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National Measurement Institute

Proficiency Test Final Report AQA 21-09 Trace Elements and Solids in River and Waste Water

October 2021

ACKNOWLEDGMENTS

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

The assistance of the following NMI staff members in the planning, conducting 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 21-09, Trace Elements and Solids in River and Waste Water. The study covers the measurement of dissolved : Ag, Al, As, Be, Bi, Cd, Co, Cr, Cu, Fe, Hg, La, Mn, Ni, P, Pb, Sb, Se, Tl, U, V and Zn in river water, total: Al, As, B, Ba, Be, Cd, Cr, Co, Cu, Fe, Hg, Li, Mn, Mo, Ni, Pb, Sb, Se, Sn, Sr, V and Zn in waste water and of total solids, total suspended solids, total dissolved solids and turbidity in river water.

The sample set consisted of three water samples. Samples S1 and S3 were river water while sample S2 was waste water.

Twenty-four laboratories registered to participate and all submitted results.

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

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

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

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

Of 789 z-scores, 761 (96%) returned a satisfactory score of $|z| \leq 2.0$.
Of 789 E_n-scores, 699 (89%) returned a satisfactory score of $|E_n| \leq 1.0$.

ii. evaluate the laboratories' methods used to determine dissolved and total elements in river and waste water respectively;

Rounding of results and reporting results with an insufficient number of significant figures was one of the main causes for participants' poor performance.

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

On average, participants' performance in fresh water has remained consistent over time.

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 820 numerical results, 813 (99%) were reported with an expanded measurement uncertainty. The magnitude of the reported expended uncertainties was within the range 0.16% to 11967% of the reported value. An example of estimating measurement uncertainty using only the proficiency testing data is given in Appendix 3.

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

The study samples were checked for homogeneity and are well characterised, both by in-house testing and from the results of the proficiency round. These samples can be used for quality control, method development and method validation. Surplus test samples 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 inter-laboratory comparison."[1] NMI PT studies target chemical testing in areas of high public significance such as trade, environment and food safety. NMI offers studies in:

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

AQA 21-09 is the 28th NMI proficiency study of inorganic analytes in water.

2.2 Study Aims

The aims of the study were to:

- compare the performance of participant laboratories and assess their accuracy;
- evaluate the laboratories' methods used in determination of dissolved and total elements in river and waste water respectively;
- compare the performance of participant laboratories with their past performance;
- develop the practical application of traceability and measurement uncertainty;
- provide participants with information that will be useful in assessing their uncertainty estimates; 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/IEC Standard 17043[1] and The International Harmonized Protocol for Proficiency Testing of (Chemical) Analytical Laboratories.[4]

NMI is accredited by National Association of Testing Authorities, Australia (NATA) to ISO/IEC 17043 as a provider of proficiency testing schemes. This scheme 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 forty-eight tests were selected from those for which an investigation level is published in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality[5] and are commonly measured by water testing laboratories.

3.2 Participation

Twenty-four laboratories participated and all submitted results.

The timetable of the study was:

Invitation issued:	01 June 2021
Samples dispatched:	28 June 2021
Results due:	09 August 2021
Interim report issued:	11 August 2021

3.3 Test Material Specification

Three samples were provided for analysis:

Sample S1 is 100 mL of filtered river water preserved by adding 2% (v/w) HNO_3 and 0.01% HCl (v/w);
Sample S2 is 100 mL of unfiltered, autoclaved waste water preserved by adding 2% (v/w) HNO_3 and 0.01% HCl (v/w).
Sample S3 is 750 mL of unfiltered river water.

3.4 Laboratory Code

All participant laboratories were assigned a confidential code number.

3.5 Sample Preparation, Analysis and Homogeneity Testing

The same preparation procedure was followed as in previous studies. A partial homogeneity test was conducted for all elements in Samples S1 and S2.[1] The test samples from previous studies were demonstrated to be sufficiently homogeneous for the evaluation of participants' performance. Results from partial homogeneity testing are reported in this study as homogeneity values.

The preparation, analysis and homogeneity testing of the study samples are described in Appendix 1. In the present study, the test samples were demonstrated to be sufficiently homogeneous for all of the analytes assessed.

3.6 Stability of Analytes

No stability study was carried out for dissolved and total elements in S1 and S2. Stability studies conducted for previous proficiency studies of metals in water found no significant changes in any of the analytes' concentration.

In addition, no stability study was also carried for turbidity in S3 as previous studies conducted for this test found no significant changes in turbidity concentration over the duration of the study.

3.7 Sample Storage, Dispatch and Receipt

Samples S1 and S3 were frozen before dispatch while sample S2 was refrigerated.

The samples were dispatched by courier on 28 June 2021.

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

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

3.8 Instructions to Participants

Participants were instructed as follows:

- Quantitatively analyse the samples using your normal test method.

- Turbidity in S3 should be measured after TS, TDS and TSS analyses.
- Participants are asked to report results in units of µg/L, except for TS, TSS, TDS and turbidity. Report TS, TSS and TDS in units of mg/L and turbidity result in nephelometric turbidity units (NTU).

SAMPLE S1 filtered, acidified river water		SAMPLE S2 unfiltered, acidified waste water		SAMPLE S3 unfiltered river water	
Test Dissolved	Approximate Conc. Range µg/L	Test Total	Approximate Conc. Range µg/L	Test	Approximate Conc. Range mg/L
Ag	0.2-5	Al	250-6250	TS (dried at 103-105°C)	>50
Al	2-50	As	5-125	TSS (dried at 103-105°C)	>50
As	0.2-5	Ba	25-500	TDS (dried at 180°C)	Not Available
Be	0.2-5	Be	2.5-75	Turbidity (NTU)	>1
Bi	0.2-5	B	250-6250		
Cd	0.2-5	Cd	2.5-75		
Co	0.2-5	Cr	2.5-75		
Cr	0.2-5	Co	2.5-75		
Cu	1-25	Cu	50-1250		
Fe	50-1000	Fe	250-6250		
Hg	0.1-2.5	Hg	0.5-15		
La	0.2-5	Li	2.5-75		
Mn	1-25	Mn	25-500		
Ni	0.2-5	Mo	2.5-75		
P	20-500	Ni	2.5-75		
Pb	0.2-5	Pb	2.5-75		
Sb	0.2-5	Sb	2.5-75		
Se	0.2-5	Se	2.5-75		
Tl	0.2-5	Sn	2.5-75		
U	0.2-5	Sr	250-6250		
V	0.2-5	V	2.5-75		
Zn	1-25	Zn	50-1250		

- Report results using the electronic results sheet emailed to you.
- Report results as you would report to a client. For each analyte in each sample, report the expanded measurement uncertainty associated with your analytical result (e.g. 5.23 ± 0.51 µg/L).
- Please send us the requested details regarding the test method and the basis of your uncertainty estimate.

3.9 Interim Report

An interim report was emailed to participants on 11 August 2021.

4 PARTICIPANT LABORATORY INFORMATION

4.1 Test Method Summaries

Summaries of test methods are transcribed in Tables 1 to 3. The instruments and settings reported by participants are presented in Appendix 5.

Table 1 Methodology for Total Elements

Lab. Code	Method Reference	Sample Volume (mL)	Temp. (°C)	Time (min)	Vol. HNO_3 (mL)	Vol. HCl (mL)	Vol. HCl (1:1) (mL)
1	US EPA 3010	20	95-105	60	0.5	0.5	
2		50	100	120	1		
3	US EPA 3010	40	96	60	1	1	
4*	USEPA methods 200.8 and 200.7	50	95	420	1		
5	USEPA3050/6010/6020/200.7/200.8	30	90-98	60	0.5		0.5
6	USEPA Method 3005A	10	95	120	0.2	0.5	
7	APHA 3125; USEPA SW846 - 6020	10	98	120	0.5		
8	USEPA SW846 and in house	10	95	120	0.5		
9*	USEPA 200.8 APHA 3030 E (Modified), APHA 3125 B.	10	100	60	0.5		
10	W32 - Referencing APHA 3125						
11*	In-house method based on APHA 23rd Edition 3030E Nitric Acid Digestion Mercury - In-house method based on USEPA Method 245.7	10	95	120	0.5		
14	USEPA Method 3005A	10	95	120	0.5		
15	In House, US EPA 6020B	20	90-95	60	0.5	0.5	
17	USEPA6020	40	95	60	1	1	
18	USEPA3050/6010/6020/200.7/200.8	30	90-98	60	0.5	0.25	
19		30	100-109	90	2		
20	USEPA3050/6010/6020/200.7/200.8	30	90-98	60	0.5	0.25	
21	APHA	5	95	90	2	1	
22	USEPA Method 3010	40	95-105	60	1	1	
24	Based on APHA 3030 E	40	100	480	2		

*Additional Information in Table 3

Table 2 Method References for Solids and Turbidity

Laboratory Code	Method Reference
4	APHA 2540 C, USEPA Method 160.1; APHA method 2540B; APHA Method 2540 D; APHA Section 2130 Turbidity
6	APHA
7	Gravimetric APHA 2540C, APHA 2540 D, APHA 2540 B
8	APHA 2540 series
10	In House W1 – Turbidity, W25 – TSS

Laboratory Code	Method Reference
11	TSS – In-house method based on APHA 23rd Edition 2540 D; TDS – In-house method based on APHA 23rd Edition 2540 C; TS – In-house method based on APHA 23rd Edition 2540 B; Turbidity – In-house method based on APHA 23rd Edition 2130 B
12	APHA 2540 B, C and D. APHA 2130 Turbidity A and B.
14	APHA 2540C
17	APHA Method 2540 B, C, D & E; APHA Method 2130 B
18	APHA Latest Edition – 2540B, 2540C, 2540D and 2130B
19	APHA
20	APHA Latest Edition – 2540B, 2540C, 2540D and 2130B
21	APHA
22	USEPA Method 3010
23	Solids inhouse method with reference to APHA 2540 B, C, D; Turbidity – Turbimetric Meter
24	SOLIDS by APHA 2540 B, C & D – Turb by APHA 2130 B

4.2 Additional Information

Participants had the option to report additional information for each sample analysed. These are transcribed in Table 3.

Table 3 Additional Information

Lab Code	Additional Information
4	Methodology for Total Elements: Sample S2 was digested. Sample S1 was analysed as received. Instrumental Techniques: Cu and Zn on S1 by ICPMS, and S2 by ICPOES.
9	Methodology for Total Elements: Dissolved Hg Reference Method is US EPA Method 245.7. Total Hg Digestion: 0.1 mL HCl also added. Instrumental Techniques: Dissolved Hg: Atomic Fluorescence.
11	Methodology for Total Elements: Mercury digestion – 20 mL sample + 1 mL 50% HCl + 1 mL $KBr/KBrO_3$ reagent. Heated on a water bath at 50 – 60 C for 20 minutes. Instrumental Techniques: Mercury – After final dilution, 2 drops of 8% hydroxylamine Chloride is added. Stannous Chloride is used as reducing agent.

4.3 Basis of Participants' Measurement Uncertainty Estimates

Participants were requested to provide information about the basis of their uncertainty estimates (Table 4).

Table 4 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	Top Down - precision and estimates of the method and laboratory bias	Control Samples	Recoveries of SS	ISO/GUM
2	Bottom Up (ISO/GUM, fish bone/ cause and effect diagram)	Control Samples – CRM Duplicate Analysis	CRM Instrument Calibration	
3	Top Down - precision and estimates of the method and laboratory bias	Control Samples – CRM Duplicate Analysis	CRM	ASTM E2554-13
4	Top Down - precision and estimates of the method and laboratory bias	Control Samples – CRM Duplicate Analysis	CRM Recoveries of SS	Top Down approach
5	Top Down - precision and estimates of the method and laboratory bias	Control Samples	Recoveries of SS	NATA General Accreditation Guidance

Lab. Code	Approach to Estimating MU	Information Sources for MU Estimation[a]		Guide Document for Estimating MU
		Precision	Method Bias	
				Estimating and Reporting Measurement Uncertainty of Chemical Test Results
6	Top Down - precision and estimates of the method and laboratory bias	Control Samples – CRM Duplicate Analysis Instrument Calibration	CRM Instrument Calibration	Eurachem/CITAC Guide
7	Top Down - precision and estimates of the method and laboratory bias	Control Samples – RM Duplicate Analysis Instrument Calibration		Eurachem/CITAC Guide
8	Top Down - precision and estimates of the method and laboratory bias	Control Samples - CRM	CRM	Eurachem/CITAC Guide
9	Standard deviation of replicate analyses multiplied by 2 or 3	Control Samples – SS Duplicate Analysis Instrument Calibration	Instrument Calibration Recoveries of SS	Eurachem/CITAC Guide
10	Top Down - precision and estimates of the method and laboratory bias	Control Samples – CRM Duplicate Analysis	CRM Instrument Calibration Standard Purity	Nordtest Report TR537
11	Top Down - precision and estimates of the method and laboratory bias	Control Samples – SS Duplicate Analysis	Recoveries of SS	NATA General Accreditation Guidance, Estimating and Reporting MU
12	Bottom Up (ISO/GUM, fish bone/ cause and effect diagram)	Control Samples Duplicate Analysis Instrument Calibration	CRM Instrument Calibration Laboratory Bias from PT Studies	Eurachem 2000 / ISO1993A
13	Top Down - precision and estimates of the method and laboratory bias	Control Samples Duplicate Analysis	CRM	NMI Uncertainty Course
14	Bottom Up (ISO/GUM, fish bone/ cause and effect diagram)	Control Samples Duplicate Analysis Instrument Calibration	CRM Instrument Calibration Laboratory Bias from PT Studies Recoveries of SS	Eurachem/CITAC Guide
15	Top Down - precision and estimates of the method and laboratory bias	Control Samples - SS	Recoveries of SS	ISO/GUM
16	Bottom Up (ISO/GUM, fish bone/ cause and effect diagram)	Control Samples – CRM Duplicate Analysis Instrument Calibration	CRM	NMI Uncertainty Course
17	Estimation of MU from within-laboratory data on bias and precision has been calculated by using the procedures outlined in ASTM E2554-13 Standard Practice for Estimating and Monitoring the Uncertainty of Test Results of a Test Method Using Control Chart Techniques	Control Samples – CRM Duplicate Analysis	CRM Instrument Calibration	ASTM E2554-13
18	Top Down - precision and estimates of the method and laboratory bias	Control Samples	Recoveries of SS	NATA General Accreditation Guidance Estimating and Reporting Measurement Uncertainty of Chemical Test Results
19		Control Samples – SS Duplicate Analysis	Instrument Calibration Recoveries of SS	Nordtest Report TR537
20	Top Down - precision and estimates of the method and laboratory bias	Control Samples	Recoveries of SS	NATA General Accreditation Guidance

Lab. Code	Approach to Estimating MU	Information Sources for MU Estimation[a]		Guide Document for Estimating MU
		Precision	Method Bias	
				Estimating and Reporting Measurement Uncertainty of Chemical Test Results
21	Top Down - precision and estimates of the method and laboratory bias	Control Samples - CRM	CRM	Eurachem/CITAC Guide; NATA recommendations
22	Top Down - precision and estimates of the method and laboratory bias	Control Samples - RM	CRM	ISO/GUM
23	Top Down - precision and estimates of the method and laboratory bias	Control Samples – SS Duplicate Analysis	Recoveries of SS	ISO/GUM
24	Standard deviation of replicate analyses multiplied by 2 or 3	Control Samples Duplicate Analysis	CRM Instrument Calibration Recoveries of SS	ISO/GUM

[a]RM = Reference Material, CRM = Certified Reference Material, SS =Spiked samples.

