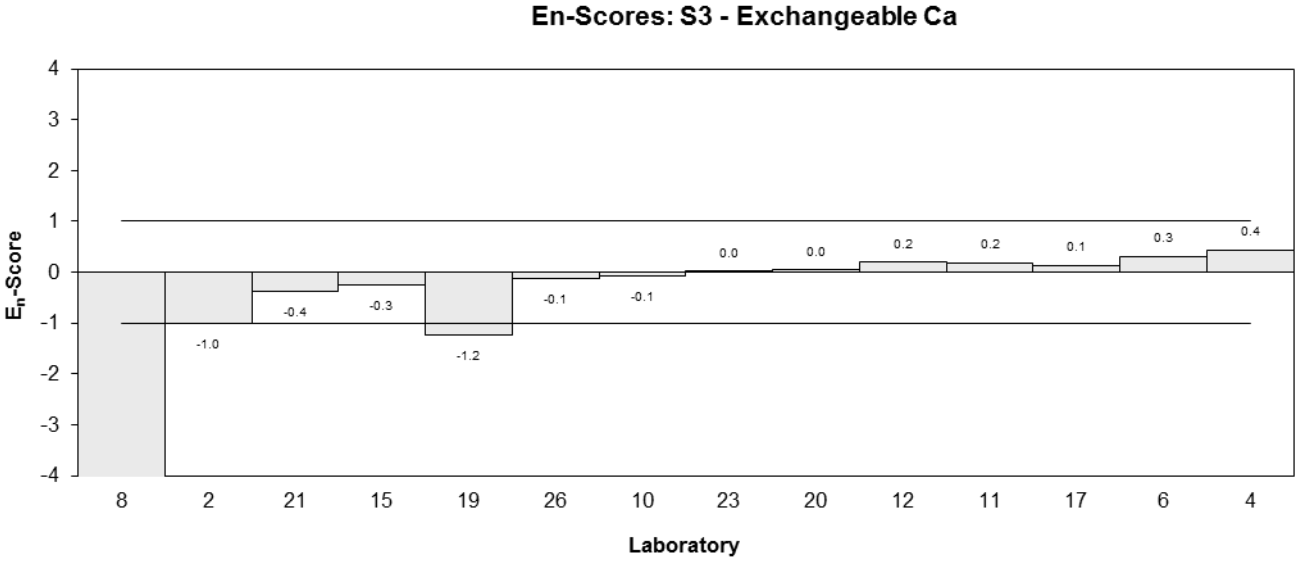

En-Scores: S3 - Exchangeable Ca
En-Score
-1.0 -0.4 -0.3 -1.2 -0.1 -0.1 0.0 0.0 0.2 0.2 0.1 0.3 0.4
8 2 21 15 19 26 10 23 20 12 11 17 6 4
Laboratory

Figure 41

Table 53

Sample Details

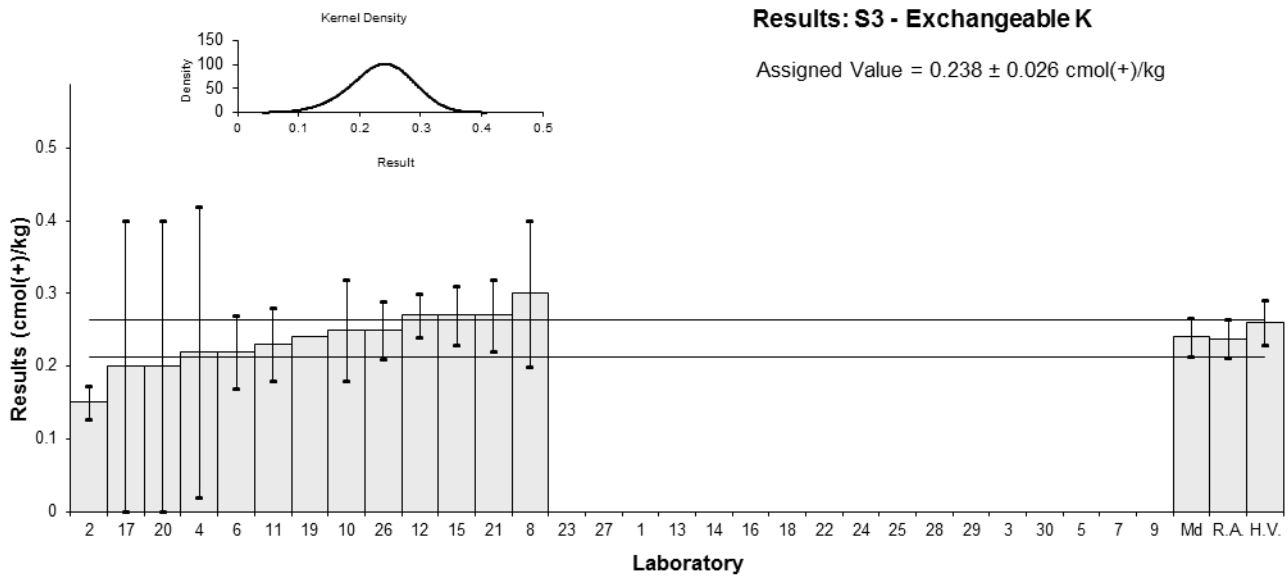
Sample No.	S3
Matrix.	Soil
Analyte.	Exchangeable K
Units	cmol(+)/kg

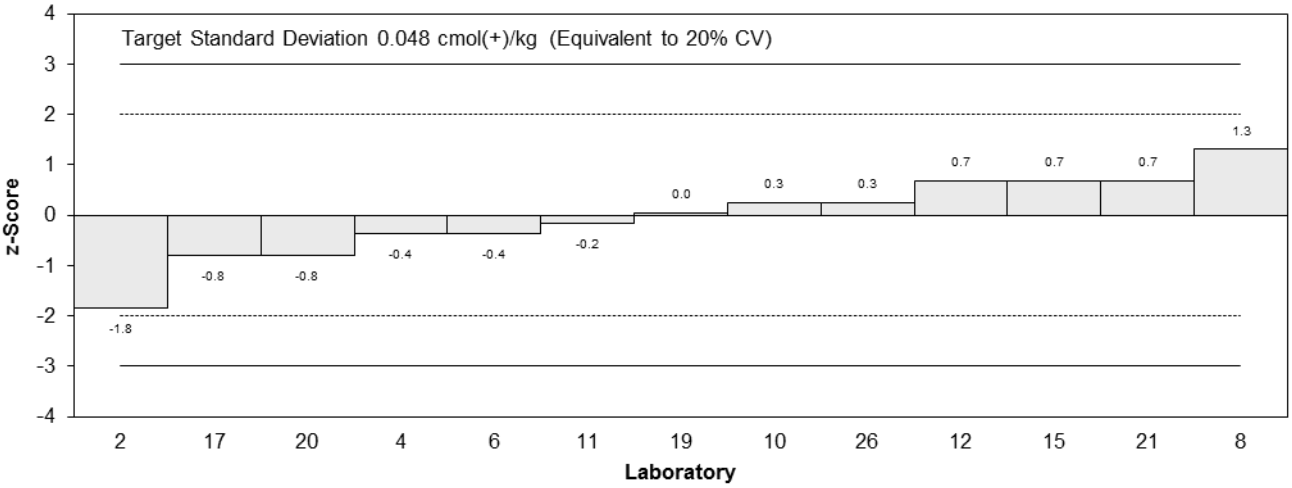
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	0.15	0.023	-1.85	-2.54
3	NT	NT		
4	0.22	0.2	-0.38	-0.09
5	NT	NT		
6	0.22	0.05	-0.38	-0.32
7	NT	NT		
8	0.3	0.10	1.30	0.60
9	NT	NT		
10	0.25	0.07	0.25	0.16
11	0.23	0.05	-0.17	-0.14
12	0.27	0.03	0.67	0.81
13	NT	NT		
14	NT	NT		
15	0.27	0.04	0.67	0.67
16	NT	NT		
17	0.2	0.2	-0.80	-0.19
18	NT	NT		
19	0.24	NR	0.04	0.08
20	0.2	0.2	-0.80	-0.19
21	0.27	0.05	0.67	0.57
22	NT	NT		
23	<0.5	0.106		
24	NT	NT		
25	NT	NT		
26	0.25	0.04	0.25	0.25
27	NR	NR		
28	NT	NT		
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value	0.238	0.026
Spike	Not Spiked	
Homogeneity Value	0.260	0.031
Robust Average	0.238	0.026
Median	0.240	0.027
Mean	0.236	
N	13	
Max.	0.3	
Min.	0.15	
Robust SD	0.038	
Robust CV	16%	


Kernel Density
Density
Result
Results: S3 - Exchangeable K
Assigned Value = 0.238 ± 0.026 cmol(+)/kg
Results (cmol(+)/kg)
Laboratory
2 17 20 4 6 11 19 10 26 12 15 21 8 23 27 1 13 14 16 18 22 24 25 28 29 3 30 5 7 9 Md R.A. H.V.


z-Scores: S3 - Exchangeable K
Target Standard Deviation 0.048 cmol(+)/kg (Equivalent to 20% CV)
z-Score
Laboratory
2 17 20 4 6 11 19 10 26 12 15 21 8
-1.8 -0.8 -0.8 -0.4 -0.4 -0.2 0.0 0.3 0.3 0.7 0.7 0.7 1.3

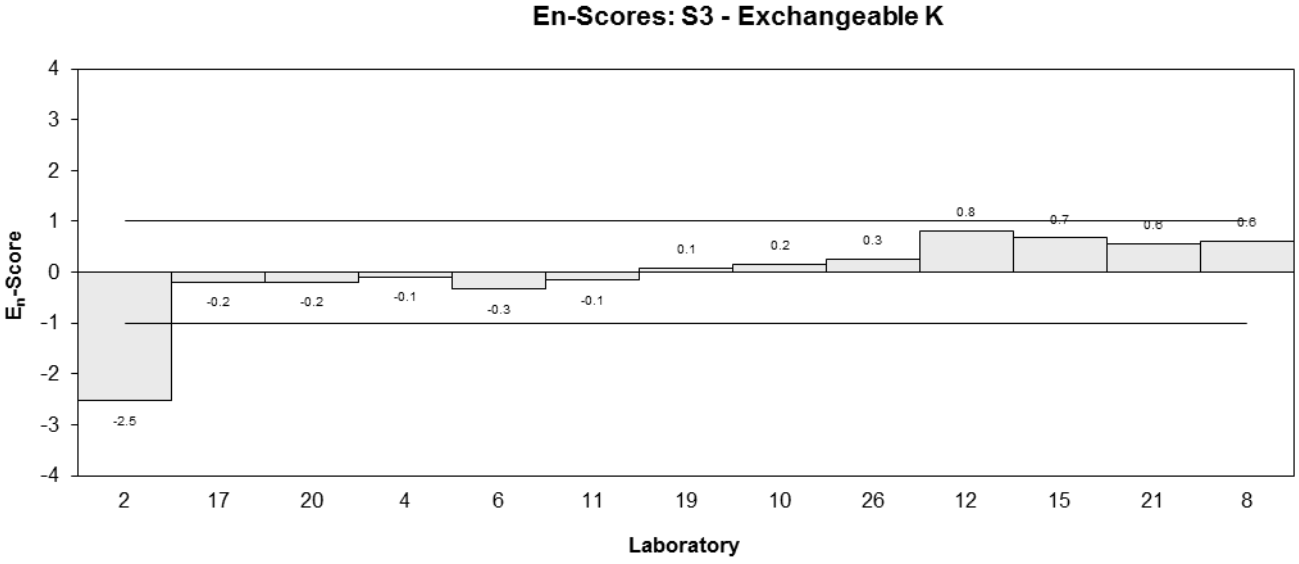

En-Scores: S3 - Exchangeable K
En-Score
Laboratory
2 17 20 4 6 11 19 10 26 12 15 21 8
-2.5 -0.2 -0.2 -0.1 -0.3 -0.1 0.1 0.2 0.3 0.8 0.7 0.6 0.6

Figure 42

Table 54

Sample Details

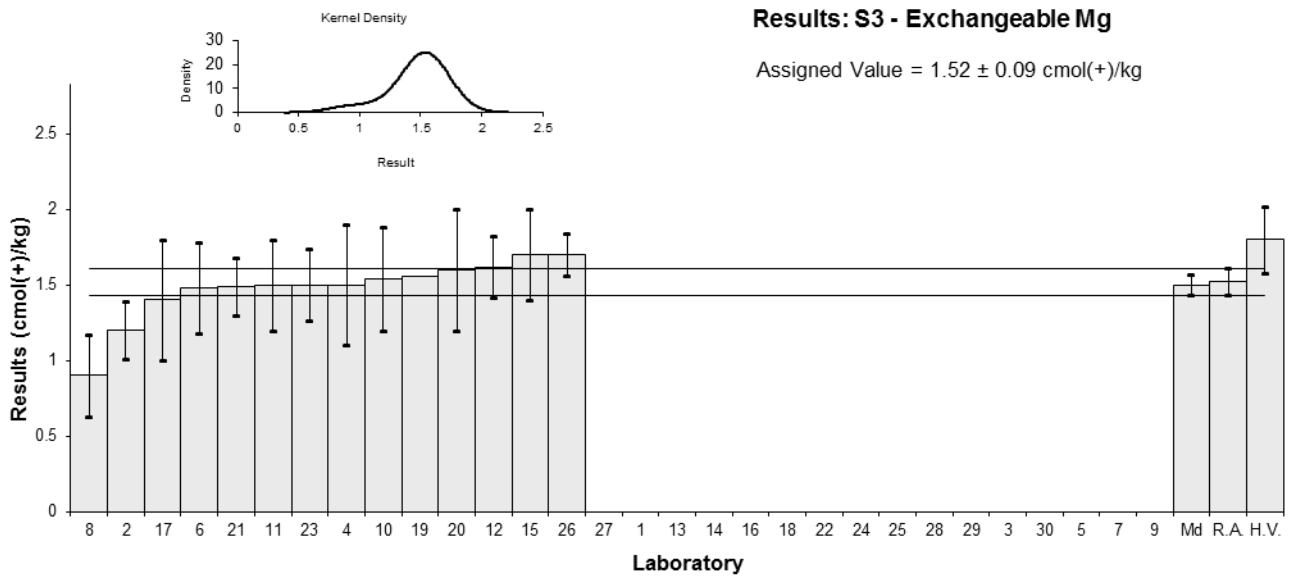
Sample No.	S3
Matrix.	Soil
Analyte.	Exchangeable Mg
Units	cmol(+)/kg

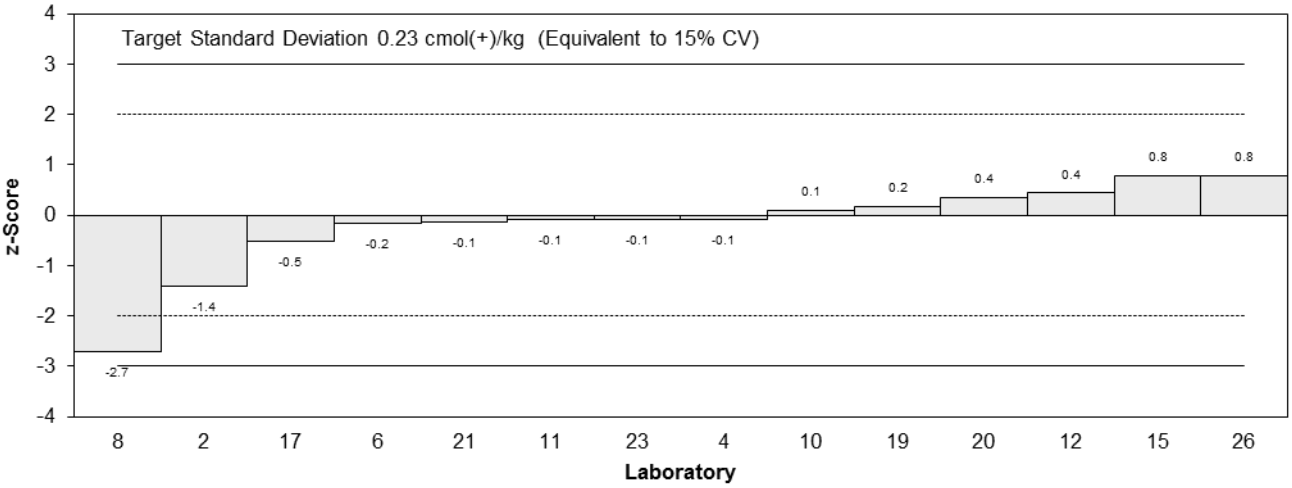
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	1.2	0.192	-1.40	-1.51
3	NT	NT		
4	1.5	0.4	-0.09	-0.05
5	NT	NT		
6	1.48	0.3	-0.18	-0.13
7	NT	NT		
8	0.9	0.27	-2.72	-2.18
9	NT	NT		
10	1.54	0.34	0.09	0.06
11	1.5	0.3	-0.09	-0.06
12	1.62	0.2	0.44	0.46
13	NT	NT		
14	NT	NT		
15	1.7	0.3	0.79	0.57
16	NT	NT		
17	1.4	0.4	-0.53	-0.29
18	NT	NT		
19	1.56	NR	0.18	0.44
20	1.6	0.4	0.35	0.20
21	1.49	0.19	-0.13	-0.14
22	NT	NT		
23	1.50	0.237	-0.09	-0.08
24	NT	NT		
25	NT	NT		
26	1.7	0.14	0.79	1.08
27	NR	NR		
28	NT	NT		
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value	1.52	0.09
Spike	Not Spiked	
Homogeneity Value	1.80	0.22
Robust Average	1.52	0.09
Median	1.50	0.07
Mean	1.48	
N	14	
Max.	1.7	
Min.	0.9	
Robust SD	0.14	
Robust CV	9.2%	


Results: S3 - Exchangeable Mg
Assigned Value = 1.52 ± 0.09 cmol(+)/kg
Kernel Density
Density
Result
Results (cmol(+)/kg)
Laboratory
8 2 17 6 21 11 23 4 10 19 20 12 15 26 27 1 13 14 16 18 22 24 25 28 29 3 30 5 7 9 Md R.A. H.V.


z-Scores: S3 - Exchangeable Mg
Target Standard Deviation 0.23 cmol(+)/kg (Equivalent to 15% CV)
z-Score
Laboratory
8 2 17 6 21 11 23 4 10 19 20 12 15 26
-2.7 -1.4 -0.5 -0.2 -0.1 -0.1 -0.1 -0.1 0.1 0.2 0.4 0.4 0.8 0.8

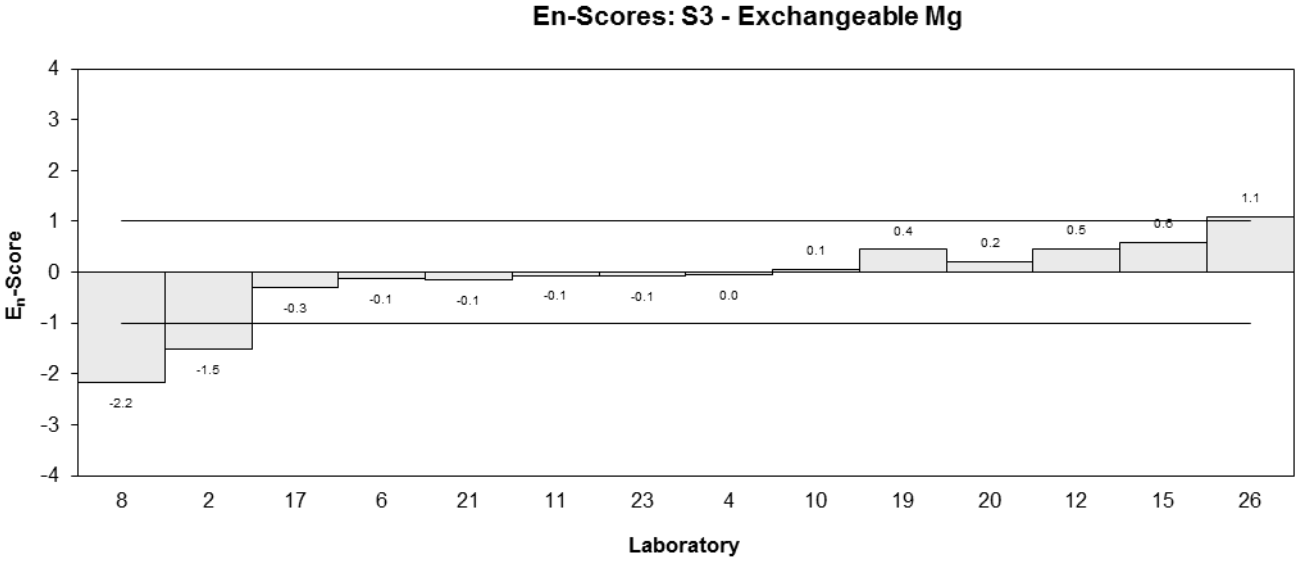

En-Scores: S3 - Exchangeable Mg
En-Score
Laboratory
8 2 17 6 21 11 23 4 10 19 20 12 15 26
-2.2 -1.5 -0.3 -0.1 -0.1 -0.1 -0.1 0.0 0.1 0.4 0.2 0.5 0.6 1.1

Figure 43

Table 55

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	Exchangeable Na
Units	cmol(+)/kg

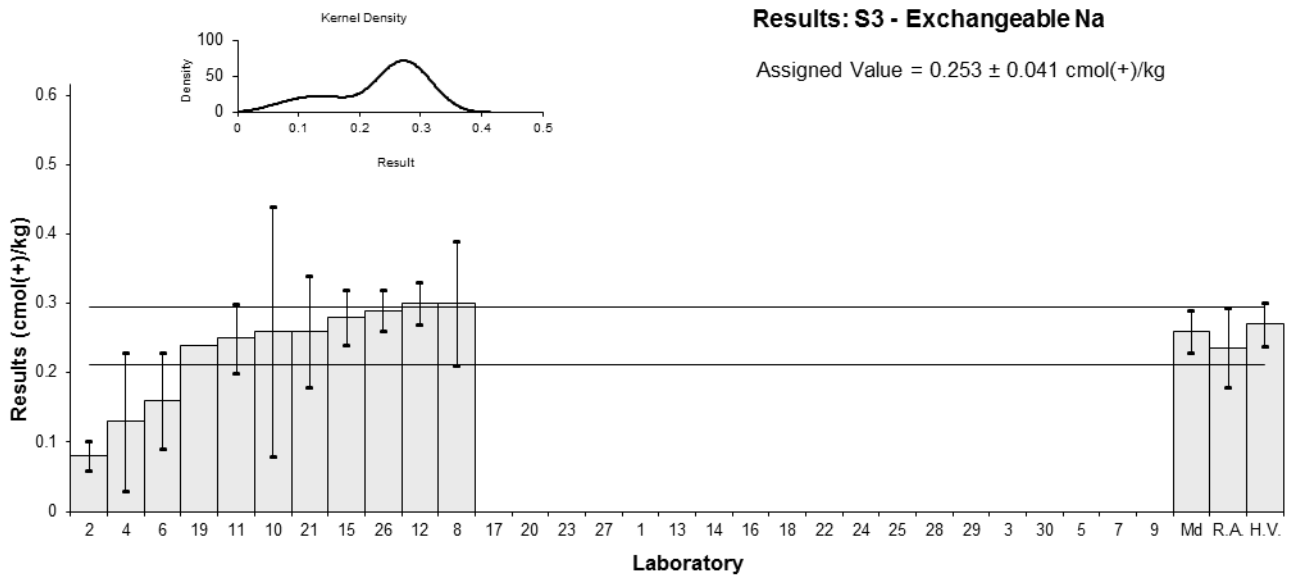
Participant Results

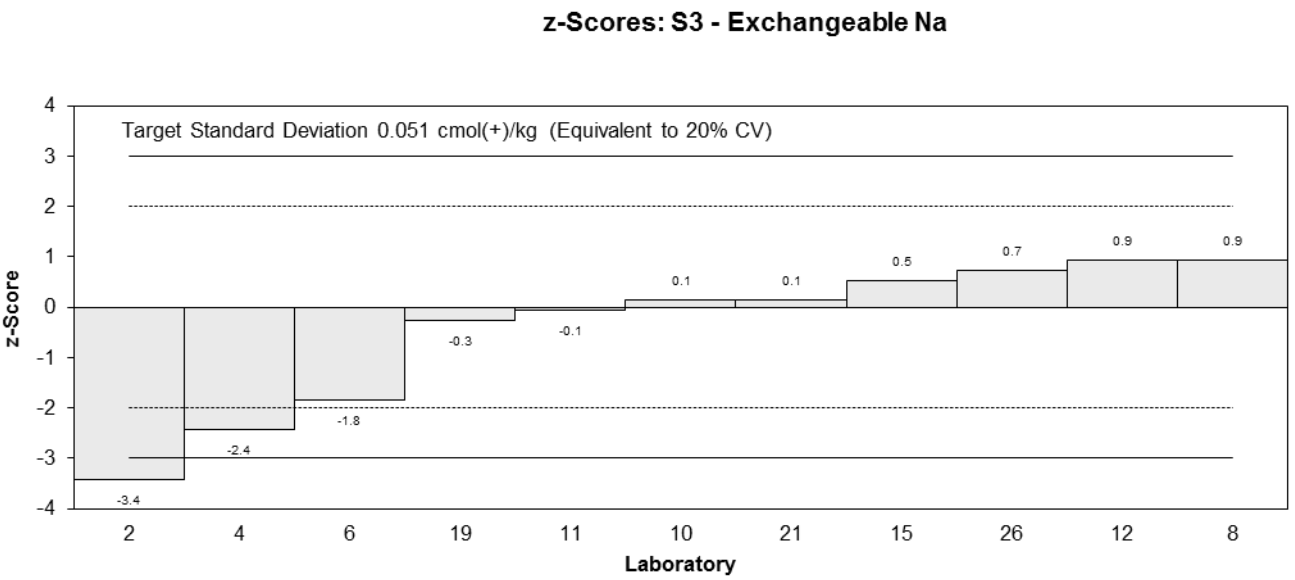
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	0.08	0.021	-3.42	-3.76
3	NT	NT		
4	0.13	0.1	-2.43	-1.14
5	NT	NT		
6	0.16	0.07	-1.84	-1.15
7	NT	NT		
8	0.3	0.09	0.93	0.48
9	NT	NT		
10	0.26	0.18	0.14	0.04
11	0.25	0.05	-0.06	-0.05
12	0.3	0.03	0.93	0.93
13	NT	NT		
14	NT	NT		
15	0.28	0.04	0.53	0.47
16	NT	NT		
17	<0.1	NR		
18	NT	NT		
19	0.24	NR	-0.26	-0.32
20	<0.3	NR		
21	0.26	0.08	0.14	0.08
22	NT	NT		
23	<0.5	0.0964		
24	NT	NT		
25	NT	NT		
26	0.29	0.03	0.73	0.73
27	NR	NR		
28	NT	NT		
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value*	0.253	0.041
Spike	Not Spiked	
Homogeneity Value	0.270	0.032
Robust Average	0.236	0.057
Median	0.260	0.030
Mean	0.232	
N	11	
Max.	0.3	
Min.	0.08	
Robust SD	0.075	
Robust CV	32%	

*Robust Average excluding Laboratory 2


Kernel Density
Density
Result
Results: S3 - Exchangeable Na
Assigned Value = 0.253 ± 0.041 cmol(+)/kg
Results (cmol(+)/kg)
Laboratory
2 4 6 19 11 10 21 15 26 12 8 17 20 23 27 1 13 14 16 18 22 24 25 28 29 3 30 5 7 9 Md R.A. H.V.


z-Scores: S3 - Exchangeable Na
Target Standard Deviation 0.051 cmol(+)/kg (Equivalent to 20% CV)
z-Score
Laboratory
2 4 6 19 11 10 21 15 26 12 8
-3.4 -2.4 -1.8 -0.3 -0.1 0.1 0.1 0.5 0.7 0.9 0.9

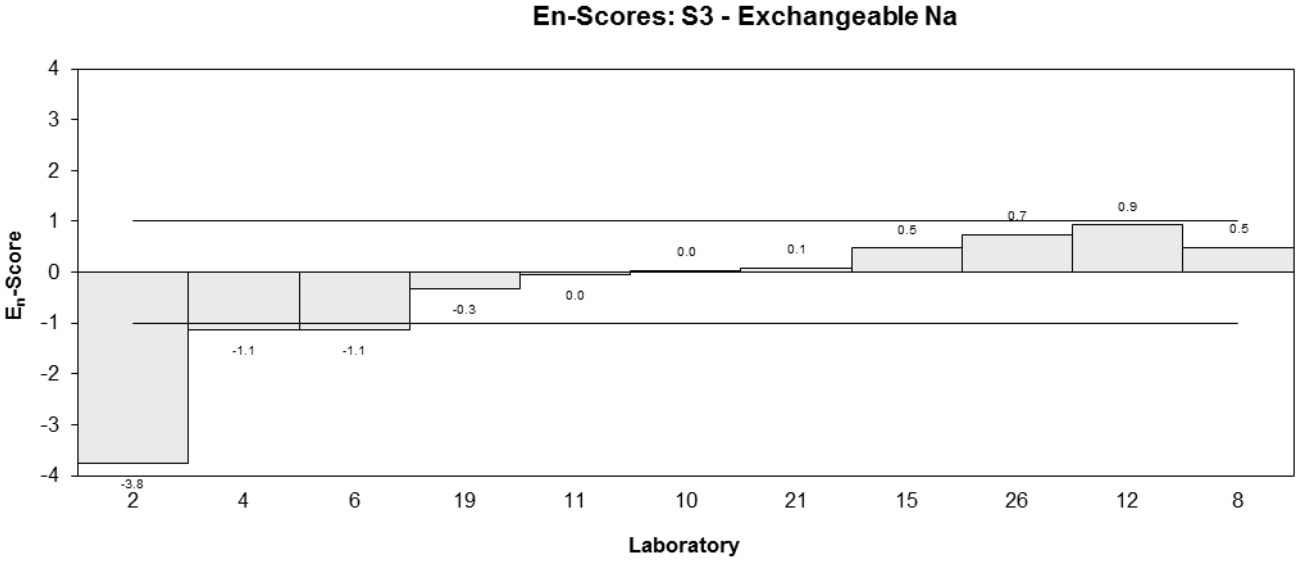

En-Scores: S3 - Exchangeable Na
En-Score
Laboratory
2 4 6 19 11 10 21 15 26 12 8
-3.8 -1.1 -1.1 -0.3 0.0 0.0 0.1 0.5 0.7 0.9 0.5

Figure 44

Table 56

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	Extractable B
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	NR	NR
7	NT	NT
8	1.5	0.9
9	NT	NT
10	NR	NR
11	NR	NR
12	NT	NT
13	NT	NT
14	NT	NT
15	0.54	0.08
16	NT	NT
17	0.6	0.4
18	NT	NT
19	0.2	NR
20	0.6	0.4
21	NT	NT
22	NT	NT
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	Not Spiked	
Robust Average	0.69	0.61
Median	0.60	0.11
Mean	0.69	
N	5	
Max.	1.5	
Min.	0.2	
Robust SD	0.55	
Robust CV	80%	

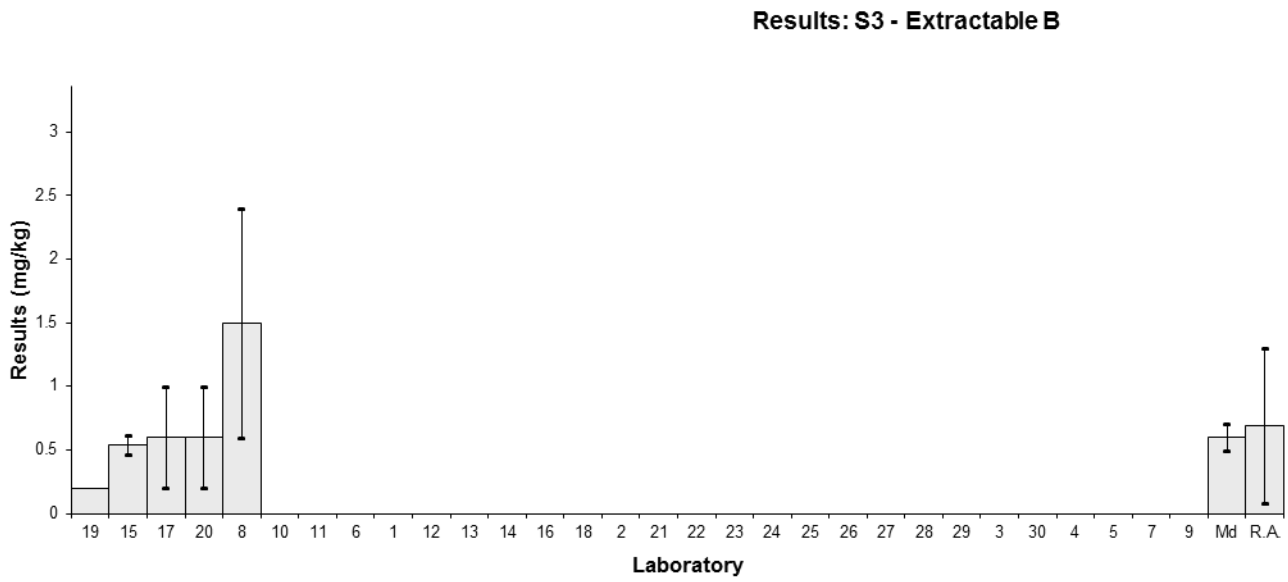

Results: S3 - Extractable B
Results (mg/kg)
3
2.5
2
1.5
1
0.5
0
19 15 17 20 8 10 11 6 1 12 13 14 16 18 2 21 22 23 24 25 26 27 28 29 3 30 4 5 7 9 Md R.A.
Laboratory

Figure 45

Table 57

Sample Details

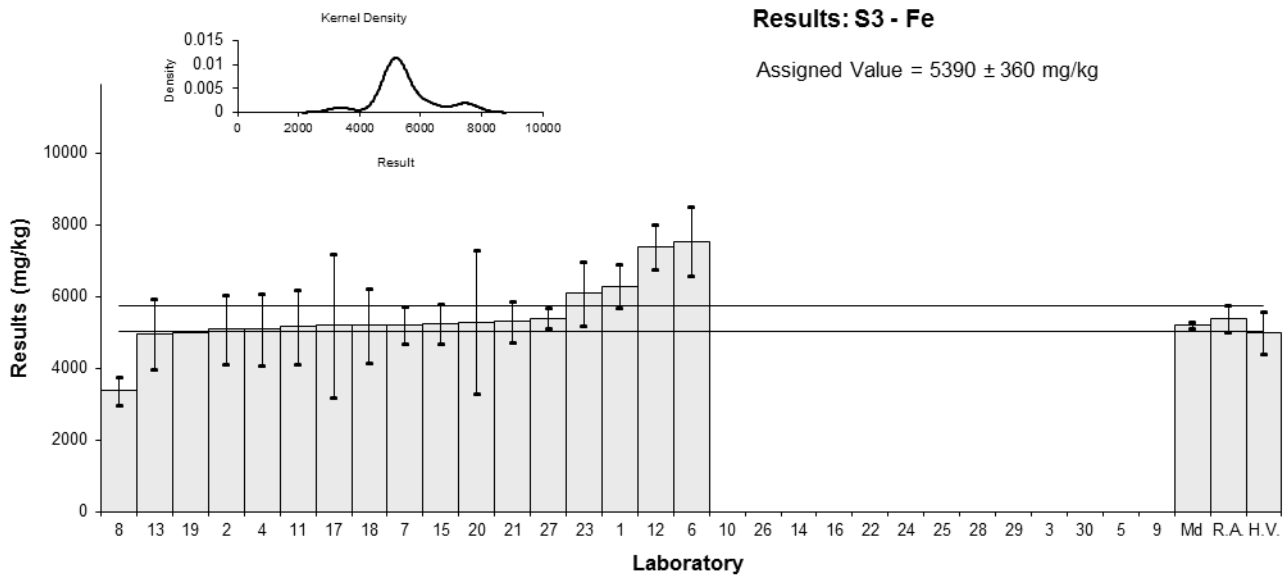
Sample No.	S3
Matrix.	Soil
Analyte.	Fe
Units	mg/kg

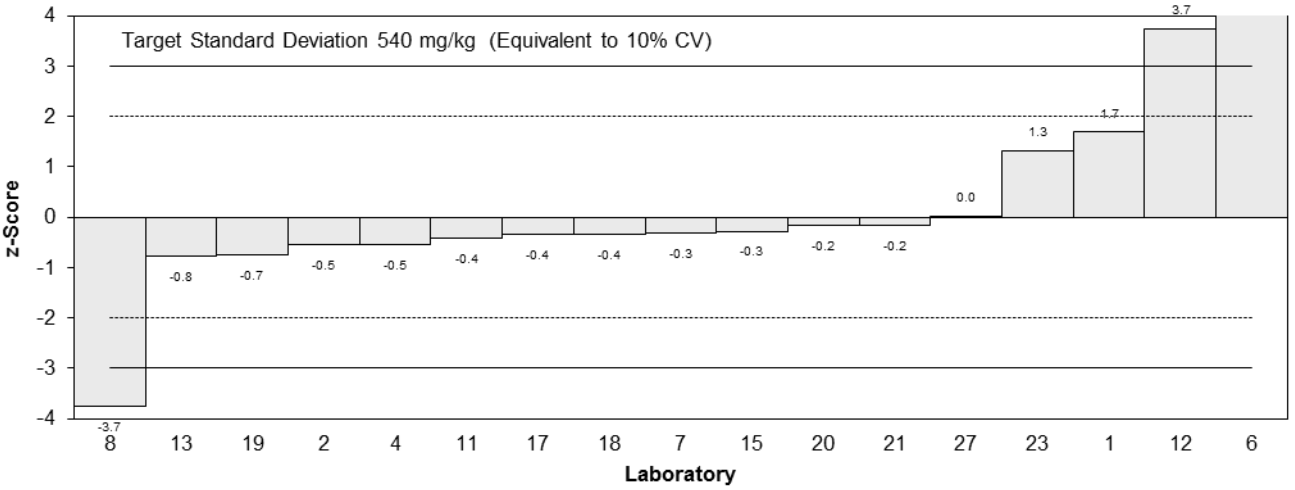
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	6300	600	1.69	1.30
2	5100	969	-0.54	-0.28
3	NT	NT		
4	5100	1000	-0.54	-0.27
5	NT	NT		
6	7550	977	4.01	2.07
7	5216	520	-0.32	-0.28
8	3370	386.8	-3.75	-3.82
9	NT	NT		
10	NR	NR		
11	5160	1030	-0.43	-0.21
12	7400	630	3.73	2.77
13	4970	979	-0.78	-0.40
14	NT	NT		
15	5240	550	-0.28	-0.23
16	NT	NT		
17	5200	2000	-0.35	-0.09
18	5200	1040	-0.35	-0.17
19	4990	NR	-0.74	-1.11
20	5300	2000	-0.17	-0.04
21	5303	564	-0.16	-0.13
22	NT	NT		
23	6100	892	1.32	0.74
24	NT	NT		
25	NT	NT		
26	NR	NR		
27	5400	280	0.02	0.02
28	NT	NT		
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value	5390	360
Spike	Not Spiked	
Homogeneity Value	5000	600
Robust Average	5390	360
Median	5220	90
Mean	5465	
N	17	
Max.	7550	
Min.	3370	
Robust SD	589	
Robust CV	11%	