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

The study co-ordinator welcomes comments or suggestions from participants about this study or possible future studies. Such feedback may be useful in improving future studies. Participants' comments are reproduced in Table 5.

Table 5 Participants' Comments

Participants' Comments	Study Co-ordinator's Response
Please provide more of sample S1 and S2 as insufficient quantity for our methods (Hg analyser, ICPMS and ICPAES)	Thank you for your feedback. Other participants are invited to comment.

5 PRESENTATION OF RESULTS AND STATISTICAL ANALYSIS

5.1 Results Summary

Participant results are listed in Tables 6 to 53 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 49. An example chart with interpretation guide is shown in Figure 1.

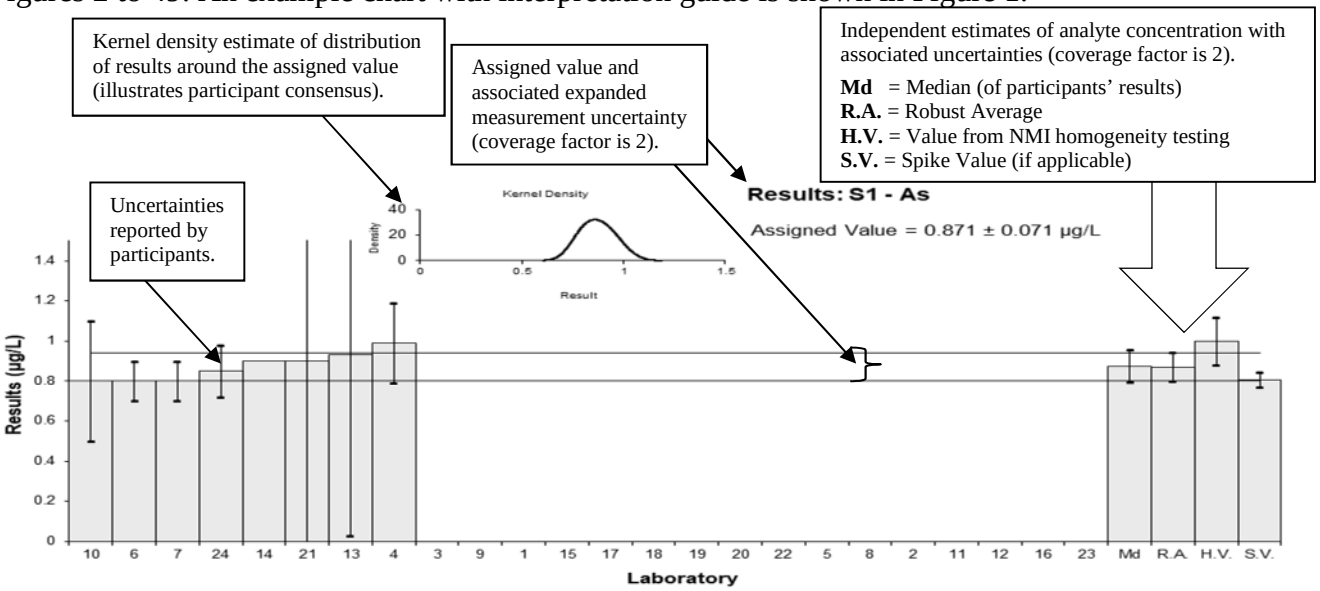


Figure 1 Guide to Presentation of Results

5.2 Outliers and Extreme Outliers

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

5.3 Assigned Value

An example of 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 the property is the mass concentration of analyte. Assigned values were the robust average of participants' results; the expanded uncertainties were estimated from the associated robust standard deviations. [4, 6.]

5.4 Robust Average

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

5.5 Robust Between-Laboratory Coefficient of Variation

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

5.6 Target Standard Deviation for Proficiency Assessment

The target standard deviation for proficiency assessment (σ) is the product of the assigned value *(X)* and the performance coefficient of variation (PCV). This value is used for

calculation of participant z-score and provides scaling for laboratory deviation from the assigned value.

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

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

5.7 z-Score

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

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

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

where:

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

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

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

5.8 E_n-Score

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

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

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

where:

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

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

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

5.9 Traceability and Measurement Uncertainty

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

6 TABLES AND FIGURES

Table 6

Sample Details

Sample No.	S1
Matrix.	River Water
Analyte.	Ag
Units	µg/L

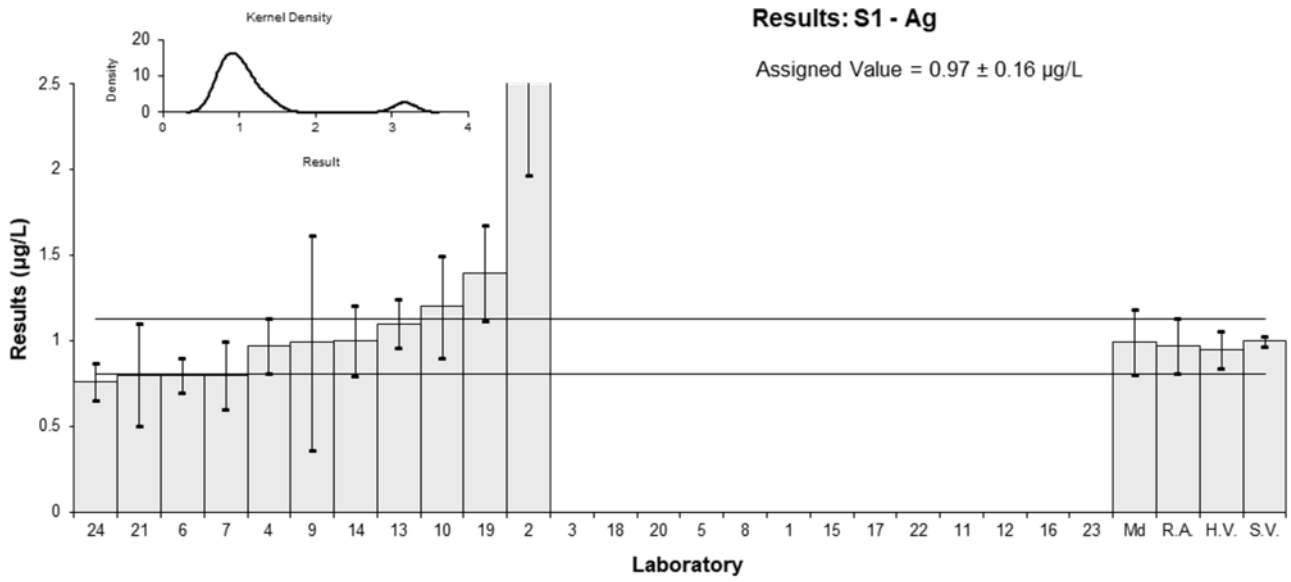
Participant Results

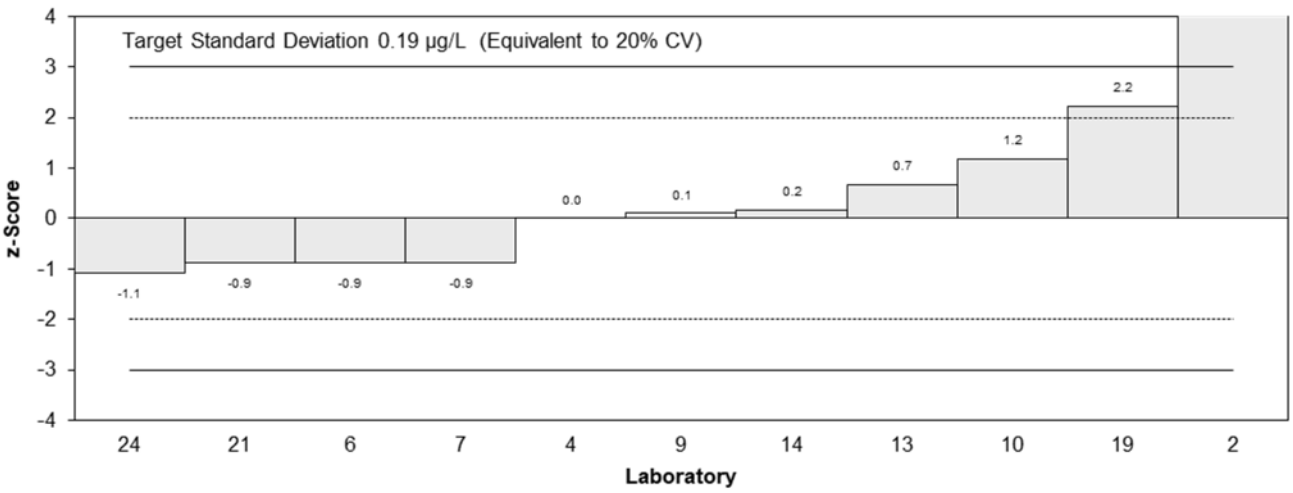
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	<5	0.62		
2	3.17	1.2	11.34	1.82
3	< 5	NR		
4	0.97	0.16	0.00	0.00
5	<1	NR		
6	0.8	0.1	-0.88	-0.90
7	0.8	0.2	-0.88	-0.66
8	<1	NR		
9	0.99	0.63	0.10	0.03
10	1.2	0.3	1.19	0.68
11	NT	NT		
12	NT	NT		
13	1.1	0.14	0.67	0.61
14	1	0.208	0.15	0.11
15	<5	1		
16	NT	NT		
17	<5	0.106		
18	<1	NR		
19	1.4	0.28	2.22	1.33
20	<1	NR		
21	0.8	0.3	-0.88	-0.50
22	<5	0.55		
23	NT	NT		
24	0.76	0.11	-1.08	-1.08

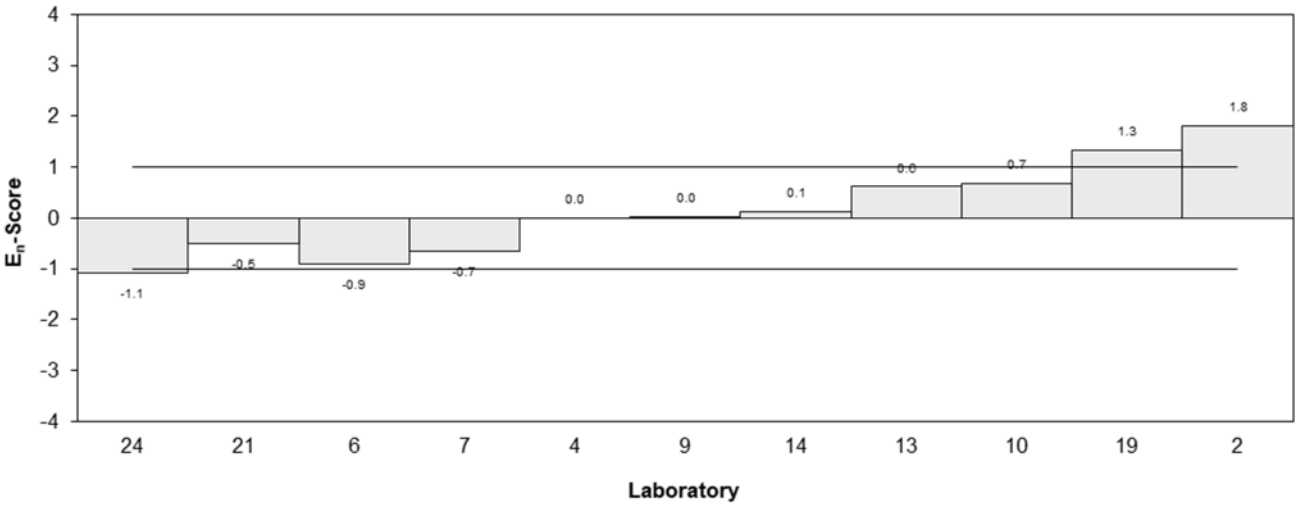
Statistics

Assigned Value*	0.97	0.16
Spike	1.00	0.03
Homogeneity Value	0.95	0.11
Robust Average	1.02	0.20
Median	0.99	0.19
Mean	1.18	
N	11	
Max.	3.17	
Min.	0.76	
Robust SD	0.27	
Robust CV	26%	

*Robust Average excluding laboratory 2.