Kernel Density
Density
Result
Results: S3 - Fe
Assigned Value = 5390 ± 360 mg/kg
Results (mg/kg)
Laboratory
8 13 19 2 4 11 17 18 7 15 20 21 27 23 1 12 6 10 26 14 16 22 24 25 28 29 3 30 5 9 Md R.A. H.V.


z-Scores: S3 - Fe
Target Standard Deviation 540 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
8 13 19 2 4 11 17 18 7 15 20 21 27 23 1 12 6

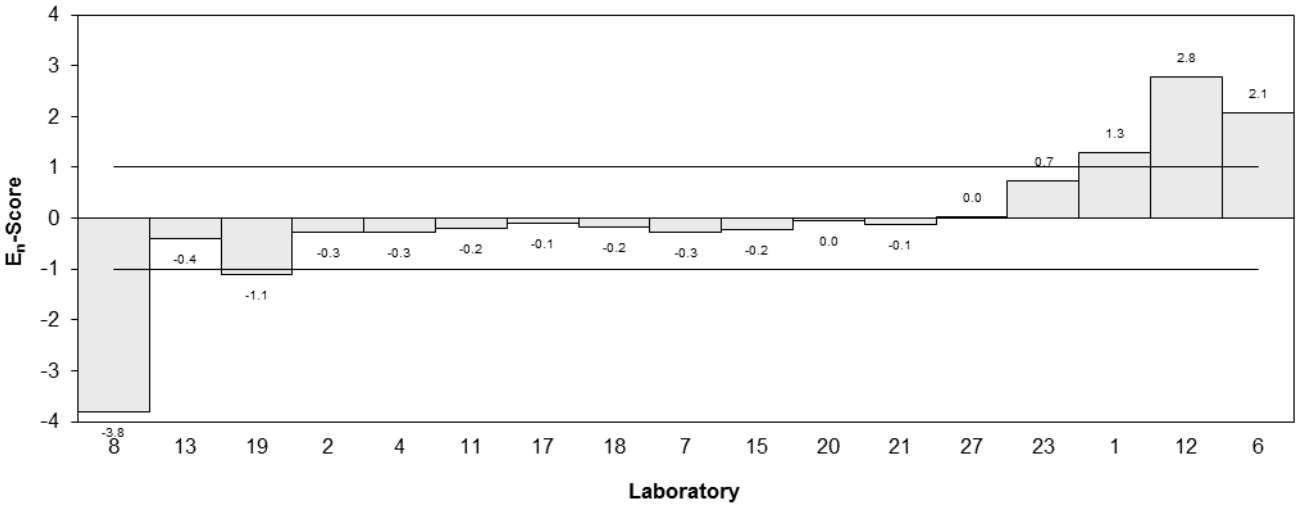

En-Scores: S3 - Fe
En-Score
Laboratory
8 13 19 2 4 11 17 18 7 15 20 21 27 23 1 12 6

Figure 46

Table 58

Sample Details

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

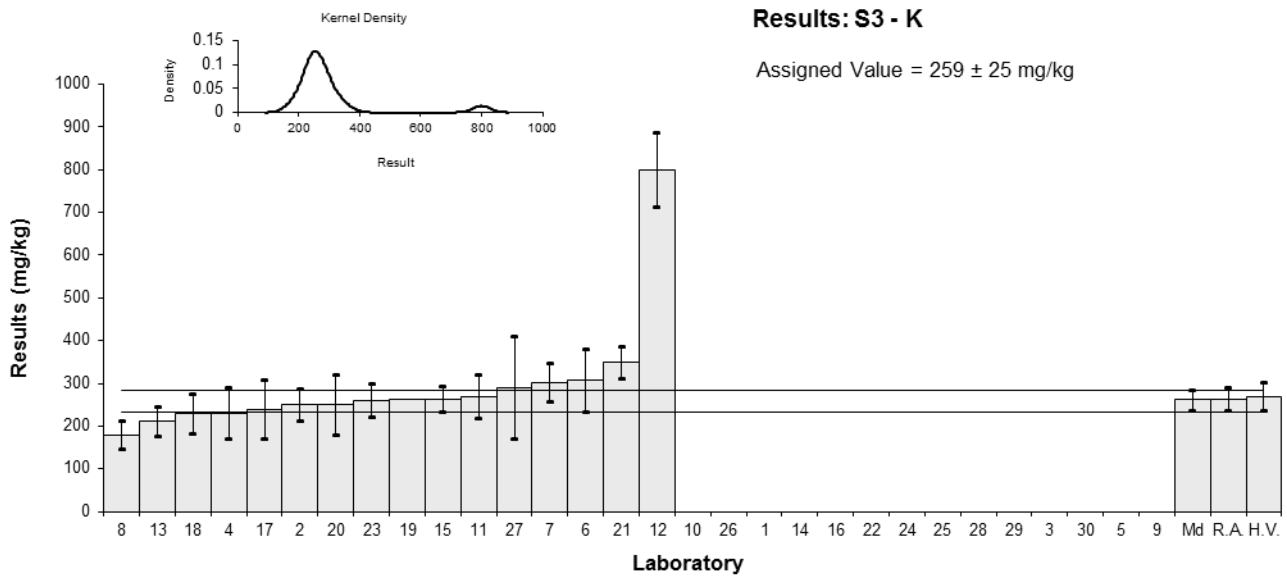
Participant Results

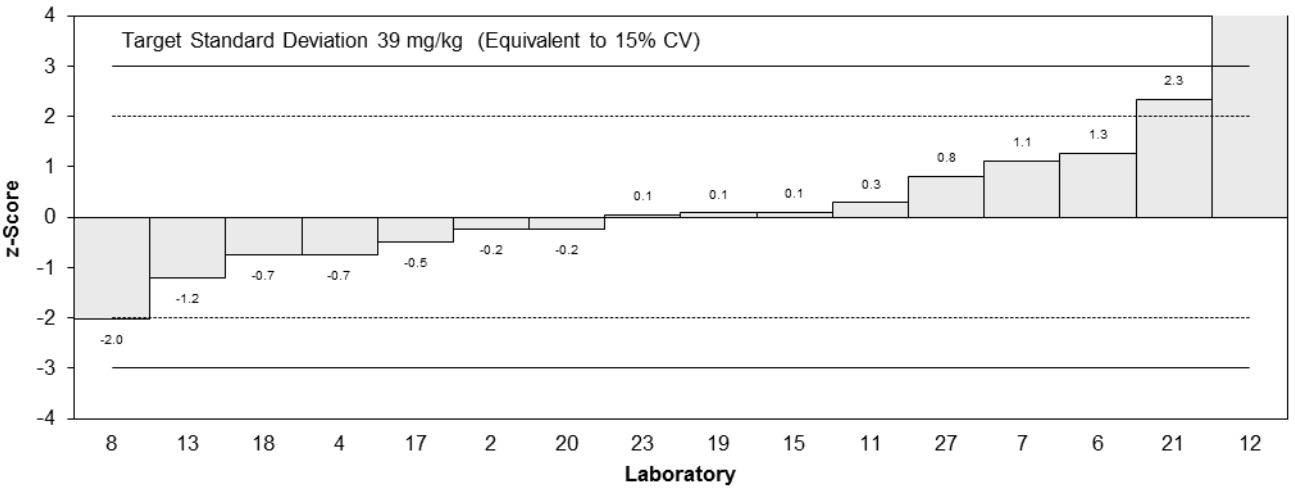
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	250	38	-0.23	-0.20
3	NT	NT		
4	230	60	-0.75	-0.45
5	NT	NT		
6	308	73.6	1.26	0.63
7	302	45	1.11	0.84
8	180	32.9	-2.03	-1.91
9	NT	NT		
10	NR	NR		
11	270	50	0.28	0.20
12	800	87	13.93	5.98
13	212	35	-1.21	-1.09
14	NT	NT		
15	263	30	0.10	0.10
16	NT	NT		
17	240	70	-0.49	-0.26
18	230	46	-0.75	-0.55
19	262.2	NR	0.08	0.13
20	250	70	-0.23	-0.12
21	350	36.7	2.34	2.05
22	NT	NT		
23	261	37.9	0.05	0.04
24	NT	NT		
25	NT	NT		
26	NR	NR		
27	290	120	0.80	0.25
28	NT	NT		
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value*	259	25
Spike	Not Spiked	
Homogeneity Value	270	32
Robust Average	264	28
Median	262	24
Mean	294	
N	16	
Max.	800	
Min.	180	
Robust SD	45	
Robust CV	17%	

*Robust Average excluding Laboratory 12


Results: S3 - K
Assigned Value = 259 ± 25 mg/kg
Kernel Density
Density
Result
Results (mg/kg)
Laboratory
8 13 18 4 17 2 20 23 19 15 11 27 7 6 21 12 10 26 1 14 16 22 24 25 28 29 3 30 5 9 Md R.A. H.V.


z-Scores: S3 - K
Target Standard Deviation 39 mg/kg (Equivalent to 15% CV)
z-Score
Laboratory
8 13 18 4 17 2 20 23 19 15 11 27 7 6 21 12
-2.0 -1.2 -0.7 -0.7 -0.5 -0.2 -0.2 0.1 0.1 0.1 0.3 0.8 1.1 1.3 2.3

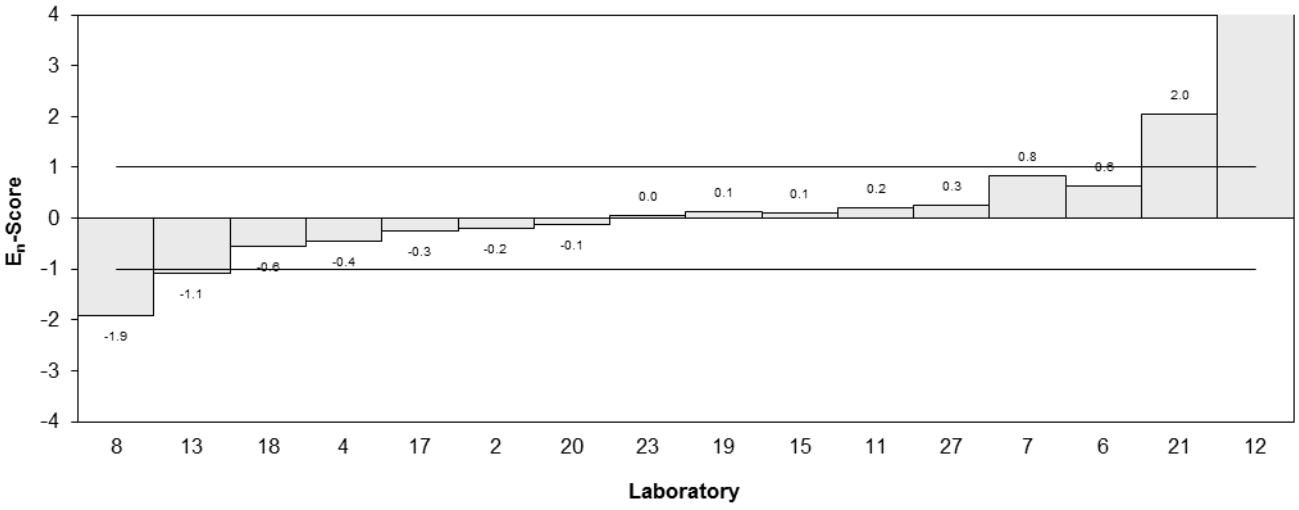

En-Scores: S3 - K
En-Score
Laboratory
8 13 18 4 17 2 20 23 19 15 11 27 7 6 21 12
-1.9 -1.1 -0.6 -0.4 -0.3 -0.2 -0.1 0.0 0.1 0.1 0.2 0.3 0.8 0.6 2.0

Figure 47

Table 59

Sample Details

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

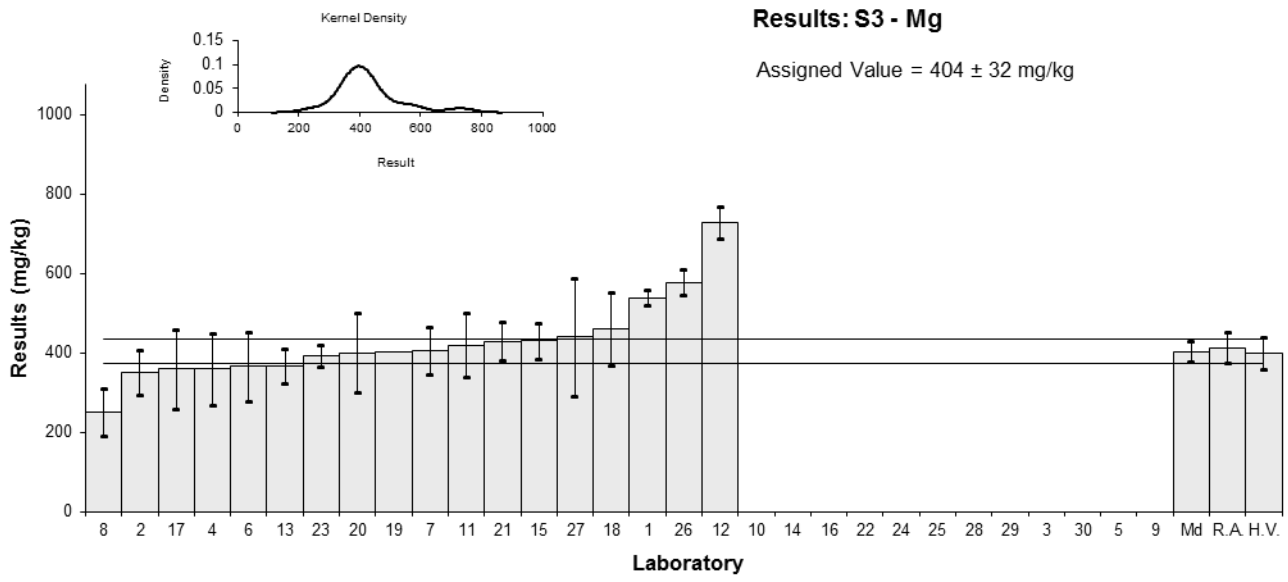
Participant Results

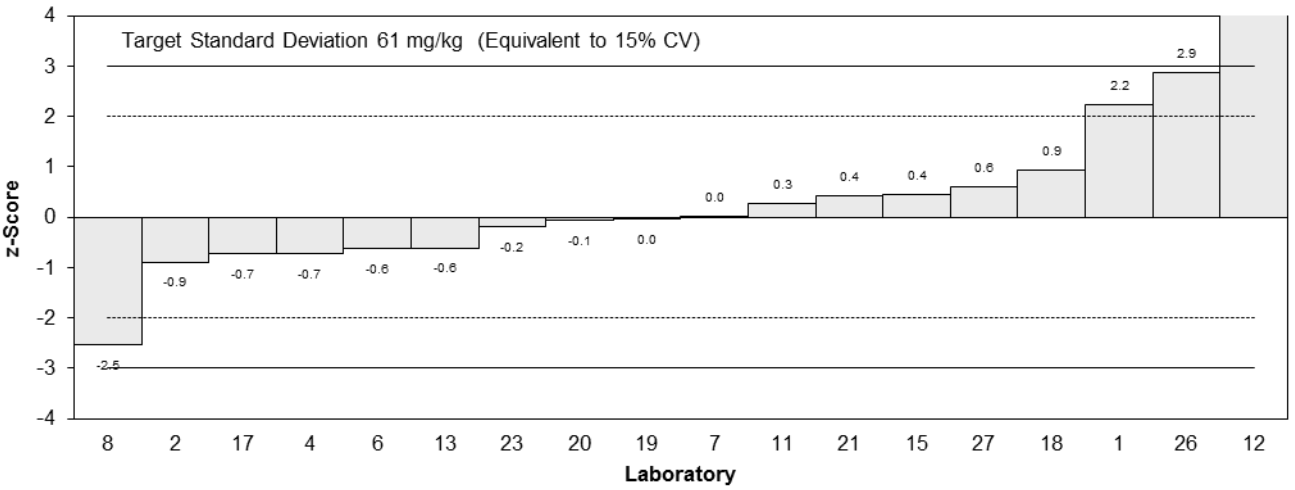
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	540	20	2.24	3.60
2	350	56	-0.89	-0.84
3	NT	NT		
4	360	90	-0.73	-0.46
5	NT	NT		
6	366	87.4	-0.63	-0.41
7	405	60	0.02	0.01
8	250	59.3	-2.54	-2.29
9	NT	NT		
10	NR	NR		
11	420	80	0.26	0.19
12	730	40	5.38	6.36
13	367	43	-0.61	-0.69
14	NT	NT		
15	431	45	0.45	0.49
16	NT	NT		
17	360	100	-0.73	-0.42
18	460	92	0.92	0.57
19	402	NR	-0.03	-0.06
20	400	100	-0.07	-0.04
21	430	47.2	0.43	0.46
22	NT	NT		
23	393	27.7	-0.18	-0.26
24	NT	NT		
25	NT	NT		
26	578	33	2.87	3.79
27	440	150	0.59	0.23
28	NT	NT		
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value*	404	32
Spike	Not Spiked	
Homogeneity Value	400	40
Robust Average	413	39
Median	404	27
Mean	427	
N	18	
Max.	730	
Min.	250	
Robust SD	66	
Robust CV	16%	

Robust Average excluding Laboratory 12


Kernel Density
Density
Result
Results: S3 - Mg
Assigned Value = 404 ± 32 mg/kg
Results (mg/kg)
Laboratory
8 2 17 4 6 13 23 20 19 7 11 21 15 27 18 1 26 12 10 14 16 22 24 25 28 29 3 30 5 9 Md R.A. H.V.


z-Scores: S3 - Mg
Target Standard Deviation 61 mg/kg (Equivalent to 15% CV)
z-Score
Laboratory
8 2 17 4 6 13 23 20 19 7 11 21 15 27 18 1 26 12

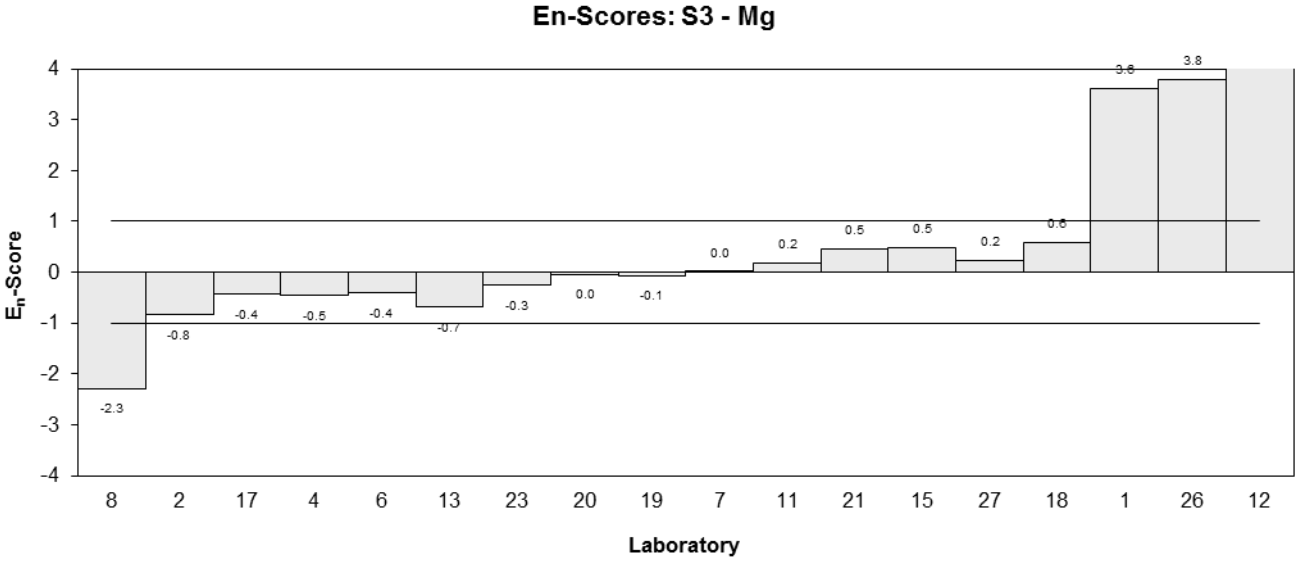

En-Scores: S3 - Mg
En-Score
Laboratory
8 2 17 4 6 13 23 20 19 7 11 21 15 27 18 1 26 12

Figure 48

Table 60

Sample Details

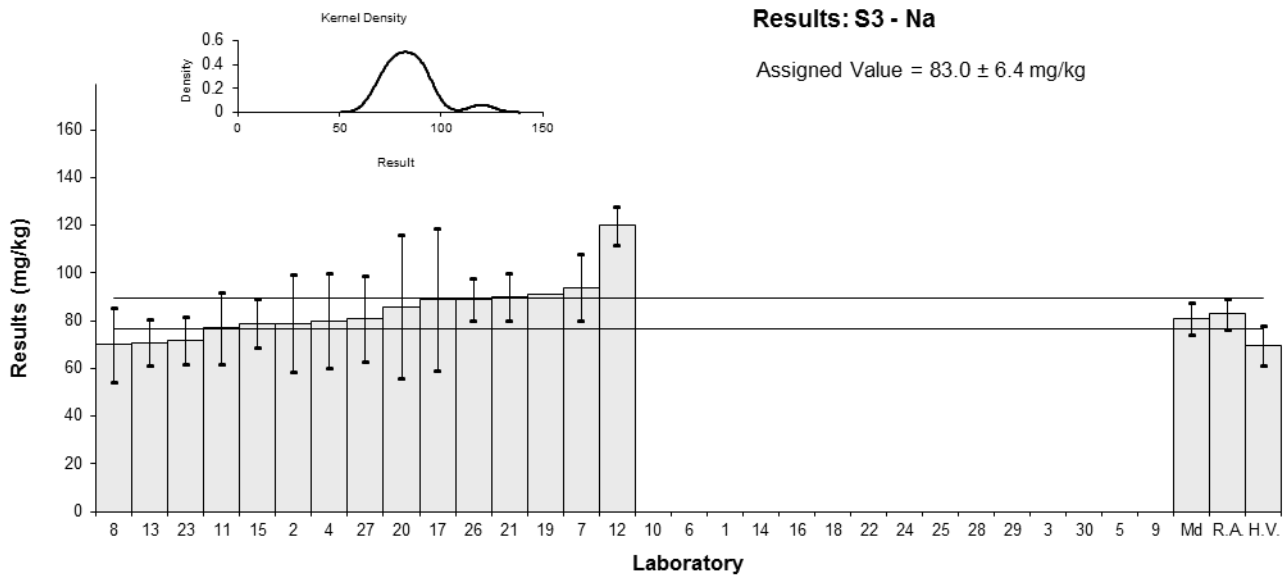
Sample No.	S3
Matrix.	Soil
Analyte.	Na
Units	mg/kg

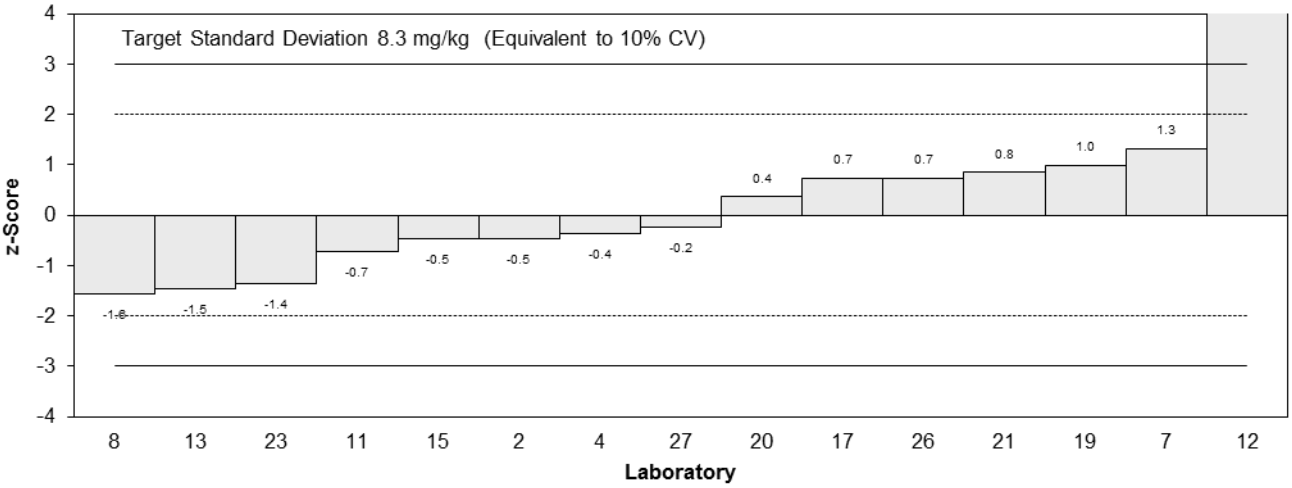
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	79	20.3	-0.48	-0.19
3	NT	NT		
4	80	20	-0.36	-0.14
5	NT	NT		
6	NR	NR		
7	94	14	1.33	0.71
8	70	15.5	-1.57	-0.78
9	NT	NT		
10	NR	NR		
11	77	15	-0.72	-0.37
12	120	8	4.46	3.61
13	70.9	9.8	-1.46	-1.03
14	NT	NT		
15	79	10	-0.48	-0.34
16	NT	NT		
17	89	30	0.72	0.20
18	NT	NT		
19	91.1	NR	0.98	1.27
20	86	30	0.36	0.10
21	90	10.1	0.84	0.59
22	NT	NT		
23	71.7	10.0	-1.36	-0.95
24	NT	NT		
25	NT	NT		
26	89	9	0.72	0.54
27	81	18	-0.24	-0.10
28	NT	NT		
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value	83.0	6.4
Spike	Not Spiked	
Homogeneity Value	69.5	8.3
Robust Average	83.0	6.4
Median	81.0	6.6
Mean	84.5	
N	15	
Max.	120	
Min.	70	
Robust SD	9.9	
Robust CV	12%	


Kernel Density
Density
Result
Results: S3 - Na
Assigned Value = 83.0 ± 6.4 mg/kg
Results (mg/kg)
Laboratory
8 13 23 11 15 2 4 27 20 17 26 21 19 7 12 10 6 1 14 16 18 22 24 25 28 29 3 30 5 9 Md R.A. H.V.


z-Scores: S3 - Na
Target Standard Deviation 8.3 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
8 13 23 11 15 2 4 27 20 17 26 21 19 7 12

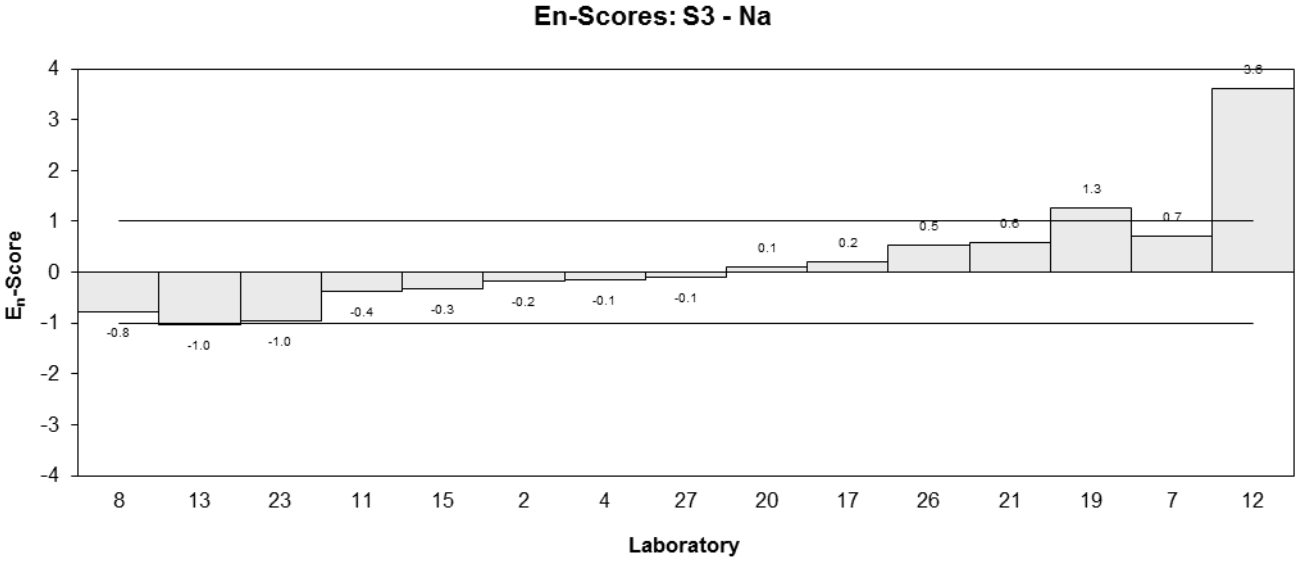

En-Scores: S3 - Na
En-Score
Laboratory
8 13 23 11 15 2 4 27 20 17 26 21 19 7 12

Figure 49

Table 61

Sample Details

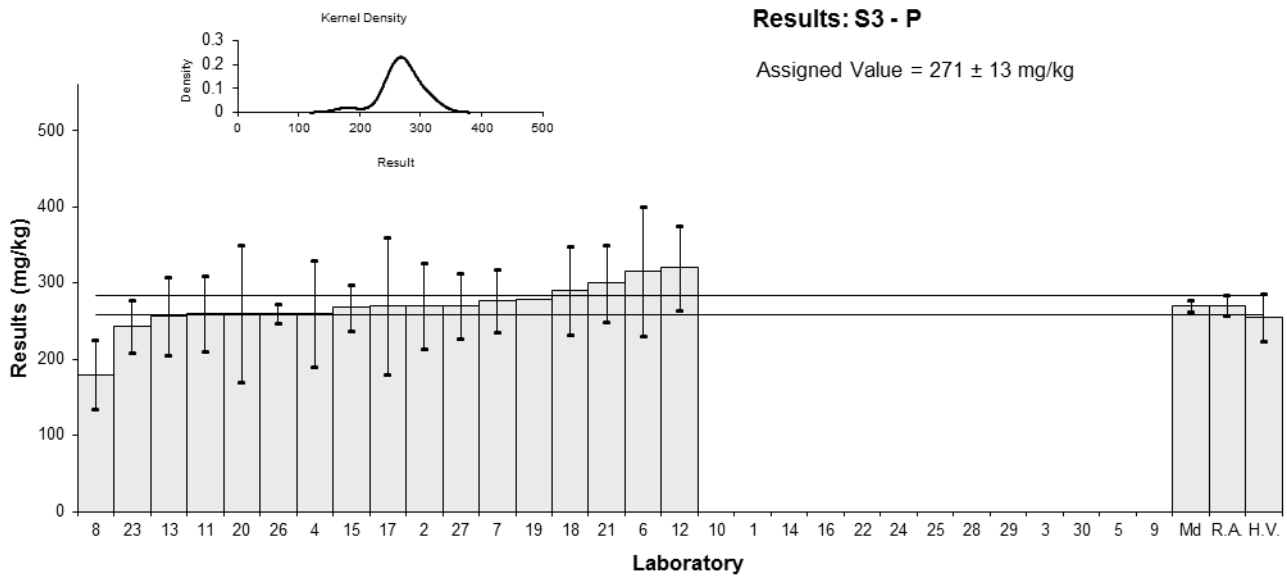
Sample No.	S3
Matrix.	Soil
Analyte.	P
Units	mg/kg

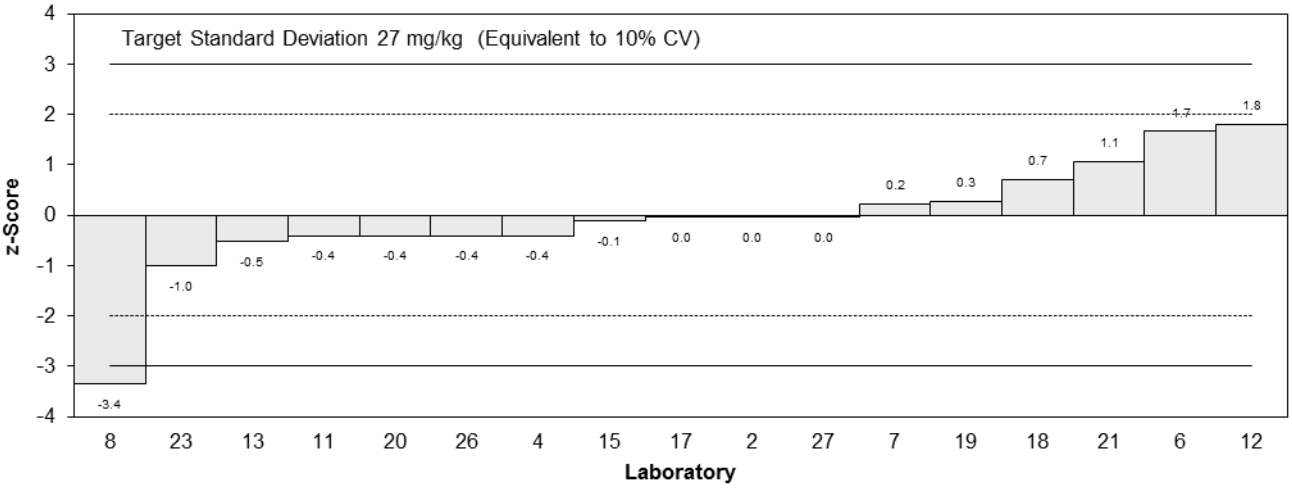
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	270	56	-0.04	-0.02
3	NT	NT		
4	260	70	-0.41	-0.15
5	NT	NT		
6	316	84.9	1.66	0.52
7	277	41	0.22	0.14
8	180	45.3	-3.36	-1.93
9	NT	NT		
10	NR	NR		
11	260	50	-0.41	-0.21
12	320	56	1.81	0.85
13	257	51	-0.52	-0.27
14	NT	NT		
15	268	30	-0.11	-0.09
16	NT	NT		
17	270	90	-0.04	-0.01
18	290	58	0.70	0.32
19	278.5	NR	0.28	0.58
20	260	90	-0.41	-0.12
21	300	50.7	1.07	0.55
22	NT	NT		
23	244	34.6	-1.00	-0.73
24	NT	NT		
25	NT	NT		
26	260	13	-0.41	-0.60
27	270	43	-0.04	-0.02
28	NT	NT		
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value	271	13
Spike	Not Spiked	
Homogeneity Value	255	31
Robust Average	271	13
Median	270	8
Mean	269	
N	17	
Max.	320	
Min.	180	
Robust SD	22	
Robust CV	8.1%	


Kernel Density
Density
Result
Results: S3 - P
Assigned Value = 271 ± 13 mg/kg
Results (mg/kg)
Laboratory
8 23 13 11 20 26 4 15 17 2 27 7 19 18 21 6 12 10 1 14 16 22 24 25 28 29 3 30 5 9 Md R.A. H.V.


z-Scores: S3 - P
Target Standard Deviation 27 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
8 23 13 11 20 26 4 15 17 2 27 7 19 18 21 6 12
-3.4 -1.0 -0.5 -0.4 -0.4 -0.4 -0.4 -0.1 0.0 0.0 0.0 0.2 0.3 0.7 1.1 1.7 1.8

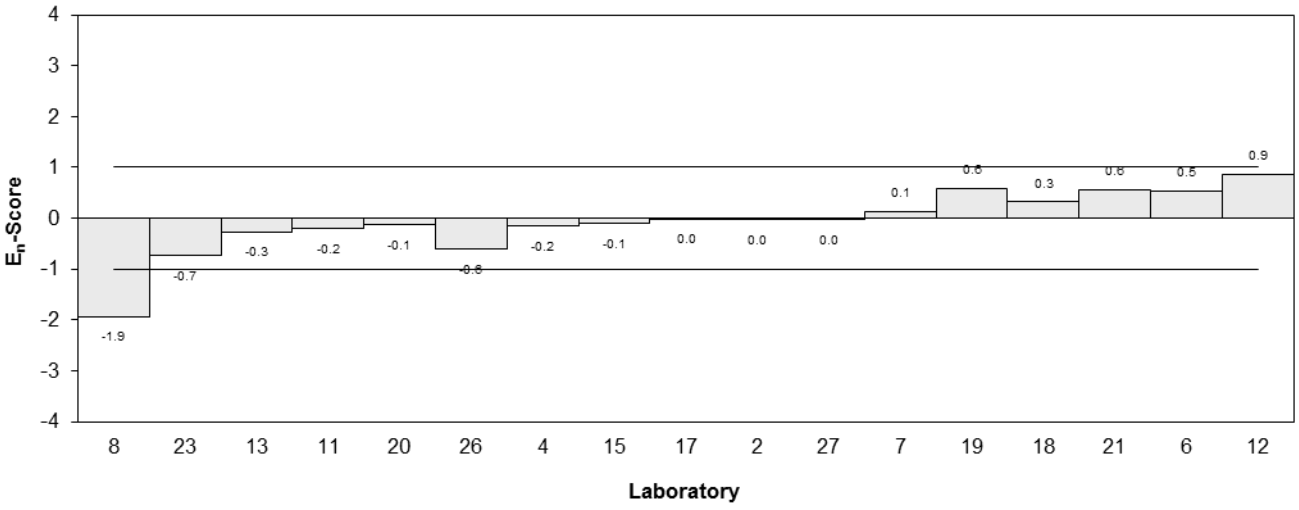

En-Scores: S3 - P
En-Score
Laboratory
8 23 13 11 20 26 4 15 17 2 27 7 19 18 21 6 12
-1.9 -0.7 -0.3 -0.2 -0.1 -0.6 -0.2 -0.1 0.0 0.0 0.0 0.1 0.6 0.3 0.6 0.5 0.9