Kernel Density
Density
Result
Results: S1 - Ag
Assigned Value = 0.97 ± 0.16 µg/L
Results (µg/L)
Laboratory
24 21 6 7 4 9 14 13 10 19 2 3 18 20 5 8 1 15 17 22 11 12 16 23 Md R.A. H.V. S.V.


z-Scores: S1 - Ag
Target Standard Deviation 0.19 µg/L (Equivalent to 20% CV)
z-Score
Laboratory
24 21 6 7 4 9 14 13 10 19 2
-1.1 -0.9 -0.9 -0.9 0.0 0.1 0.2 0.7 1.2 2.2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En-Score
Laboratory
24 21 6 7 4 9 14 13 10 19 2
-1.1 -0.5 -0.9 -0.7 0.0 0.0 0.1 0.6 0.7 1.3 1.8

Figure 2

Table 7

Sample Details

Sample No.	S1
Matrix.	River Water
Analyte.	Al
Units	µg/L

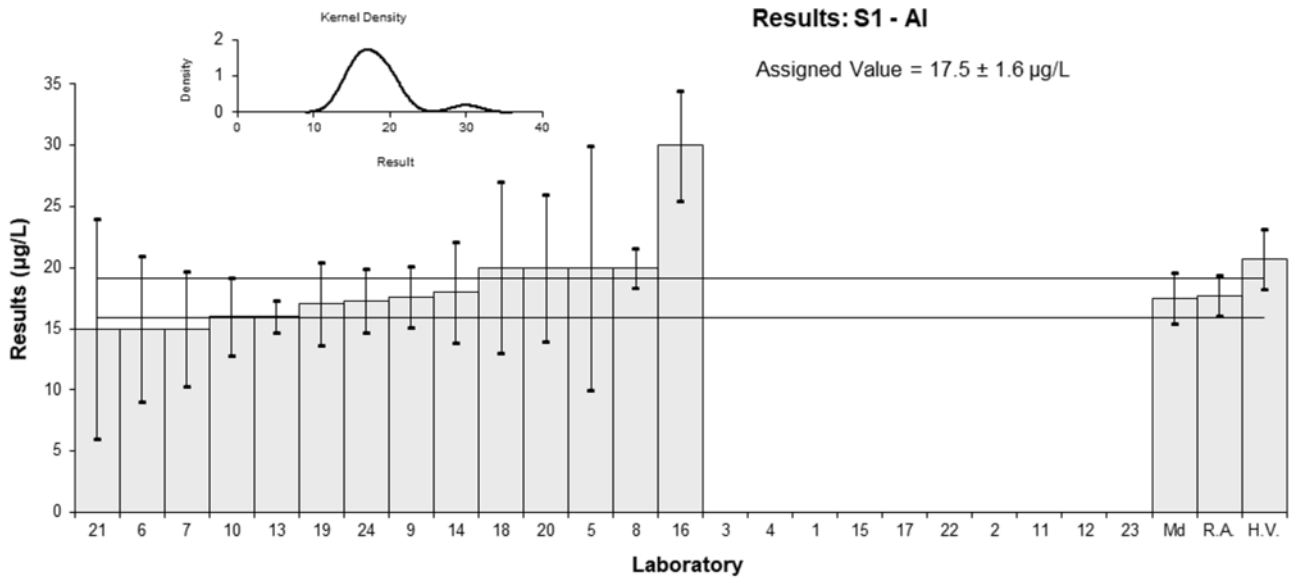
Participant Results

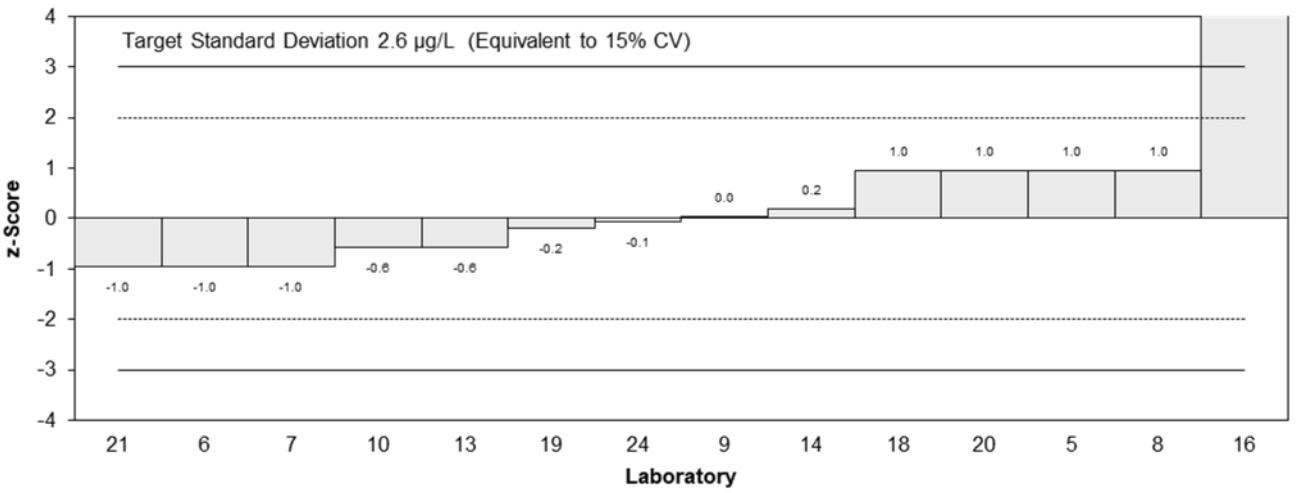
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	<50	5.1		
2	NR	NR		
3	< 50	NR		
4	<40	NR		
5	20	10	0.95	0.25
6	15	6	-0.95	-0.40
7	15	4.7	-0.95	-0.50
8	20	1.61	0.95	1.10
9	17.6	2.5	0.04	0.03
10	16	3.2	-0.57	-0.42
11	NT	NT		
12	NT	NT		
13	16	1.3	-0.57	-0.73
14	18	4.16	0.19	0.11
15	<50	10		
16	30	4.5	4.76	2.62
17	<50	2.8		
18	20	7	0.95	0.35
19	17	3.4	-0.19	-0.13
20	20	6	0.95	0.40
21	15	9	-0.95	-0.27
22	<50	5.8		
23	NT	NT		
24	17.3	2.6	-0.08	-0.07

Statistics

Assigned Value*	17.5	1.6
Spike	Not Spiked	
Homogeneity Value	20.7	2.5
Robust Average	17.7	1.7
Median	17.5	2.1
Mean	18.4	
N	14	
Max.	30	
Min.	15	
Robust SD	2.5	
Robust CV	14%	

*Robust Average excluding laboratory 16.


Kernel Density
Density
Result
Results: S1 - Al
Assigned Value = 17.5 ± 1.6 µg/L
Results (µg/L)
Laboratory
21 6 7 10 13 19 24 9 14 18 20 5 8 16 3 4 1 15 17 22 2 11 12 23 Md R.A. H.V.


z-Scores: S1 - Al
Target Standard Deviation 2.6 µg/L (Equivalent to 15% CV)
z-Score
Laboratory
21 6 7 10 13 19 24 9 14 18 20 5 8 16
-1.0 -1.0 -1.0 -0.6 -0.6 -0.2 -0.1 0.0 0.2 1.0 1.0 1.0 1.0

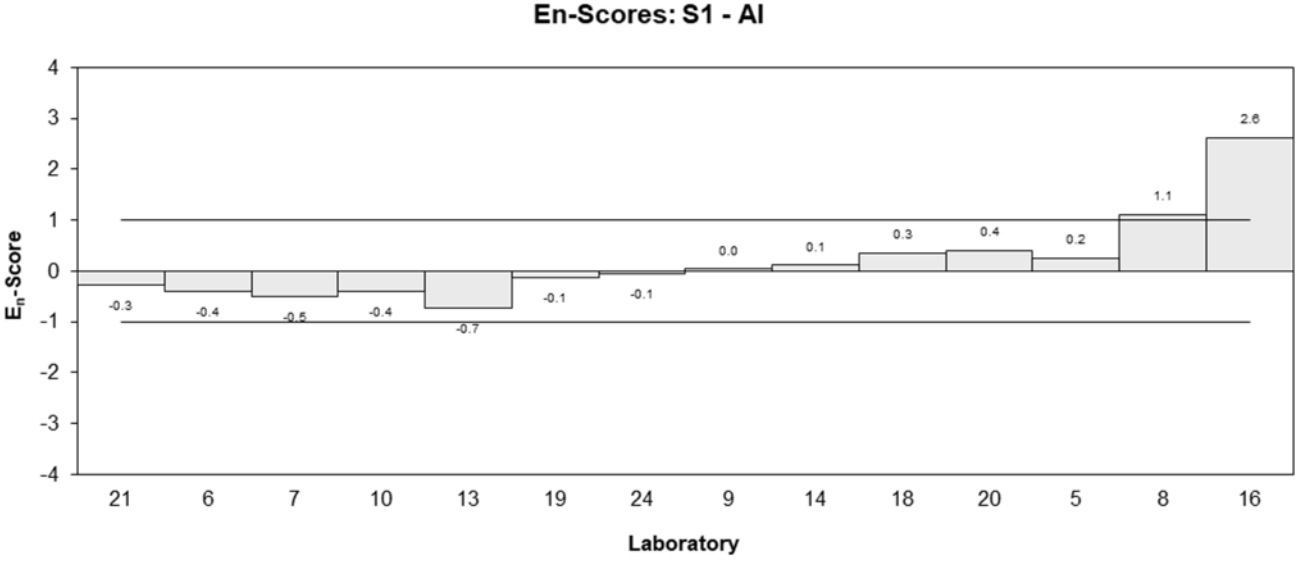

En-Scores: S1 - Al
En-Score
Laboratory
21 6 7 10 13 19 24 9 14 18 20 5 8 16
-0.3 -0.4 -0.5 -0.4 -0.7 -0.1 -0.1 0.0 0.1 0.3 0.4 0.2 1.1 2.6

Figure 3

Table 8

Sample Details

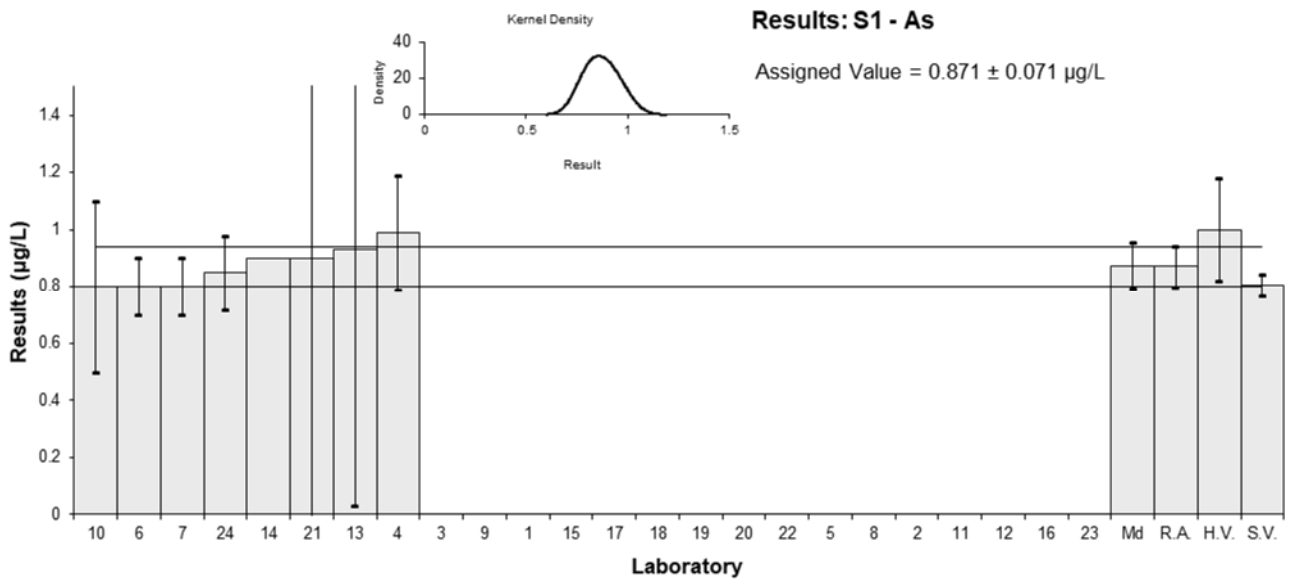
Sample No.	S1
Matrix.	River Water
Analyte.	As
Units	µg/L

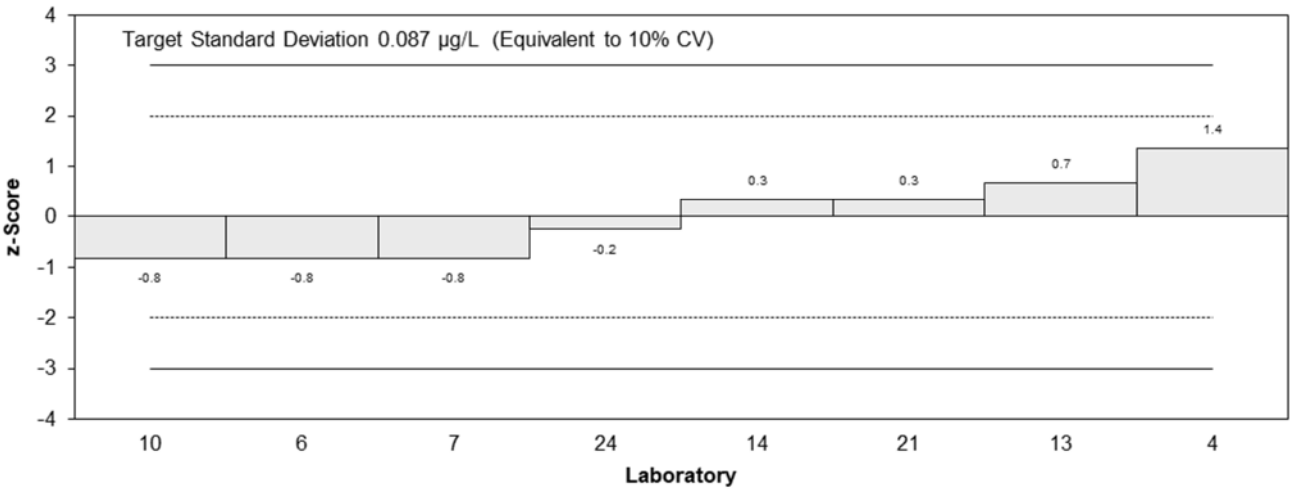
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	<1	0.14		
2	NR	NR		
3	< 1	NR		
4	0.99	0.20	1.37	0.56
5	<1	NR		
6	0.8	0.1	-0.82	-0.58
7	0.8	0.1	-0.82	-0.58
8	<1	NR		
9	< 1.0	0.67		
10	0.8	0.3	-0.82	-0.23
11	NT	NT		
12	NT	NT		
13	0.93	0.9	0.68	0.07
14	0.9	NR	0.33	0.41
15	<1	0.2		
16	NT	NT		
17	<1	0.133		
18	<1	NR		
19	<1	NR		
20	<1	NR		
21	0.9	5	0.33	0.01
22	<1	0.13		
23	NT	NT		
24	0.85	0.13	-0.24	-0.14

Statistics

Assigned Value	0.871	0.071
Spike	0.806	0.039
Homogeneity Value	1.00	0.18
Robust Average	0.871	0.071
Median	0.875	0.081
Mean	0.871	
N	8	
Max.	0.99	
Min.	0.8	
Robust SD	0.080	
Robust CV	9.2%	


Kernel Density
Density
Result
Results: S1 - As
Assigned Value = 0.871 ± 0.071 µg/L
Results (µg/L)
Laboratory
10 6 7 24 14 21 13 4 3 9 1 15 17 18 19 20 22 5 8 2 11 12 16 23 Md R.A. H.V. S.V.