Figure 50

Table 62

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	PBI
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	NR	NR
7	NT	NT
8	NT	NT
9	NT	NT
10	NR	NR
11	NR	NR
12	NT	NT
13	NT	NT
14	NT	NT
15	75	10
16	NT	NT
17	NT	NT
18	NT	NT
19	NR	NR
20	60	20
21	NT	NT
22	NT	NT
23	NT	NT
24	NT	NT
25	NT	NT
26	76.8	3.5
27	NT	NT
28	NT	NT
29	NT	NT
30	NT	NT

Statistics

Assigned Value	Not Set	
Spike	Not Spiked	
Homogeneity Value	100	20
Median	75	7
Mean	71	
N	3	
Max.	76.8	
Min.	60	

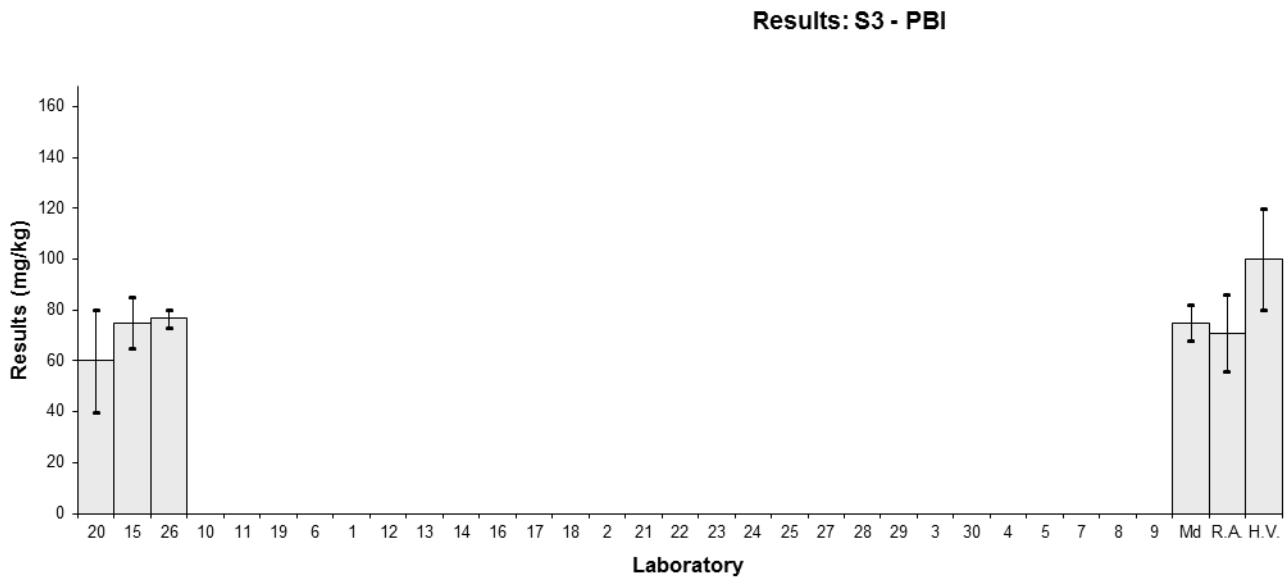

Results: S3 - PBI
Results (mg/kg)
160
140
120
100
80
60
40
20
0
20 15 26 10 11 19 6 1 12 13 14 16 17 18 2 21 22 23 24 25 27 28 29 3 30 4 5 7 8 9 Md R.A. H.V.
Laboratory

Figure 51

Table 63

Sample Details

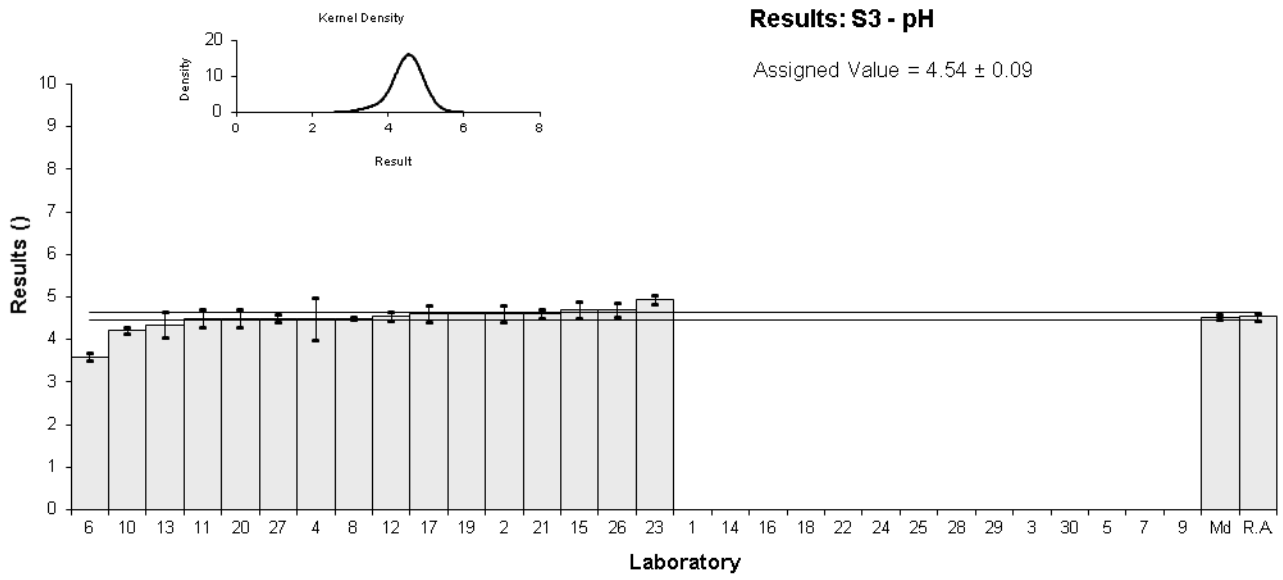
Sample No.	S3
Matrix.	Soil
Analyte.	pH

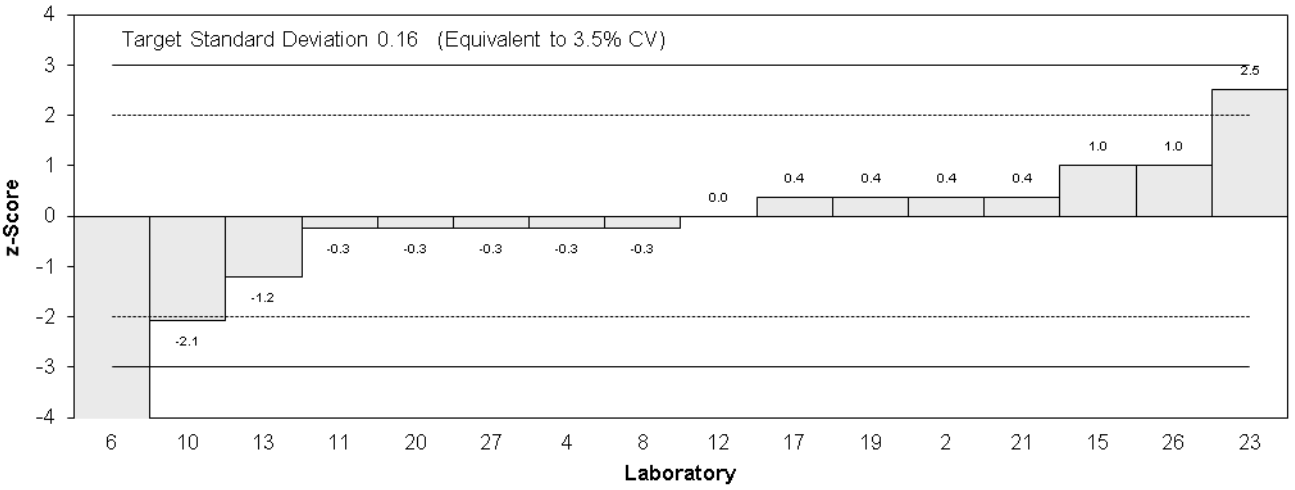
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NR	NR		
2	4.6	0.2	0.38	0.27
3	NT	NT		
4	4.5	0.5	-0.25	-0.08
5	NT	NT		
6	3.6	0.1	-5.92	-6.99
7	NT	NT		
8	4.5	0.04	-0.25	-0.41
9	NT	NT		
10	4.21	0.082	-2.08	-2.71
11	4.5	0.2	-0.25	-0.18
12	4.54	0.1	0	0
13	4.35	0.3	-1.2	-0.61
14	NT	NT		
15	4.70	0.2	1.01	0.73
16	NT	NT		
17	4.6	0.2	0.38	0.27
18	NT	NT		
19	4.6	NR	0.38	0.67
20	4.5	0.2	-0.25	-0.18
21	4.6	0.1	0.38	0.45
22	NT	NT		
23	4.94	0.1	2.52	2.97
24	NT	NT		
25	NT	NT		
26	4.7	0.16	1.01	0.87
27	4.5	0.1	-0.25	-0.30
28	NT	NT		
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value	4.54	0.09
Spike	Not Spiked	
Robust Average	4.54	0.09
Median	4.52	0.06
Mean	4.50	
N	16	
Max.	4.94	
Min.	3.6	
Robust SD	0.15	
Robust CV	3.3%	


Kernel Density
Density
Result
Results: S3 - pH
Assigned Value = 4.54 ± 0.09
Results ()
Laboratory
6 10 13 11 20 27 4 8 12 17 19 2 21 15 26 23 1 14 16 18 22 24 25 28 29 3 30 5 7 9 Md R.A


z-Scores: S3 - pH
Target Standard Deviation 0.16 (Equivalent to 3.5% CV)
z-Score
Laboratory
6 10 13 11 20 27 4 8 12 17 19 2 21 15 26 23
2.5
1.0 1.0
0.4 0.4 0.4 0.4
0.0
-0.3 -0.3 -0.3 -0.3 -0.3
-1.2
-2.1

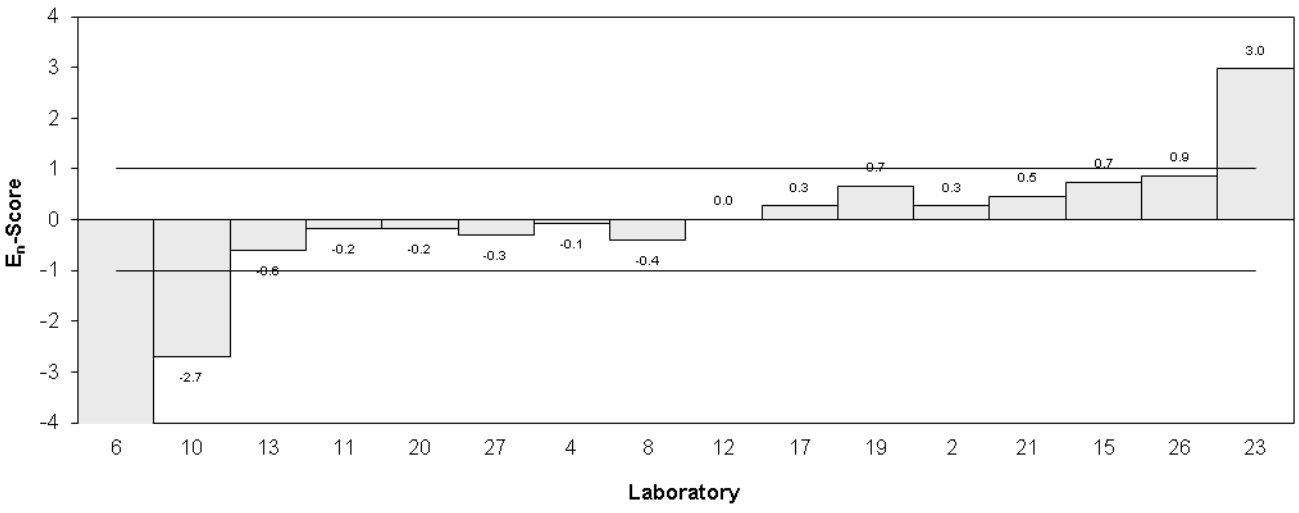

En-Scores: S3 - pH
En-Score
Laboratory
6 10 13 11 20 27 4 8 12 17 19 2 21 15 26 23
3.0
0.9
0.7 0.7
0.5
0.3 0.3
0.0
-0.1
-0.2 -0.2 -0.3
-0.4
-0.6
-2.7

Figure 52

Table 64

Sample Details

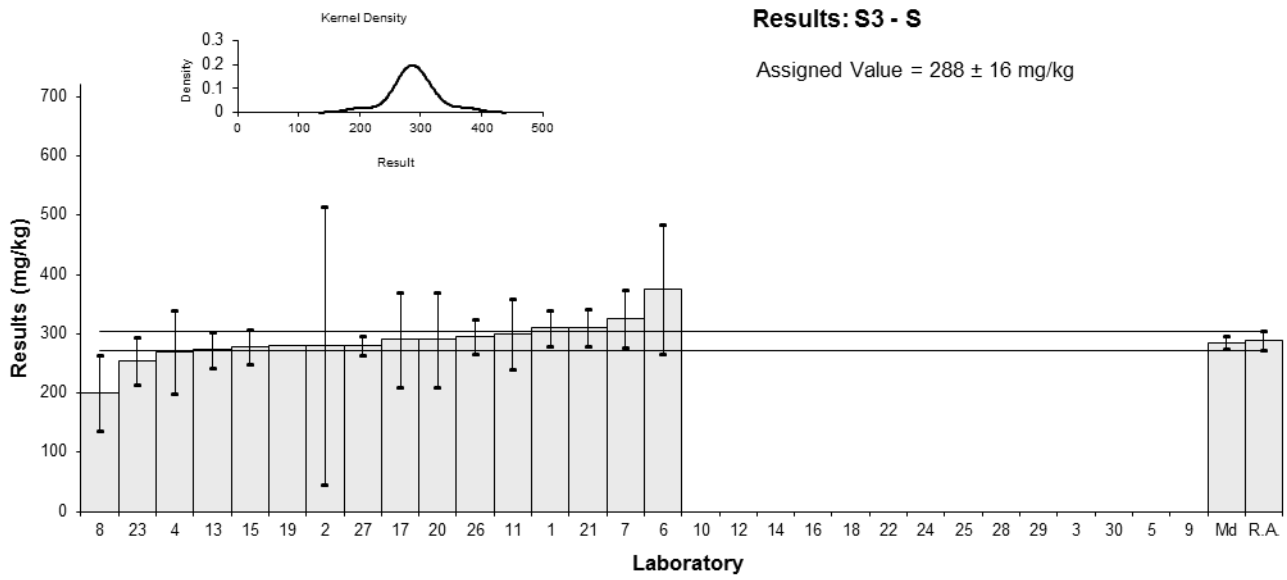
Sample No.	S3
Matrix.	Soil
Analyte.	S
Units	mg/kg

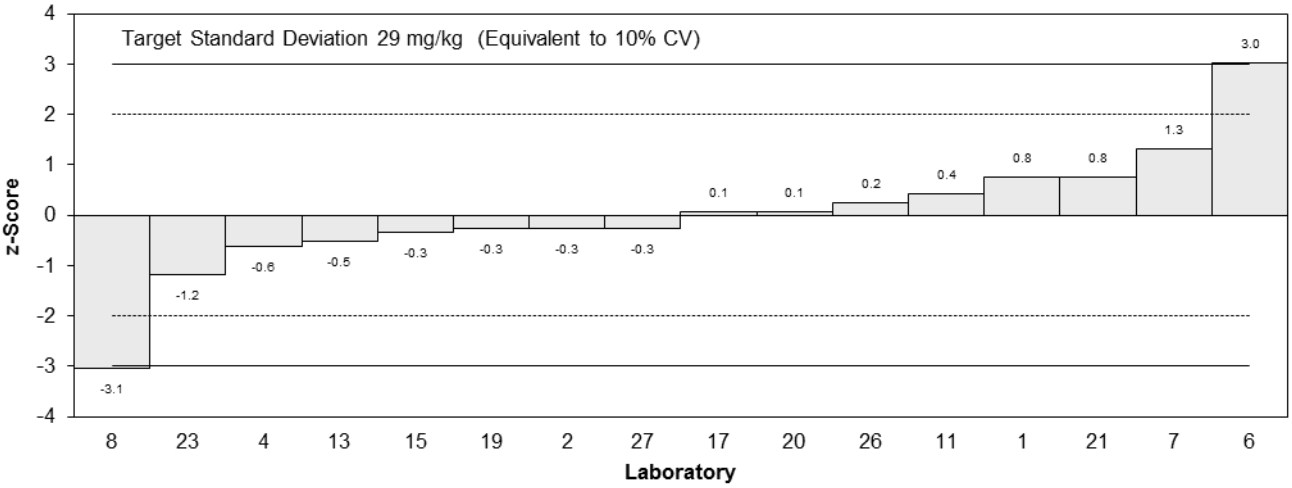
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	310	30	0.76	0.65
2	280	235	-0.28	-0.03
3	NT	NT		
4	270	70	-0.62	-0.25
5	NT	NT		
6	375	109	3.02	0.79
7	326	49	1.32	0.74
8	200	64.0	-3.06	-1.33
9	NT	NT		
10	NR	NR		
11	300	60	0.42	0.19
12	NT	NT		
13	273	30	-0.52	-0.44
14	NT	NT		
15	278	30	-0.35	-0.29
16	NT	NT		
17	290	80	0.07	0.02
18	NT	NT		
19	280	NR	-0.28	-0.50
20	290	80	0.07	0.02
21	310	31	0.76	0.63
22	NT	NT		
23	254	39.6	-1.18	-0.80
24	NT	NT		
25	NT	NT		
26	295	30	0.24	0.21
27	280	16	-0.28	-0.35
28	NT	NT		
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value	288	16
Spike	Not Spiked	
Robust Average	288	16
Median	285	11
Mean	288	
N	16	
Max.	375	
Min.	200	
Robust SD	25	
Robust CV	8.7%	


Kernel Density
Density
Result
Results: S3 - S
Assigned Value = 288 ± 16 mg/kg
Results (mg/kg)
Laboratory
8 23 4 13 15 19 2 27 17 20 26 11 1 21 7 6 10 12 14 16 18 22 24 25 28 29 3 30 5 9 Md R.A.


z-Scores: S3 - S
Target Standard Deviation 29 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
8 23 4 13 15 19 2 27 17 20 26 11 1 21 7 6
-3.1 -1.2 -0.6 -0.5 -0.3 -0.3 -0.3 -0.3 0.1 0.1 0.2 0.4 0.8 0.8 1.3 3.0

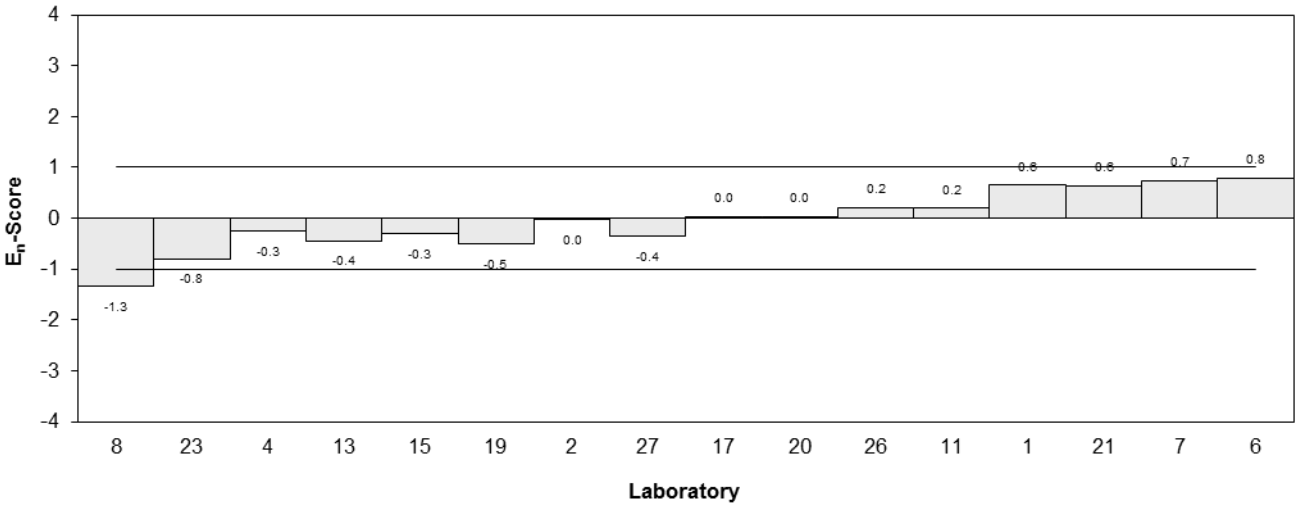

En-Scores: S3 - S
En-Score
Laboratory
8 23 4 13 15 19 2 27 17 20 26 11 1 21 7 6
-1.3 -0.8 -0.3 -0.4 -0.3 -0.5 0.0 -0.4 0.0 0.0 0.2 0.2 0.6 0.6 0.7 0.8

Figure 53

Table 65

Sample Details

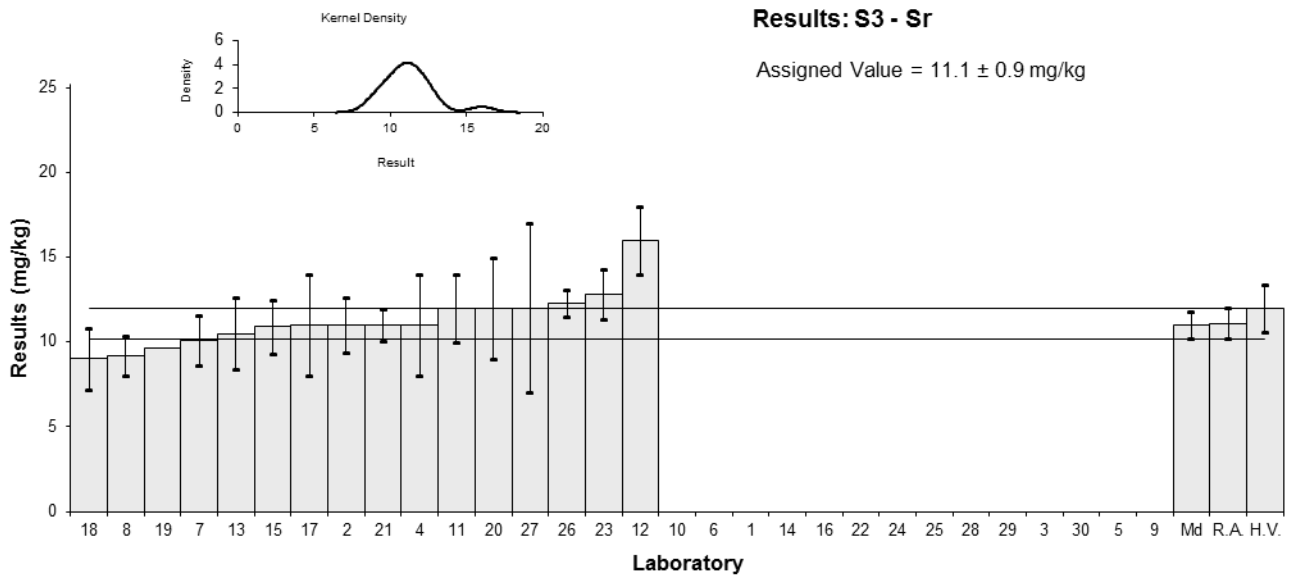
Sample No.	S3
Matrix.	Soil
Analyte.	Sr
Units	mg/kg

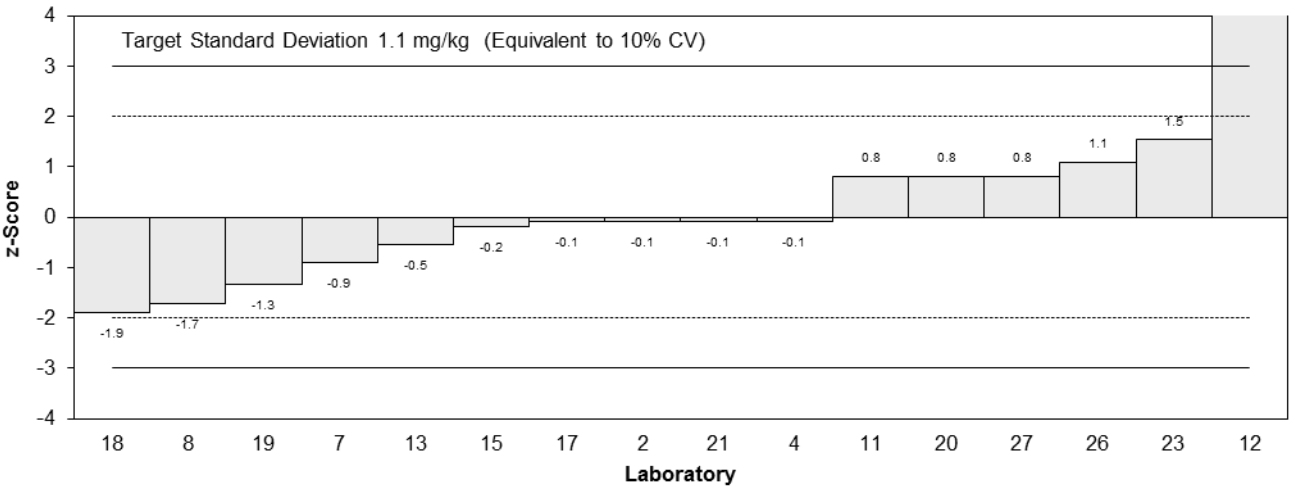
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	11	1.6	-0.09	-0.05
3	NT	NT		
4	11	3	-0.09	-0.03
5	NT	NT		
6	NR	NR		
7	10.1	1.5	-0.90	-0.57
8	9.2	1.15	-1.71	-1.30
9	NT	NT		
10	NR	NR		
11	12	2	0.81	0.41
12	16	2	4.41	2.23
13	10.5	2.1	-0.54	-0.26
14	NT	NT		
15	10.9	1.6	-0.18	-0.11
16	NT	NT		
17	11	3	-0.09	-0.03
18	9	1.8	-1.89	-1.04
19	9.61	NR	-1.34	-1.66
20	12	3	0.81	0.29
21	11	0.92	-0.09	-0.08
22	NT	NT		
23	12.8	1.45	1.53	1.00
24	NT	NT		
25	NT	NT		
26	12.3	0.8	1.08	1.00
27	12	5	0.81	0.18
28	NT	NT		
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value	11.1	0.9
Spike	Not Spiked	
Homogeneity Value	12.0	1.4
Robust Average	11.1	0.9
Median	11.0	0.8
Mean	11.3	
N	16	
Max.	16	
Min.	9	
Robust SD	1.4	
Robust CV	13%	


Kernel Density
Density
Result
Results: S3 - Sr
Assigned Value = 11.1 ± 0.9 mg/kg
Results (mg/kg)
Laboratory
18 8 19 7 13 15 17 2 21 4 11 20 27 26 23 12 10 6 1 14 16 22 24 25 28 29 3 30 5 9 Md R.A. H.V.


z-Scores: S3 - Sr
Target Standard Deviation 1.1 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
18 8 19 7 13 15 17 2 21 4 11 20 27 26 23 12
-1.9 -1.7 -1.3 -0.9 -0.5 -0.2 -0.1 -0.1 -0.1 -0.1 0.8 0.8 0.8 1.1 1.5

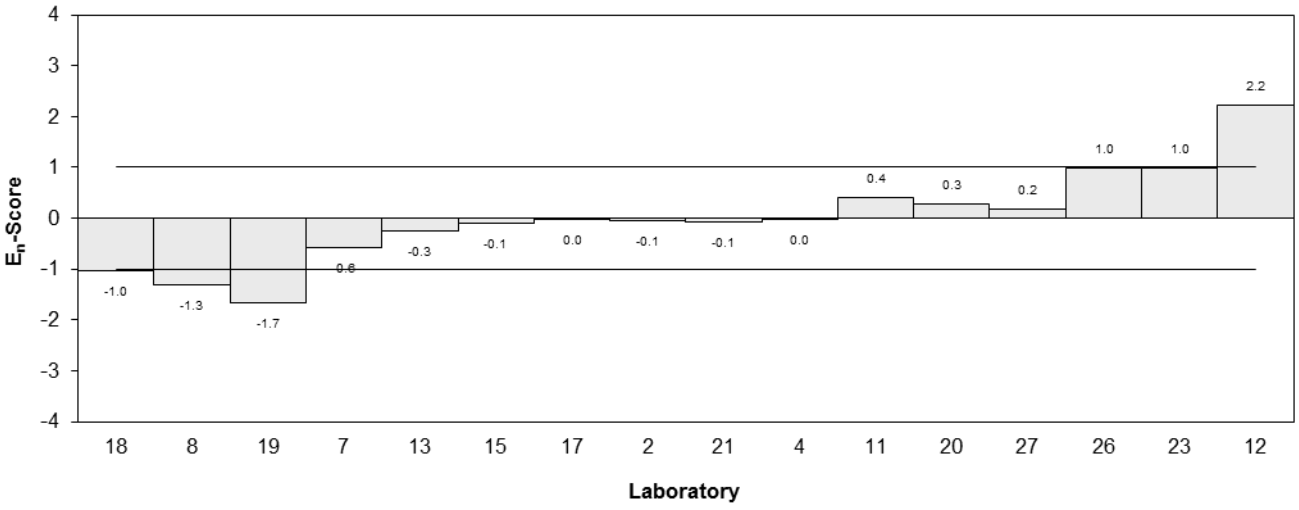

En-Scores: S3 - Sr
En-Score
Laboratory
18 8 19 7 13 15 17 2 21 4 11 20 27 26 23 12
-1.0 -1.3 -1.7 -0.6 -0.3 -0.1 0.0 -0.1 -0.1 0.0 0.4 0.3 0.2 1.0 1.0 2.2

Figure 54

Table 66

Sample Details

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

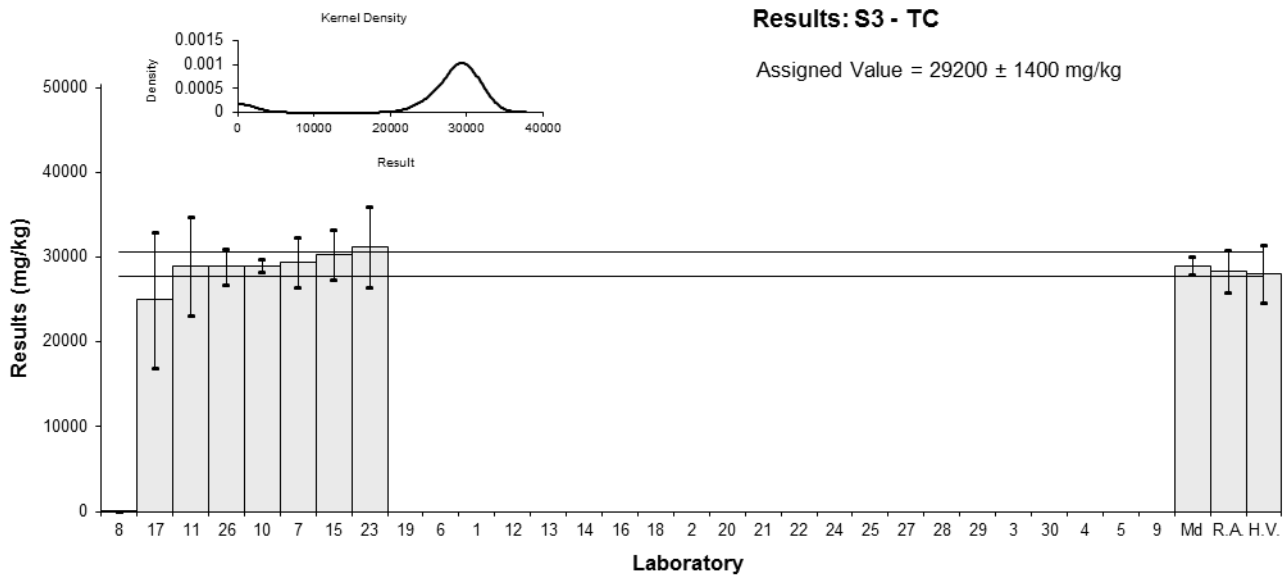
Participant Results

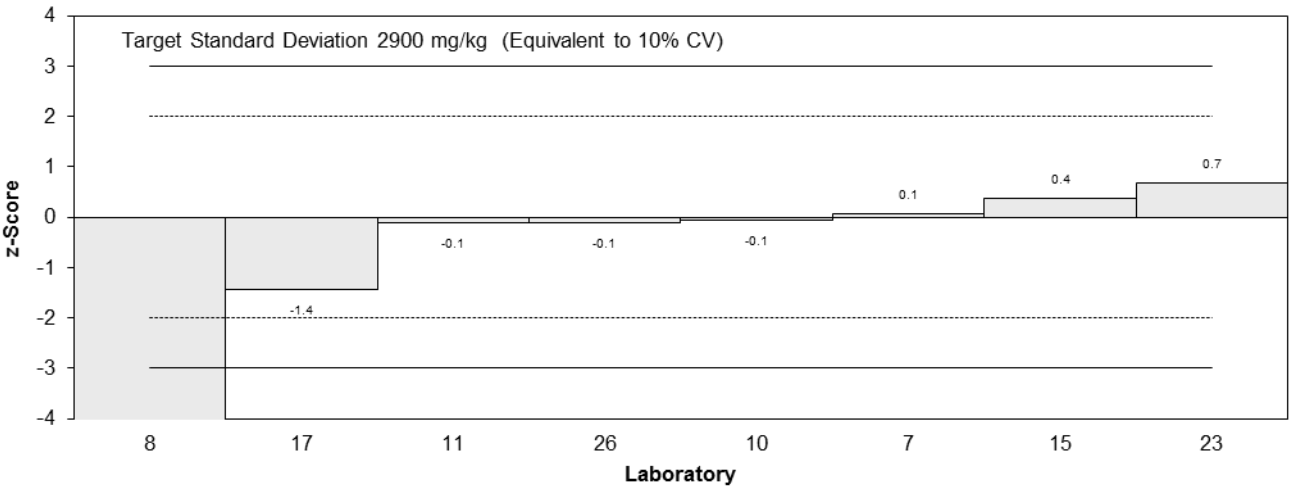
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	NT	NT		
3	NT	NT		
4	NT	NT		
5	NT	NT		
6	NR	NR		
7	29400	2900	0.07	0.06
8	2.79	0.837	-10.00	-20.86
9	NT	NT		
10	29000	800	-0.07	-0.12
11	28900	5800	-0.10	-0.05
12	NT	NT		
13	NT	NT		
14	NT	NT		
15	30300	3000	0.38	0.33
16	NT	NT		
17	25000	8000	-1.44	-0.52
18	NT	NT		
19	NR	NR		
20	NT	NT		
21	NT	NT		
22	NT	NT		
23	31200	4800	0.68	0.40
24	NT	NT		
25	NT	NT		
26	28900	2100	-0.10	-0.12
27	NT	NT		
28	NT	NT		
29	NT	NT		
30	NT	NT		

Statistics*

Assigned Value**	29200	1400
Spike	Not Spiked	
Homogeneity Value	28000	3400
Robust Average	29200	1400
Median	29000	550
Mean	29000	
N	7	
Max.	31200	
Min.	2.79	
Robust SD	2811	
Robust CV	2%	

*Laboratory 8 result excluded from the statistical calculations. **Robust Average excluding Laboratory 8


Kernel Density
Density
Result
Results: S3 - TC
Assigned Value = 29200 ± 1400 mg/kg
Results (mg/kg)
Laboratory
8 17 11 26 10 7 15 23 19 6 1 12 13 14 16 18 2 20 21 22 24 25 27 28 29 3 30 4 5 9 Md R.A. H.V.


z-Scores: S3 - TC
Target Standard Deviation 2900 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
8 17 11 26 10 7 15 23
-1.4
-0.1
-0.1
-0.1
0.1
0.4
0.7

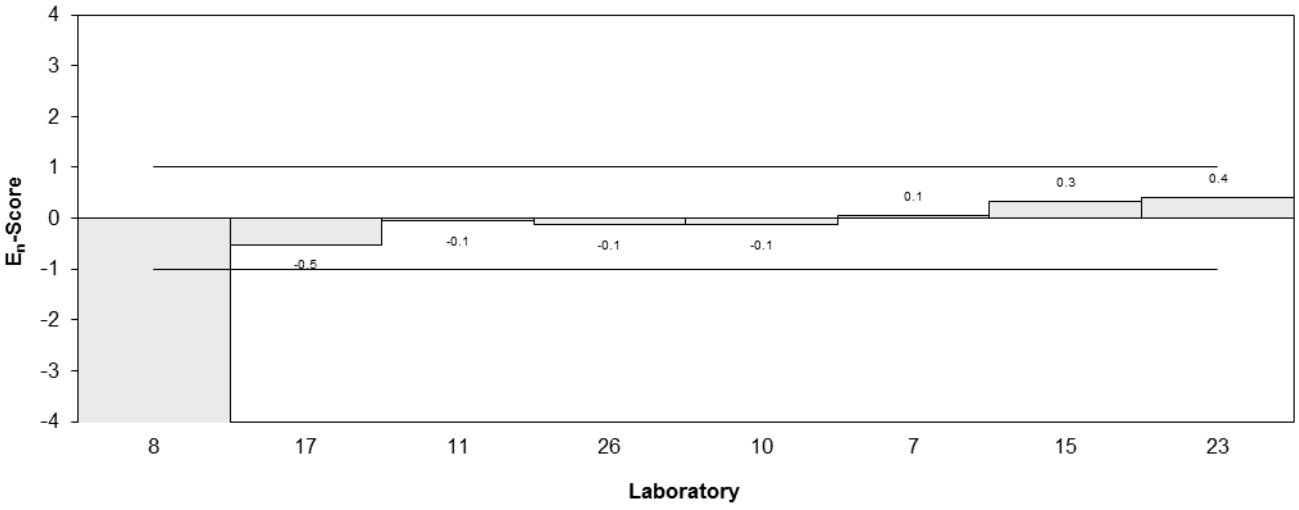

En-Scores: S3 - TC
En-Score
Laboratory
8 17 11 26 10 7 15 23
-0.5
-0.1
-0.1
-0.1
0.1
0.3
0.4

Figure 55

Table 67

Sample Details

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

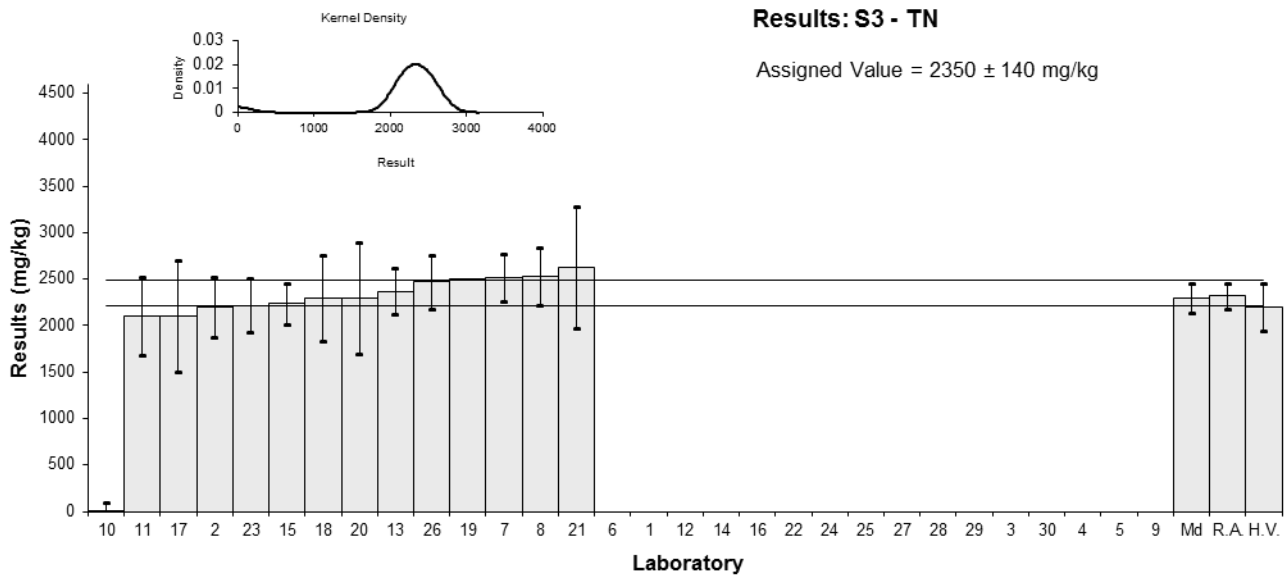
Participant Results

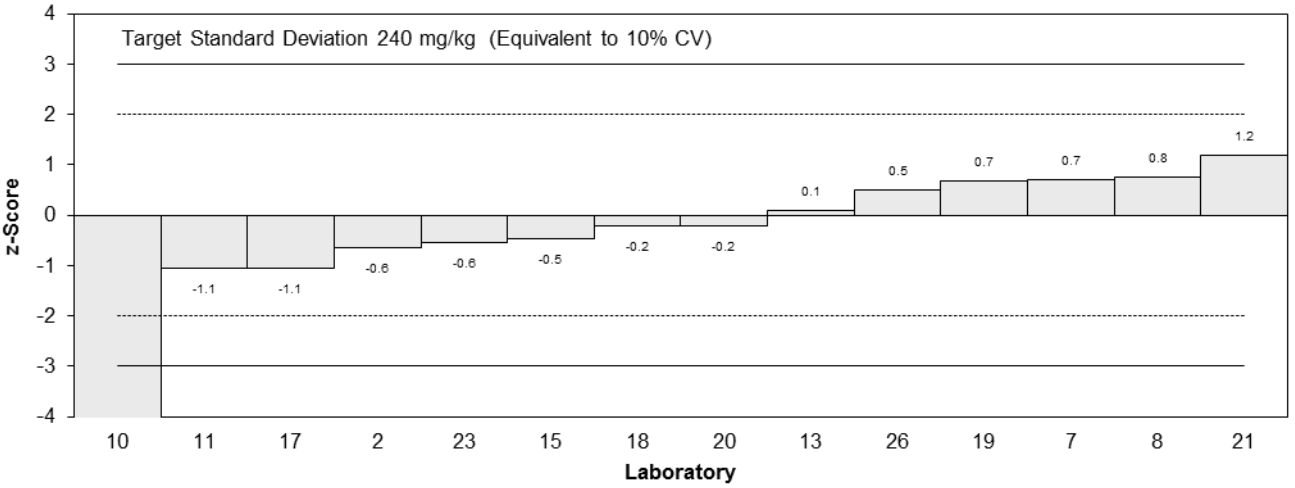
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	2200	323	-0.64	-0.43
3	NT	NT		
4	NT	NT		
5	NT	NT		
6	NR	NR		
7	2517	250	0.71	0.58
8	2530	304.1	0.77	0.54
9	NT	NT		
10	0.25	100	-10.00	-13.66
11	2100	420	-1.06	-0.56
12	NT	NT		
13	2370	250	0.09	0.07
14	NT	NT		
15	2240	220	-0.47	-0.42
16	NT	NT		
17	2100	600	-1.06	-0.41
18	2300	460	-0.21	-0.10
19	2509	NR	0.68	1.14
20	2300	600	-0.21	-0.08
21	2630	654	1.19	0.42
22	NT	NT		
23	2220	285	-0.55	-0.41
24	NT	NT		
25	NT	NT		
26	2470	290	0.51	0.37
27	NT	NT		
28	NT	NT		
29	NT	NT		
30	NT	NT		

Statistics*

Assigned Value**	2350	140
Spike	Not Spiked	
Homogeneity Value	2200	260
Robust Average	2350	140
Median	2300	150
Mean	2350	
N	13	
Max.	2630	
Min.	0.25	
Robust SD	216	
Robust CV	8.4%	

*Laboratory 10 result excluded from the statistical calculations. **Robust Average excluding Laboratory 10


Kernel Density
Density
Result
Results: S3 - TN
Assigned Value = 2350 ± 140 mg/kg
Results (mg/kg)
Laboratory
10 11 17 2 23 15 18 20 13 26 19 7 8 21 6 1 12 14 16 22 24 25 27 28 29 3 30 4 5 9 Md R.A. H.V.


z-Scores: S3 - TN
Target Standard Deviation 240 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
10 11 17 2 23 15 18 20 13 26 19 7 8 21
-1.1 -1.1 -0.6 -0.6 -0.5 -0.2 -0.2 0.1 0.5 0.7 0.7 0.8 1.2

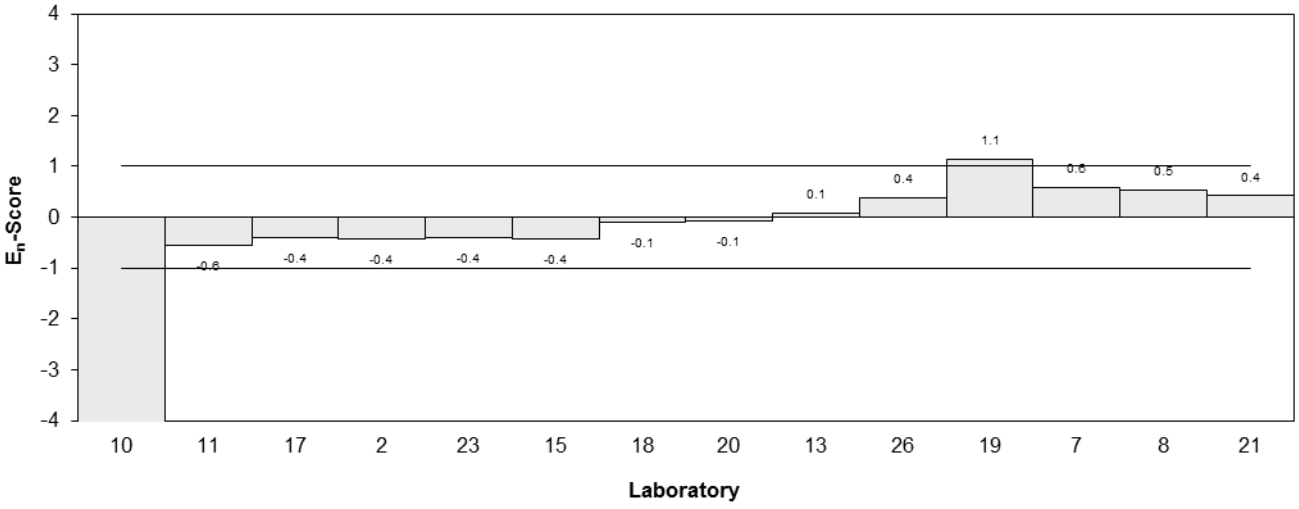

En-Scores: S3 - TN
En-Score
Laboratory
10 11 17 2 23 15 18 20 13 26 19 7 8 21
-0.6 -0.4 -0.4 -0.4 -0.4 -0.1 -0.1 0.1 0.4 1.1 0.6 0.5 0.4

Figure 56

Table 68

Sample Details

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

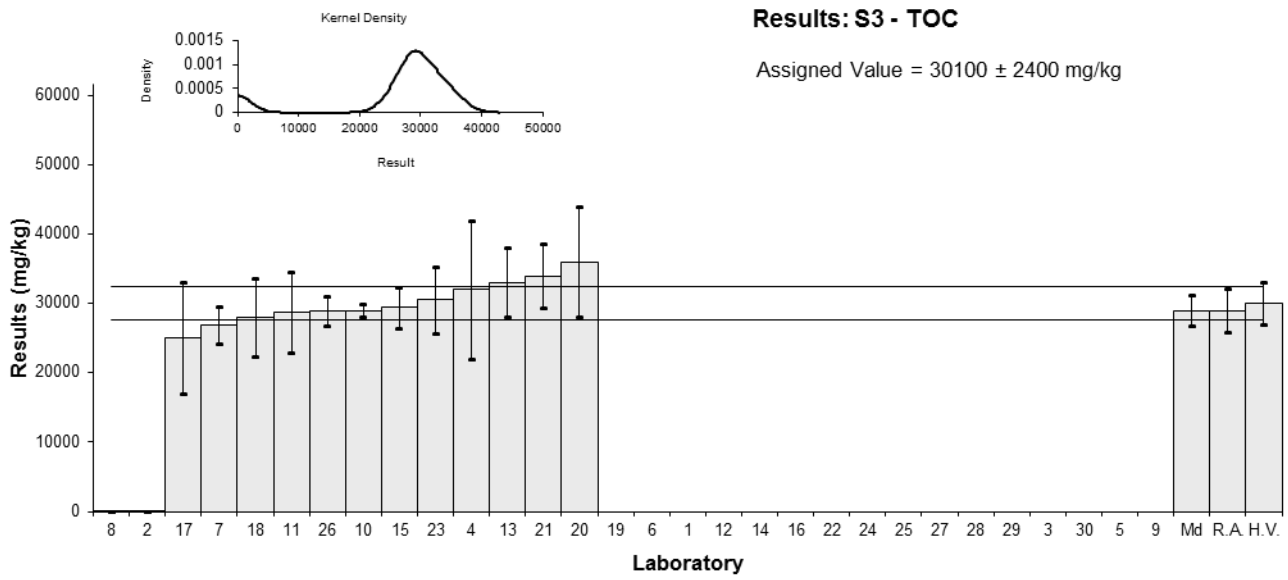
Participant Results

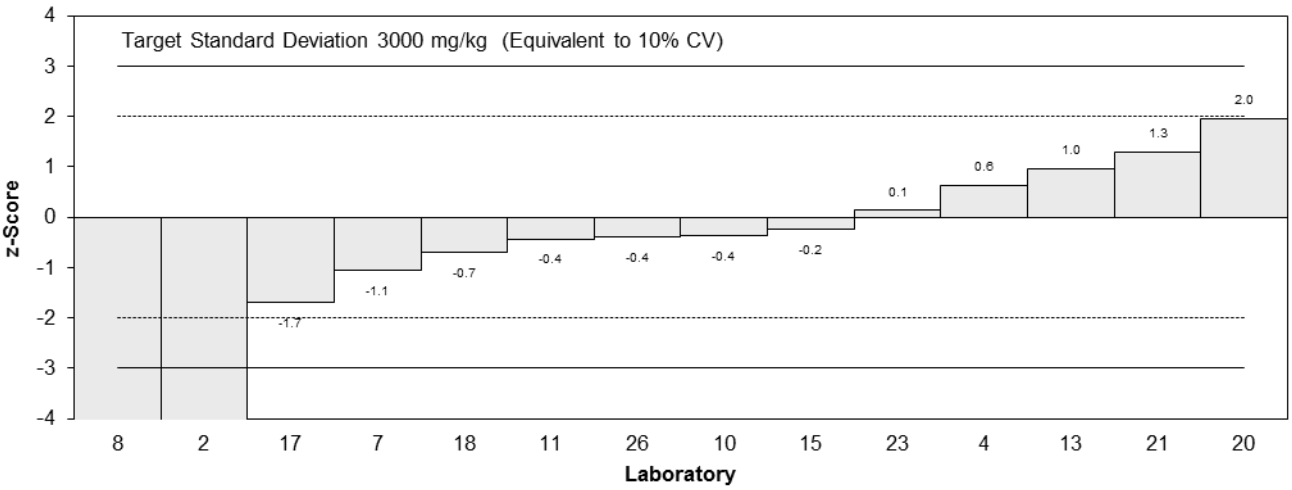
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	2.9	0.9	-10.00	-12.54
3	NT	NT		
4	32000	10000	0.63	0.18
5	NT	NT		
6	NR	NR		
7	26925	2690	-1.05	-0.88
8	2.25	0.675	-10.00	-12.54
9	NT	NT		
10	29000	853	-0.37	-0.43
11	28800	5800	-0.43	-0.21
12	NT	NT		
13	33000	5000	0.96	0.52
14	NT	NT		
15	29400	3000	-0.23	-0.18
16	NT	NT		
17	25000	8000	-1.69	-0.61
18	28000	5600	-0.70	-0.34
19	NR	NR		
20	36000	8000	1.96	0.71
21	34000	4658	1.30	0.74
22	NT	NT		
23	30500	4800	0.13	0.07
24	NT	NT		
25	NT	NT		
26	28900	2100	-0.40	-0.38
27	NT	NT		
28	NT	NT		
29	NT	NT		
30	NT	NT		

Statistics*

Assigned Value**	30100	2400
Spike	Not Spiked	
Homogeneity Value	30000	3000
Robust Average	30100	2400
Median	29000	1900
Mean	27800	
N	12	
Max.	36000	
Min.	2.25	
Robust SD	4703	
Robust CV	8.9%	

*The results reported by laboratories 2 and 8 were excluded from the statistical calculations. **Robust Average excluding Laboratories 2 and 8.


Results: S3 - TOC
Assigned Value = 30100 ± 2400 mg/kg
Kernel Density
Density
Result
Results (mg/kg)
Laboratory
8 2 17 7 18 11 26 10 15 23 4 13 21 20 19 6 1 12 14 16 22 24 25 27 28 29 3 30 5 9 Md R.A. H.V.


z-Scores: S3 - TOC
Target Standard Deviation 3000 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
8 2 17 7 18 11 26 10 15 23 4 13 21 20
-1.7 -1.1 -0.7 -0.4 -0.4 -0.4 -0.2 0.1 0.6 1.0 1.3 2.0

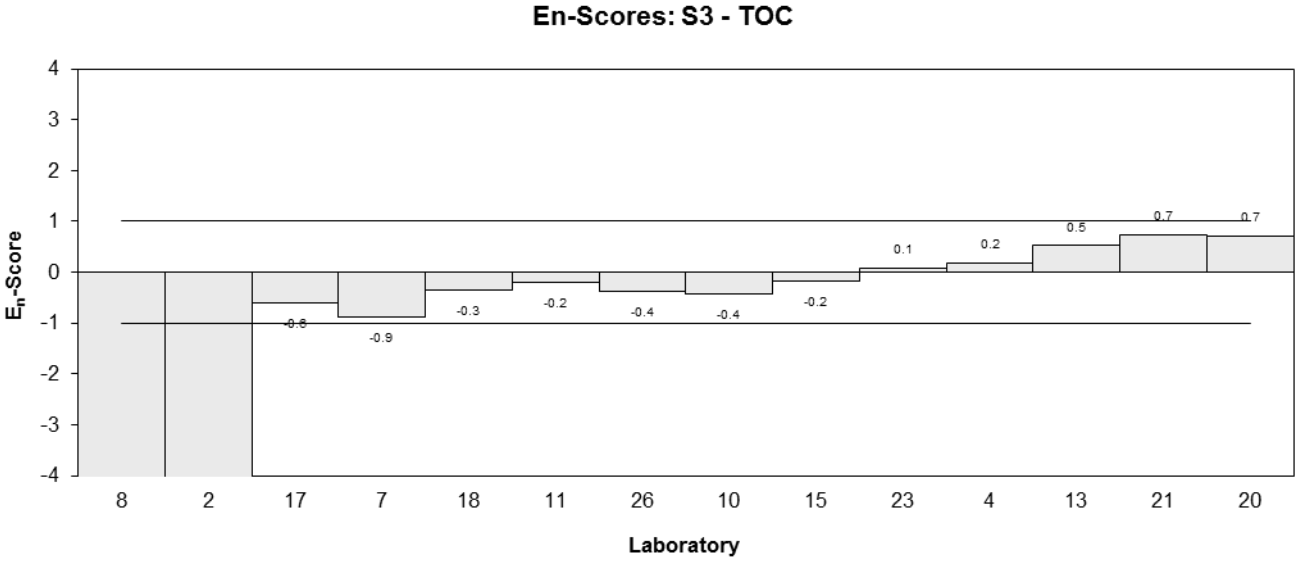

En-Scores: S3 - TOC
En-Score
Laboratory
8 2 17 7 18 11 26 10 15 23 4 13 21 20
-0.6 -0.9 -0.3 -0.2 -0.4 -0.4 -0.2 0.1 0.2 0.5 0.7 0.7

Figure 57

Table 69

Sample Details

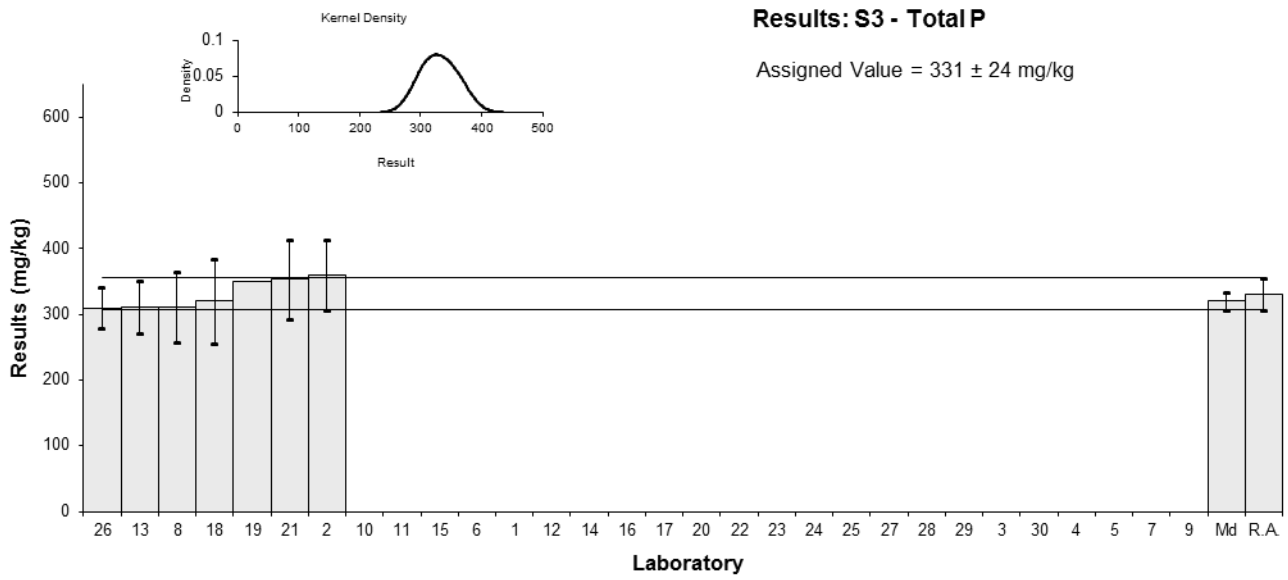
Sample No.	S3
Matrix.	Soil
Analyte.	Total P
Units	mg/kg

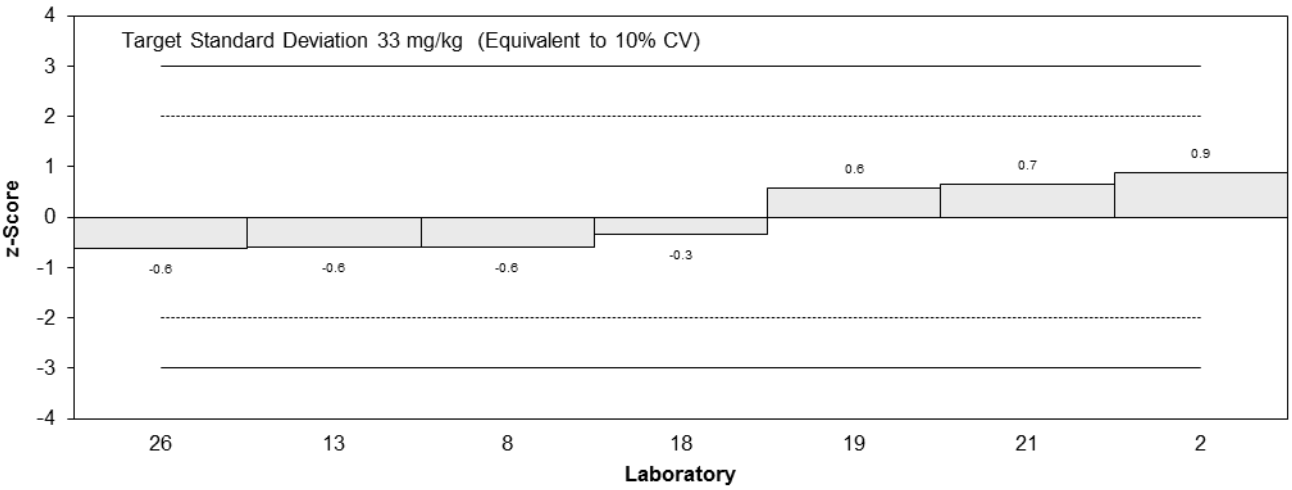
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	360	54	0.88	0.49
3	NT	NT		
4	NT	NT		
5	NT	NT		
6	NR	NR		
7	NT	NT		
8	311	53.9	-0.60	-0.34
9	NT	NT		
10	NR	NR		
11	NR	NR		
12	NT	NT		
13	311	39	-0.60	-0.44
14	NT	NT		
15	NR	NR		
16	NT	NT		
17	NT	NT		
18	320	64	-0.33	-0.16
19	350.4	NR	0.59	0.81
20	NT	NT		
21	353	59.7	0.66	0.34
22	NT	NT		
23	NT	NT		
24	NT	NT		
25	NT	NT		
26	310	32	-0.63	-0.52
27	NT	NT		
28	NT	NT		
29	NT	NT		
30	NT	NT		

Statistics

Assigned Value	331	24
Spike	Not Spiked	
Robust Average	331	24
Median	320	14
Mean	331	
N	7	
Max.	360	
Min.	310	
Robust SD	26	
Robust CV	7.9%	


Kernel Density
Density
Result
Results: S3 - Total P
Assigned Value = 331 ± 24 mg/kg
Results (mg/kg)
Laboratory
26 13 8 18 19 21 2 10 11 15 6 1 12 14 16 17 20 22 23 24 25 27 28 29 3 30 4 5 7 9 Md R.A.


z-Scores: S3 - Total P
Target Standard Deviation 33 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
26 13 8 18 19 21 2
-0.6 -0.6 -0.6 -0.3 0.6 0.7 0.9

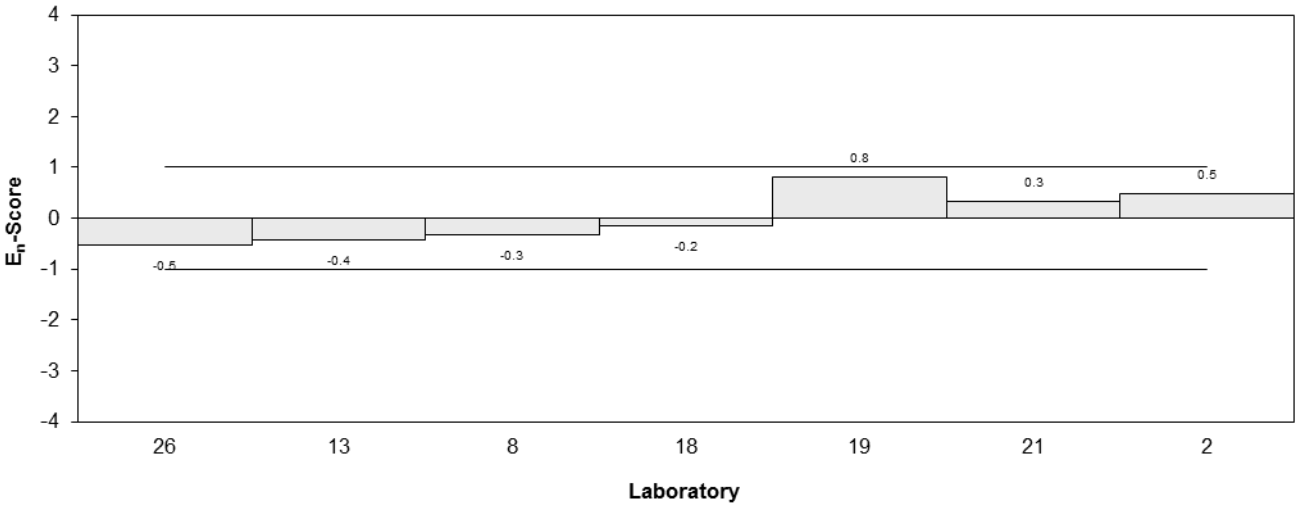

En-Scores: S3 - Total P
En-Score
Laboratory
26 13 8 18 19 21 2
-0.5 -0.4 -0.3 -0.2 0.8 0.3 0.5

Figure 58

7 DISCUSSION OF RESULTS

7.1 Assigned Value

Sample S1 was dried soil and **Sample S2** was moist soil. Participants were asked to report the results for Sample S1 on as received bases and to correct the results for Sample S2 for moisture content.

Sample S3 was dried agricultural soil.

Assigned values for the 50 tests in the study samples were the robust averages of participants' results. The robust averages and their associated expanded uncertainties were calculated using the procedures described in ISO 13528:2015(E). Results less than 50% and more than 150% of the robust average were removed before calculation of the assigned value.[6] Appendix 2 sets out the calculation for the robust average of As in Sample S1 and its associated uncertainty.

No assigned value was set for B, Sb in S1, Li in S2 and Colwell K, Extractable B and Phosphorus Buffer Index in S3 because the reported results were either too variable or too few. An assigned value was also not set for Hg in S1 as there was no agreement between the spike value and the robust average.

Traceability The assigned values are not traceable to any external reference; they are traceable to the consensus of participants' results derived 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 1039 numerical results, 988 were reported with an expanded measurement uncertainty, indicating that not all laboratories have addressed this requirement of ISO 17025.[8] 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, long term reproducibility, professional judgement, top down approach using precision and estimates of method and laboratory bias and top down approach using only the reproducibility from inter-laboratory comparisons studies.[9– 16]

Proficiency tests allow a check of participants' uncertainty estimates. Results and the expanded MU are presented in the bar charts for each analyte (Figure 2 to 58). In this study, the reported expanded measurement uncertainty has been over-estimated in some cases (e.g. Lab 20 for Cr in Sample S1) or under-estimated (e.g. Lab 22 for Mo in Sample S1). As a simple rule of thumb, when the uncertainty estimate is smaller than the 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.

Double counting the precision uncertainty components and overestimation of the laboratory or method bias are the most common errors seen when preparing uncertainty budgets. According to General Accreditation Guidance-Estimating and Reporting MU of Chemical Test Results[12] and to NORDTEST TR 537, [10] the most common experimental data used for estimating the precision component for the measurement uncertainty calculation in the top down approach are from:

- Stable control samples that cover the whole analytical process (including extraction) and **have a matrix similar** to the samples; **or**
- Stable control samples **and** duplicate analyses if control samples do not cover whole analytical process (e.g. the control sample is a synthetic sample- we have to take into consideration uncertainties arising from different matrices); **or**

- When control samples are not stable, from analysis of natural duplicates (gives within-day variation for sampling and measurement) and long-term uncertainty component from the variation in the instrument calibration; **or**
- Replicate analyses performed on the same sample at different times to obtain estimates of intermediate precision; within-batch replication provides estimates of repeatability only.

The most common sources for estimating the method bias component for the measurement uncertainty calculation are from:

- Certified reference material recoveries; **or**
- Participation in PT studies (laboratory bias from at least 6 successful PT studies); **or**
- From sample spike recoveries.

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, 12] An example of estimating measurement uncertainty using proficiency testing data only is given in Appendix 3.

Laboratories 3, 5, 8, 12, 23 and 25 attached estimates of the expanded measurement uncertainty for 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]

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 383.55 ± 76.71mg/kg, it is better to report 384 ± 77 mg/kg or instead of 84 ± 16.1 mg/kg, it is better to report 84 ± 16 mg/kg.[11]

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 59. 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 956 results for which E_n-scores were calculated, 796 (83%) returned a satisfactory score of $|E_n| \leq 1$ indicating agreement of the participants' results with the assigned values within their respective expanded measurement uncertainties.

7.4 z-Score

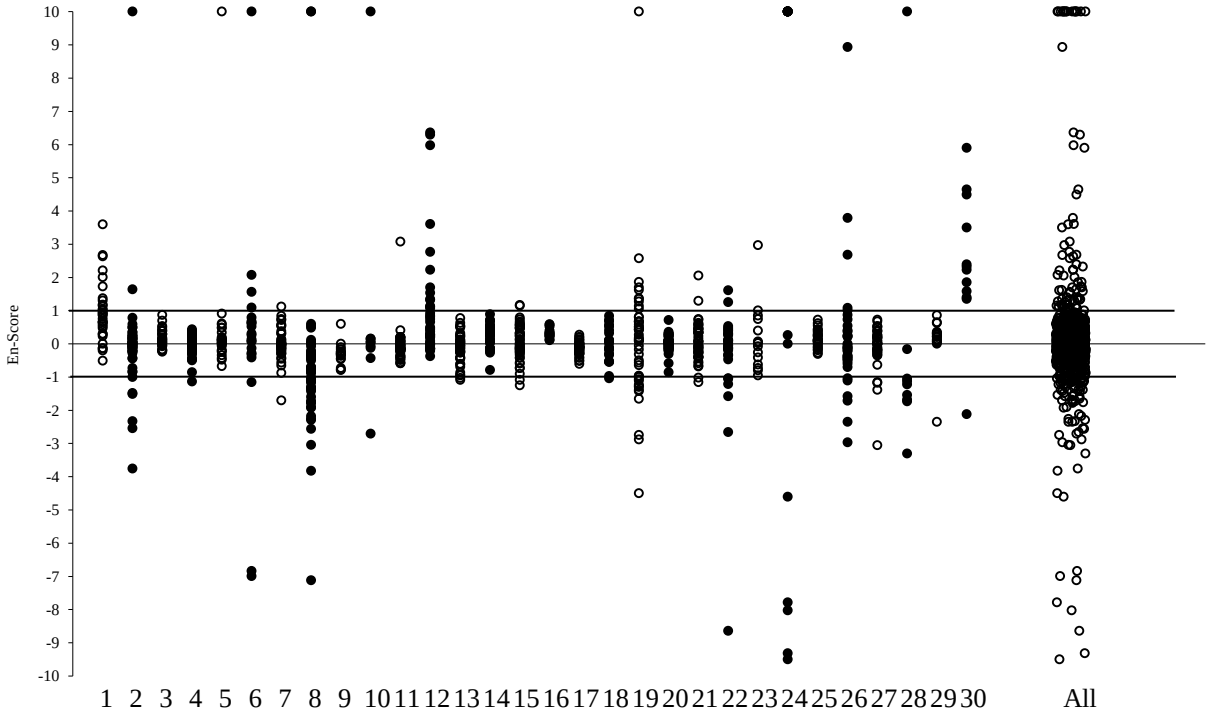
The z-score compares participant's deviation from the assigned value with the target standard deviation set for proficiency assessment.

The target standard deviation defines satisfactory performance in a proficiency test. Target standard deviations equivalent to 3.5%, 10%, 15% and 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 a fixed reference value point for assessment of laboratory performance, independent of group performance.

The between laboratory coefficient of variation predicted by the Thompson equation[7] and the between laboratory coefficient of variation resulted in this study are presented for comparison in Table 70. The dispersal of participants' z-scores is presented in Figure 60 (by laboratory code) and in Figure 61 (by test). Of 956 results for which z-scores were calculated, 883 (92%)

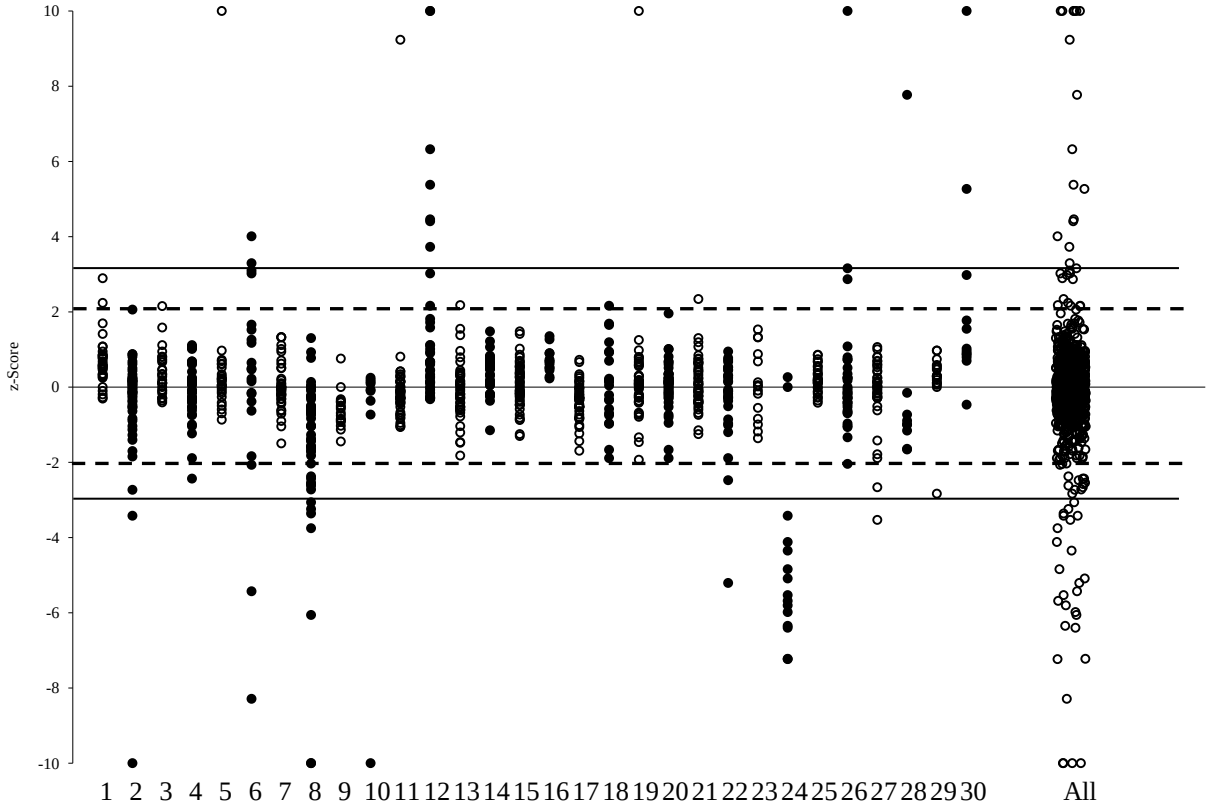
returned a satisfactory score of $|z| \leq 2$ and 25 (3%) were questionable of $2 < |z| < 3$. Participants with multiple z-scores larger than 2 or smaller than -2 should check for laboratory bias.

Laboratories 7, 9, 14, 15, 16, 17, 20, 23 and **25** returned satisfactory z-scores for all analytes reported.