z-Scores: S1 - As
Target Standard Deviation 0.087 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
10 6 7 24 14 21 13 4
-0.8 -0.8 -0.8 -0.2 0.3 0.3 0.7 1.4

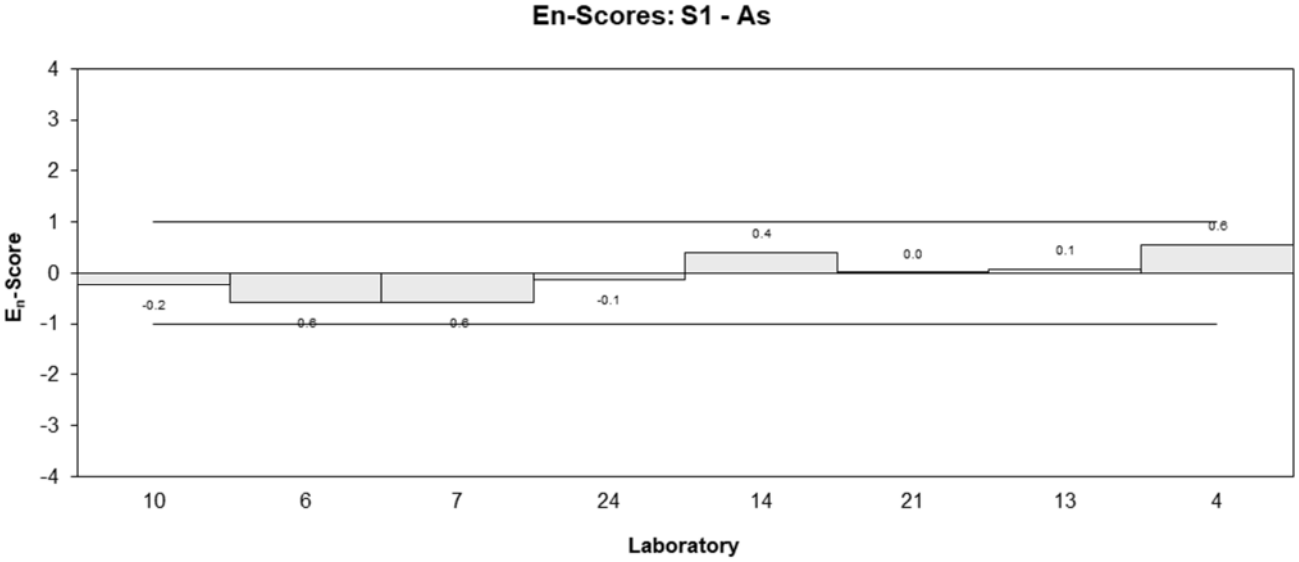

En-Scores: S1 - As
En-Score
Laboratory
10 6 7 24 14 21 13 4
-0.2 -0.6 -0.6 -0.1 0.4 0.0 0.1 0.6

Figure 4

Table 9

Sample Details

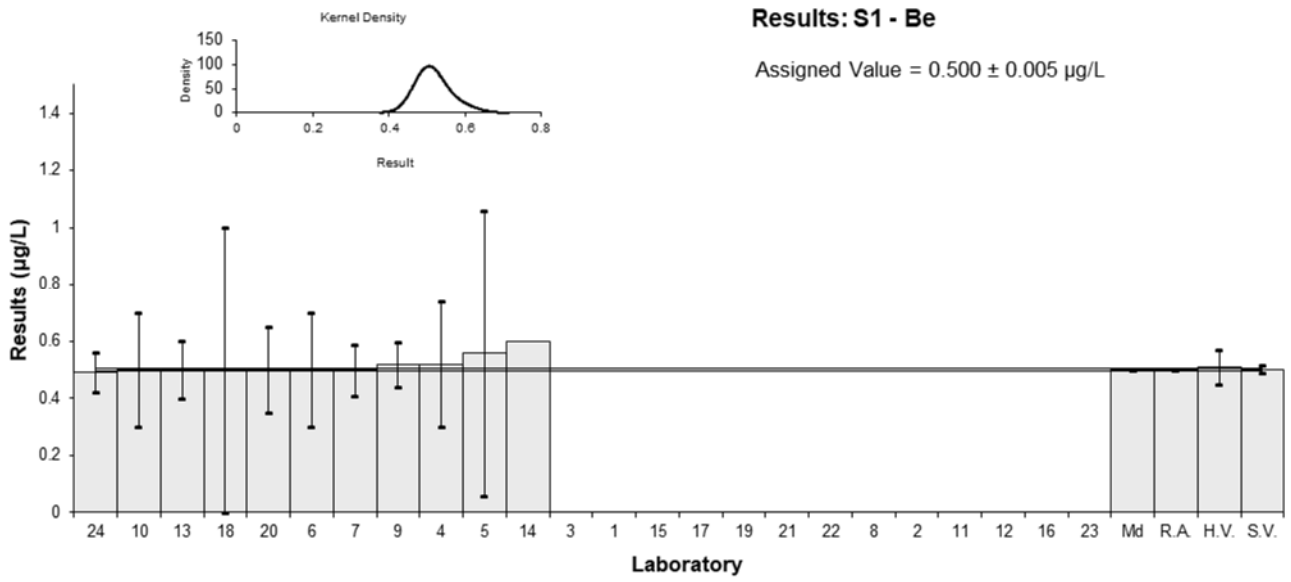
Sample No.	S1
Matrix.	River Water
Analyte.	Be
Units	µg/L

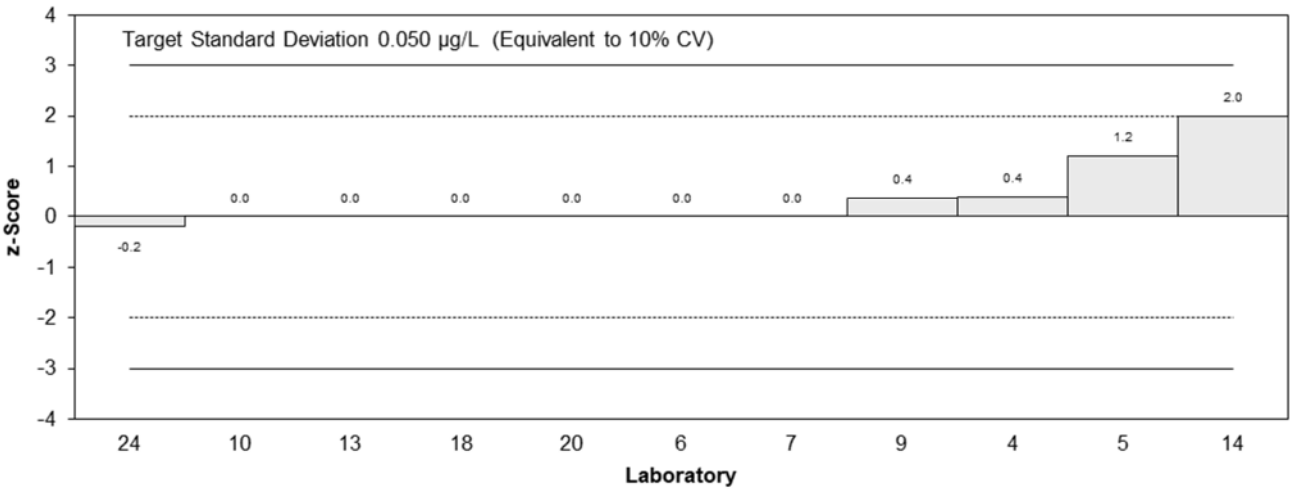
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	<1	0.12		
2	NR	NR		
3	< 1	NR		
4	0.52	0.22	0.40	0.09
5	0.56	0.5	1.20	0.12
6	0.5	0.2	0.00	0.00
7	0.5	0.09	0.00	0.00
8	<1	NR		
9	0.518	0.079	0.36	0.23
10	0.5	0.2	0.00	0.00
11	NT	NT		
12	NT	NT		
13	0.5	0.1	0.00	0.00
14	0.6	NR	2.00	20.00
15	<1	0.2		
16	NT	NT		
17	<1	0.110		
18	0.5	0.5	0.00	0.00
19	<1	NR		
20	0.5	0.15	0.00	0.00
21	<1	2		
22	<1	0.13		
23	NT	NT		
24	0.49	0.07	-0.20	-0.14

Statistics

Assigned Value	0.500	0.005
Spike	0.502	0.014
Homogeneity Value	0.510	0.061
Robust Average	0.500	0.005
Median	0.500	0.005
Mean	0.5	
N	11	
Max.	0.6	
Min.	0.49	
Robust SD	0.0005	
Robust CV	0.1%	


Kernel Density
Density
Result
Results: S1 - Be
Assigned Value = 0.500 ± 0.005 µg/L
Results (µg/L)
Laboratory
24 10 13 18 20 6 7 9 4 5 14 3 1 15 17 19 21 22 8 2 11 12 16 23 Md R.A. H.V. S.V.


z-Scores: S1 - Be
Target Standard Deviation 0.050 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
24 10 13 18 20 6 7 9 4 5 14

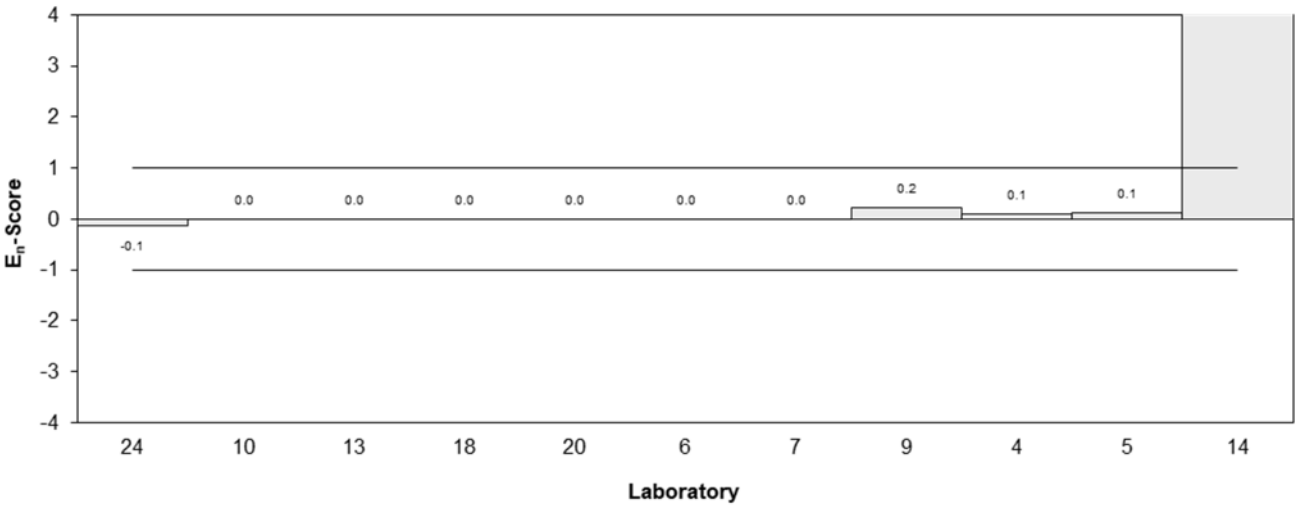

En-Scores: S1 - Be
En-Score
Laboratory
24 10 13 18 20 6 7 9 4 5 14

Figure 5

Table 10

Sample Details

Sample No.	S1
Matrix.	River Water
Analyte.	Bi
Units	µg/L

Participant Results

Lab Code	Result	Uncertainty
1	NT	NT
2	0.2	0.8
3	< 5	NR
4	NT	NT
5	<1	NR
6	0.36	0.07
7	0.36	0.06
8	4	0.35
9	NT	NT
10	1.6	0.3
11	NT	NT
12	NT	NT
13	0.3	0.1
14	0.36	0.072
15	<5	1
16	NT	NT
17	<5	0.052
18	<1	NR
19	<1	NR
20	<1	NR
21	<1	1
22	<5	0.76
23	NT	NT
24	0.34	0.05

Statistics*

Assigned Value	Not Set	
Spike	0.378	0.011
Homogeneity Value	0.338	0.041
Robust Average	0.345	0.093
Median	0.360	0.027
Mean	0.503	
N	7	
Max.	4	
Min.	0.2	
Robust SD	0.099	
Robust CV	29%	

*Laboratory 8 excluded from statistical calculation (gross error) .