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

Figure 59 E_n-Score Dispersal by Laboratory



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

Figure 60 z-Score Dispersal by Laboratory

Table 70 Between-Laboratory CV of this Study, Thompson CV and Set Target CV

Sample	Test	Assigned Value (mg/kg)	Between Laboratories CV*	Thompson/ Horwitz CV	Target SD (as PCV)
S1	As	21.6	8.8%	10%	10%
S1	B	Not Set	36%	N/A	Not Set
S1	Be	1.27	9.4%	15%	15%
S1	Cd	1.97	5.8%	14%	10%
S1	Cr	128	13%	7.7%	10%
S1	Cu	71.0	4.4%	8.4%	10%
S1	Hg	Not Set	19%	N/A	Not Set
S1	Mn	365	4.1%	6.6%	10%
S1	Mo	30.0	7.3%	9.6%	10%
S1	Ni	80.7	9.8%	8.3%	10%
S1	Pb	41.1	4.9%	9.1%	10%
S1	Sb	Not Set	37%	N/A	Not Set
S1	Se	14.8	16%	11%	10%
S1	Sn	13.4	7.5%	11%	10%
S1	V	36.1	6.2%	9.3%	10%
S1	Zn	62.1	3.9%	8.6%	10%
S2	Ag	7.10	6.5%	12%	10%
S2	Al	8230	10%	4.1%	10%
S2	As	17.8	6.7%	10%	10%
S2	Ba	283	5.7%	6.8%	10%
S2	Bi	14.4	7.6%	11%	10%
S2	Cd	2.99	4.4%	14%	10%
S2	Co	94.0	3.2%	8.1%	10%
S2	Cr	19.0	9.8%	10%	10%
S2	Cu	103	5.9%	8%	10%
S2	Hg	1.35	10%	15%	15%
S2	Li	Not Set	47%	N/A	Not Set
S2	Ni	73.6	5.3%	8.4%	10%
S2	Pb	433	5.9%	6.4%	10%
S2	Se	10.9	10%	11%	10%
S2	Tl	6.37	12%	12%	15%
S2	U	4.75	7.2%	13%	10%
S2	V	57.0	7.3%	8.7%	10%
S2	Zn	752	5.1%	5.9%	10%
S2	Moisture Content	25.4 %	2.8%	9.8%	10%
S3	Ca	1030	8.4%	5.6%	10%
S3	EC	203 µS/cm	5.2%	7.2%	10%
S3	Colwell P	39.0	21%	9.2%	20%
S3	Colwell K	Not Set	37%	N/A	Not Set
S3	$CaCl_2$-Extractable B	Not Set	80%	N/A	Not Set
S3	Exchangeable Ca^{2+}	4.06 cmol(+)/kg	4.7%	13%	10%
S3	Exchangeable Mg^{2+}	1.52 cmol(+)/kg	9.2%	15%	15%
S3	Exchangeable Na^{+}	0.253 cmol(+)/kg	21%	20%	20%
S3	Exchangeable K^{+}	0.238 cmol(+)/kg	16%	20%	20%
S3	Fe	5390	11%	4.4%	10%
S3	K	259	15%	6.9%	15%
S3	Mg	404	13%	6.5%	15%
S3	Na	83.0	12%	8.2%	10%
S3	P	271	8.1%	6.9%	10%
S3	PBI_{+ColP}	Not Set	15%	N/A	Not Set

Table 70 Between-Laboratory CV of this Study, Thompson CV and Set Target CV (continued)

Sample	Test	Assigned Value (mg/kg)	Between Laboratories CV*	Thompson/ Horwitz CV	Target SD (as CV)
S3	Total P	331	7.9%	6.7%	10%
S3	pH	4.54	3.3%	3.5%**	10%
S3	S	288	8.7%	6.8%	10%
S3	Sr	11.1	13%	11%	10%
S3	TC	29200	2%	3.4%	10%
S3	TOC	30100	8.9%	3.4%	10%
S3	TN	2350	8.4%	5%	10%

*Robust between Laboratories CV with outliers removed; N/A = Not Applicable, **As per APHA Method 4500H, requirements for precision and bias. N/A Not applicable

7.5 Participants' Results and Analytical Methods for Acid Extractable Elements

A summary of participants' results and performance is presented in Tables 71 to 73 and in Figures 60 and 61.

B, Li and B in S1 were the most difficult elements to analyse. No agreement was found between the results reported by participants for these elements.

Zn in S1, Co and moisture content in S2 were the tests that presented the least analytical difficulty to participating laboratories with a between laboratory CV of less than 4%.

Laboratory 8 should check for laboratory bias (e.g. recalibrate their balance) as most of the results they reported for acid extractable elements, nutrients and exchangeable bases were lower than the assigned value.

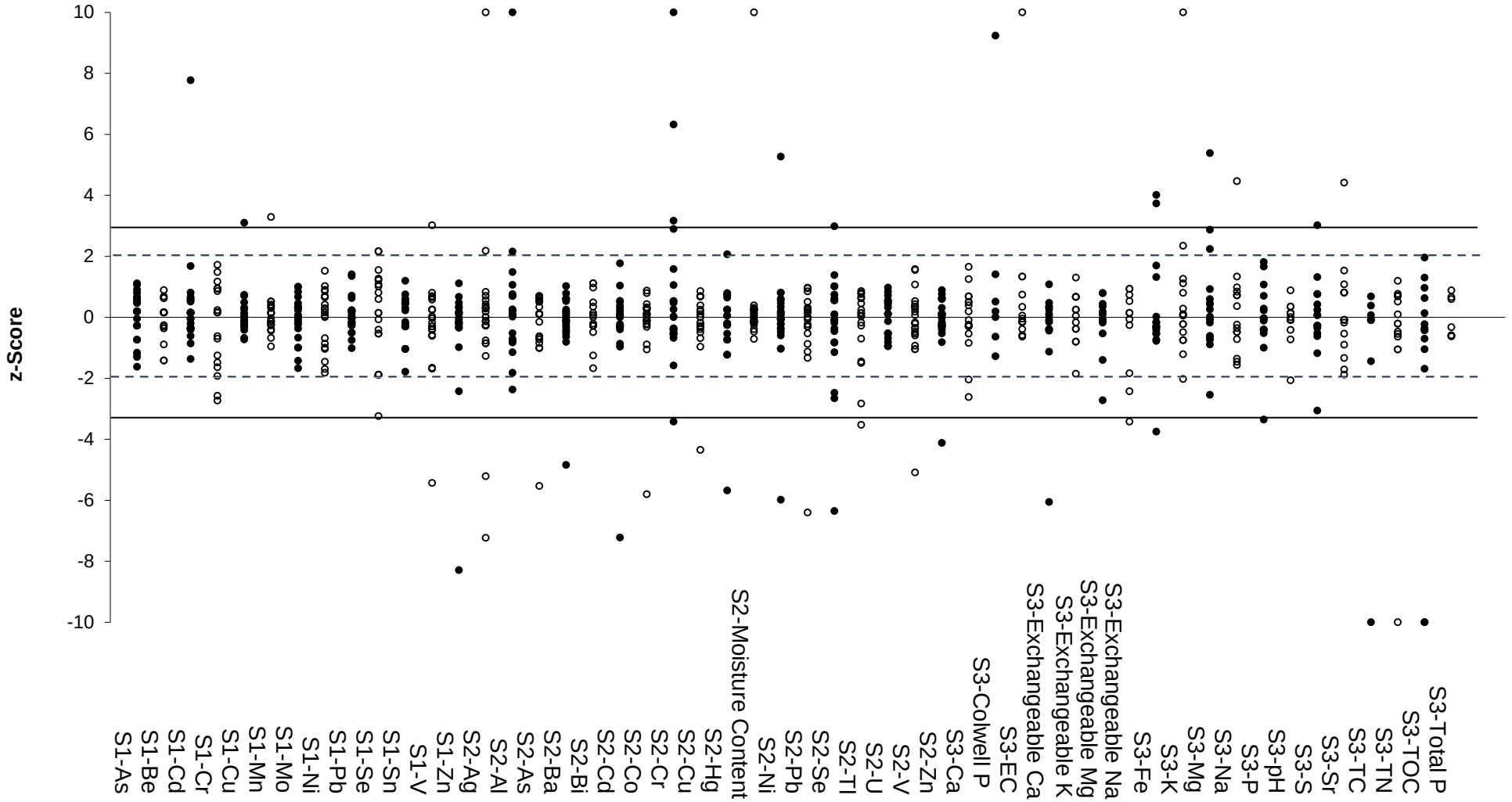
All the unsatisfactory results reported by Laboratory 24 were lower than the assigned value by a factor of approximately 2 or 3. This laboratory should check their dilution and/or standard preparation procedure. The results from this laboratory were not included in the analyses of extraction methods and of instrumental techniques employed by participants.

The method descriptions provided by participants for acid extractable elements are presented in Tables 1 and 2 while instrumental conditions are presented in Appendix 5.

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 can lead to misleading conclusions – since metals can be extracted from the fraction naturally present in the soil matrix.[5, 17-19] 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 except for Sb and Li.[20-22]

Laboratory 1 only used HNO_3 while Laboratory 26 used diluted HNO_3 and HCl; both used a digestion temperature of 170-175°C. The results these laboratories reported, were satisfactory for most elements with the exception of Cr, Mg and Ca. Both reported high unsatisfactory results for Cr in S2. A high digestion temperature may have facilitated Cr extraction from silica lattice.



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

Figure 61 z-Score Dispersal by Element

Table 71 Summary of Participants' Results and Performance for Sample S1

Lab Code	As (mg/kg)	B (mg/kg)	Be (mg/kg)	Cd (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)	Sn (mg/kg)	V (mg/kg)	Zn (mg/kg)
A.V.	21.6	Not Set	1.27	1.97	128	71.0	Not Set	365	30.0	80.7	41.1	Not Set	14.8	13.4	36.1	62.1
H.V.	19.6	16.1	1.25	1.89	129	66.7	0.171	309	26.6	86	37.9	11.0	15.1	12.3	35.5	60.6
S.V.	22.0	25.0	1.20	1.84	118	70.0	0.413	Not spiked	30.0	78.5	44.0	20.0	15.0	12.4	37.3	65.3
1	22.6	NT	1.21	2.07	140	73.2	0.11	355	31.0	87.6	46.9	18.8	16.4	NT	38.2	64.3
2	22	7.8	1.3	1.9	93	70	0.14	370	31	67	41	6	14	12	37	61
3	22	22	<5	1.9	140	73	0.2	350	31	86	44	17	16	14	39	65
4	21	17	1.4	2.0	130	70	0.11	380	27	81	40	9.9	12	12	35	60
5	22.9	<20	1.22	1.96	119	71.3	0.131	384	30.7	73.7	41.8	12.5	<20	13.7	<100	63.0
6	23.0	NR	NR	2.0	143	93.0	NR	485	NR	93.0	42.0	NR	NR	NR	16.5	10.6
7	22.7	18.1	NT	1.85	140	68.8	0.13	349	29.3	80.7	40.9	16.4	16.3	13.1	35.4	62.7
8	18.1	<50	1.0	1.7	95	69.1	0.1	340	25.7	66	36.9	6.8	10	12.0	30	47.0
9	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
10	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
11	20	17	1.3	1.9	130	71	<0.2	360	28	83	38	10	15	13	35	63
12	24	31	<2	2.0	150	73	<0.2	370	31	88	41	19	18	14	47	69
13	21.5	34.4	1.30	1.93	109	66.2	0.151	356	29.7	72.3	40.3	13.4	17.1	13.0	33.9	60.4
14	23.9	11.7	< 2	2.13	147	74.5	0.137	376	32.5	86.3	43.7	17.8	16.6	14.4	38.4	63.1
15	18.8	17.5	1.39	2.08	139	76.0	0.17	378	29.5	88.9	40.3	NT	14.7	13.2	36.2	63.1
16	23.55	17.08	1.44	2.09	130.91	76.15	0.14	383.55	31.35	82.85	46.64	13.79	16.68	14.10	38.59	66.29
17	21	14	1.3	2.1	130	69	0.1	360	30	83	41	13	14	13	36	60
18	22	13	1.3	2.3	140	72	0.11	330	25	81	42	18	18	15	34	56
19	23.3	<50	1.3	1.96	103.3	71.14	0.12	357	30.22	68.88	41.90	8.50	15.68	13.80	34.58	60.71
20	20	14	1.3	2.0	130	70	0.12	370	33	86	42	10	12	13	37	62
21	23.0	<50	1.39	1.89	112	70.1	0.14	364	28.9	75.1	41.4	8.89	14.2	14.2	34.7	61.5
22	19	12	1.2	1.8	140	69	<1.0	370	32	82	39	NT	12	14	37	64
23	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
25	22	25	<2	1.9	130	68	0.13	360	30	82	40	18	15	14	36	61
26	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
27	21	15	1	2	120	71	0.11	370	33	84	39	NT	12	11	37	61
28	19.100	NT	1.100	3.500	107.000	65.800	0.170	NT	27.000	72.600	40.500	NT	NT	NT	30.100	NT
29	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
30	NT	NT	NT	NT	NT	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, S.V. = Spike Value

Table 72 Summary of Participants' Results and Performance for Sample S2

Lab Code	Ag (mg/kg)	Al (mg/kg)	As (mg/kg)	Ba (mg/kg)	Bi (mg/kg)	Cd (mg/kg)	Co (mg/kg)	Cr (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Li (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Tl (mg/kg)	U (mg/kg)	V (mg/kg)	Zn (mg/kg)	Moisture Content (%)
A.V.	7.10	8230	17.8	283	14.4	2.99	94.0	19.0	103	1.35	Not Set	73.6	433	10.9	6.37	4.75	57.0	752	25.4
H.V.	7.53	8830	16.3	253	15.0	2.97	93	17.7	100	1.50	3.17	75.3	443	11.0	6.93	4.90	55.5	773	25.5
S.V.	7.22	Not Spiked	18.0	267	14.1	3.03	100.0	19.0	100	1.25	Not Spiked	71.2	416	11.7	7.14	4.49	54.9	724	25.0
1	7.69	NT	18.8	305	NT	3.14	96.5	24.5	110	1.31	6.02	79.5	444	11.5	NT	5.15	63.1	798	25.4
2	7.01	7543.04	17.54	288.71	NT	3.01	102.21	19.06	105.56	1.767	NT	79.57	454.6	11.56	NT	NT	59.45	758.27	25.8
3	7.1	10000	18	280	16	2.9	95	22	100	1.5	<5	73	420	11	<10	<10	59	760	25
4	7.0	8300	18	300	16	3.3	93	21	110	1.1	2.8	71	420	12	6.6	4.8	54	730	26
5	7.3	8800	18.4	284	15.8	3.05	93	18.2	98	1.36	2.67	69.2	433	<20	6.96	5.09	<100	740	76.1
6	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
7	7.23	7648	18.9	265	NT	2.87	93.7	NT	103	1.31	NT	73.2	433	10.8	4.94	4.69	55.98	751	25.2
8	6.2	6280	16.7	268	14.6	3.0	94	16	95.9	1.2	1.2	70	423	10	6.4	4.5	51	728	24.8
9	6.56	8856	16.3	274	13.7	2.73	85.6	17.9	103	1.24	2.35	66.0	384	10.5	4.98	4.42	51.7	721	24.4
10	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
11	7.4	8250	16	260	14	2.9	93	18	99	1.3	3.1	72	420	10	6.5	4.3	51	730	25.1
12	6.9	23000	18	300	14	2.9	91	31	100	1.3	8.1	73	420	12	7.0	4.8	66	800	25
13	8.65	6730	19.0	278	14.9	2.90	96.8	18.2	104	1.51	1.55	74.7	446	12.4	6.42	4.96	57.4	753	26.4
14	7.34	7280	18.8	276	15.1	3.15	94.7	18.3	101	1.36	NT	74.0	441	10.7	7.10	4.98	55.8	736	25.7
15	6.49	9450	16.5	298	12.6	2.99	96.5	19.5	107	1.40	3.40	77.7	395	10.8	6.49	4.36	54.3	775	25.1
16	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
17	6.5	7800	16	270	14	2.9	92	18	100	1.1	2.6	72	410	10	6.2	4.5	55	690	26
18	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
19	14.64	7577.1	17.96	287.11	14	3.02	95.0	17.70	101.08	1.48	1.98	70.62	446.59	11.71	7.13	5.01	54.88	733.62	23.6
20	7.1	8300	18	300	12	3.0	95	18	110	1.4	2.8	76	440	12	6.1	4.3	59	760	26.0
21	6.92	8410	18.7	271	14.5	2.92	91.7	18.3	99.6	1.20	2.1	73.2	444	9.65	6.8	4.9	53.6	712	25.6
22	3.4	8820	16	280	NT	2.7	93	20	100	1.3	1.8	77	430	8.2	NT	5.0	56	810	26.2
23	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
24	1.97	8440	7.96	146	NT	0.83	39.5	12.5	58.2	0.2	4.81	29.6	156	3.98	NT	NT	28.0	442	25.4
25	7.5	8400	19	280	14	3.1	97	20	110	1.5	<5	75	470	11	7.19	4.8	59	760	26
26	6.9	NR	16.6	282	14.1	2.9	84	25	93	1.4	6.1	66	375	10.4	5.7	4.5	58	730	25
27	7.6	9100	18	290	NT	3	98	19	110	1.3	3	78	440	8	3	NT	60	760	25
28	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
29	7.31	8280	18.7	286	14.4	3.08	96.3	19.9	105	1.50	2.54	74.4	475	11.5	3.67	5.21	58.6	796.3	26.1
30	NR	NR	19.04	312	NR	3.52	101.4	61.88	111.81	NR	NR	112.36	473.95	14.15	NR	NR	65.83	819	24.2

Shaded cells are results which returned a questionable or unsatisfactory z-score. A.V. = Assigned Value, H.V. = Homogeneity Value, S.V. = Spike Value

Table 73 Summary of Participants' Results and Performance for Sample S3

Lab Code	Ca (mg/kg)	Extractable-B (mg/kg)	Colwell-P (mg/kg)	Colwell-K (mg/kg)	EC (µS/cm)	Exchangeable-Ca (cmol(+)/kg)	Exchangeable-Mg (cmol(+)/kg)	Exchangeable-Na (cmol(+)/kg)	Exchangeable-K (cmol(+)/kg)	Fe (mg/kg)	K (mg/kg)
A.V.	1030	Not Set	39.0	Not Set	203	4.06	1.52	0.253	0.238	5390	259
H.V.	1000	N/A	N/A	160	N/A	5.10	1.80	0.270	0.260	5000	270
1	1020	NT	NT	NT	NT	NT	NT	NT	NT	6300	NT
2	1100	NT	29	NT	195	3.6	1.2	0.08	0.15	5100	250
3	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
4	1000	NT	NT	NT	200	4.5	1.5	0.13	0.22	5100	230
5	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
6	1080	NR	NR	NR	200	4.25	1.48	0.16	0.22	7550	308
7	1082	NT	NT	NT	230	NT	NT	NT	NT	5216	302
8	760	1.5	34	152	202	1.6	0.9	0.3	0.3	3370	180
9	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
10	NR	NR	40.5	NR	NR	4.02	1.54	0.26	0.25	NR	NR
11	1000	NR	111	106	200	4.2	1.5	0.25	0.23	5160	270
12	1100	NT	NT	NT	200	4.16	1.62	0.3	0.27	7400	800
13	974	NT	NT	NT	210	NT	NT	NT	NT	4970	212
14	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
15	1005	0.54	50	126	191	3.9	1.7	0.28	0.27	5240	263
16	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
17	1000	0.6	NT	NT	190	4.2	1.4	<0.1	0.2	5200	240
18	1200	NT	NT	NT	NT	NT	NT	NT	NT	5200	230
19	1158.6	0.2	NR	NR	204	3.9	1.56	0.24	0.24	4990	262.2
20	1050	0.6	43	220	200	4.1	1.6	<0.3	0.2	5300	250
21	1070	NT	NT	NT	218	3.88	1.49	0.26	0.27	5303	350
22	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
23	943	NT	NT	NT	230	4.07	1.50	<0.5	<0.5	6100	261
24	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
25	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
26	820	NT	39	NT	1900	4	1.7	0.29	0.25	NR	NR
27	1000	NT	NT	NT	200	NR	NR	NR	NR	5400	290
28	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
29	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	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, N/A = Not Available

Table 73 Summary of Participants' Results and Performance for Sample S3 (Continued)

Lab Code	Mg (mg/kg)	Na (mg/kg)	P (mg/kg)	Total P (mg/kg)	PBI_{+ColP} (mg/kg)	pH	S (mg/kg)	Sr (mg/kg)	TC (mg/kg)	TOC (mg/kg)	TN (mg/kg)
A.V.	404	83.0	271	331	Not Set	4.54	288	11.1	29200	30100	2350
H.V.	400	69.5	255	N/A	100	N/A	N/A	12.0	28000	30000	2200
1	540	NT	NT	NT	NT	NR	310	NT	NT	NT	NT
2	350	79	270	360	NT	4.6	280	11	NT	2.9	2200
3	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
4	360	80	260	NT	NT	4.5	270	11	NT	32000	NT
5	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
6	366	NR	316	NR	NR	3.6	375	NR	NR	NR	NR
7	405	94	277	NT	NT	NT	326	10.1	29400	26925	2517
8	250	70	180	311	NT	4.5	200	9.2	2.79	2.25	2530
9	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
10	NR	NR	NR	NR	NR	4.21	NR	NR	29000	29000	0.25
11	420	77	260	NR	NR	4.5	300	12	28900	28800	2100
12	730	120	320	NT	NT	4.54	NT	16	NT	NT	NT
13	367	70.9	257	311	NT	4.35	273	10.5	NT	33000	2370
14	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
15	431	79	268	NR	75	4.70	278	10.9	30300	29400	2240
16	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
17	360	89	270	NT	NT	4.6	290	11	25000	25000	2100
18	460	NT	290	320	NT	NT	NT	9	NT	28000	2300
19	402	91.1	278.5	350.4	NR	4.6	280	9.61	NR	NR	2509
20	400	86	260	NT	60	4.5	290	12	NT	36000	2300
21	430	90	300	353	NT	4.6	310	11	NT	34000	2630
22	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
23	393	71.7	244	NT	NT	4.94	254	12.8	31200	30500	2220
24	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
25	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
26	578	89	260	310	76.8	4.7	295	12.3	28900	28900	2470
27	440	81	270	NT	NT	4.5	280	12	NT	NT	NT
28	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
29	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	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

Laboratories 19 and 21 used a digestion temperature of 95°C but dilute HNO_3 and HCl while Laboratory 2 used a digestion temperature of 85°C and a small ratio acid sample size of 15 mL to 3 g. Most of the results reported by these laboratories were lower than the assigned value. Weak digestion regimes may only extract a fraction of the elements from soil.

Laboratory 7 digested its samples at 85°C for 240 min using a high ratio acid sample size of 10 mL to 0.5 g. All the results they reported for acid extractable elements returned satisfactory z-scores.

Laboratories 5 and 13 digested the samples at 95°C for less than an hour, which may explain some of the low results they have reported for those elements which are strongly dependent on digestion regime.

Laboratories 12 and 30 used an extraction regime which involved concentrated acids, a high ratio acid sample size and a digestion temperature of 180°C. All the unsatisfactory results they reported were higher than the assigned value; an aggressive digestion regime may facilitate elements extraction from silica lattice.

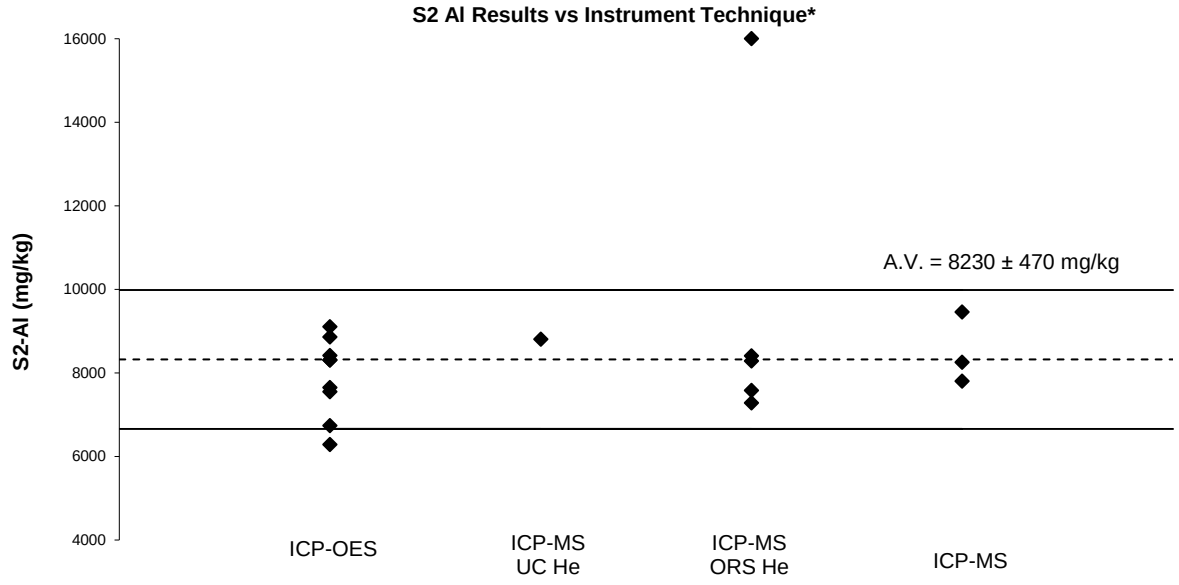
Laboratory 30 used a very small sample size of 0.1 to 0.2 g. Caution should be exercised when such a small sample size is taken for analysis as this might not be representative of the whole sample.

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. A high extraction temperature (180°C) may explain the high results reported by Laboratory 12.

Plots of results for Al versus instrumental technique used are presented in Figure 62.



*Result >16000 mg/kg has been plotted as 16000mg/kg.

Figure 62 Al 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. All high Sb results were from digestion temperatures of 175°C or higher, while all low results were from a digestion temperature of 85°C and/or dilute acids (Figure 63).

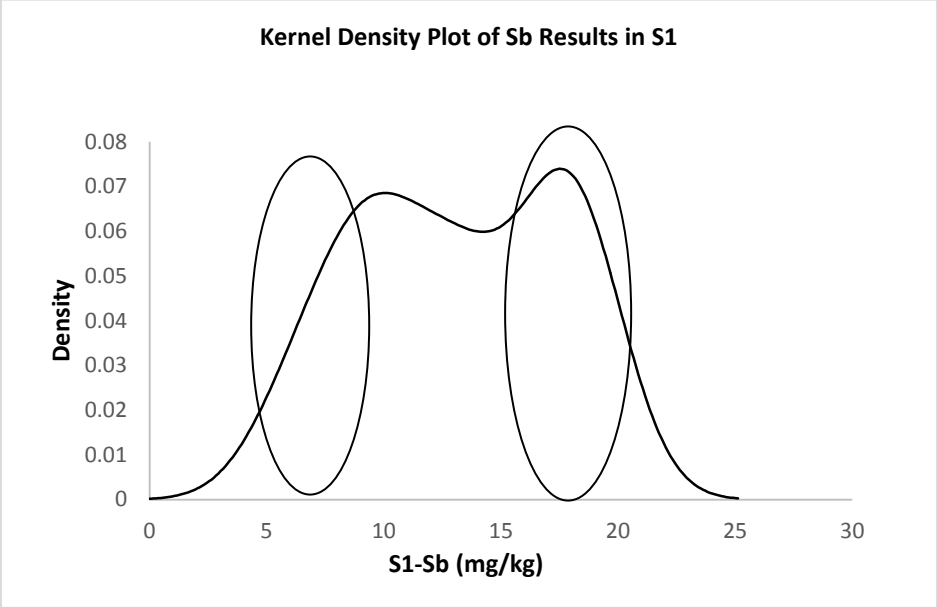


Figure 63 Participants' Results versus Digestion Regime

Lab code	S1 Sb Results mg/kg	Digestion Regime					
		Sample Mass (g)	Temp ºC	Time (min.)	HNO_3 (mL)	HCl (mL)	H_2O_2 (mL)
2	6	3	**85**	120	10 (1:1)	5	6
19	8.5	1	95	60	**2 (1:1)**	**10 (1:1)**	2
21	8.89	1	95	60	**2 (1:1)**	**10 (1:1)**	2
4	9.9	2	90 - 98	90	3	3	
11	10	1	95-100	120	3	3	
20	10	1	90-98	120	3	3	
5	12.5	1	95	50	2	2	
17	13	2	90-98	120	3	3	
13	13.4	1	95	45	2.5	2.5	
16	13.79		109	60	800	400	
7	16.4	0.5	85	240	5	5	
14	17.8	2	100	60	4	12	
18	18		95	120	2	6	
1	18.8	0.5	**175**	4.5	10	0	2
12	19	0.5	**180**	20	9	3	

There was no evident relationship between participants' Sb results and the instrumental technique they used (Figure 64).

Laboratories should consider increasing their estimates of uncertainty for Sb measurements in soil.

Arsenic Most participants used ICP-MS for As measurements with various collision/reaction cells and He as collision gas (Figure 65).

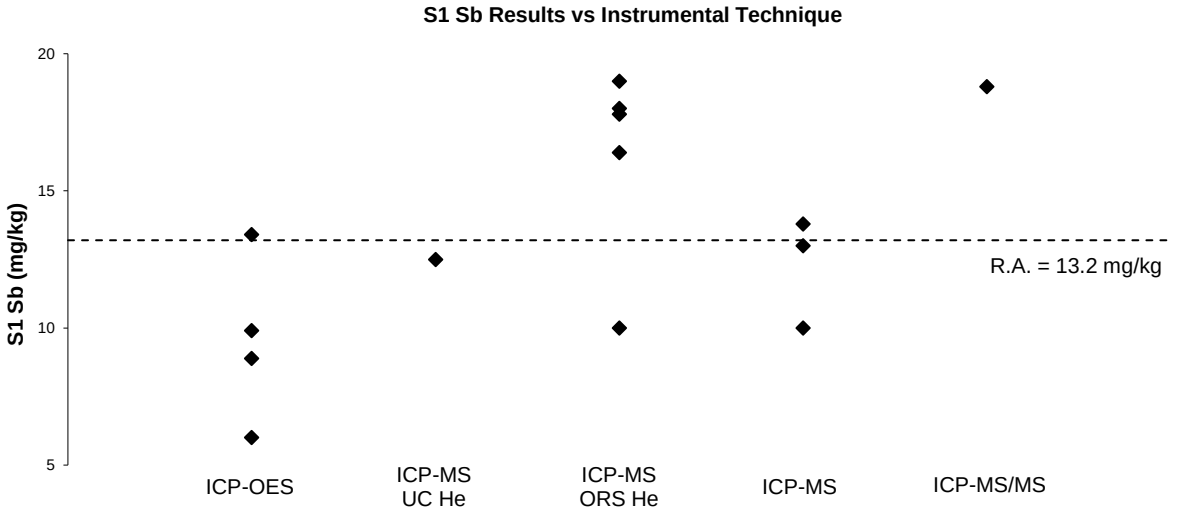


Figure 64 Sb Performance in S1 vs. Instrumental Technique

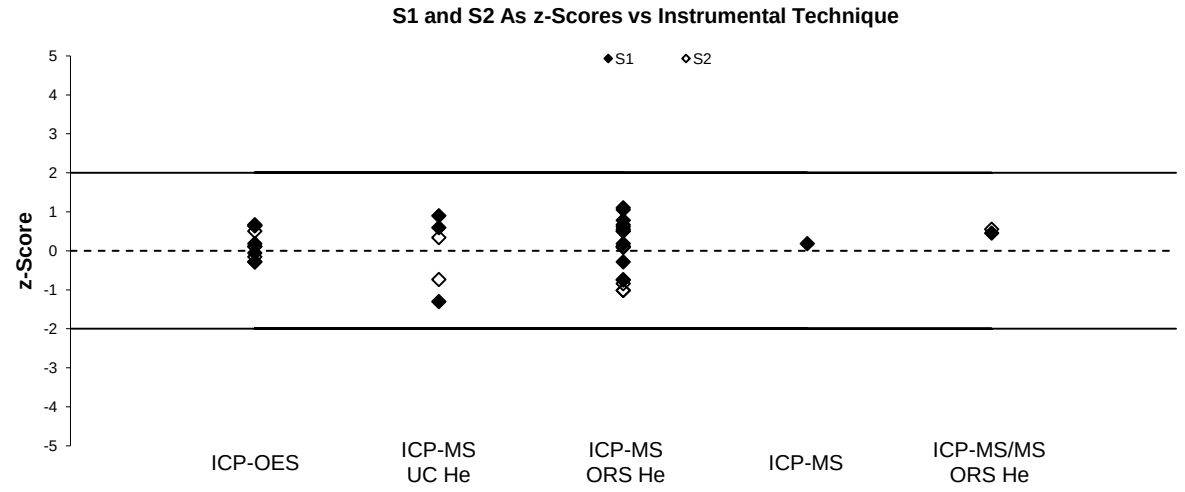


Figure 65 As Performance in S1 and S2 vs. Instrumental Technique

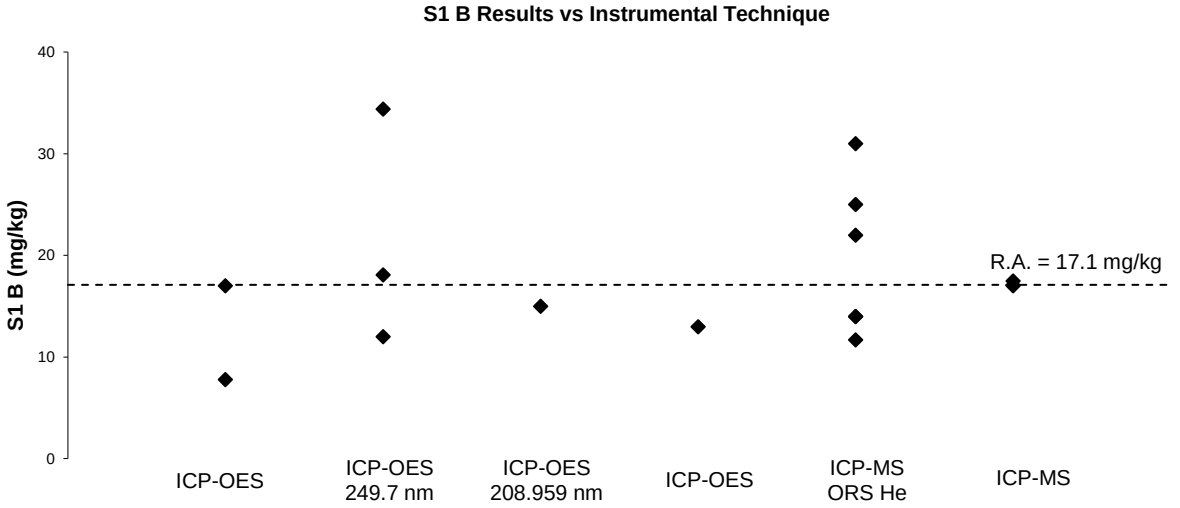


Figure 66 B Results in S1 vs. Instrumental Technique

Boron level in Sample S1 was low and this might have presented difficulty to some laboratories. The between laboratory coefficient of variation was high (36%) no assigned value was set for this element in S1. Boron is an element prone to contamination. The sampling system should be cleaned before low level B determination.

Plots of participants' results versus instrumental technique used are presented in Figure 66.

Lithium The results reported for Li were variable with a between laboratory CV of 47%. All high Li results were from digestion temperatures of 170°C and above.

Selenium Participants'S1 and S2 Se results versus the instrumental techniques they used are presented in Figure 67.

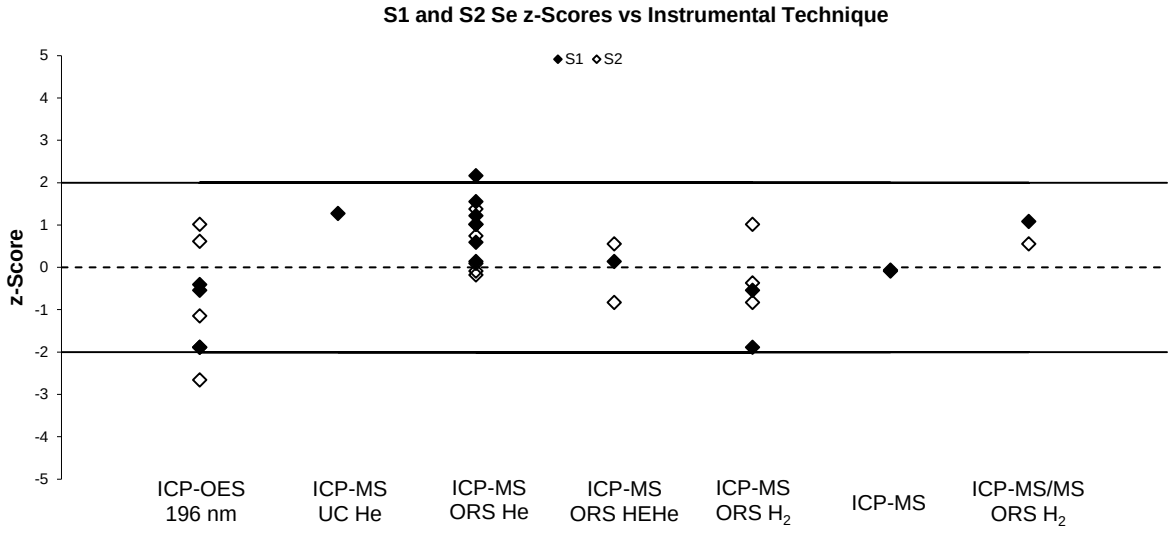


Figure 67 S1-Se and S2-Se Results vs. Instrumental Technique

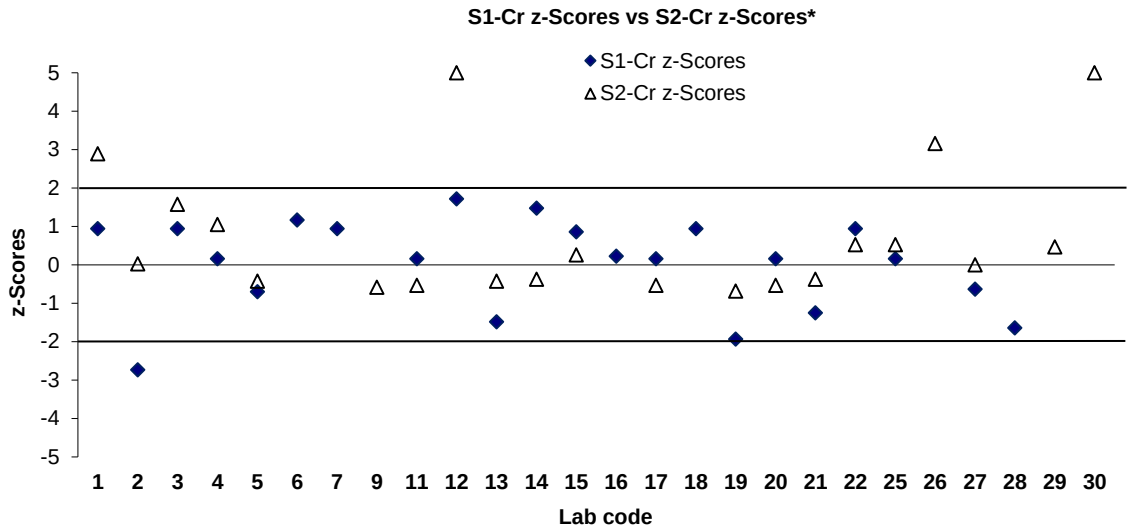
Chromium, Nickel and Vanadium are three elements which are highly dependent on extraction regime. Plots of participants' performance for these elements in S1 and S2 are presented in Figures 68, 69 and 70.