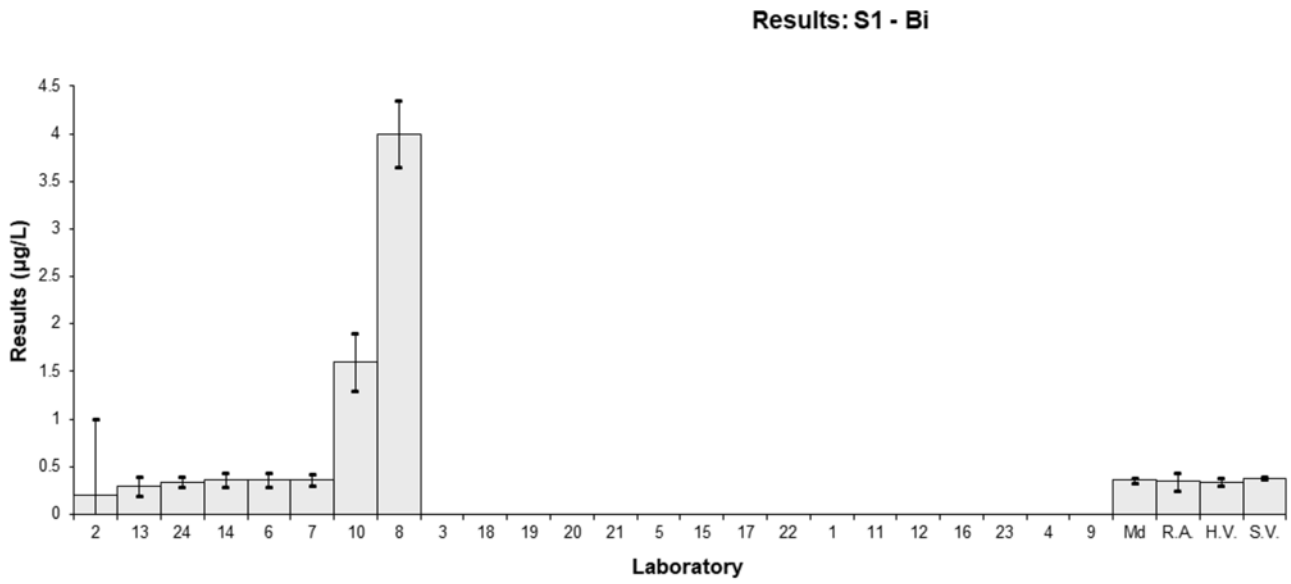

Results: S1 - Bi
Results (µg/L)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
2 13 24 14 6 7 10 8 3 18 19 20 21 5 15 17 22 1 11 12 16 23 4 9 Md R.A. H.V. S.V.
Laboratory

Figure 6

Table 11

Sample Details

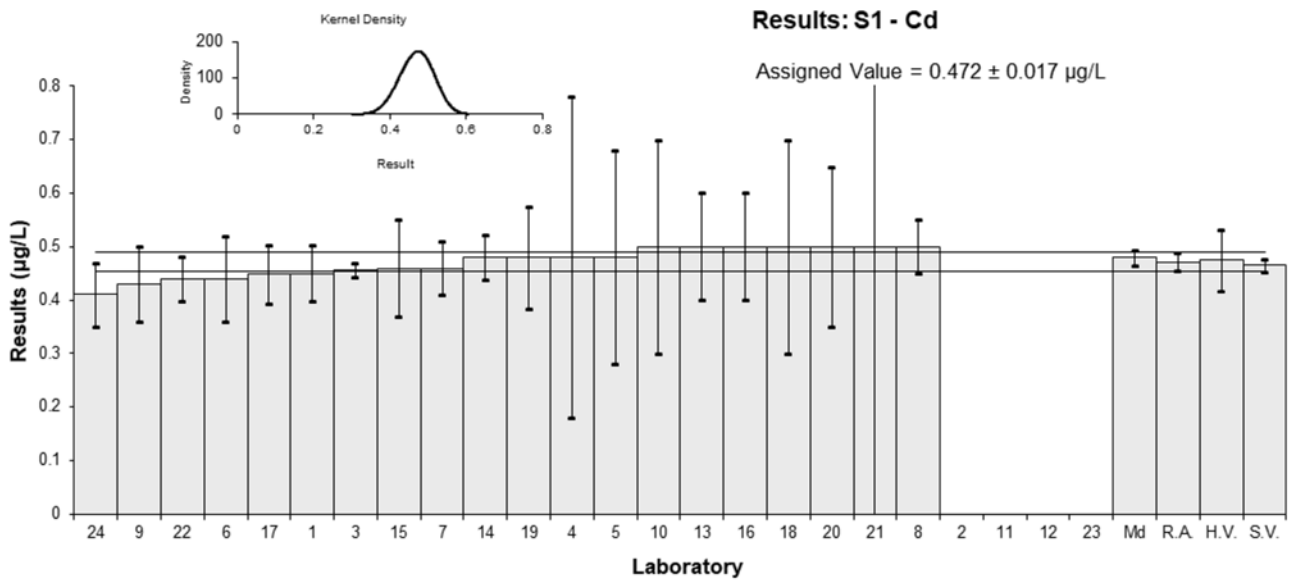
Sample No.	S1
Matrix.	River Water
Analyte.	Cd
Units	µg/L

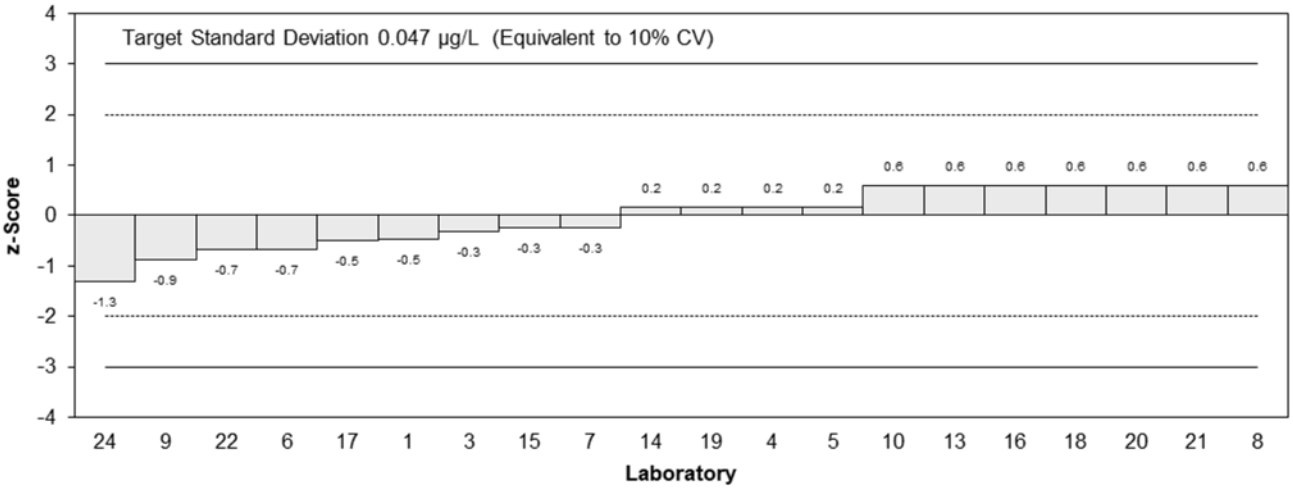
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	0.45	0.052	-0.47	-0.40
2	NR	NR		
3	0.457	0.0127	-0.32	-0.71
4	0.48	0.30	0.17	0.03
5	0.48	0.2	0.17	0.04
6	0.44	0.08	-0.68	-0.39
7	0.46	0.05	-0.25	-0.23
8	0.5	0.05	0.59	0.53
9	0.430	0.070	-0.89	-0.58
10	0.5	0.2	0.59	0.14
11	NT	NT		
12	NT	NT		
13	0.5	0.1	0.59	0.28
14	0.48	0.0420	0.17	0.18
15	0.46	0.09	-0.25	-0.13
16	0.5	0.1	0.59	0.28
17	0.449	0.055	-0.49	-0.40
18	0.5	0.2	0.59	0.14
19	0.48	0.096	0.17	0.08
20	0.5	0.15	0.59	0.19
21	0.5	0.7	0.59	0.04
22	0.44	0.042	-0.68	-0.71
23	NT	NT		
24	0.41	0.06	-1.31	-0.99

Statistics

Assigned Value	0.472	0.017
Spike	0.465	0.013
Homogeneity Value	0.475	0.057
Robust Average	0.472	0.017
Median	0.480	0.014
Mean	0.471	
N	20	
Max.	0.5	
Min.	0.41	
Robust SD	0.030	
Robust CV	6.3%	


Kernel Density
Density
Result
Results: S1 - Cd
Assigned Value = 0.472 ± 0.017 µg/L
Results (µg/L)
Laboratory
24 9 22 6 17 1 3 15 7 14 19 4 5 10 13 16 18 20 21 8 2 11 12 23 Md R.A. H.V. S.V.


z-Scores: S1 - Cd
Target Standard Deviation 0.047 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
24 9 22 6 17 1 3 15 7 14 19 4 5 10 13 16 18 20 21 8

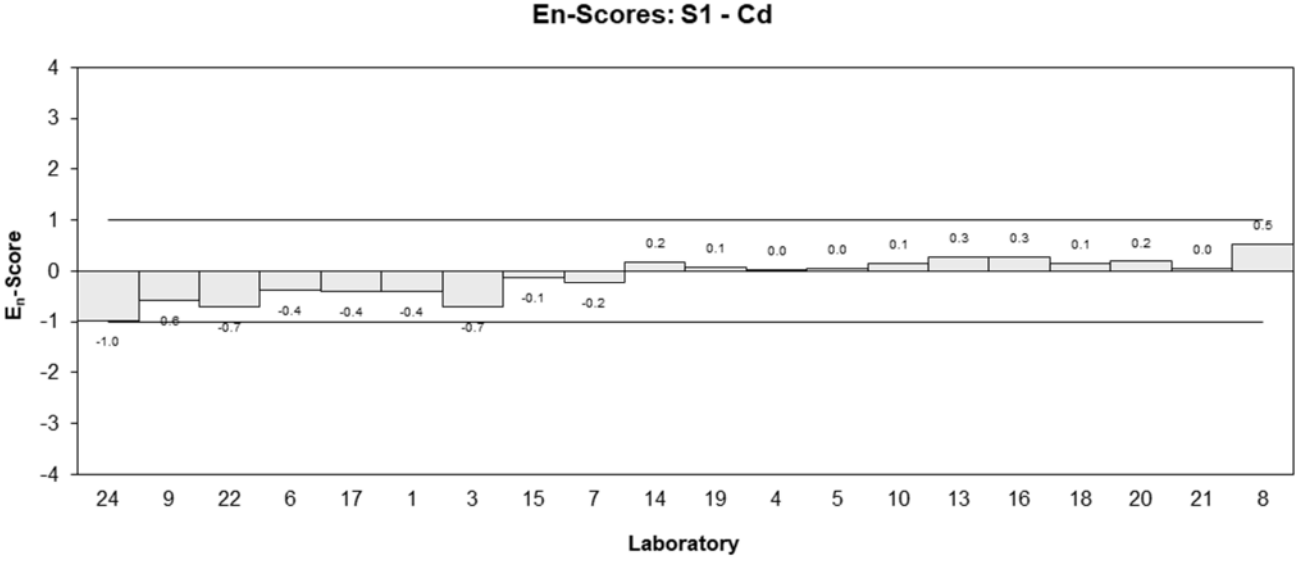

En-Scores: S1 - Cd
En-Score
Laboratory
24 9 22 6 17 1 3 15 7 14 19 4 5 10 13 16 18 20 21 8

Figure 7

Table 12

Sample Details

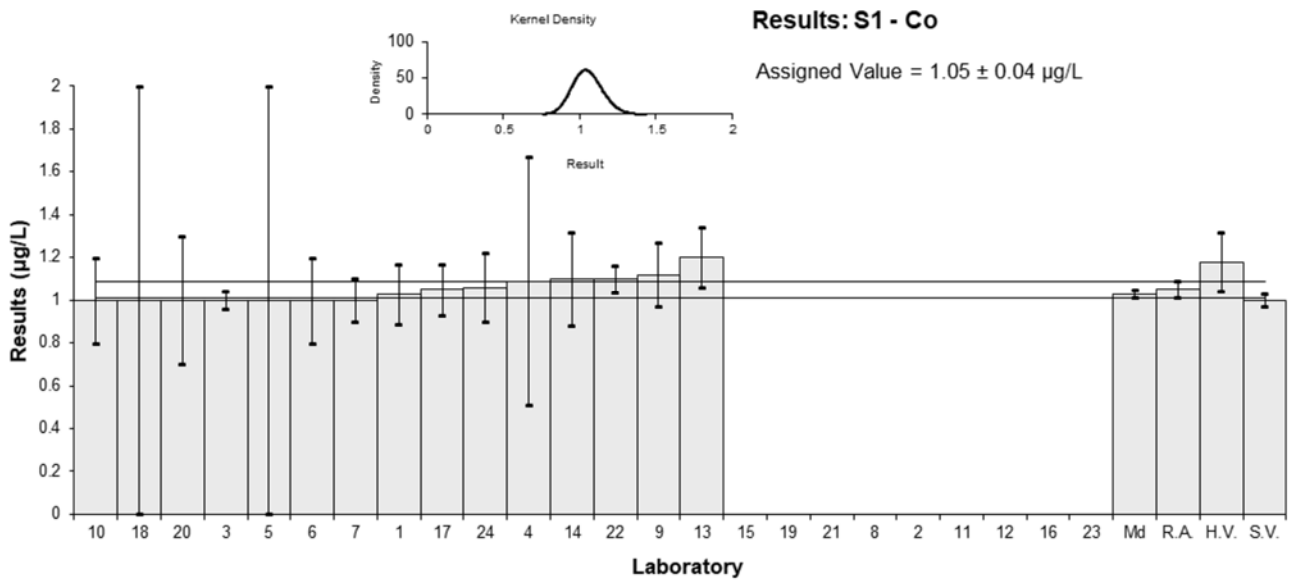
Sample No.	S1
Matrix.	River Water
Analyte.	Co
Units	µg/L

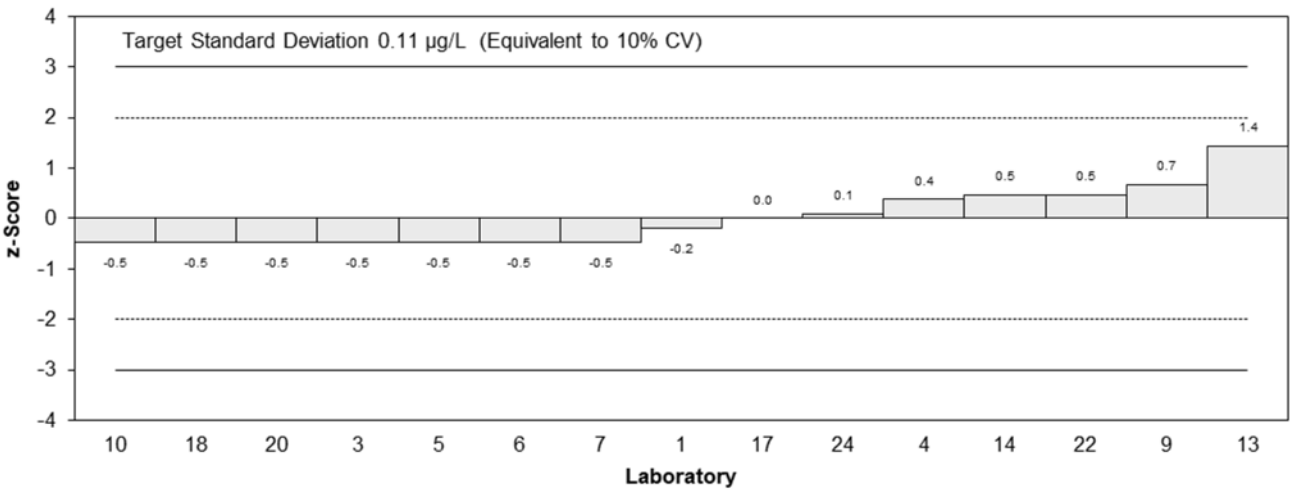
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	1.03	0.14	-0.19	-0.14
2	NR	NR		
3	1.00	0.0421	-0.48	-0.86
4	1.09	0.58	0.38	0.07
5	1.0	1	-0.48	-0.05
6	1.0	0.2	-0.48	-0.25
7	1.0	0.1	-0.48	-0.46
8	<1	NR		
9	1.12	0.15	0.67	0.45
10	1.0	0.2	-0.48	-0.25
11	NT	NT		
12	NT	NT		
13	1.2	0.14	1.43	1.03
14	1.1	0.22	0.48	0.22
15	<1	0.2		
16	NT	NT		
17	1.05	0.12	0.00	0.00
18	1	1	-0.48	-0.05
19	<1	NR		
20	1	0.3	-0.48	-0.17
21	<1	1		
22	1.1	0.063	0.48	0.67
23	NT	NT		
24	1.06	0.16	0.10	0.06

Statistics

Assigned Value	1.05	0.04
Spike	1.00	0.03
Homogeneity Value	1.18	0.14
Robust Average	1.05	0.04
Median	1.03	0.02
Mean	1.05	
N	15	
Max.	1.2	
Min.	1	
Robust SD	0.057	
Robust CV	5.5%	


Kernel Density
Density
Result
Results: S1 - Co
Assigned Value = 1.05 ± 0.04 µg/L
Results (µg/L)
Laboratory
10 18 20 3 5 6 7 1 17 24 4 14 22 9 13 15 19 21 8 2 11 12 16 23 Md R.A. H.V. S.V.


z-Scores: S1 - Co
Target Standard Deviation 0.11 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
10 18 20 3 5 6 7 1 17 24 4 14 22 9 13
-0.5 -0.5 -0.5 -0.5 -0.5 -0.5 -0.5 -0.2 0.0 0.1 0.4 0.5 0.5 0.7 1.4

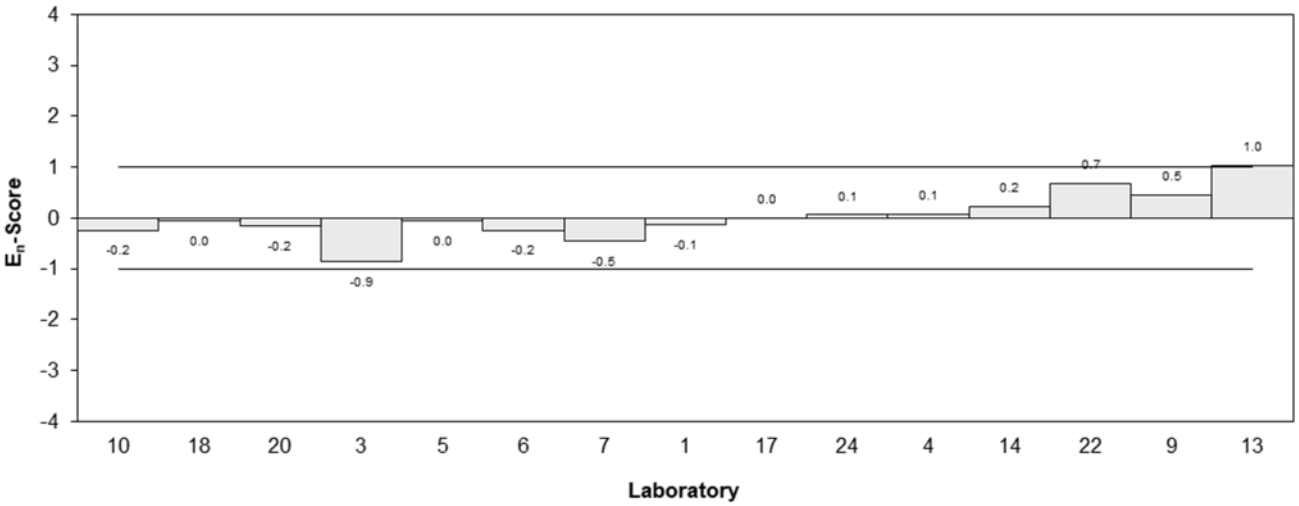

En-Scores: S1 - Co
En-Score
Laboratory
10 18 20 3 5 6 7 1 17 24 4 14 22 9 13
-0.2 0.0 -0.2 -0.9 0.0 -0.2 -0.5 -0.1 0.0 0.1 0.1 0.2 0.7 0.5 1.0

Figure 8

Table 13

Sample Details

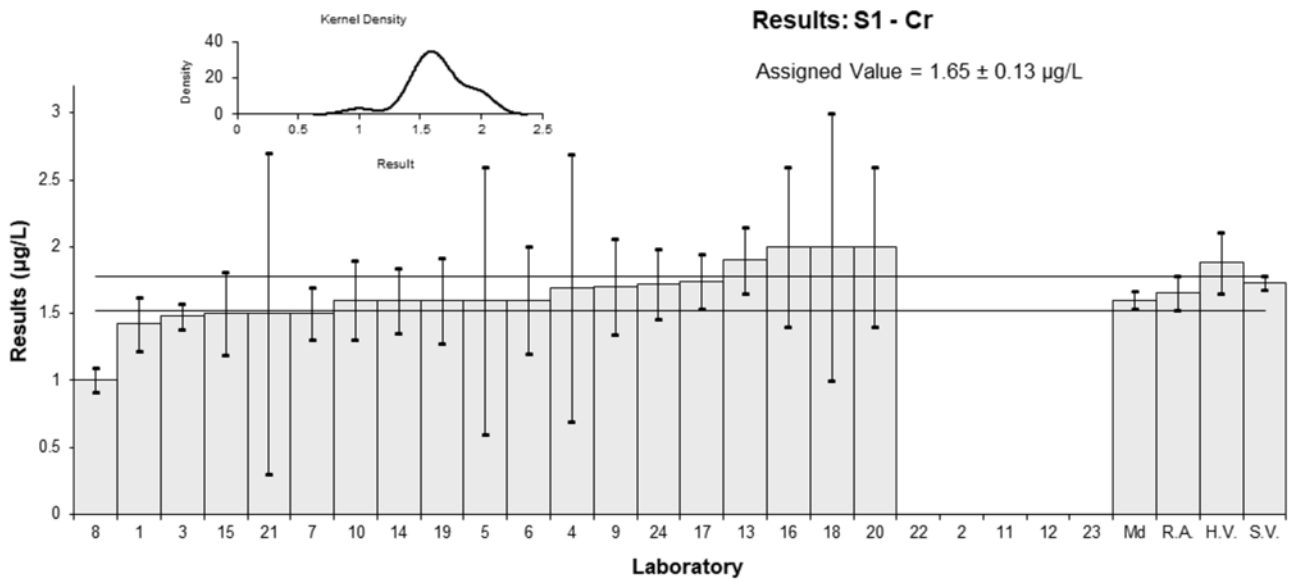
Sample No.	S1
Matrix.	River Water
Analyte.	Cr
Units	µg/L

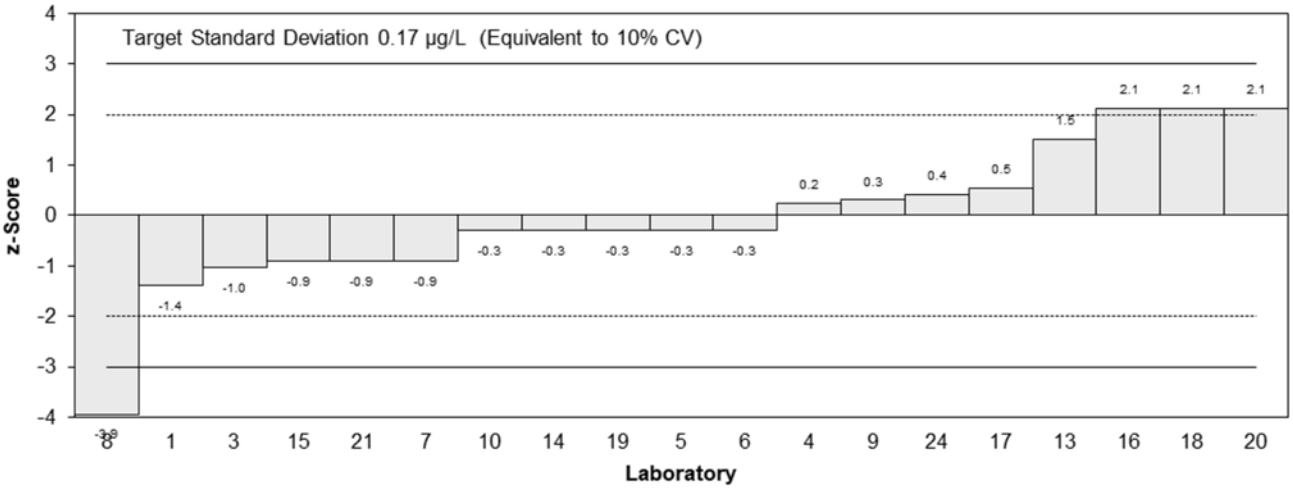
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	1.42	0.20	-1.39	-0.96
2	NR	NR		
3	1.48	0.0972	-1.03	-1.05
4	1.69	1.0	0.24	0.04
5	1.6	1	-0.30	-0.05
6	1.6	0.4	-0.30	-0.12
7	1.5	0.2	-0.91	-0.63
8	1	0.09	-3.94	-4.11
9	1.70	0.36	0.30	0.13
10	1.6	0.3	-0.30	-0.15
11	NT	NT		
12	NT	NT		
13	1.9	0.25	1.52	0.89
14	1.6	0.244	-0.30	-0.18
15	1.5	0.31	-0.91	-0.45
16	2	0.6	2.12	0.57
17	1.74	0.21	0.55	0.36
18	2	1	2.12	0.35
19	1.6	0.32	-0.30	-0.14
20	2	0.6	2.12	0.57
21	1.5	1.2	-0.91	-0.12
22	<1	0.16		
23	NT	NT		
24	1.72	0.26	0.42	0.24

Statistics

Assigned Value	1.65	0.13
Spike	1.73	0.05
Homogeneity Value	1.88	0.23
Robust Average	1.65	0.13
Median	1.60	0.07
Mean	1.64	
N	19	
Max.	2	
Min.	1	
Robust SD	0.22	
Robust CV	13%	


Kernel Density
Density
Result
Results: S1 - Cr
Assigned Value = 1.65 ± 0.13 µg/L
Results (µg/L)
Laboratory
8 1 3 15 21 7 10 14 19 5 6 4 9 24 17 13 16 18 20 22 2 11 12 23 Md R.A. H.V. S.V.


z-Scores: S1 - Cr
Target Standard Deviation 0.17 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
8 1 3 15 21 7 10 14 19 5 6 4 9 24 17 13 16 18 20

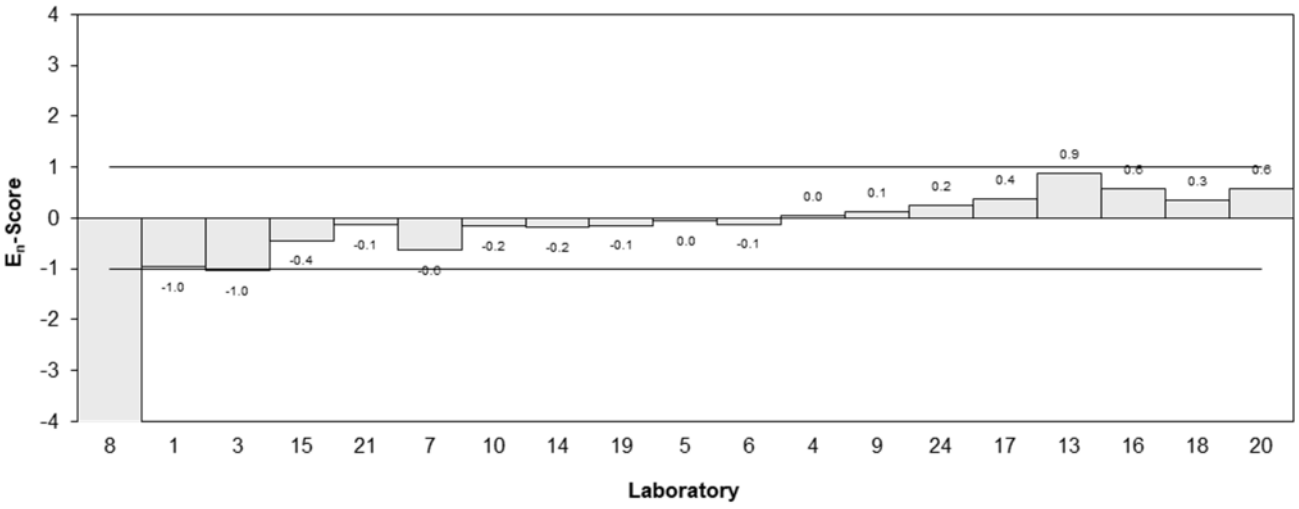

En-Scores: S1 - Cr
En-Score
Laboratory
8 1 3 15 21 7 10 14 19 5 6 4 9 24 17 13 16 18 20

Figure 9

Table 14

Sample Details

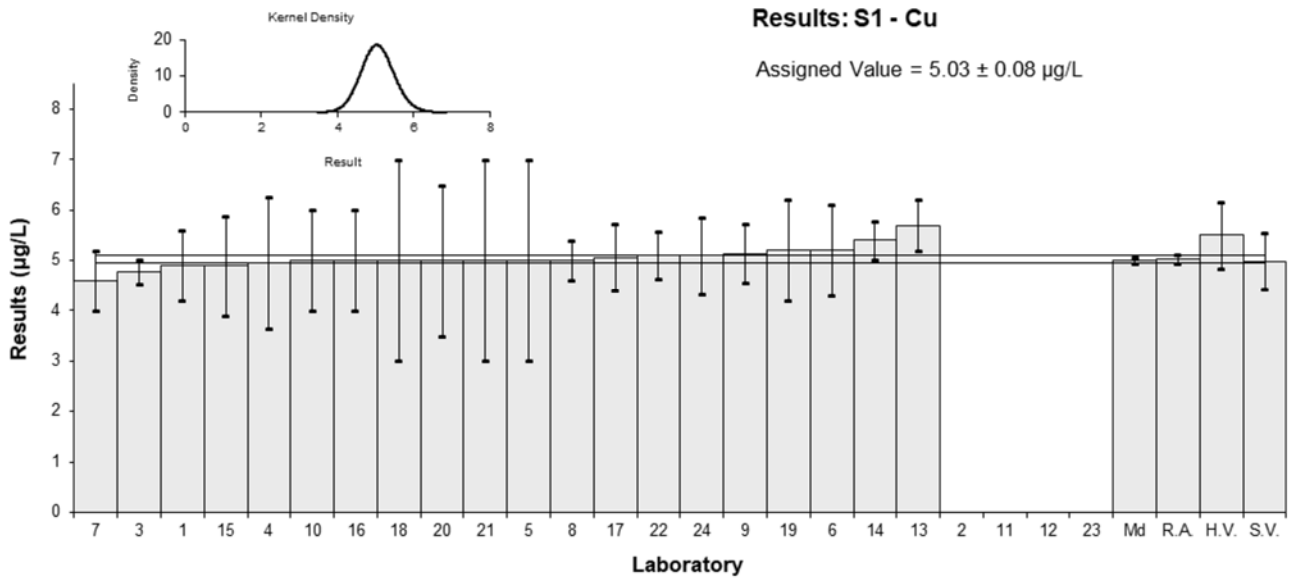
Sample No.	S1
Matrix.	River Water
Analyte.	Cu
Units	µg/L