Laboratories whose z-scores for all three elements lie on the same side of the centre line may need to monitor their procedure as this can be an indication of method bias.

Aggressive digestion regimes (digestion temperatures of 170°C or above and high ratios acid sample sizes of 20 to 1 or above) might explain high results, while weak extraction conditions (small amounts of acids or dilute HNO_3 and dilute HCl) or short extraction time might explain any low results.

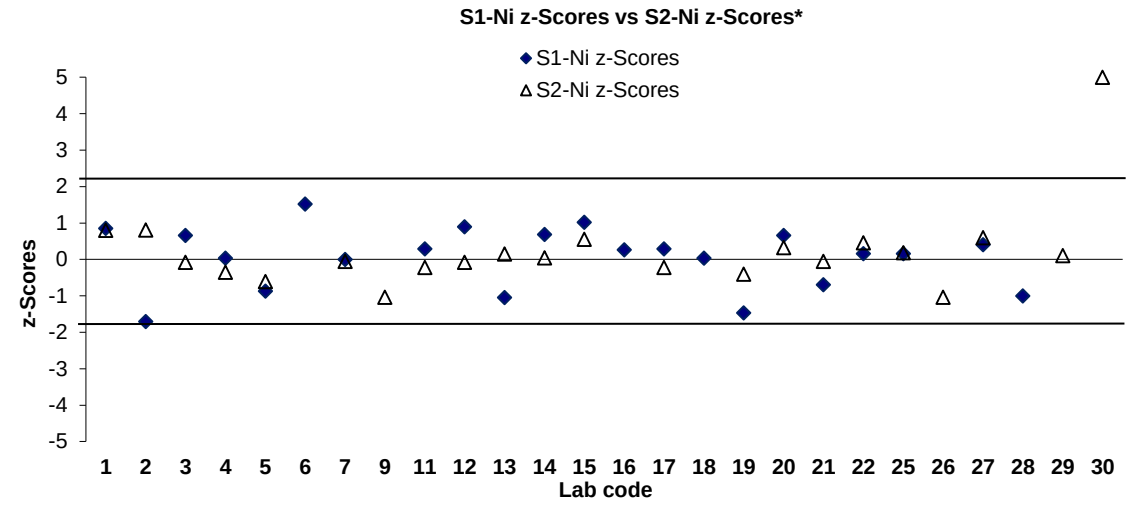
Figure 71 presents plots of participants' performance for Cr in S1 and S2 versus the instrumental technique they used. There is no evident relationship between instrumental technique and performance.

Magnesium, Potassium, Phosphorus and Sodium Plots of Mg, K, P and Na results versus instrumental technique are presented in Figures 72 to 75. ICP-OES was the preferred analytical technique.



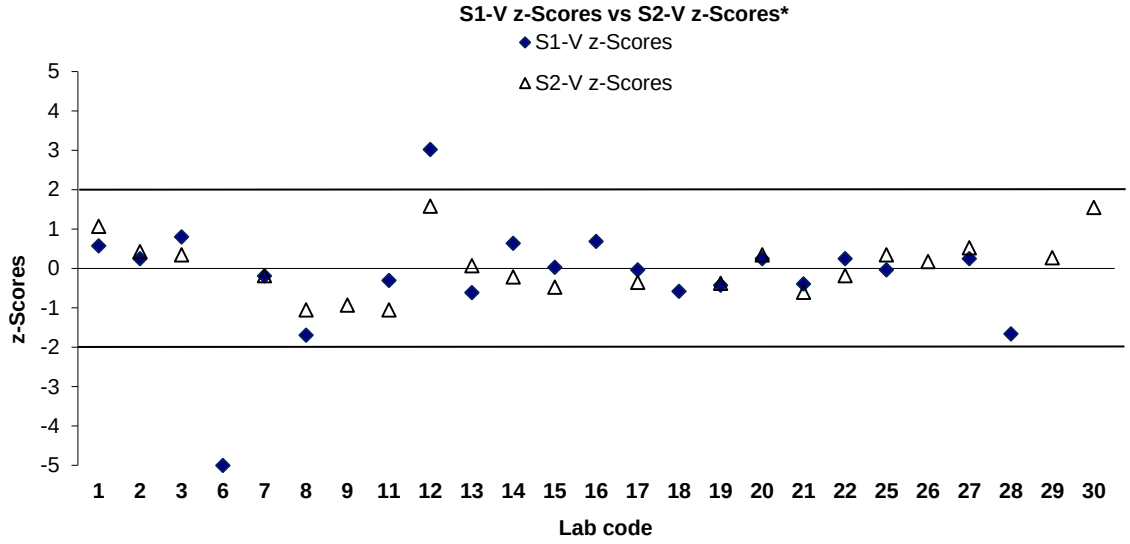
*z-Scores>5 have been plotted as 5.

Figure 68 Comparison of Participants' Performance for Cr in S1 and S2



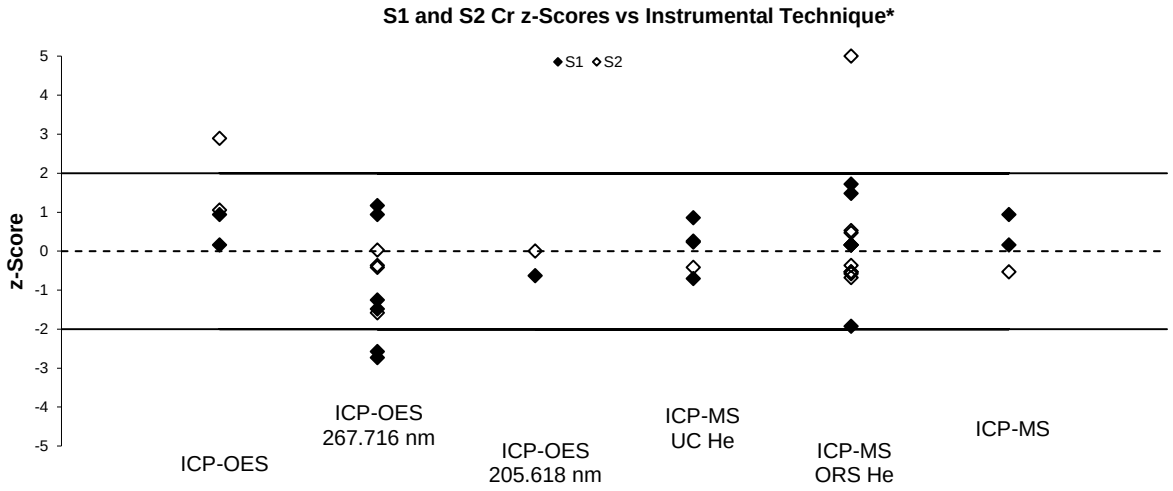
*z-Score>5 has been plotted as 5.

Figure 69 Comparison of Participants' Performance for Ni in S1 and S2



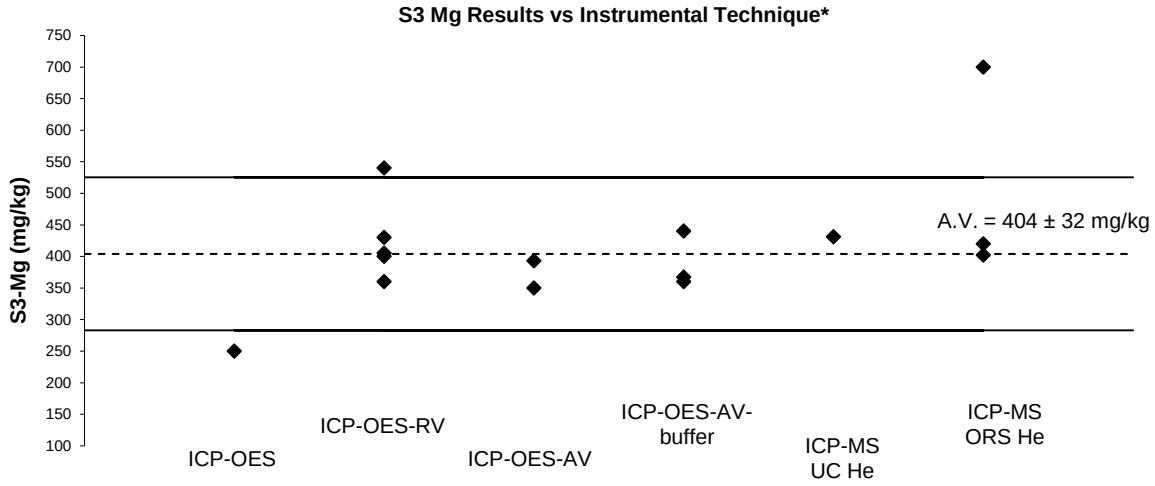
*z-Score<-5 has been plotted as -5.

Figure 70 Comparison of Participants' Performance for V in S1 and S2



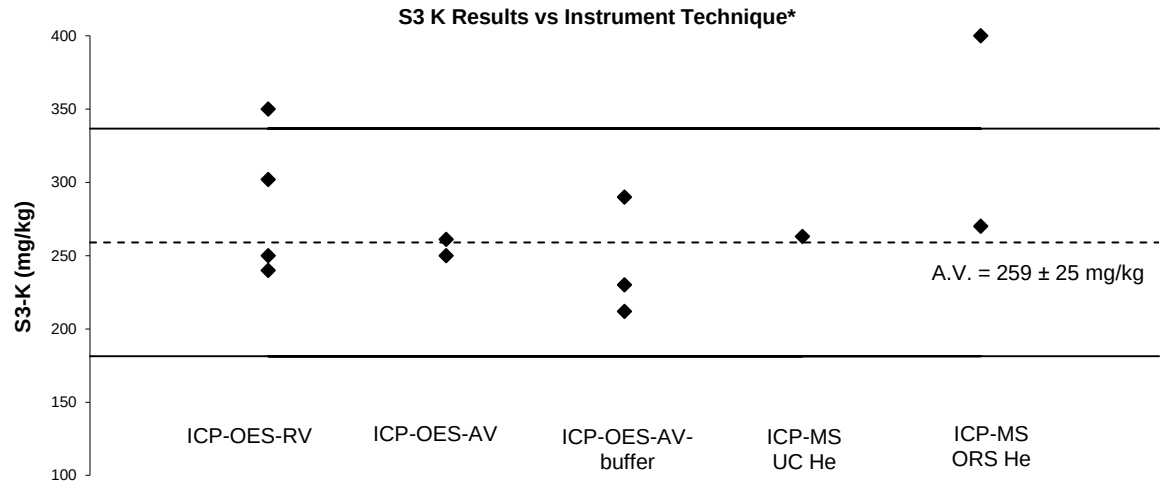
*z-Score>5 has been plotted as 5.

Figure 71 Cr Results vs. Instrumental Technique



*Result > 750 mg/kg has been plotted as 700 mg/kg.

Figure 72 Mg Results vs. Instrumental Technique



*Result > 400 mg/kg has been plotted as 400 mg/kg.

Figure 73 K Results vs. Instrumental Technique

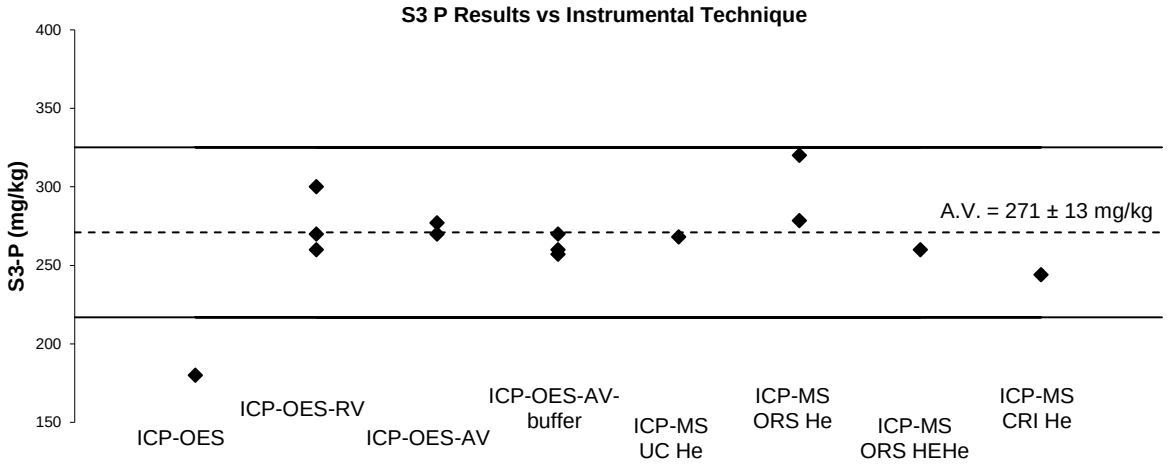


Figure 74 P Results vs. Instrumental Technique

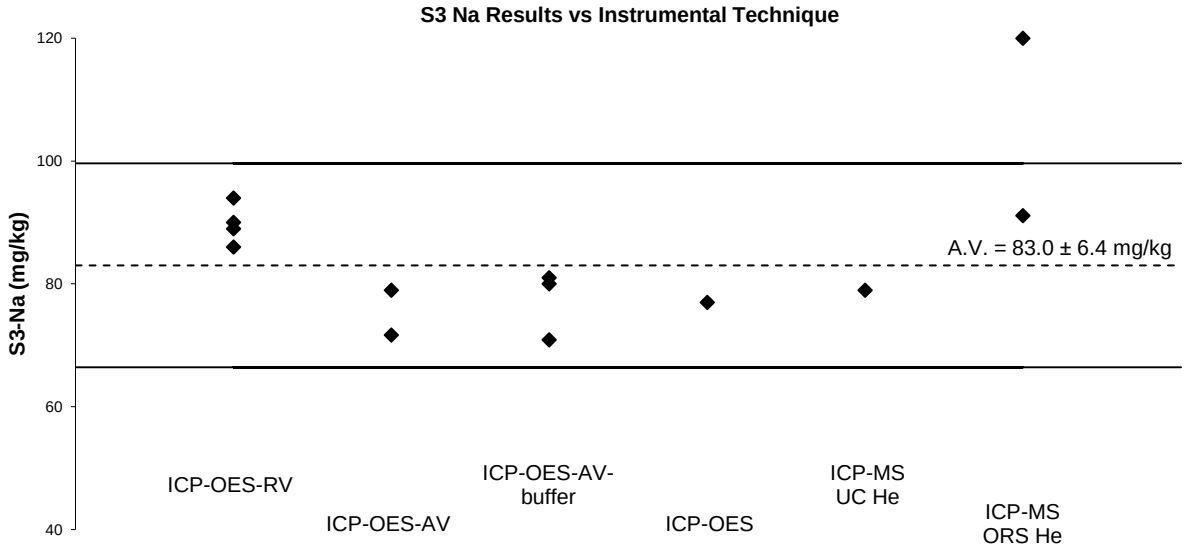


Figure 75 Na Results vs. Instrumental Technique

Moisture content Measurement of moisture content in the test sample S2 did not present significant difficulty to participating laboratories. All results reported for moisture content returned satisfactory z-scores except for one.

Laboratory 5 might have reported result for solid content and not for moisture content.

7.6 Participants' Results and Analytical Methods for Exchangeable Cations

Measurement of exchangeable bases in soil is an empirical measurement – where the method of extraction defines the measurand. The participating laboratories were asked to analyse the sample using their normal measurement technique but to use the same preparation procedure Method 15A1 as defined by Rayment, G.E. and David, J. L in "Soil Chemical Methods-Australasia".[25] The method descriptions provided by participants are presented in Table 10. All participants used a ratio sample mass/extraction solution of 1 to 20 and shook the sample for 1-2 min.

Laboratory 12 noted:" CEC was not corrected by soluble Na salt according to 15A1, however soluble Na does dominate the NH4Cl extraction therefore bring large positive bias".

Plots of participants' results versus the analytical methods used for the exchangeable bases measurement are presented in Figures 76 to 79.

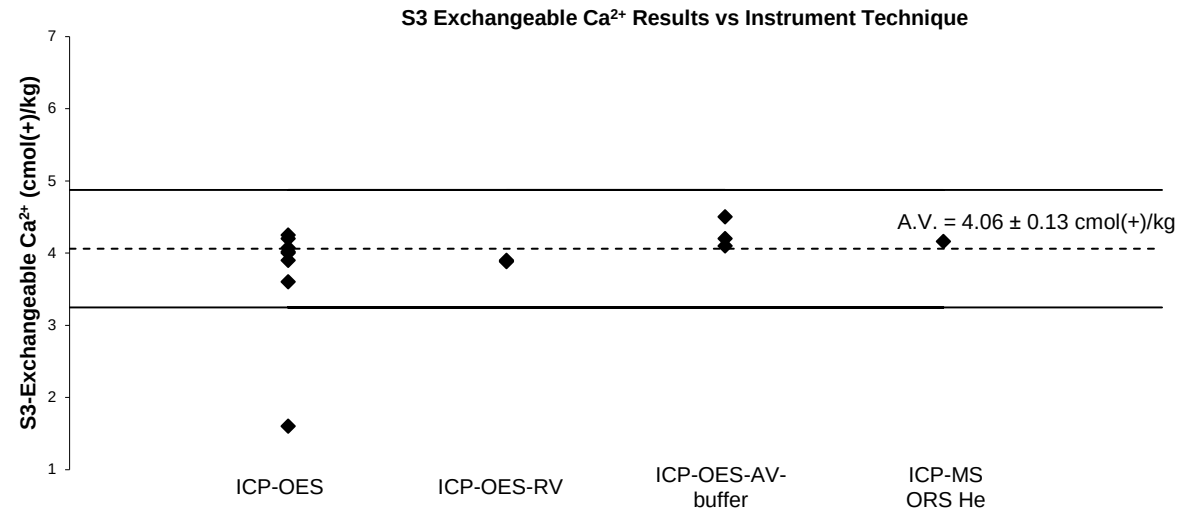


Figure 76 Exchangeable Ca^{2+} Results vs. Analytical Methods

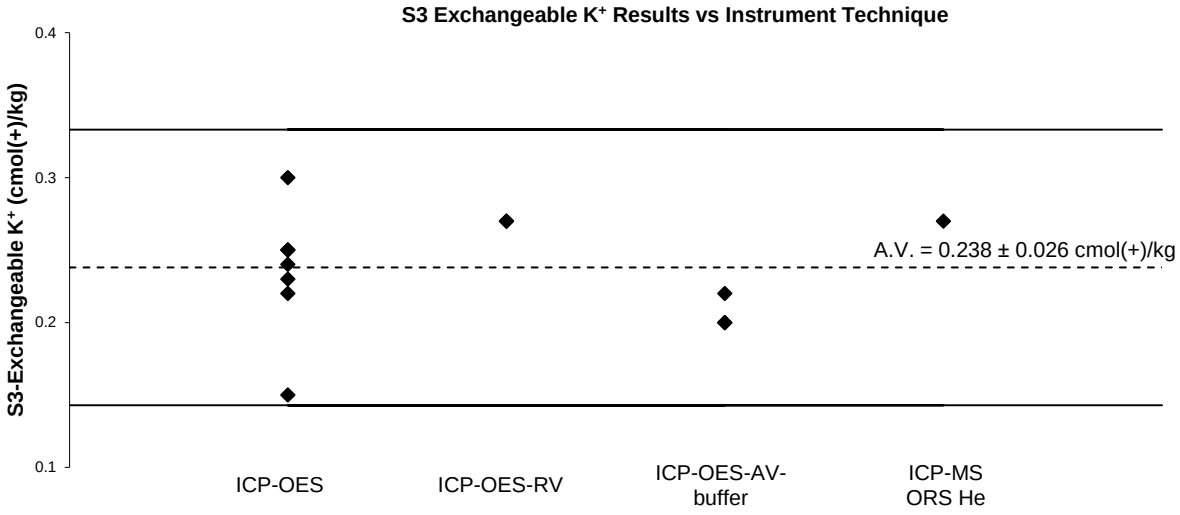


Figure 77 Exchangeable K^{+} Results vs. Analytical Methods

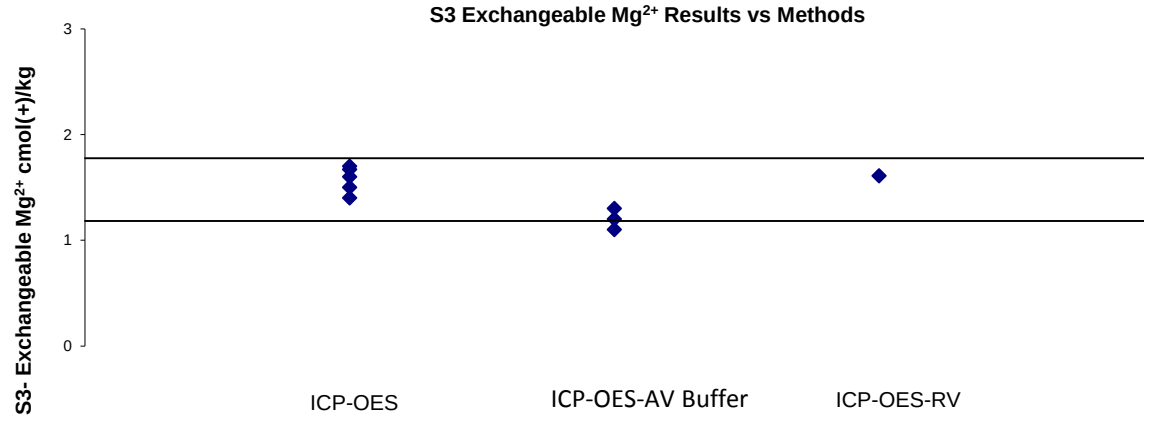


Figure 78 Exchangeable Mg^{2+} Results vs. Analytical Methods

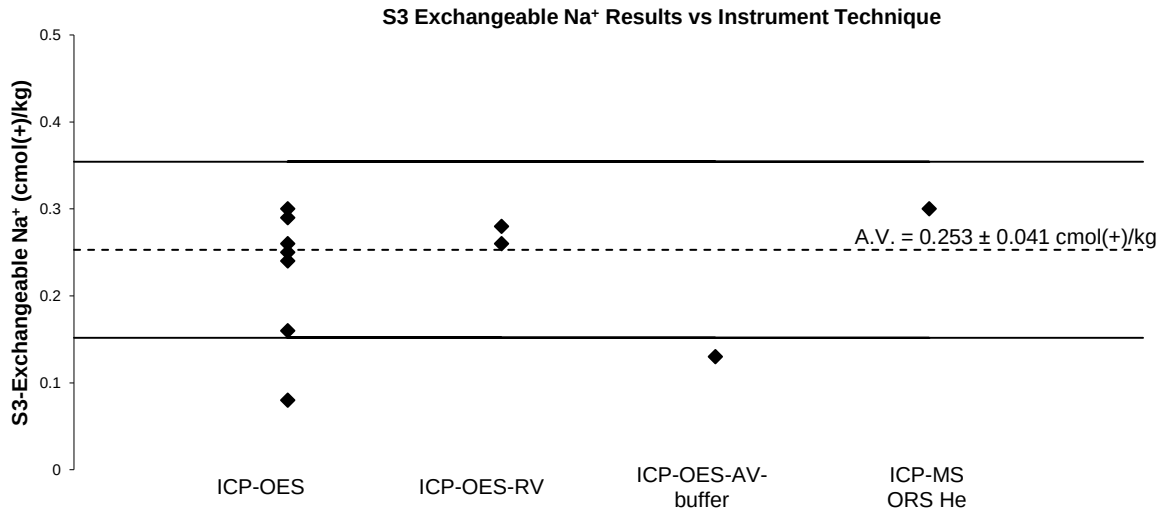


Figure 79 Exchangeable Na^+ Results vs. Analytical Methods

7.7 Participants' Results and Analytical Methods for Colwell P and Colwell K

The participating laboratories were asked to follow the preparation procedure described in Method 9B1 as defined by Rayment, G.E. and David, J. L in "Soil Chemical Methods-Australasia".[23] All participants shook the sample for 16 hours and all used a ratio sample mass/extraction solution of 1 to 100 (Table 5).

Colwell K Four participants extracted K in S3 using 0.5 M $NaHCO_3$ and reported results for this test. Three laboratories used ICP-OES to measurer Colwell K and one used ICP-MS. The four results were in a relative agreement with each other, centred on 151 mg/kg (Figure 80).

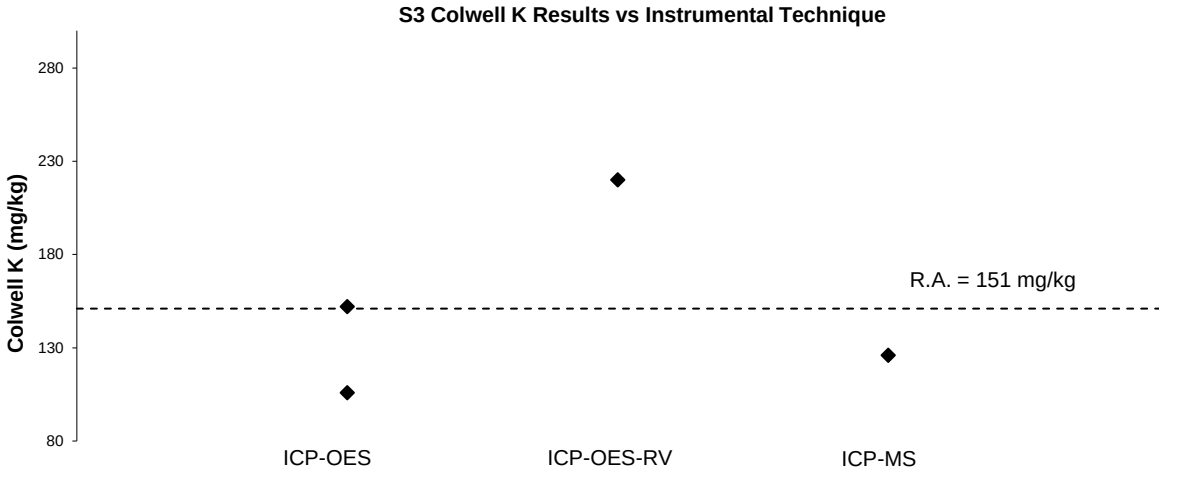
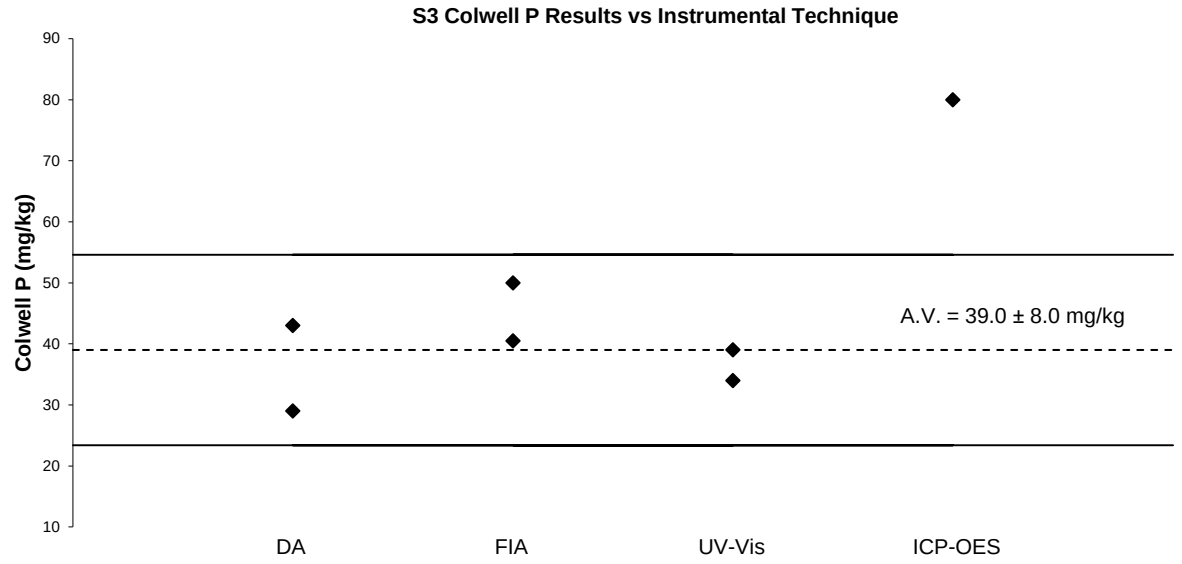


Figure 80 Colwell K Results vs. Instrumental Technique

Colwell P Seven results were reported for Colwell P in S3 and with the exception of one all were in agreement with each other and with the assigned value of 39 mg/kg. Plots of participants' results versus the instrumental technique used are presented in Figure 81.



Result > 80 mg/kg has been plotted as 80 mg/kg

Figure 81 Colwell P Results vs. Instrumental Technique

7.8 Participants' Results and Analytical Methods for Phosphorus Buffer Index-PBI$_{+ColP}$

P Buffer Index-PBI$_{+ColP}$ gives an indication of soil ability to fix P and make it unavailable to plant uptake. Three laboratories reported results for this test. The results were in relatively good agreement with each other, centred on the value of 70.6 mg/kg (Figure 82).

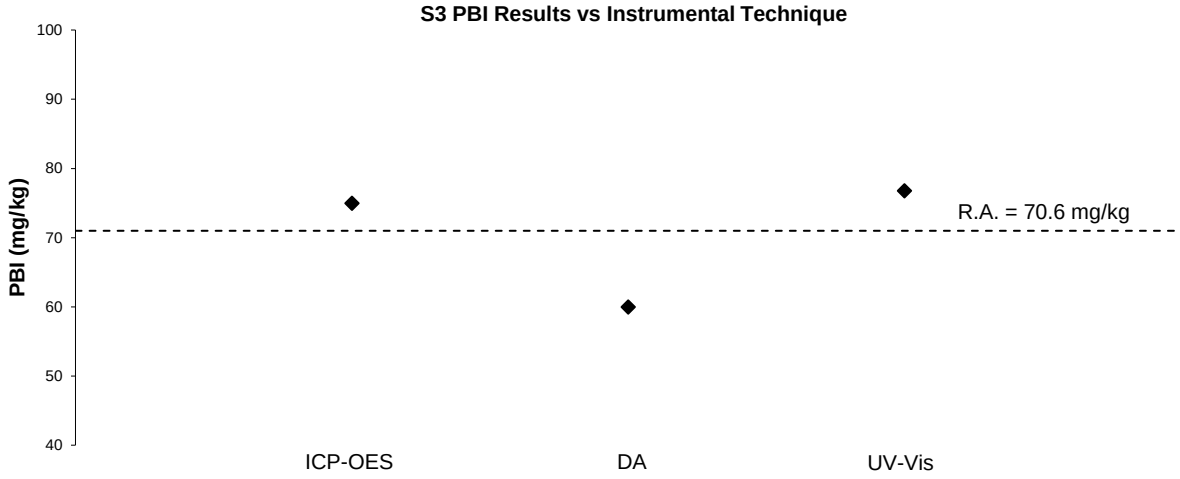


Figure 82 PBI Results vs. Instrumental Technique

7.9 Participants' Results and Analytical Methods for Total P

Total P assigned value was 331 mg/kg. Seven participants reported results for total P and all performed satisfactorily (Figure 83).

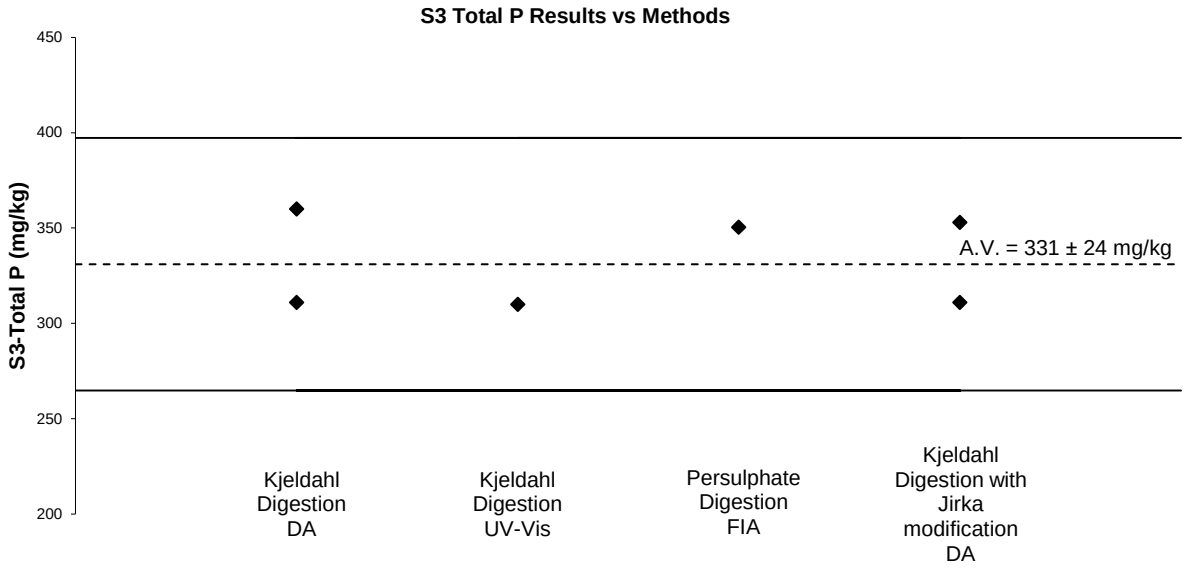


Figure 83 Total P Results vs. Methods

7.10 Participants' Results and Analytical Methods for Calcium Chloride Extractable B

Three results were reported for Calcium Chloride Extractable B in S3. All measured B by ICP-OES and used a ratio of sample mass extraction solution of 10 g to 20 mL (Figure 84).

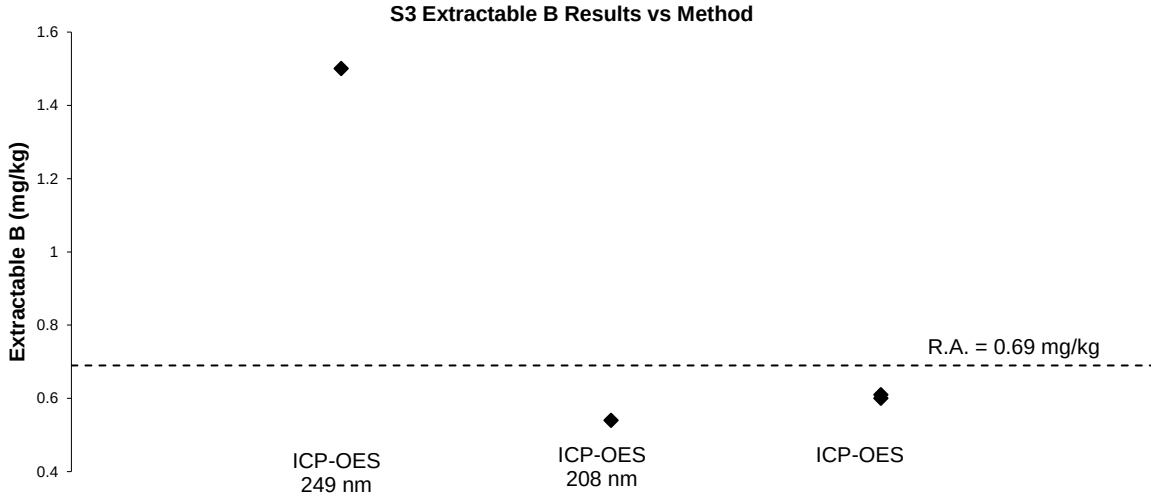


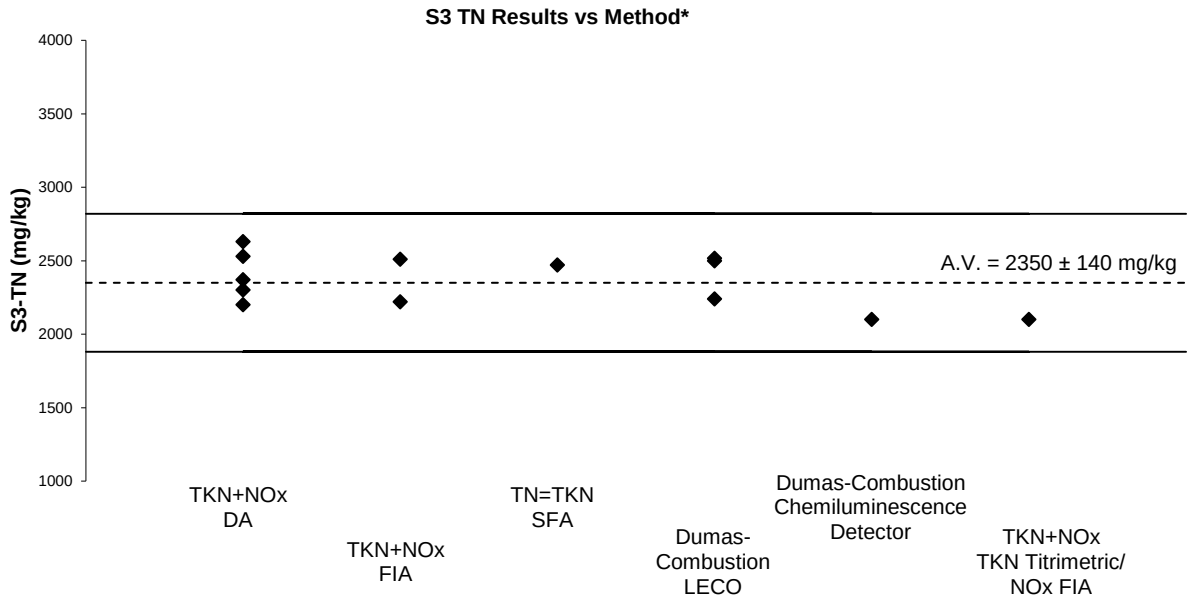
Figure 84 Extractable B Results vs. Methods

Boron measured at 249.7 nm can have significant interference from Fe 249.771 nm if on-line inter-element correction is not used.

7.11 Participants' Results and Analytical Methods for Total Nitrogen

No significant difference was found between TN results from combustion and those results calculated from TKN and NO_x. The method descriptions provided by participants are presented in Table 9. A plot of participants' results versus analytical method and measurement technique used for TN analysis in S3 is presented in Figure 85.

Laboratory 10 correctly measured TN in S3 but reported result in the wrong units.



*Laboratory 10 result of 0.25 mg/kg has been plotted as 2500 mg/kg.

Figure 85 TN Results vs. Analytical Method

7.12 Participants' Results and Analytical Methods for Total Carbon and Total Organic Carbon

Participants were free to choose an appropriate method and were given no guidance apart from the instruction to: "Quantitatively analyse the samples using your normal test method." The method descriptions provided by participants for TC and TOC analyses are presented in Tables 3 and 4.

Total Carbon assigned value was 9200 mg/kg. All reported results returned satisfactory z-scores with the exception of Laboratory 8.

Laboratory 8 correctly measured TC in S3 but reported results in the wrong units.

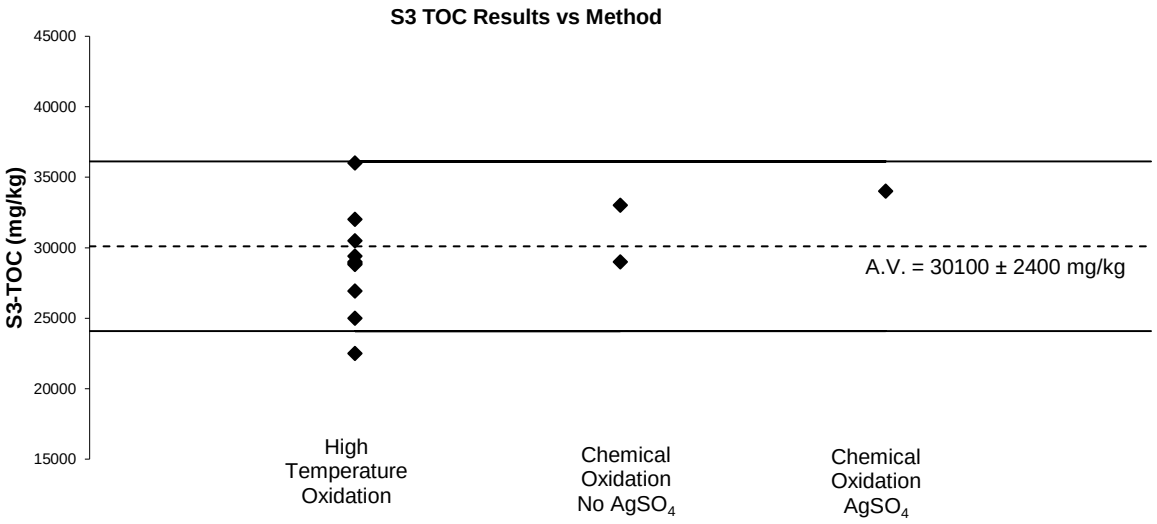
Total Organic Carbon assigned value was 30100 mg/kg.

Total organic carbon (TOC) measurements should involve the measurement of both volatile organic carbon (VOC) and of non–purgeable organic carbon (NPOC). As the loss of VOC is considered negligible when compared to the content of NPOC in a soil sample, all the NPOC reported results in sample S3 have been considered as TOC.[24 to 26]

Ten participants used a high temperature oxidation method and three used a chemical oxidation method based on the "Walkley-Black" method.

The high temperature oxidation method for organic carbon determination can be rapid and reliable when inorganic carbon is removed prior to combustion. The separation of organic carbon from inorganic carbon can be achieved by ashing or acid treatment. When ashing is used, good knowledge of the nature of soil is required to choose the right ashing temperature. The major problem when acid treatment is used is uncertainty about the completeness of inorganic carbon removal. Introduction of a pretesting step to establish the right amount of the sample to be taken for analysis and the right type and concentration of acid to be used can help avoid these problems.[26, 27]

Comparison studies on the efficiency of TOC methods that the most appropriate method for soil TOC analyses is the automated dry combustion technique after pre-testing and pre-treatment for IC removal.[26, 27]



Laboratories 2 and 8 results of 2.9 mg/kg and 2.25 mg/kg have been plotted as 29000 and 22500 mg/kg respectively.

Figure 86 TOC Result vs. Analytical Method

Laboratory 2 and 8 reported results in the wrong units.

7.13 Comparison with Previous NMI Proficiency Tests of Metals in Soil

AQA 20-02 is the twenty-sixth NMI proficiency test of metals in soil.

Participants' performance in measurement of metals in soil over time is presented in Figure 87. 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.

Over time, laboratories should expect at least 95% of their scores to lie within the range $|z| \leq 2$. Scores in the range $2 < |z| < 3$ can occasionally 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 is an indication of method or laboratory bias.

7.14 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 74).

Table 74 Control Samples Used by Participants

Lab. Code	Description of Control Samples
3	CRM
4	Spiked Sample
5	CRM – Agal-10 Hawkesbury River Sediment
6	CRM
8	CRM
9	CRM – Novachem SQC001S
10	CRM – ASPAC 7098-C1 ASPAC 7118-QC-PR5659RF
11	CRM – Agal-10
12	CRM – AGAL10
13	RM
14	CRM – P/MET/P20/0113

15	RM – AGAL 12
16	RM
18	CRM
19	RM
21	CRM
23	CRM
25	RM – AGAL-10 & AGAL-12
26	CRM – PACS3 Marine Sediment (NRCC) and OREAS45
27	CRM – CRM036
28	RM – Reference Material Metals in Soil ERA 540
29	CRM – ICV 1, ICV 3 and AGAL 10

Matrix matched control samples taken through all steps of the analytical process, are the most valuable quality control tools for assessing a 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 '*[29]

Surplus test samples from this study are available from NMI.

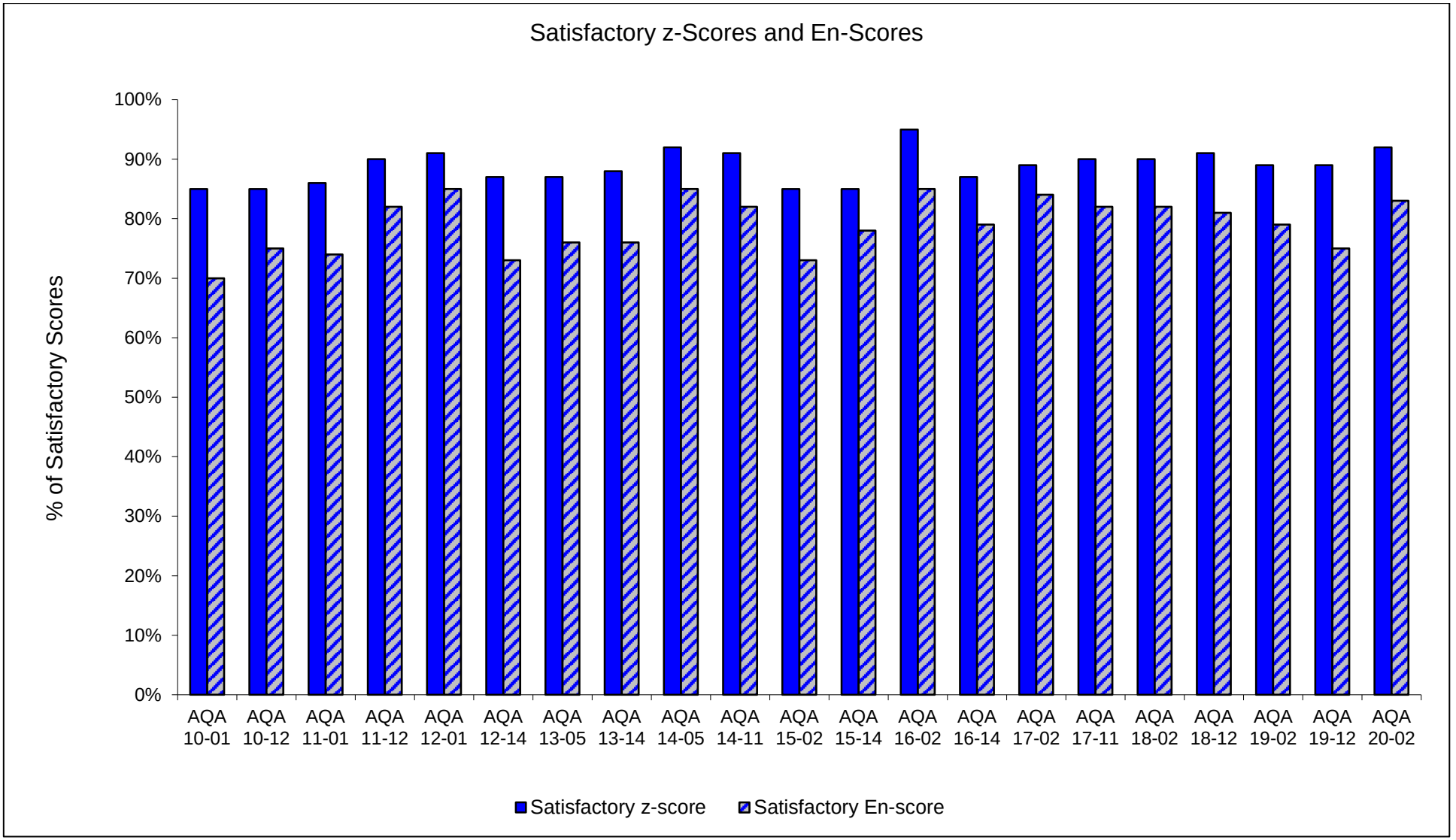


Figure 87 Participants' Performance over Time (2010-2020)

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APPENDIX 1 - SAMPLE PREPARATION, ANALYSIS AND HOMOGENEITY TESTING

Sample Preparation

Sample S1 was a soil material fortified for 15 elements, dried, ground and passed through a 212 µm sieve prior to being divided into portions of approximately 25 g each.

Sample S2 was a moist soil sample prepared from a composite soil samples submitted to NMI for metal analysis. The soil was blended, fortified for 18 elements, dried, ground and passed through a 212 µm sieve. The resulting soil material was accurately weighed and wet with a known amount of water. The moist soil was mixed and divided into portions of 30 g each.

Sample S3 was an unfortified, dried, agricultural soil material. It was ground and sieved through a 212 µm sieve, further mixed and divided into portions of approximately 75 g each.

Sample Analysis and Homogeneity Testing

The same procedure was followed for the preparation of Samples S2 and S3 as in previous NMI PT studies. Partial homogeneity testing was conducted for elements of interest. Three bottles were analysed in duplicate and the average of the results was reported as the homogeneity value. Measurements were made under repeatability conditions in random order.

A full homogeneity test was conducted for Sample S1. This sample was demonstrated to be sufficiently homogeneous for the evaluation of participants' performance. Homogeneity testing was based on that described in the International Protocol. Seven sample bottles were selected at random. Duplicate test-portions were taken from each bottle and the concentration of all targeted analytes measured. Measurements were made under repeatability conditions in random order. Table 75 sets out an example for the testing of the homogeneity of As in Sample S1.

Table 75 Homogeneity Testing of As in Sample S1

BOTTLE	A As (mg/kg)	B As (mg/kg)
3	19	19
26	19	20
39	20	20
48	20	20
50	19	20
51	19	20
60	20	20

	Value	Critical	Result
Cochran	0.33	0.73	**Pass**
S_{an}/σ	0.47	0.50	**Pass**
s^2_{sam}	0.036	0.49	**Pass**

Sample Analysis for Acid Extractable Elements

Measurements for acid extractable elements involved solubilisation of metals and metal complexes using a mixture of nitric acid and hydrochloric acid. Metals were then measured using ICP-MS and ICP-OES.

Test portions of approximately 0.5 g for the dried soil sample and 1 g for the moist soil sample were weighed into a 50 mL graduated polypropylene centrifuge tube. The samples were 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 for ICP-MS determination.

The measurement instrument was calibrated using external standards for targeted analytes. A set of quality control samples consisting of blanks, blank matrix spike, 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 condition used and the ion/wavelength monitored for each analyte is given in Table 76.

Table 76 Instrumental Technique used for Acid Extractable Elements

Analyte	Instrument	Internal Standard	Reaction/ Collision Cell (if applicable)	Cell Mode/Gas (if applicable)	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Ion (m/z)/ Wavelength (nm)
Ag	ICP-MS	Rh	NA	He	NA	800	107 m/z
Al	ICP-MS	Rh	NA	NA	NA	800	27 m/z
As	ICP-MS	Rh	ORS	He	800	800	75 m/z
B	ICP-MS	Rh	NA	NA	800	NA	11 m/z
Ba	ICP-MS	Rh	ORS	He	NA	800	137 m/z
Be	ICP-MS	Rh	NA	NA	800	NA	9 m/z
Bi	ICP-MS	Ir	NA	He	NA	800	209 m/z
Ca	ICP-MS	Rh	ORS	He	800	NA	43 m/z
Cd	ICP-MS	Rh	NA	He	800	800	111 m/z
Co	ICP-MS	Rh	ORS	He	NA	800	59 m/z
Cr	ICP-MS	Rh	ORS	He	800	800	52 m/z
Cu	ICP-MS	Rh	ORS	He	800	800	63 m/z
Fe	ICP-MS	Rh	NA	He	800	NA	56 m/z
Hg	ICP-MS	Rh	NA	He	800	800	201 m/z
K	ICP-MS	Rh	ORS	He	800	NA	39 m/z
Li	ICP-MS	Rh	ORS	He	NA	800	7 m/z
Mg	ICP-MS	Rh	ORS	He	800	NA	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	800	NA	23 m/z
Ni	ICP-MS	Rh	ORS	He	800	800	60 m/z
P	ICP-MS	Rh	ORS	HEHe	800	NA	31 m/z
Pb	ICP-MS	Ir	NA	He	800	800	Average of 206, 207 m/z
Sb	ICP-MS	Rh	ORS	He	800	NA	121 m/z
Se	ICP-MS	Rh	ORS	HEHe	800	800	78 m/z
Sn	ICP-MS	Rh	NA	He	800	NA	118 m/z
Sr	ICP-MS	Rh	ORS	He	800	NA	88 m/z
Tl	ICP-MS	Rh	ORS	He	NA	800	205 m/z
U	ICP-MS	Ir	NA	He	NA	800	238 m/z
V	ICP-MS	Rh	ORS	He	800	800	51 m/z
Zn	ICP-MS	Rh	ORS	He	800	800	64 m/z

Sample Analysis for Exchangeable Bases

A test portion of 5 g was weighed into a 100 mL polypropylene container. The container was then filled with 100 mL 1M NH_4Cl. The suspension was shaken, at room temperature for 1 h,

centrifuged, and filtered through 0.45 µm filter. A summary of the measurement techniques used is presented in Table 77.

Table 77 Instrumental Technique used for Exchangeable Bases

Analyte	Instrument	Internal Standard	Final Dilution Factor	Wavelength nm
Exchangeable Ca^{2+}	ICP-OES	Y	40	315.887
Exchangeable Mg^{2+}	ICP-OES	Y	40	279.08
Exchangeable Na^{+}	ICP-OES	Y	40	588.995
Exchangeable K^{+}	ICP-OES equation	Y	40	766.49

Sample Analysis for Total Carbon and Total Organic Carbon

For TOC measurements a portion of sample weighing 0.25 g was reacted for 12 hours with 20 mL diluted hydrochloric acid to remove inorganic carbon. The sample was further purged with nitrogen gas to remove the inorganic carbon in solution and further diluted with 20 mL Milli-Q water. The insoluble part was then filtered and collected on a filter, dried and analysed as total carbon (TC). The TOC was calculated as the sum of the TOC from the insoluble part and the dissolved organic carbon (DOC) from liquid solution.

Sample Analysis for Total Nitrogen

Total Nitrogen in Sample S3 was measured as the sum of TKN +NOx.
Organic nitrogen from a test portion of 1 g was converted to ammonia with 50 mL digestion reagent (potassium sulfate, sulfuric acid and cupric sulfate) on a block digester at 400 ºC ± 5 ºC for 4 hours. The digested solution was then made alkaline with sodium hydroxide solution, distilled into a steam distillation analyser unit and automatically titrated with standard hydrochloric acid to the end point. The amount of ammonia nitrogen was then calculated.

For NOx measurements a test portion of 10 g was weighed into a 100 mL polypropylene container. The container was then filled with 95 mL Milli-Q water. The suspension was shaken, at room temperature for 1 h, centrifuged, and filtered through 0.45 µm filter. NO_3^--N was further measured by cadmium reduction to NO_2^--N followed by NO_x (the reduced NO_2^--N plus original NO_2^--N) measurements by FIA.

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 'ISO 13258:2015(E)[8]; 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
$S_{rob\ mean}$ 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 78.

Table 78 Uncertainty of Assigned Value for As in Sample S1

No. results (p)	23
Robust Average	21.6 mg/kg
$S_{rob\ av}$	1.89 mg/kg
$u_{rob\ av}$	0.49 mg/kg
k	2
$U_{rob\ av}$	1.0 mg/kg

The assigned value for **As** in Sample S1 is **21.6 ± 1.0 mg/kg**

z-Score and E_n-score

For each participant's result z-score and E_n-score are calculated according to Equation 2 and Equation 3 respectively (see page 15).

A worked example is set out below in Table 79.

Table 79 z-Score and E_n-score for As result reported by Laboratory 5 in S1

As Result mg/kg	Assigned Value mg/kg	Set Target Standard Deviation	z-Score	E_n-Score
22.9±3.7	21.6±1.0	10% as PCV or 0.10x21.6 = =2.16 mg/kg	$z = \frac{(22.9 - 21.6)}{2.16}$ z = 0.60	$En = \frac{(22.9 - 21.6)}{\sqrt{1.0^2 + 3.7^2}}$ $E_n = 0.34$

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] Between 2009 and 2019 NMI carried out twenty-two 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 be separated into two ranges of results: 0.5 to 10 mg/kg and 10 to 100 mg/kg. Results are presented in Tables 80 and 81.

Table 80 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
AQA09-13	S1-biosoil	4.091	3.64	16	11
	S2-sludge	4.29	4.57	15	12
AQA11-01	S1-biosoil	3.54	3.57	19.7	18
AQA13-05	S1-soil	9.22	9.21	14	22
AQA14-11	S1-sediment	7.91	7.37	11.8	21
AQA15-02	S1-moist sludge	8.29	7.02	13	22
	S2-moist sludge	7.42	7.02	11.3	17
AQA15-14	S1-sedimentl	10	9.95	6.7	17
	S2-soil	4.53	4.47	6.4	14
AQA16-02	S2-agricultural soil	2.67	2.11	14	20
AQA 16-14	S1-clay	6.03	5.61	15	17
	S1 - soil	6.03	5.61	20	17
AQA 17-02	S1 – moist soil	3.71	3.76	10	13
AQA 18-02	S1 - compost	2.22	2.73	11	17
AQA 19-02	S1 – moist soil	2.83	2.65	11	24
AQA 19-12	S1 - soil	2.32	2.12	16	16
Average				12.5**	

* Expanded uncertainty at approximately 95% confidence. ** The mean value of Robust CV was used. The pooled standard deviation could also be used. In this case, the pooled standard deviation is 13.3%.

Table 81 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
AQA10-12	S1-soil	16.6	14.4	8.5	19
AQA11-12	S1-moist sludge	25	21.6	15	13
AQA12-01	S1-sediment	18.4	17.3	8.1	21
AQA12-14	S2-soil	16.6	14.8	11	20
AQA13-14	S1-sandy soil	16.6	15.1	10.4	21
AQA14-05	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
Average				9.9**	

* Expanded uncertainty at approximately 95% confidence. ** The mean value of Robust CV was used. The pooled standard deviation could also be used. In this case, the pooled standard deviation is 9.7%.

Taking the average of the robust CV over these PT samples for each concentration range gives estimates of the relative standard uncertainty of 13% and 10% respectively. Using a coverage factor of two gives relative expanded uncertainties of 26% and 20% respectively, at a level of confidence of approximately 95%.

Table 82 sets out the expanded uncertainty for results of the measurement of As in soil, biosoil, sediment, sludge, sandy soil, moist soil and agricultural soil over the ranges 0.5 to 10 mg/kg and 10 to 100 mg/kg.

Table 82 Uncertainty of As Results Estimated Using PT Data.

Results mg/kg	Uncertainty mg/kg
1.00	0.26
5.0	1.3
20	4
75	15

The estimates of 26% and 20% relative passes the test of being reasonable, and the analysis of the twenty-five different PT samples over 11years can be assumed to include all the relevant uncertainty components (different matrices, operators, reagents, calibrators etc.), and so complies with ISO 17025.[8]

APPENDIX 4 - ACRONYMS AND ABBREVIATIONS

APHA	American Public Health Association
A.V.	Assigned Value
CRI	Collision Reaction Interface
CRM	Certified Reference Material
CV	Coefficient of Variation
CV-AAS	Cold Vapour-Atomic Absorption Spectrometry
CV-AFS	Cold Vapour-Atomic Florescence Spectrometry
DA	Discreet Analyser
FIA	Flow Injection Analyser
HEHe	High energy He mode
H.V.	Homogeneity Value
ICP-MS	Quadrupole - Inductively Coupled Plasma - Mass Spectrometry
ICP-OES-AV	Inductively Coupled Plasma - Optical Emission Spectrometry- axial view
ICP-OES-AV-buffer	Inductively Coupled Plasma - Optical Emission Spectrometry- axial view with buffer
ICP-OES-AV-equation	Inductively Coupled Plasma - Optical Emission Spectrometry- axial view with correction equation
ICP-OES-RV	Inductively Coupled Plasma - Optical Emission Spectrometry- radial view
IC	Ion chromatograph
IR	Infrared Detector
Max	Maximum value in a set of results
Md	Median
Min	Minimum value in a set of results
NMI	National Measurement Institute (of Australia)
NR	Not Reported
NT	Not Tested
ORS	Octopole Reaction System
PCV	Performance Coefficient of Variation
RM	Reference Material
Robust CV	Robust Coefficient of Variation
Robust SD	Robust Standard Deviation
S.V.	Spiked value or formulated concentration of a PT sample
SS	Spiked sample
SI	The International System of Units
s^2_{sam}	Sampling variance
s_a/σ	Analytical standard deviation divided by the target standard deviation
SFA	Segment Flow Analyser
SRM	Standard Reference Material (Trademark of NIST)
Target SD	Target standard deviation
σ	Target standard deviation
UC	Universal Cell
UV-Vis	Ultraviolet and Visible Spectroscopy

APPENDIX 5 - INSTRUMENT DETAILS

Table 83 Instrument Conditions Ag

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS/MS				N/A	800	107
2	ICP-OES-AV				N/A	83	328.068
3					N/A		
4	ICP-OES-AV-buffer	Lu			N/A	25	328.068
5	ICP-MS	Rh	UC	He	N/A	2000	109
6	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7	ICP-MS	Ge 72	ORS		N/A		107 m/z
8	ICP-MS	Ir, Rh & Sc	NA	NA	N/A	50	328.069nm
9	ICP-MS	Rh	ORS	He	N/A	200	107
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	ICPMS				N/A		
12	ICP-MS	Rh 103	ORS	He	N/A	1000	109
13	ICP-OES-AV-buffer	Yittrium	NA	NA	N/A	50	328.068
14	ICP-MS	Rh 103	ORS	He	500	N/A	
15	ICP-MS	Rh	NA	NA	N/A	625	109
16	ICP-MS	Rh	NA		N/A	250	
17	ICP-MS	Rh			N/A	25-250	107
18	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	ICP-MS	103 Rh	ORS	He	N/A	50	107
20	ICP-MS	Rh			N/A	25-250	107
21	ICP-OES-RV					NA	328.068
22					N/A		
23	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24					N/A		
25	ICP-MS	Rh	ORS	He	N/A	500	107
26					N/A		
27	ICP-OES-AV-buffer	Yttrium	NA	NA	N/A	100	328.068
28	N/A	N/A	N/A	N/A	N/A	N/A	N/A
29	ICP-MS	Rh	ORS	He	N/A	500	107
30					N/A		

Table 84 Instrument Conditions Al

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1					N/A	800	
2	ICP-OES-AV				N/A	166	396.152
3					N/A		
4	ICP-OES-AV-buffer	Lu			N/A	25	396.152
5	ICP-MS	Sc	UC	He	N/A	2000	27
6	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7	ICP-OES-RV	Y377	NA		N/A		396.152 nm
8	ICP-OES	Eu & Cs	NA	NA	N/A	50	236.707, 308.215, 396.15nm
9	ICP-OES-AV	Lu	N/A	N/A	N/A	200	237.312
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	ICPMS				N/A		
12	ICP-MS	Sc 45	ORS	He	N/A	50000	27
13	ICP-OES-AV-buffer	Yittrium	NA	NA	N/A	500	396.152
14	ICP-MS	Sc 45	ORS	He	500	N/A	
15	ICP-MS	Sc	NA	NA	N/A	625	27
16	ICP-MS	Sc	NA		N/A	250	
17	ICP-MS	Li6			N/A	25-250	396.152
18	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	ICP-MS	45 Sc	ORS	He	N/A	50	27
20	ICP-OES-AV	Lu			N/A	25-250	396.152
21	ICP-OES-RV					NA	308.215
22					N/A		
23	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24					N/A		
25	ICP-MS	Sc	ORS	He	N/A	500	27
26					N/A		
27	ICP-OES-AV-buffer	Yttrium	NA	NA	N/A	100	308.215
28	N/A	N/A	N/A	N/A	N/A	N/A	N/A
29	ICP-MS	Sc	ORS	He	N/A	2000	27
30					N/A		

Table 85 Instrument Conditions As

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS/MS		ORS	Helium	800	800	75
2	ICP-OES-AV				83	83	188.98
3							
4	ICP-OES-AV-buffer	Lu			25	250	188.98
5	ICP-MS	Rh	UC	He	1000	1000	75
6	ICP-OES-AV	Lu			100	N/A	188.98
7	ICP-MS	Ge 72	ORS				75m/z
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	50	188.89nm
9	ICP-MS	Ge	ORS	He	N/A	200	75
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	ICPMS						
12	ICP-MS	Rh 103	ORS	He	1000	1000	75
13	ICP-OES-AV-buffer	Yittrium	NA	NA	50	50	188.98
14	ICP-MS	Rh 103	ORS	He	500	N/A	
15	ICP-MS	Ge	UC	He	625	625	75
16	ICP-MS	Rh	UC	He	250	250	
17	ICP-MS	Ge	ORS	He	25-250	N/A	75
18	ICP-MS					N/A	
19	ICP-MS	103 Rh	ORS	He	50	N/A	75
20	ICP-MS	Ge	ORS	He	25-250	N/A	75
21	ICP-OES-RV						188.98
22							
23	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24					N/A		
25	ICP-MS	Rh	ORS	He	500	500	75
26					N/A		
27	ICP-OES-AV-buffer	Yttrium	NA	NA	100	100	189.042
28						N/A	
29	ICP-MS	Y	ORS	He	N/A	500	75
30					N/A		

Table 86 Instrument Conditions B

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1						N/A	
2	ICP-OES-AV				83	N/A	182.577
3						N/A	
4	ICP-OES-AV-buffer	Lu			25	N/A	182.577
5	ICP-MS	Sc	UC	He	1000	N/A	11
6						N/A	
7	ICP-OES-RV	Te214	NA			N/A	249.678nm
8	ICP-OES	Eu & Cs	NA	NA	50	N/A	249.773nm
9	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	ICPMS					N/A	
12	ICP-MS	Sc 45	ORS	He	1000	N/A	11
13	ICP-OES-AV-buffer	Yittrium	NA	NA	50	N/A	249.772
14	ICP-MS	Sc 45	ORS	He	500	N/A	
15	ICP-MS	Sc	NA	NA	625	N/A	10
16	ICP-MS	Sc	NA		250	N/A	
17	ICP-MS	Li6			N/A	25-250	11
18	ICP-OES-RV					N/A	
19	ICP-MS	45 Sc	NA		N/A	50	11
20	ICP-MS	Li6			N/A	25-250	11
21	ICP-OES-RV				NA		249.772
22						N/A	
23	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25	ICP-MS	Sc	ORS	He	500	N/A	11
26	N/A	N/A	N/A	N/A	N/A	N/A	N/A
27	ICP-OES-AV-buffer	Yttrium	NA	NA	100	N/A	208.959
28						N/A	
29	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 87 Instrument Conditions Ba

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV				N/A	800	455.403
2	ICP-OES-AV				N/A	83	493.408
3					N/A		
4	ICP-OES-AV-buffer	Lu			N/A	250	230.424
5	ICP-MS	Tb	UC	He	N/A	2000	137
6	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7	ICP-OES-RV	Y371	NA		N/A		493.408 nm
8	ICP-MS	Ir, Rh & Sc	NA	NA	N/A	50	585.369nm
9	ICP-OES-RV	Lu	N/A	N/A	N/A	200	455.403
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	ICPMS				N/A		
12	ICP-MS	Rh 103	ORS	He	N/A	1000	137
13	ICP-OES-AV-buffer	Yittrium	NA	NA	N/A	50	493.408
14	ICP-MS	Rh 103	ORS	He	500	N/A	
15	ICP-MS	Rh	NA	NA	N/A	625	138
16	ICP-MS	In	NA		N/A	250	
17	ICP-MS	Rh			25-250	25-250	138
18	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	ICP-MS	103 Rh	ORS	He	50	50	137
20	ICP-MS	Rh			25-250	25-250	138
21	ICP-OES-RV					NA	585.367
22					N/A		
23	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24					N/A		
25	ICP-MS	Rh	ORS	He	N/A	500	135
26					N/A		
27	ICP-OES-AV-buffer	Yttrium	NA	NA	N/A	100	233.527
28	N/A	N/A	N/A	N/A	N/A	N/A	N/A
29	ICP-MS	Rh	ORS	He	N/A	2000	135
30					N/A		

Table 88 Instrument Conditions Be

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS/MS					N/A	
2	ICP-OES-AV				83	N/A	313.042
3						N/A	
4	ICP-OES-AV-buffer	Lu			25	N/A	313.107
5	ICP-MS	Sc	UC	He	2000	N/A	9
6						N/A	
7	ICP-MS	Ge 72	ORS			N/A	9m/z
8	ICP-MS	Ir, Rh & Sc	NA	NA	N/A	50	313.042nm
9	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	ICPMS					N/A	
12	ICP-MS	Sc 45	ORS	He	1000	N/A	9
13	ICP-OES-AV-buffer	Yittrium	NA	NA	50	N/A	313.042
14	ICP-MS	Sc 45	ORS		500	N/A	
15	ICP-MS	Sc	NA	NA	625	N/A	9
16	ICP-MS	Sc	NA		250	N/A	
17	ICP-MS	Li6			25-250	N/A	9
18	ICP-MS					N/A	
19	ICP-MS	45 Sc	NA		50	N/A	9
20	ICP-MS	Li6			25-250	N/A	9
21	ICP-OES-RV					NA	585.367
22						N/A	
23	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25	ICP-MS	Sc[No Gas]	ORS	He	500	N/A	9
26	N/A	N/A	N/A	N/A	N/A	N/A	N/A
27	ICP-OES-AV-buffer	Yttrium	NA	NA	100	N/A	313.042
28						N/A	
29	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 89 Instrument Conditions Bi

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS/MS				N/A	800	
2	ICP-OES-AV				N/A		N/A
3					N/A		
4	ICP-MS	Lu			N/A	250	209
5	ICP-MS	Tb	UC	He	N/A	2000	209
6	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7	ICP-MS	Rh 103	ORS		N/A		209m/z
8	ICP-MS	Ir, Rh & Sc	NA	NA	N/A	50	209 m/z
9	ICP-MS	Ir	ORS	He	N/A	200	209
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	ICPMS				N/A		
12	ICP-MS	Ir 193	ORS	He	N/A	1000	209
13	ICP-OES-AV-buffer	Yittrium	NA	NA	N/A	50	223.061
14	ICP-MS	Lu 175	ORS	He	500	N/A	
15	ICP-MS	Ir	NA	NA	N/A	625	209
16	ICP-MS	Ir	NA		N/A	250	
17	ICP-MS	Lu			N/A	25-250	209
18	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	ICP-MS	193 Y	ORS	He	N/A	50	209
20	ICP-MS	Lu			N/A	25-250	209
21	ICP-MS	Rh, Sc, Ir	ORS			NA	209
22					N/A		
23	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24					N/A		
25	ICP-MS	Lu	ORS	He	N/A	500	209
26					N/A		
27					N/A		Not Tested
28	N/A	N/A	N/A	N/A	N/A	N/A	N/A
29	ICP-MS	Lu	ORS	He	N/A	500	209
30					N/A		

Table 90 Instrument Conditions Ca

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-RV				800	N/A	315.887
2	ICP-OES-AV				83	N/A	317.933
3	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4	ICP-OES-AV-buffer	Lu			25	N/A	315.887
5	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6						N/A	
7	ICP-OES-RV	Y377	NA			N/A	317.933 nm
8	ICP-OES	Eu & Cs	NA	NA	N/A	50	315.887, 370.602nm
9	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10						N/A	
11	ICPMS					N/A	
12	ICP-MS	Sc 45	ORS	He	1000	N/A	44
13	ICP-OES-AV-buffer	Yittrium	NA	NA	50	N/A	317.933
14	N/A	N/A	N/A	N/A	N/A	N/A	
15	ICP-MS	Sc	UC	He	625	N/A	44
16	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17	ICP-OES-RV	Lu			N/A	25-250	316
18	ICP-OES-RV					N/A	
19	ICP-MS	45 Sc	ORS	He	N/A	50	44
20	ICP-OES-RV	Lu			N/A	25-250	316
21	ICP-OES-RV						315.887
22	N/A	N/A	N/A	N/A	N/A	N/A	N/A
23	ICP-OES-AV	Lu	NA	Ag	20	N/A	317.932
24	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25	N/A	N/A	N/A	N/A	N/A	N/A	N/A
26						N/A	
27	ICP-OES-AV-buffer	Yttrium	NA	NA	100	N/A	317.933
28	N/A	N/A	N/A	N/A	N/A	N/A	N/A
29	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 91 Instrument Conditions Cd

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS/MS		ORS	Helium	800	800	111
2	ICP-OES-AV				83	83	214.439
3							
4	ICP-OES-AV-buffer	Lu			25	250	228.802
5	ICP-MS	Rh	UC	He	1000	1000	111
6	ICP-OES-AV	Lu			100	N/A	228.802
7	ICP-MS	Rh 103	ORS				111m/z
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	50	226.502nm
9	ICP-MS	In	ORS	He	N/A	200	111
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	ICPMS						
12	ICP-MS	Rh 103	ORS	He	1000	1000	111
13	ICP-OES-AV-buffer	Yittrium	NA	NA	50	50	228.802
14	ICP-MS	Rh 103	ORS	He	500	N/A	
15	ICP-MS	Rh	NA	NA	625	625	111
16	ICP-MS	Rh	NA		250	250	
17	ICP-MS	Rh			25-250	N/A	111
18	ICP-MS					N/A	
19	ICP-MS	103 Rh	ORS	He	50	N/A	111
20	ICP-MS	Rh			25-250	N/A	111
21	ICP-OES-RV				NA		226.502
22							
23	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24					N/A		
25	ICP-MS	Rh	ORS	He	500	500	111
26					N/A		
27	ICP-OES-AV-buffer	Yttrium	NA	NA	100	100	228.802
28						N/A	
29	ICP-MS	Rh	ORS	He	N/A	500	111
30					N/A		

Table 92 Instrument Conditions Co

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV				N/A	800	228.615
2	ICP-OES-AV				N/A	83	230.786
3					N/A		
4	ICP-OES-AV-buffer	Lu			N/A	25	228.615
5	ICP-MS	Ga	UC	He	N/A	2000	59
6	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7	ICP-OES-AV	Te214	NA		N/A		228.615 nm
8	ICP-MS	Ir, Rh & Sc	NA	NA	N/A	50	228.616nm
9	ICP-MS	Ge	ORS	He	N/A	200	59
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	ICPMS				N/A		
12	ICP-MS	Sc 45	ORS	He	N/A	1000	59
13	ICP-OES-AV-buffer	Yittrium	NA	NA	N/A	50	228.615
14	ICP-MS	Sc 45	ORS	He	500	N/A	
15	ICP-MS	Ge	UC	He	N/A	625	59
16	ICP-MS	Rh	UC	He	N/A	250	
17	ICP-MS	Ge	ORS	He	N/A	25-250	59
18	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	ICP-MS	103 Rh	ORS	He	N/A	50	59
20	ICP-MS	Ge	ORS	He	N/A	25-250	59
21	ICP-OES-RV				NA		228.615
22					N/A		
23	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24					N/A		
25	ICP-MS	Sc	ORS	He	N/A	500	59
26					N/A		
27	ICP-OES-AV-buffer	Yttrium	NA	NA	N/A	100	230.786
28	N/A	N/A	N/A	N/A	N/A	N/A	N/A
29	ICP-MS	Sc	ORS	He	N/A	500	59
30					N/A		