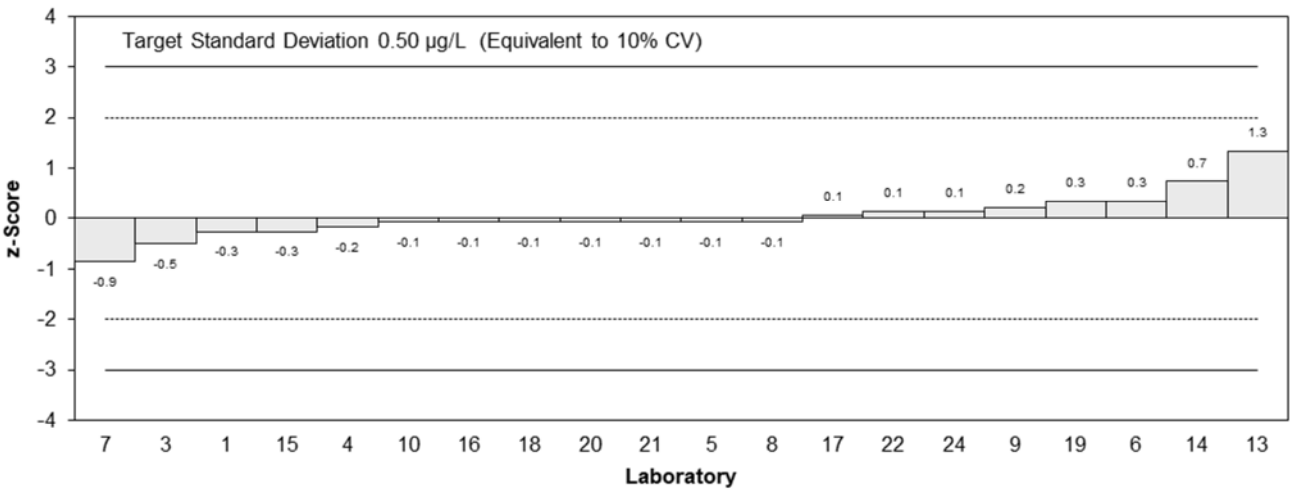
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	4.9	0.69	-0.26	-0.19
2	NR	NR		
3	4.78	0.239	-0.50	-0.99
4	4.95	1.3	-0.16	-0.06
5	5	2	-0.06	-0.01
6	5.2	0.9	0.34	0.19
7	4.6	0.6	-0.85	-0.71
8	5	0.4	-0.06	-0.07
9	5.14	0.58	0.22	0.19
10	5.0	1.0	-0.06	-0.03
11	NT	NT		
12	NT	NT		
13	5.7	0.51	1.33	1.30
14	5.4	0.380	0.74	0.95
15	4.9	0.99	-0.26	-0.13
16	5	1	-0.06	-0.03
17	5.06	0.66	0.06	0.05
18	5	2	-0.06	-0.01
19	5.2	1.0	0.34	0.17
20	5	1.5	-0.06	-0.02
21	5	2	-0.06	-0.01
22	5.1	0.47	0.14	0.15
23	NT	NT		
24	5.10	0.76	0.14	0.09

Statistics

Assigned Value	5.03	0.08
Spike	4.99	0.56
Homogeneity Value	5.50	0.66
Robust Average	5.03	0.08
Median	5.00	0.07
Mean	5.05	
N	20	
Max.	5.7	
Min.	4.6	
Robust SD	0.15	
Robust CV	3%	


Kernel Density
Density
Result
Results: S1 - Cu
Assigned Value = 5.03 ± 0.08 µg/L
Results (µg/L)
Laboratory
7 3 1 15 4 10 16 18 20 21 5 8 17 22 24 9 19 6 14 13 2 11 12 23 Md R.A. H.V. S.V.


z-Scores: S1 - Cu
Target Standard Deviation 0.50 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
7 3 1 15 4 10 16 18 20 21 5 8 17 22 24 9 19 6 14 13
-0.9 -0.5 -0.3 -0.3 -0.2 -0.1 -0.1 -0.1 -0.1 -0.1 -0.1 -0.1 0.1 0.1 0.1 0.2 0.3 0.3 0.7 1.3

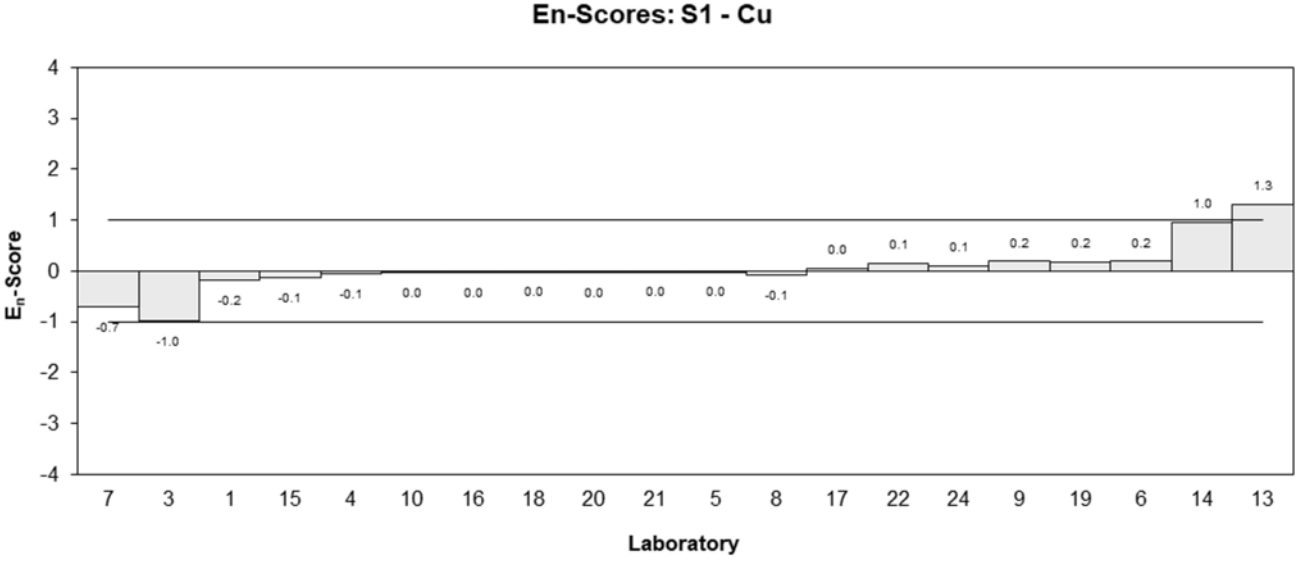

En-Scores: S1 - Cu
En-Score
Laboratory
7 3 1 15 4 10 16 18 20 21 5 8 17 22 24 9 19 6 14 13
-0.7 -1.0 -0.2 -0.1 -0.1 0.0 0.0 0.0 0.0 0.0 0.0 -0.1 0.0 0.1 0.1 0.2 0.2 0.2 1.0 1.3

Figure 10

Table 15

Sample Details

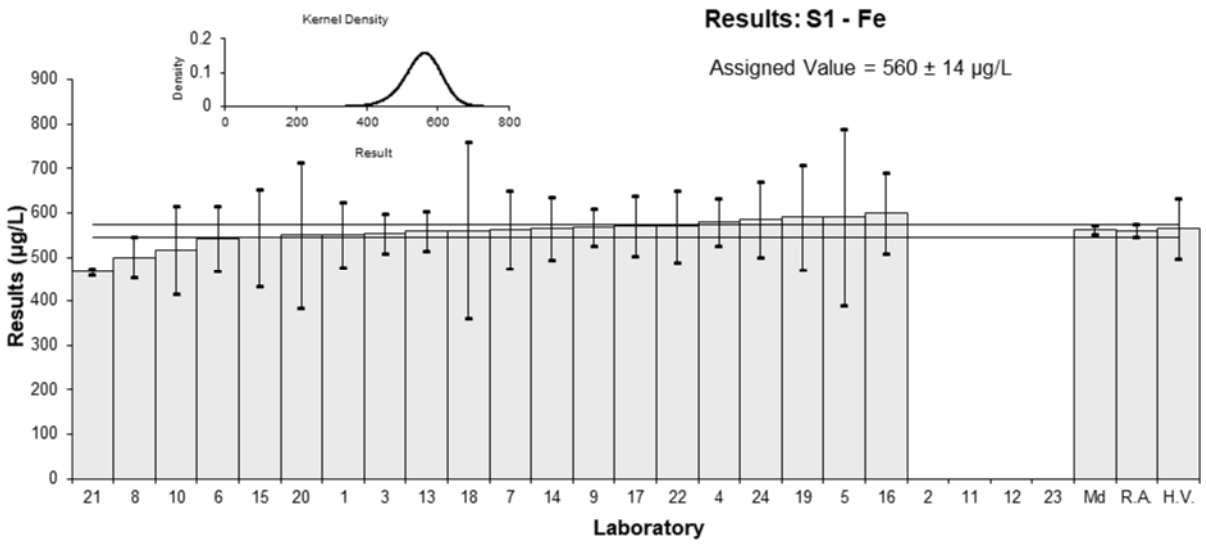
Sample No.	S1
Matrix.	River Water
Analyte.	Fe
Units	µg/L

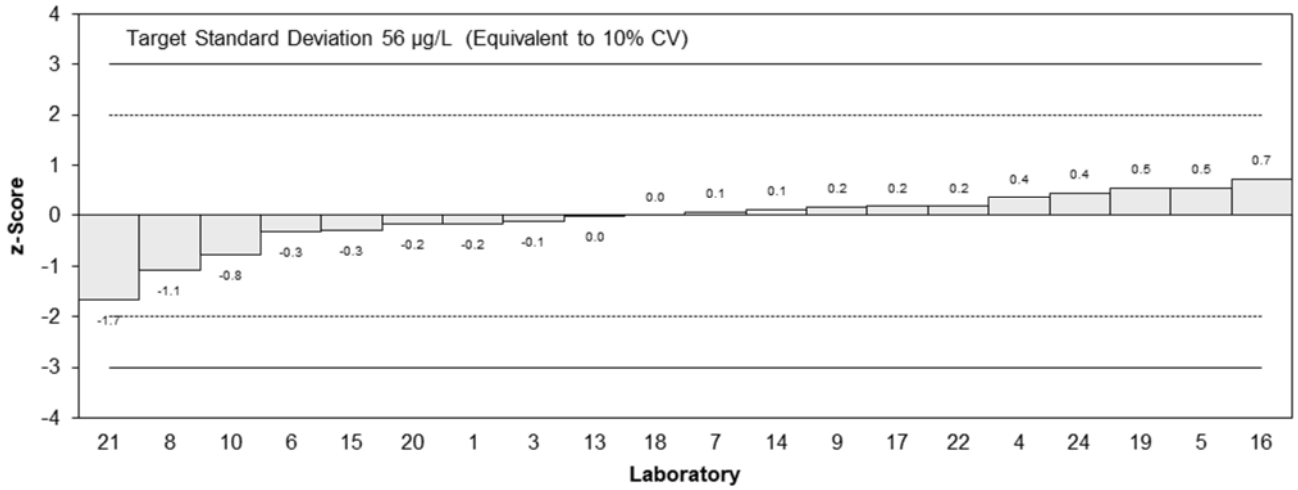
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	551	74	-0.16	-0.12
2	NR	NR		
3	554	44.7	-0.11	-0.13
4	580	53	0.36	0.36
5	590	200	0.54	0.15
6	542	73	-0.32	-0.24
7	563	88	0.05	0.03
8	500	47	-1.07	-1.22
9	569	42	0.16	0.20
10	516	100	-0.79	-0.44
11	NT	NT		
12	NT	NT		
13	558.7	45	-0.02	-0.03
14	566	71.2	0.11	0.08
15	544	109	-0.29	-0.15
16	600	90	0.71	0.44
17	570	68	0.18	0.14
18	560	200	0.00	0.00
19	590	118	0.54	0.25
20	550	165	-0.18	-0.06
21	466	7	-1.68	-6.01
22	570	81	0.18	0.12
23	NT	NT		
24	585	85	0.45	0.29

Statistics

Assigned Value	560	14
Spike	Not Spiked	
Homogeneity Value	564	68
Robust Average	560	14
Median	562	10
Mean	556	
N	20	
Max.	600	
Min.	466	
Robust SD	26	
Robust CV	4.6%	


Results: S1 - Fe
Assigned Value = 560 ± 14 µg/L
Kernel Density
Density
Result
Results (µg/L)
Laboratory
21 8 10 6 15 20 1 3 13 18 7 14 9 17 22 4 24 19 5 16 2 11 12 23 Md R.A. H.V.


z-Scores: S1 - Fe
Target Standard Deviation 56 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
21 8 10 6 15 20 1 3 13 18 7 14 9 17 22 4 24 19 5 16