Table 93 Instrument Conditions Cr

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV					800	205.56
2	ICP-OES-AV				83	83	267.716
3							
4	ICP-OES-AV-buffer	Lu			25	250	205.56
5	ICP-MS	Sc	UC	He	1000	1000	52
6	ICP-OES-AV	Lu			100	N/A	267.716
7	ICP-OES-AV	Te214	NA				267.716 nm
8	ICP-MS	Ir, Rh & Sc	NA	NA	N/A	50	267.716nm
9	ICP-MS	Ge	ORS	He	N/A	200	52
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	ICPMS						
12	ICP-MS	Sc 45	ORS	He	1000	1000	52
13	ICP-OES-AV-buffer	Yittrium	NA	NA	50	50	267.716
14	ICP-MS	Sc 45	ORS	He	500	N/A	
15	ICP-MS	Sc	UC	He	625	625	52
16	ICP-MS	Sc	UC	He	250	250	
17	ICP-MS	Ge	ORS	He	25-250	N/A	52
18	ICP-MS					N/A	
19	ICP-MS	45 Sc	ORS	He	50	N/A	52
20	ICP-MS	Ge	ORS	He	25-250	N/A	52
21	ICP-OES-RV						267.716
22							
23	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24					N/A		
25	ICP-MS	Sc	ORS	He	500	500	52
26					N/A		
27	ICP-OES-AV-buffer	Yttrium	NA	NA	100	100	205.618
28						N/A	
29	ICP-MS	Sc	ORS	He	N/A	500	52
30					N/A		

Table 94 Instrument Conditions Cu

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV					800	324.754
2	ICP-OES-AV				83	83	327.395
3							
4	ICP-OES-AV-buffer	Lu			25	250	324.754
5	ICP-MS	Ga	UC	He	1000	1000	63
6	ICP-OES-AV	Lu			100	N/A	324.754
7	ICP-OES-RV	Y377	NA				327.395 nm
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	50	327.395nm
9	ICP-OES-AV	Lu	N/A	N/A	N/A	200	324.754
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	ICPMS						
12	ICP-MS	Sc 45	ORS	He	1000	1000	63
13	ICP-OES-AV-buffer	Yittrium	NA	NA	50	50	324.754
14	ICP-MS	Sc 45	ORS	He	500	N/A	
15	ICP-MS	Ge	UC	He	625	625	63
16	ICP-MS	Rh	UC	He	250	250	
17	ICP-MS	Ge	ORS	He	25-250	N/A	63
18	ICP-MS					N/A	
19	ICP-MS	103 Rh	ORS	He	50	N/A	63
20	ICP-MS	Ge	ORS	He	25-250	N/A	63
21	ICP-OES-RV						327.395
22							
23	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24					N/A		
25	ICP-MS	Sc	ORS	He	500	500	63
26					N/A		
27	ICP-OES-AV-buffer	Yttrium	NA	NA	100	100	324.754
28						N/A	
29	ICP-MS	Sc	ORS	He	N/A	500	63
30					N/A		

Table 95 Instrument Conditions Fe

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV					N/A	234.35
2	ICP-OES-AV				166	N/A	238.204
3	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4	ICP-OES-AV-buffer	Lu			25	N/A	261.382
5	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6						N/A	
7	ICP-OES-AV	Te214	NA			N/A	259.940nm
8	ICP-OES	Eu & Cs	NA	NA	N/A	50	238.204, 258.588, 259.940nm
9	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10						N/A	
11	ICPMS					N/A	
12	ICP-MS	Sc 45	ORS	He	5000	N/A	56
13	ICP-OES-AV-buffer	Yittrium	NA	NA	500	N/A	259.94
14	ICP-MS	Sc 45	ORS	He	500	N/A	
15	ICP-MS	Sc	UC	He	625	N/A	56
16	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17	ICP-OES-RV	Ge	ORS	He	N/A	25-250	259.94
18						N/A	
19	ICP-MS	103 Rh	ORS	He	N/A	50	133
20	ICP-OES-RV	Ge	ORS	He	N/A	25-250	259.94
21	ICP-OES-RV						258.588
22	N/A	N/A	N/A	N/A	N/A	N/A	N/A
23	ICP-MS	Lu	CRI	He	20	N/A	N/A
24	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25	N/A	N/A	N/A	N/A	N/A	N/A	N/A
26						N/A	
27	ICP-OES-AV-buffer	Yttrium	NA	NA	100	N/A	259.941
28	N/A	N/A	N/A	N/A	N/A	N/A	N/A
29	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 96 Instrument Conditions Hg

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS/MS				800	800	202
2	CVAAS						
3							
4	CVAAS	-			250	250	253.7
5	ICP-MS	Tb	UC	He	1000	1000	201
6						N/A	
7	ICP-MS	Ir 193	ORS				202m/z
8	FIMS-AAS	NA	NA	NA	50	N/A	253.7nm
9	CVAFS	N/A	N/A	N/A	N/A	200	253.7
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	ICPMS						
12	ICP-MS	Ir 193	ORS	He	1000	1000	202
13	CVAAS	NA	NA	NA	50	250	253.7
14	ICP-MS	Lu 175	ORS	He	500	N/A	
15	ICP-MS	Ir	NA	NA	625	625	201
16	ICP-MS	Ir	NA		250	250	
17	CVAAS	--			25-250	N/A	253.7
18						N/A	
19	CVAAS	103 Rh	NA		50	N/A	253.7
20	CVAAS	--			25-250	N/A	253.7
21	AAS						253.7
22							
23	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24					N/A		
25	ICP-MS	Lu	ORS	He	500	500	202
26					N/A		
27	CVAAS		NA	NA	100	1000	253.7
28						N/A	
29	ICP-MS	Lu	ORS	He	N/A	500	201
30					N/A		

Table 97 Instrument Conditions K

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1						N/A	
2	ICP-OES-AV				83	N/A	769.897
3	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4	ICP-OES-AV-buffer	Lu			25	N/A	766.491
5	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6						N/A	
7	ICP-OES-RV	Y377	NA			N/A	766.491nm
8	ICP-OES	Eu & Cs	NA	NA	N/A	50	404.721nm, 766.491nm
9	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10						N/A	
11	ICPMS					N/A	
12	ICP-MS	Sc 45	ORS	He	1000	N/A	39
13	ICP-OES-AV-buffer	Yittrium	NA	NA	50	N/A	766.491
14	N/A	N/A	N/A	N/A	N/A	N/A	
15	ICP-MS	Sc	UC	He	625	N/A	39
16	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17	ICP-OES-RV	Lu			N/A	25-250	766.491
18						N/A	
19	ICP-MS	45 Sc	ORS	He	N/A	50	39
20	ICP-OES-RV	Lu			N/A	25-250	766.491
21	ICP-OES-RV						766.491
22	N/A	N/A	N/A	N/A	N/A	N/A	N/A
23	ICP-OES-AV	Lu	NA	Ag	20	N/A	766.5
24	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25	N/A	N/A	N/A	N/A	N/A	N/A	N/A
26						N/A	
27	ICP-OES-AV-buffer	Yttrium	NA	NA	100	N/A	769.896
28	N/A	N/A	N/A	N/A	N/A	N/A	N/A
29	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 98 Instrument Conditions Li

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS/MS				N/A	800	7
2	ICP-OES-AV				N/A		N/A
3					N/A		
4	ICP-OES-AV-buffer	Lu			N/A	250	670.783
5	ICP-MS	Sc	UC	He	N/A	2000	7
6	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7	ICP-MS	Ge 72	ORS		N/A		7 m/z
8	ICP-MS	Ir, Rh & Sc	NA	NA	N/A	50	7 m/z
9	ICP-MS	Li6	N/A	N/A	N/A	200	7
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	ICPMS				N/A		
12	ICP-MS	Sc 45	ORS	He	N/A	1000	7
13	ICP-OES-AV-buffer	Yittrium	NA	NA	N/A	50	670.783
14	N/A	N/A	N/A	N/A	N/A	N/A	
15	ICP-MS	Sc	NA	NA	N/A	625	7
16	ICP-MS	Sc	NA		N/A	250	
17	ICP-OES-RV	Li6			N/A	25-250	670.3
18	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	ICP-MS	45 Sc	NA		N/A	50	7
20	ICP-OES-RV	Li6			N/A	25-250	670.3
21	ICP-MS	Rh, Sc, Ir	ORS				7
22					N/A		
23	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24					N/A		
25	ICP-MS	Sc[No Gas]	ORS	He	N/A	500	7
26					N/A		
27	ICP-OES-AV-buffer	Yttrium	NA	NA	N/A	100	670.78
28	N/A	N/A	N/A	N/A	N/A	N/A	N/A
29	ICP-MS	Sc	ORS	He	N/A	500	7
30					N/A		

Table 99 Instrument Conditions Mg

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-RV					N/A	279.078
2	ICP-OES-AV				83	N/A	383.829
3	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4	ICP-OES-AV-buffer	Lu			25	N/A	279.8
5	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6						N/A	
7	ICP-OES-RV	Y377	NA			N/A	280.27 nm
8	ICP-OES	Eu & Cs	NA	NA	N/A	50	383.829nm
9	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10						N/A	
11	ICPMS					N/A	
12	ICP-MS	Sc 45	ORS	He	1000	N/A	24
13	ICP-OES-AV-buffer	Yittrium	NA	NA	50	N/A	285.213
14	N/A	N/A	N/A	N/A	N/A	N/A	
15	ICP-MS	Sc	UC	He	625	N/A	25
16	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17	ICP-OES-RV	Lu			N/A	25-250	279.8
18						N/A	
19	ICP-MS	45 Sc	ORS	He	N/A	50	24
20	ICP-OES-RV	Lu			N/A	25-250	279.8
21	ICP-OES-RV				NA		383.829
22	N/A	N/A	N/A	N/A	N/A	N/A	N/A
23	ICP-OES-AV	Lu	NA	Ag	20	N/A	285.213
24	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25	N/A	N/A	N/A	N/A	N/A	N/A	N/A
26						N/A	
27	ICP-OES-AV-buffer	Yttrium	NA	NA	100	N/A	279.553
28	N/A	N/A	N/A	N/A	N/A	N/A	N/A
29	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 100 Instrument Conditions Mn

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV					N/A	257.61
2	ICP-OES-AV				83	N/A	260.568
3						N/A	
4	ICP-OES-AV-buffer	Lu			25	N/A	257.61
5	ICP-MS	Sc	UC	He	2000	N/A	55
6	ICP-OES-AV	Lu			100	N/A	257.61
7	ICP-OES-AV	Te214	NA			N/A	191.446 nm
8	ICP-MS	Ir, Rh & Sc	NA	NA	N/A	50	261.021nm
9	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	ICPMS					N/A	
12	ICP-MS	Sc 45	ORS	He	1000	N/A	55
13	ICP-OES-AV-buffer	Yittrium	NA	NA	50	N/A	257.61
14	ICP-MS	Sc 45	ORS	He	500	N/A	
15	ICP-MS	Sc	UC	He	625	N/A	55
16	ICP-MS	Rh	UC	He	250	N/A	
17	ICP-MS	Ge	ORS	He	25-250	N/A	55
18						N/A	
19	ICP-MS	45 Sc	ORS	He	50	N/A	55
20	ICP-MS	Ge	ORS	He	25-250	N/A	55
21	ICP-OES-RV						261.02
22						N/A	
23	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25	ICP-MS	Sc	ORS	He	500	N/A	55
26	N/A	N/A	N/A	N/A	N/A	N/A	N/A
27	ICP-OES-AV-buffer	Yttrium	NA	NA	100	N/A	257.611
28						N/A	
29	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 101 Instrument Conditions Mo

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV					N/A	203.846
2	ICP-OES-AV				83	N/A	202.032
3						N/A	
4	ICP-OES-AV-buffer	Lu			25	N/A	202.032
5	ICP-MS	Rh	UC	He	2000	N/A	98
6						N/A	
7	ICP-OES-AV	Te214	NA			N/A	204.598 nm
8	ICP-MS	Ir, Rh & Sc	NA	NA	N/A	50	202.032nm
9	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	ICPMS					N/A	
12	ICP-MS	Rh 103	ORS	He	1000	N/A	95
13	ICP-OES-AV-buffer	Yittrium	NA	NA	50	N/A	202.032
14	ICP-MS	Sc 45	ORS	He	500	N/A	
15	ICP-MS	Rh	NA	NA	625	N/A	95
16	ICP-MS	Rh	NA		250	N/A	
17	ICP-MS	Rh			25-250	N/A	95
18						N/A	
19	ICP-MS	103 Rh	ORS	He	50	N/A	95
20	ICP-MS	Rh			25-250	N/A	95
21	ICP-OES-RV					NA	202.032
22						N/A	
23	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25	ICP-MS	Rh	ORS	He	500	N/A	95
26	N/A	N/A	N/A	N/A	N/A	N/A	N/A
27	ICP-OES-AV-buffer	Yttrium	NA	NA	100	N/A	202.095
28						N/A	
29	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 102 Instrument Conditions Na

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1						N/A	
2	ICP-OES-AV				83	N/A	330.237
3	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4	ICP-OES-AV-buffer	Lu			25	N/A	589.592
5	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6						N/A	
7	ICP-OES-RV	Y377	NA			N/A	589.592 nm
8	ICP-OES	Eu & Cs	NA	NA	N/A	50	330.237, 589.592nm
9	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10						N/A	
11	ICPAES					N/A	
12	ICP-MS	Sc 45	ORS	He	1000	N/A	23
13	ICP-OES-AV-buffer	Yittrium	NA	NA	50	N/A	589.592
14	N/A	N/A	N/A	N/A	N/A	N/A	
15	ICP-MS	Sc	UC	He	625	N/A	23
16	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17	ICP-OES-RV	Lu			N/A	25-250	588.995
18						N/A	
19	ICP-MS	45 Sc	ORS	He	N/A	50	23
20	ICP-OES-RV	Lu			N/A	25-250	588.995
21	ICP-OES-RV				NA		589.592
22	N/A	N/A	N/A	N/A	N/A	N/A	N/A
23	ICP-OES-AV	Lu	NA	Ag	20	N/A	589.588
24	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25	N/A	N/A	N/A	N/A	N/A	N/A	N/A
26						N/A	
27	ICP-OES-AV-buffer	Yttrium	NA	NA	100	N/A	589.592
28	N/A	N/A	N/A	N/A	N/A	N/A	N/A
29	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 103 Instrument Conditions Ni

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV					800	231.604
2	ICP-OES-AV				83	83	231.604
3							
4	ICP-OES-AV-buffer	Lu			25	250	231.604
5	ICP-MS	Ga	UC	He	1000	1000	60
6	ICP-OES-AV	Lu			100	N/A	231.604
7	ICP-OES-AV	Te214	NA				216.555 nm
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	N/A	231.604nm
9	ICP-MS	Ge	ORS	He	N/A	200	60
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	ICPMS						
12	ICP-MS	Sc 45	ORS	He	1000	1000	60
13	ICP-OES-AV-buffer	Yittrium	NA	NA	50	50	231.604
14	ICP-MS	Sc 45	ORS	He	500	N/A	
15	ICP-MS	Ge	UC	He	625	625	60
16	ICP-MS	Rh	UC	He	250	250	
17	ICP-MS	Ge	ORS	He	25-250	N/A	60
18						N/A	
19	ICP-MS	103 Rh	ORS	He	50	N/A	60
20	ICP-MS	Ge	ORS	He	25-250	N/A	60
21	ICP-OES-RV						231.604
22							
23	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24					N/A		
25	ICP-MS	Sc	ORS	He	500	500	60
26					N/A		
27	ICP-OES-AV-buffer	Yttrium	NA	NA	100	100	231.604
28						N/A	
29	ICP-MS	Sc	ORS	He	N/A	500	60
30					N/A		

Table 104 Instrument Conditions P

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1						N/A	
2	ICP-OES-AV				166	N/A	178.222
3	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4	ICP-OES-AV-buffer	Lu			25	N/A	178.222
5	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6						N/A	
7	ICP-OES-AV	Te214	NA			N/A	177.434 nm
8	ICP-OES	Eu & Cs	NA	NA	N/A	50	185.827nm
9	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10						N/A	
11	ICPMS					N/A	
12	ICP-MS	Sc 45	ORS	He	1000	N/A	31
13	ICP-OES-AV-buffer	Yittrium	NA	NA	50	N/A	213.618
14	N/A	N/A	N/A	N/A	N/A	N/A	
15	ICP-MS	Sc	UC	He	625	N/A	31
16	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17	ICP-OES-RV	Lu			N/A	25-250	213.618
18						N/A	
19	ICP-OES-AV-equation	Eu	NA		N/A	50	185.8
20	ICP-OES-RV	Lu			N/A	25-250	213.618
21	ICP-OES-RV				NA		185.827
22	N/A	N/A	N/A	N/A	N/A	N/A	N/A
23	ICP-MS	Lu	CRI	He	20	N/A	N/A
24	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25	N/A	N/A	N/A	N/A	N/A	N/A	N/A
26						N/A	
27	ICP-OES-AV-buffer	Yttrium	NA	NA	100	N/A	177.495
28	N/A	N/A	N/A	N/A	N/A	N/A	N/A
29	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 105 Instrument Conditions Pb

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV					800	220.353
2	ICP-OES-AV				83	83	220.353
3							
4	ICP-OES-AV-buffer	Lu			25	250	220.353
5	ICP-MS	Tb	UC	He	1000	1000	206+207+208
6	ICP-OES-AV	Lu			100	N/A	220.353
7	ICP-OES-AV	Te214	NA				220.353 nm
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	N/A	220.353nm
9	ICP-MS	Ir	ORS	He	N/A	200	208
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	ICPMS						
12	ICP-MS	Ir 193	ORS	He	1000	1000	206+207+208
13	ICP-OES-AV-buffer	Yittrium	NA	NA	50	50	220.353
14	ICP-MS	Lu 175	ORS	He	500	N/A	
15	ICP-MS	Ir	NA	NA	625	625	206+207+208
16	ICP-MS	Ir	NA		250	250	
17	ICP-MS	Lu			25-250	N/A	206+207+208
18						N/A	
19	ICP-MS	193 Y	ORS	He	50	N/A	208
20	ICP-MS	Lu			25-250	N/A	206+207+208
21	ICP-OES-RV						220.353
22							
23	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24					N/A		
25	ICP-MS	Lu	ORS	He	500	500	208
26					N/A		
27	ICP-OES-AV-buffer	Yttrium	NA	NA	100	100	220.353
28						N/A	
29	ICP-MS	Lu	ORS	He	N/A	2000	208
30					N/A		

Table 106 Instrument Conditions S

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV					N/A	181.972
2	ICP-OES-AV				83	N/A	181.972
3	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4	ICP-OES-AV-buffer	Lu			25	N/A	180.669
5	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6						N/A	
7	ICP-OES-AV	Te214	NA			N/A	180.669 nm
8	ICP-OES	Eu & Cs	NA	NA	N/A	50	178.165,181.972nm
9	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10						N/A	
11	ICPAES					N/A	
12	NT	NT	NT	NT	NT	NT	NT
13	ICP-OES-AV-buffer	Yittrium	NA	NA	50	N/A	181.972
14	N/A	N/A	N/A	N/A	N/A	N/A	
15	ICP-OES-AV	Y	NA	NA	62.5	N/A	181.975
16	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17	ICP-OES-RV	Lu			N/A	25-250	181.972
18						N/A	
19	ICP-OES-AV-equation	Eu	NA		N/A	50	178.2
20	ICP-OES-RV	Lu			N/A	25-250	181.972
21	ICP-OES-RV						178.165
22	N/A	N/A	N/A	N/A	N/A	N/A	N/A
23	ICP-OES-AV	Lu	NA	Ag	20	N/A	181.976
24	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25	N/A	N/A	N/A	N/A	N/A	N/A	N/A
26						N/A	
27	ICP-OES-AV-buffer	Yttrium	NA	NA	100	N/A	182.034
28	N/A	N/A	N/A	N/A	N/A	N/A	N/A
29	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 107 Instrument Conditions Sb

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS/MS					N/A	
2	ICP-OES-AV				83	N/A	206.834
3						N/A	
4	ICP-OES-AV-buffer	Lu			25	N/A	206.834
5	ICP-MS	Rh	UC	He	2000	N/A	121
6						N/A	
7	ICP-MS	Rh 103	ORS			N/A	122m/z
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	N/A	206.834nm
9	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	ICPMS					N/A	
12	ICP-MS	Rh 103	ORS	He	1000	N/A	121
13	ICP-OES-AV-buffer	Yittrium	NA	NA	50	N/A	206.834
14	ICP-MS	Rh 103	ORS	He	500	N/A	
15							
16	ICP-MS	Rh	NA		250	N/A	
17	ICP-MS	Ge			25-250	N/A	121
18						N/A	
19							
20	ICP-MS	Ge			25-250	N/A	121
21	ICP-OES-RV				NA		206.834
22						N/A	
23	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25	ICP-MS	Rh	ORS	He	500	N/A	123
26	N/A	N/A	N/A	N/A	N/A	N/A	N/A
27						N/A	Not Tested
28						N/A	
29	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 108 Instrument Conditions Se

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS/MS		ORS	Hydrogen		800	78
2	ICP-OES-AV				83	83	196.026
3							
4	ICP-OES-AV-buffer	Lu			25	250	196.026
5	ICP-MS	Te	UC	He	2000	2000	82
6						N/A	
7	ICP-MS	Rh 103	ORS				78m/z
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	50	196.026nm
9	ICP-MS	Ge	ORS	H2	N/A	200	78
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	ICPMS						
12	ICP-MS	Rh 103	ORS	He	1000	1000	78
13	ICP-MS	Rh	Collision Cell	He	50	50	78
14	ICP-MS	Sc 45	ORS	He	500	N/A	
15	ICP-MS	Rh	NA	NA	625	625	82
16	ICP-MS	Rh	UC	He	250	250	
17	ICP-MS	Ge	ORS	H2	25-250	25-250	78
18						N/A	
19	ICP-MS	103 Rh	ORS	He	50	50	78
20	ICP-MS	Ge	ORS	H2	25-250	25-250	78
21	ICP-OES-RV						196.026
22							
23	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24					N/A		
25	ICP-MS	Rh	ORS	He	500	500	78
26					N/A		
27	ICP-OES-AV-buffer	Yttrium	NA	NA	100	100	196.09
28						N/A	
29	ICP-MS	Y	ORS	HEHe	N/A	500	78
30					N/A		

Table 109 Instrument Conditions Sn

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1						N/A	
2	ICP-OES-AV				83	N/A	189.925
3						N/A	
4	ICP-OES-AV-buffer	Lu			25	N/A	189.925
5	ICP-MS	Rh	UC	He	2000	N/A	120
6						N/A	
7	ICP-MS	Rh 103	ORS			N/A	118m/z
8	ICP-MS	Ir, Rh & Sc	NA	NA	N/A	50	189.926nm
9	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	ICPMS					N/A	
12	ICP-MS	Rh 103	ORS	He	1000	N/A	118
13	ICP-OES-AV-buffer	Yittrium	NA	NA	50	N/A	189.925
14	ICP-MS	Rh 103	ORS	He	500	N/A	
15	ICP-MS	Rh	NA	NA	625	N/A	118
16	ICP-MS	Rh	NA		250	N/A	
17	ICP-MS	Rh			25-250	25-250	118
18						N/A	
19	ICP-MS	103 Rh	ORS	He	50	50	118
20	ICP-MS	Rh			25-250	25-250	118
21	ICP-OES-RV					NA	189.925
22						N/A	
23	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25	ICP-MS	Rh	ORS	He	500	N/A	118
26	N/A	N/A	N/A	N/A	N/A	N/A	N/A
27	ICP-OES-AV-buffer	Yttrium	NA	NA	100	N/A	189.991
28						N/A	
29	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 110 Instrument Conditions Sr

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1						N/A	
2	ICP-OES-AV				83	N/A	407.771
3	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4	ICP-OES-AV-buffer	Lu			25	N/A	421.552
5	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6						N/A	
7	ICP-OES-RV	Y371	NA			N/A	407.771 nm
8	ICP-MS	Ir, Rh & Sc	NA	NA	N/A	50	430.545nm
9	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10						N/A	
11	ICPMS					N/A	
12	ICP-MS	Rh 103	ORS	He	1000	N/A	88
13	ICP-OES-AV-buffer	Yittrium	NA	NA	50	N/A	421.552
14	N/A	N/A	N/A	N/A	N/A	N/A	
15	ICP-MS	Rh	NA	NA	625	N/A	88
16	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17	ICP-OES-RV	Ge			N/A	25-250	407.771
18						N/A	
19	ICP-MS	103 Rh	ORS	He	N/A	50	88
20	ICP-OES-RV	Lu			N/A	25-250	407.771
21	ICP-OES-RV						430.544
22	N/A	N/A	N/A	N/A	N/A	N/A	N/A
23	ICP-MS	Lu	CRI	He	20	N/A	N/A
24	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25	N/A	N/A	N/A	N/A	N/A	N/A	N/A
26						N/A	
27	ICP-OES-AV-buffer	Yttrium	NA	NA	100	N/A	407.771
28	N/A	N/A	N/A	N/A	N/A	N/A	N/A
29	N/A	N/A	N/A	N/A	N/A	N/A	N/A
30	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 111 Instrument Conditions Tl

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1					N/A		
2					N/A		N/A
3					N/A		
4	ICP-MS	Lu			N/A	250	205
5	ICP-MS	Tb	UC	He	N/A	2000	205
6	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7	ICP-MS	Rh 103	ORS		N/A		205 m/z
8	ICP-MS	Ir, Rh & Sc	NA	NA	N/A	50	203 m/z
9	ICP-MS	Ir	ORS	He	N/A	200	205
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	ICPMS				N/A		
12	ICP-MS	Ir 193	ORS	He	N/A	1000	205
13	ICP-MS	Ir	NA	NA	N/A	50	205
14	ICP-MS	Lu 175	ORS	He	500	N/A	
15	ICP-MS	Ir	NA	NA	N/A	625	205
16	ICP-MS	Ir	NA		N/A	250	
17	ICP-MS	Lu			N/A	25-250	205
18	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	ICP-MS	193 Y	ORS	He	N/A	50	205
20	ICP-MS	Lu			N/A	25-250	205
21	ICP-MS	Rh, Sc, Ir	ORS			NA	205
22					N/A		
23	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24					N/A		
25	ICP-MS	Lu	ORS	He	N/A	500	205
26					N/A		
27	ICP-OES-AV-buffer	Yttrium	NA	NA	N/A	100	190.864
28	N/A	N/A	N/A	N/A	N/A	N/A	N/A
29	ICP-MS	Lu	ORS	He	N/A	500	205
30					N/A		

Table 112 Instrument Conditions U

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS/MS				N/A		238
2					N/A		N/A
3					N/A		
4	ICP-MS	Lu			N/A	250	238
5	ICP-MS	Tb	UC	He	N/A	2000	238
6	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7	ICP-MS	Ir 193	ORS		N/A		238m/z
8	ICP-MS	Ir, Rh & Sc	NA	NA	N/A	50	238 m/z
9	ICP-MS	Ir	ORS	He	N/A	200	238
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	ICPMS				N/A		
12	ICP-MS	Ir 193	ORS	He	N/A	1000	238
13	ICP-MS	Ir	NA	NA	N/A	50	238
14	ICP-MS	Lu 175	ORS	He	500	N/A	
15	ICP-MS	Ir	NA	NA	N/A	625	238
16	ICP-MS	Ir	NA		N/A	250	
17	ICP-MS	Lu			N/A	25-250	238
18	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	ICP-MS	193 Y	ORS	He	N/A	50	238
20	ICP-MS	Lu			N/A	25-250	238
21	ICP-MS	Rh, Sc, Ir	ORS	He		NA	238
22					N/A		
23	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24					N/A		
25	ICP-MS	Lu	ORS	He	N/A	500	238
26					N/A		
27					N/A		Not Tested
28	N/A	N/A	N/A	N/A	N/A	N/A	N/A
29	ICP-MS	Lu	ORS	He	N/A	500	238
30					N/A		

Table 113 Instrument Conditions V

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV						292.401
2	ICP-OES-AV				83	83	292.401
3							
4	ICP-OES-AV-buffer	Lu			25	25	292.401
5	ICP-MS	Sc	UC	He	2000	2000	51
6	ICP-OES-AV	Lu			100	N/A	292.401
7	ICP-OES-RV	Y371	NA				310.229 nm
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	N/A	311.837nm
9	ICP-OES-AV	Lu	ORS	He	N/A	200	292.401
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	ICPMS						
12	ICP-MS	Sc 45	ORS	He	1000	1000	51
13	ICP-OES-AV-buffer	Yittrium	NA	NA	50	50	292.401
14	ICP-MS	Sc 45	ORS	He	500	N/A	
15	ICP-MS	Sc	UC	He	625	625	51
16	ICP-MS	Sc	UC	He	250	250	
17	ICP-MS	Ge			25-250	N/A	51
18	ICP-MS					N/A	
19	ICP-MS	45 Sc	ORS	He	50	N/A	51
20	ICP-MS	Ge			25-250	N/A	51
21	ICP-OES-RV			He			311.837
22							
23	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24					N/A		
25	ICP-MS	Sc	ORS	He	500	500	51
26					N/A		
27	ICP-OES-AV-buffer	Yttrium	NA	NA	100	100	292.402
28						N/A	
29	ICP-MS	Sc	ORS	He	N/A	500	51
30					N/A		

Table 114 Instrument Conditions Zn

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1/S3 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV						202.548
2	ICP-OES-AV				83	83	213.857
3							
4	ICP-OES-AV-buffer	Lu			25	25	206.2
5	ICP-MS	Ga	UC	He	1000	1000	66
6	ICP-OES-AV	Lu			100	N/A	213.857
7	ICP-OES-AV	Te214	NA				202.548 nm
8	ICP-MS	Ir, Rh & Sc	NA	NA	50	N/A	206.2, 334.502nm
9	ICP-OES-AV	Lu	N/A	N/A	N/A	200	213.857
10	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	ICPMS						
12	ICP-MS	Sc 45	ORS	He	1000	1000	66
13	ICP-OES-AV-buffer	Yittrium	NA	NA	50	50	213.857
14	ICP-MS	Sc 45	ORS	He	500	N/A	
15	ICP-MS	Ge	UC	He	625	625	66
16	ICP-MS	Rh	UC	He	250	250	
17	ICP-MS	Ge			25-250	25-250	66
18	ICP-OES-RV					N/A	
19	ICP-MS	103 Rh	ORS	He	50	50	66
20	ICP-MS	Ge			25-250	25-250	66
21	ICP-OES-RV			He			206.2
22							
23	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24					N/A		
25	ICP-MS	Sc	ORS	He	500	500	66
26					N/A		
27	ICP-OES-AV-buffer	Yttrium	NA	NA	100	100	231.856
28						N/A	
29	ICP-MS	Sc	ORS	He	N/A	2000	66
30					N/A		

Table 115 Instrument Conditions Exchangeable Ca^{2+}

Laboratory Code	Instrument	Internal standard	Reaction Collision Cell	Cell Gas	Final Dilution Factor	Wavelength (nm)/Ion(m/z)/ Absorbance(nm)
1						
2	ICP-OES					317.933
3	N/A	N/A	N/A	N/A	N/A	N/A
4	ICP-OES-AV-buffer	Lu			100	315.887
5	N/A	N/A	N/A	N/A	N/A	N/A
6	ICP-OES	Lu			100	315.887
7						
8	ICP-OES	Eu & Cs	NA	NA	500	315.887, 370.602nm
9	N/A	N/A	N/A	N/A	N/A	N/A
10	ICP-OES					
11	ICPAES					
12	ICP-MS	Sc 45	ORS	He	200	44
13	NT	NT	NT	NT	NT	NT
14	N/A	N/A	N/A	N/A	N/A	N/A
15	ICP-OES-RV	Y	NA		20	317.933
16	N/A	N/A	N/A	N/A	N/A	N/A
17	ICP-OES-AV-buffer				100	316
18						
19	ICP-OES	Eu	NA		1	315.9
20	ICP-OES-AV-buffer				100	316
21	ICP-OES-RV					315.887
22	N/A	N/A	N/A	N/A	N/A	N/A
23	ICP-OES	Lu	NA	NA	50	317.932
24	N/A	N/A	N/A	N/A	N/A	N/A
25	N/A	N/A	N/A	N/A	N/A	N/A
26	ICP-OES					317.933
27						
28	N/A	N/A	N/A	N/A	N/A	N/A
29	N/A	N/A	N/A	N/A	N/A	N/A
30	N/A	N/A	N/A	N/A	N/A	N/A

Table 116 Instrument Conditions Exchangeable Mg^{2+}

Laboratory Code	Instrument	Internal standard	Reaction Collision Cell	Cell Gas	Final Dilution Factor	Wavelength (nm)/Ion(m/z)/ Absorbance(nm)
1						
2	ICP-OES					383.829
3	N/A	N/A	N/A	N/A	N/A	N/A
4	ICP-OES-AV-buffer	Lu			100	279.8
5	N/A	N/A	N/A	N/A	N/A	N/A
6	ICP-OES	Lu			100	279.079
7						
8	ICP-OES	Eu & Cs	NA	NA	500	383.829nm
9	N/A	N/A	N/A	N/A	N/A	N/A
10	ICP-OES					
11	ICPAES					
12	ICP-MS	Sc 45	ORS	He	200	24
13	NT	NT	NT	NT	NT	NT
14	N/A	N/A	N/A	N/A	N/A	N/A
15	ICP-OES-RV	Y	NA		20	285.213
16	N/A	N/A	N/A	N/A	N/A	N/A
17	ICP-OES-AV-buffer				100	279.8
18						
19	ICP-OES	Eu	NA		1	383.8
20	ICP-OES-AV-buffer				100	279.8
21	ICP-OES-RV					383.829
22	N/A	N/A	N/A	N/A	N/A	N/A
23	ICP-OES	Lu	NA	NA	50	285.213
24	N/A	N/A	N/A	N/A	N/A	N/A
25	N/A	N/A	N/A	N/A	N/A	N/A
26	ICP-OES					383.829
27						
28	N/A	N/A	N/A	N/A	N/A	N/A
29	N/A	N/A	N/A	N/A	N/A	N/A
30	N/A	N/A	N/A	N/A	N/A	N/A

Table 117 Instrument Conditions Exchangeable Na^+

Laboratory Code	Instrument	Internal standard	Reaction Collision Cell	Cell Gas	Final Dilution Factor	Wavelength (nm)/Ion(m/z)/ Absorbance(nm)
1						
2	ICP-OES					589.592
3	N/A	N/A	N/A	N/A	N/A	N/A
4	ICP-OES-AV-buffer	Lu			100	589.592
5	N/A	N/A	N/A	N/A	N/A	N/A
6	ICP-OES	Lu			100	589.592
7						
8	ICP-OES	Eu & Cs	NA	NA	500	330.237, 589.592nm
9	N/A	N/A	N/A	N/A	N/A	N/A
10	ICP-OES					
11	ICPAES					
12	ICP-MS	Sc 45	ORS	He	200	23
13	NT	NT	NT	NT	NT	NT
14	N/A	N/A	N/A	N/A	N/A	N/A
15	ICP-OES-RV	Y	NA		20	589.592
16	N/A	N/A	N/A	N/A	N/A	N/A
17	ICP-OES-AV-buffer				100	588.995
18						
19	ICP-OES	Eu	NA		1	766.5
20	ICP-OES-AV-buffer				100	588.995
21	ICP-OES-RV					589.592
22	N/A	N/A	N/A	N/A	N/A	N/A
23	ICP-OES	Lu	NA	NA	50	589.588
24	N/A	N/A	N/A	N/A	N/A	N/A
25	N/A	N/A	N/A	N/A	N/A	N/A
26	ICP-OES					589.592
27						
28	N/A	N/A	N/A	N/A	N/A	N/A
29	N/A	N/A	N/A	N/A	N/A	N/A
30	N/A	N/A	N/A	N/A	N/A	N/A

Table 118 Instrument Conditions Exchangeable K^+

Laboratory Code	Instrument	Internal standard	Reaction Collision Cell	Cell Gas	Final Dilution Factor	Wavelength (nm)/Ion(m/z)/ Absorbance(nm)
1						
2	ICP-OES					769.897
3	N/A	N/A	N/A	N/A	N/A	N/A
4	ICP-OES-AV-buffer	Lu			100	766.491
5	N/A	N/A	N/A	N/A	N/A	N/A
6	ICP-OES	Lu			100	769.896
7						
8	ICP-OES	Eu & Cs	NA	NA	500	404.721nm, 766.491nm
9	N/A	N/A	N/A	N/A	N/A	N/A
10	ICP-OES					
11	ICPAES					
12	ICP-MS	Sc 45	ORS	He	200	39
13	NT	NT	NT	NT	NT	NT
14	N/A	N/A	N/A	N/A	N/A	N/A
15	ICP-OES-RV	Y	NA		20	766.49
16	N/A	N/A	N/A	N/A	N/A	N/A
17	ICP-OES-AV-buffer				100	766.491
18						
19	ICP-OES	Eu	NA		1	589.6
20	ICP-OES-AV-buffer				100	766.491
21	ICP-OES-RV					253.7
22	N/A	N/A	N/A	N/A	N/A	N/A
23	ICP-OES	Lu	NA	NA	50	766.5
24	N/A	N/A	N/A	N/A	N/A	N/A
25	N/A	N/A	N/A	N/A	N/A	N/A
26	ICP-OES					766.491
27						
28	N/A	N/A	N/A	N/A	N/A	N/A
29	N/A	N/A	N/A	N/A	N/A	N/A
30	N/A	N/A	N/A	N/A	N/A	N/A

END OF REPORT