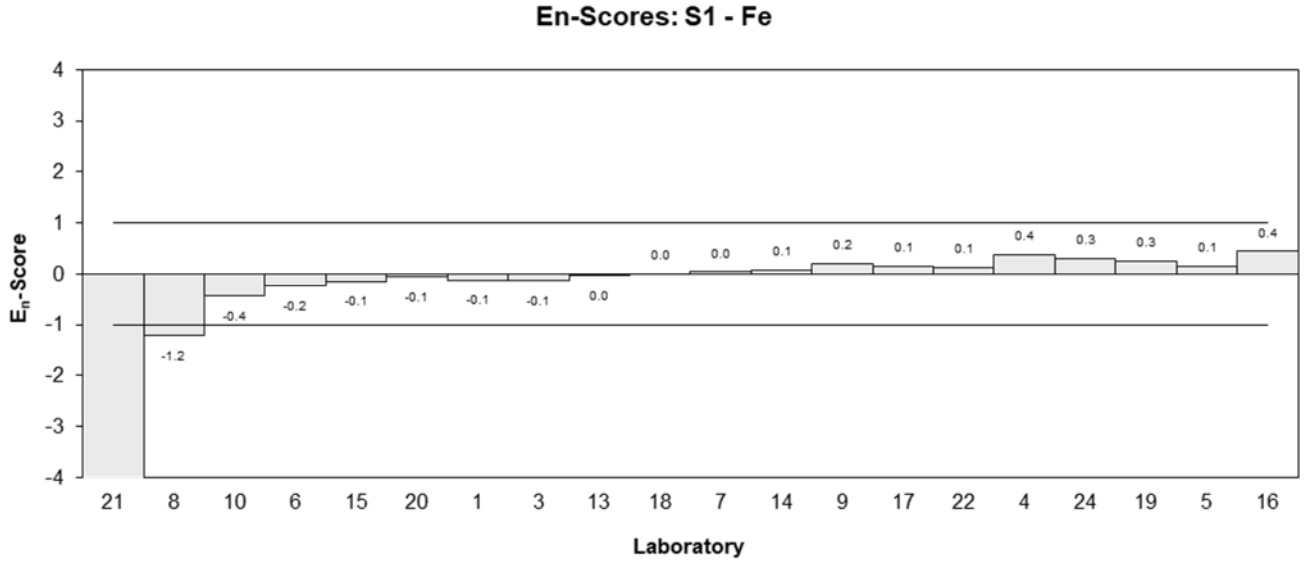

En-Scores: S1 - Fe
En-Score
Laboratory
21 8 10 6 15 20 1 3 13 18 7 14 9 17 22 4 24 19 5 16

Figure 11

Table 16

Sample Details

Sample No.	S1
Matrix.	River Water
Analyte.	Hg
Units	µg/L

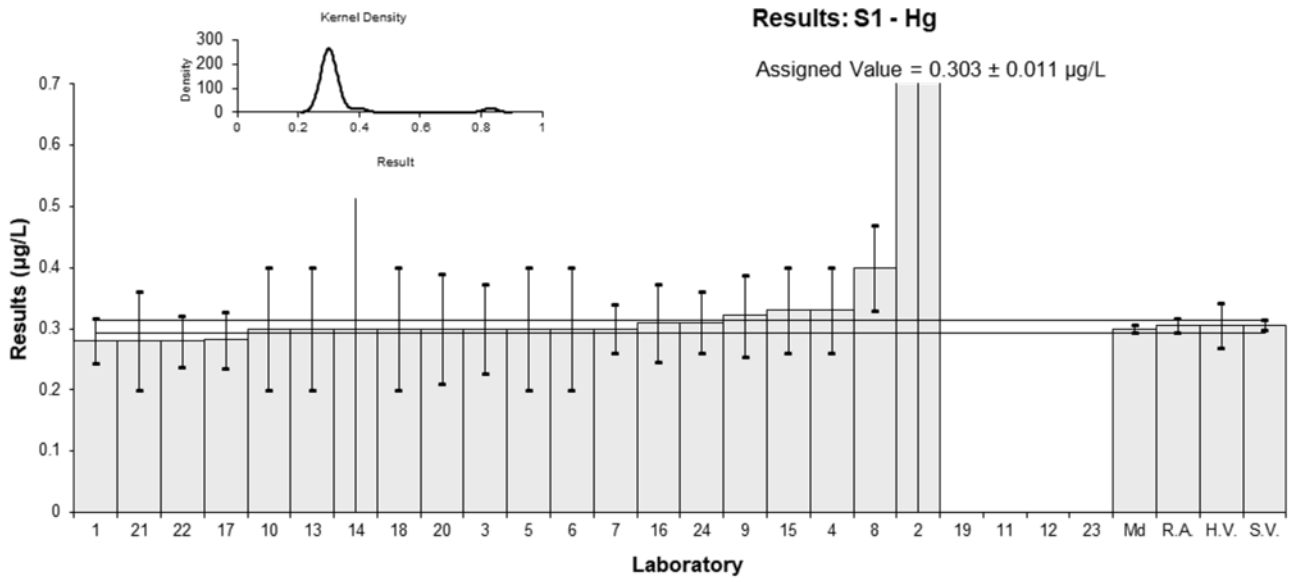
Participant Results

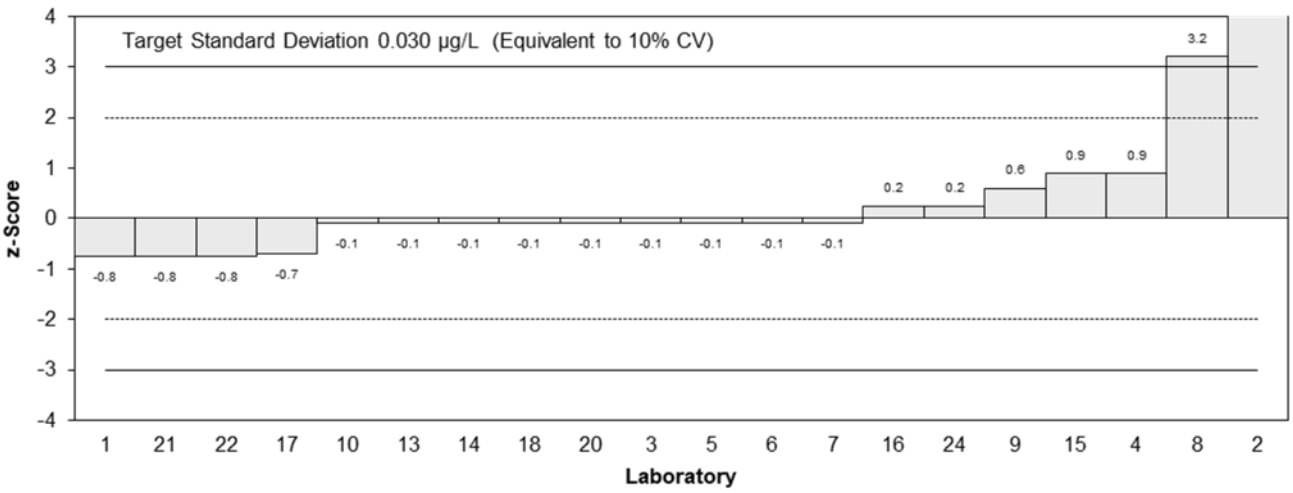
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	0.28	0.036	-0.76	-0.61
2	0.83	1	17.39	0.53
3	0.300	0.0731	-0.10	-0.04
4	0.33	0.07	0.89	0.38
5	0.3	0.1	-0.10	-0.03
6	0.3	0.1	-0.10	-0.03
7	0.3	0.04	-0.10	-0.07
8	0.4	0.07	3.20	1.37
9	0.321	0.066	0.59	0.27
10	0.3	0.1	-0.10	-0.03
11	NT	NT		
12	NT	NT		
13	0.3	0.1	-0.10	-0.03
14	0.3	35.9	-0.10	0.00
15	0.33	0.07	0.89	0.38
16	0.31	0.064	0.23	0.11
17	0.282	0.046	-0.69	-0.44
18	0.3	0.1	-0.10	-0.03
19	NR	NR		
20	0.3	0.09	-0.10	-0.03
21	0.28	0.08	-0.76	-0.28
22	0.28	0.042	-0.76	-0.53
23	NT	NT		
24	0.31	0.05	0.23	0.14

Statistics

Assigned Value*	0.303	0.011
Spike	0.306	0.009
Homogeneity Value	0.305	0.037
Robust Average	0.305	0.011
Median	0.300	0.007
Mean	0.333	
N	20	
Max.	0.83	
Min.	0.28	
Robust SD	0.020	
Robust CV	6.6%	

*Robust Average excluding laboratory 2.


Kernel Density
Density
Result
Results: S1 - Hg
Assigned Value = 0.303 ± 0.011 µg/L
Results (µg/L)
Laboratory
1 21 22 17 10 13 14 18 20 3 5 6 7 16 24 9 15 4 8 2 19 11 12 23 Md R.A. H.V. S.V.


z-Scores: S1 - Hg
Target Standard Deviation 0.030 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
1 21 22 17 10 13 14 18 20 3 5 6 7 16 24 9 15 4 8 2

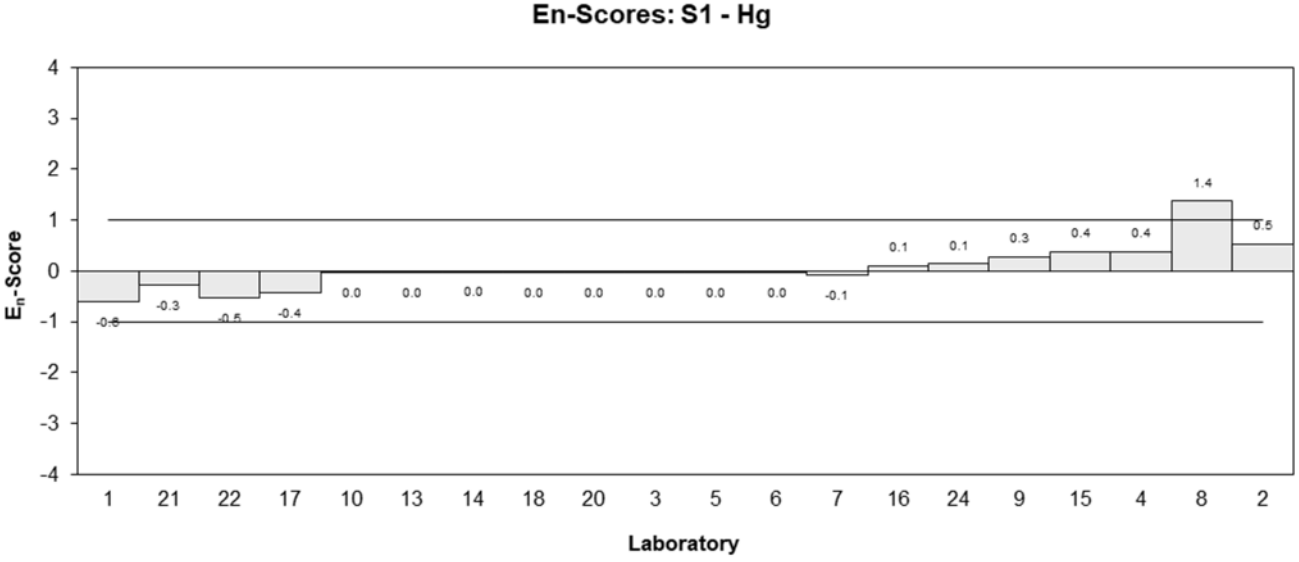

En-Scores: S1 - Hg
En-Score
Laboratory
1 21 22 17 10 13 14 18 20 3 5 6 7 16 24 9 15 4 8 2

Figure 12

Table 17

Sample Details

Sample No.	S1
Matrix.	River Water
Analyte.	La
Units	µg/L

Participant Results

Lab Code	Result	Uncertainty
1	NT	NT
2	NR	NR
3	NT	NT
4	NT	NT
5	<0.5	NR
6	<1	NR
7	<1	NR
8	<1	NR
9	0.450	0.078
10	NT	NT
11	NT	NT
12	NT	NT
13	0.4	0.1
14	<1	NR
15	NT	NT
16	NT	NT
17	NT	NT
18	<0.5	NR
19	<1	NR
20	<0.5	NR
21	NT	NT
22	NT	NT
23	NT	NT
24	0.45	0.07

Statistics

Assigned Value	Not Set	
Spike	0.444	0.010
Homogeneity Value	0.473	0.057
Median	0.450	0.001
Mean	0.43	
N	3	

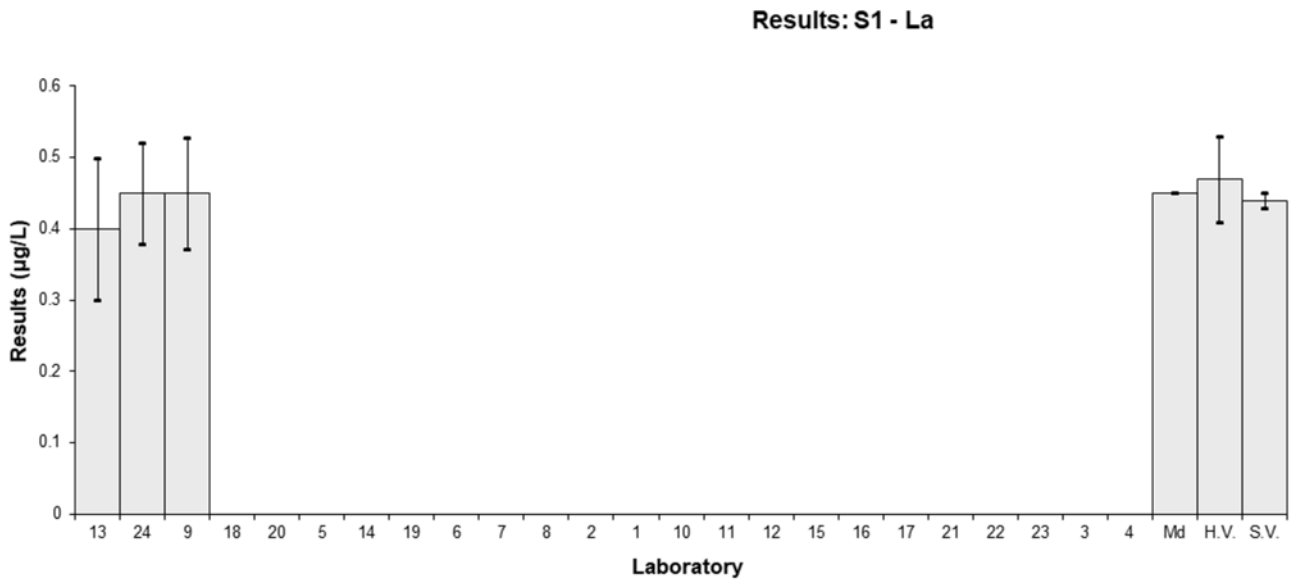

Results: S1 - La
Results (µg/L)
0.6
0.5
0.4
0.3
0.2
0.1
0
13 24 9 18 20 5 14 19 6 7 8 2 1 10 11 12 15 16 17 21 22 23 3 4 Md H.V. S.V.
Laboratory

Figure 13

Table 18

Sample Details

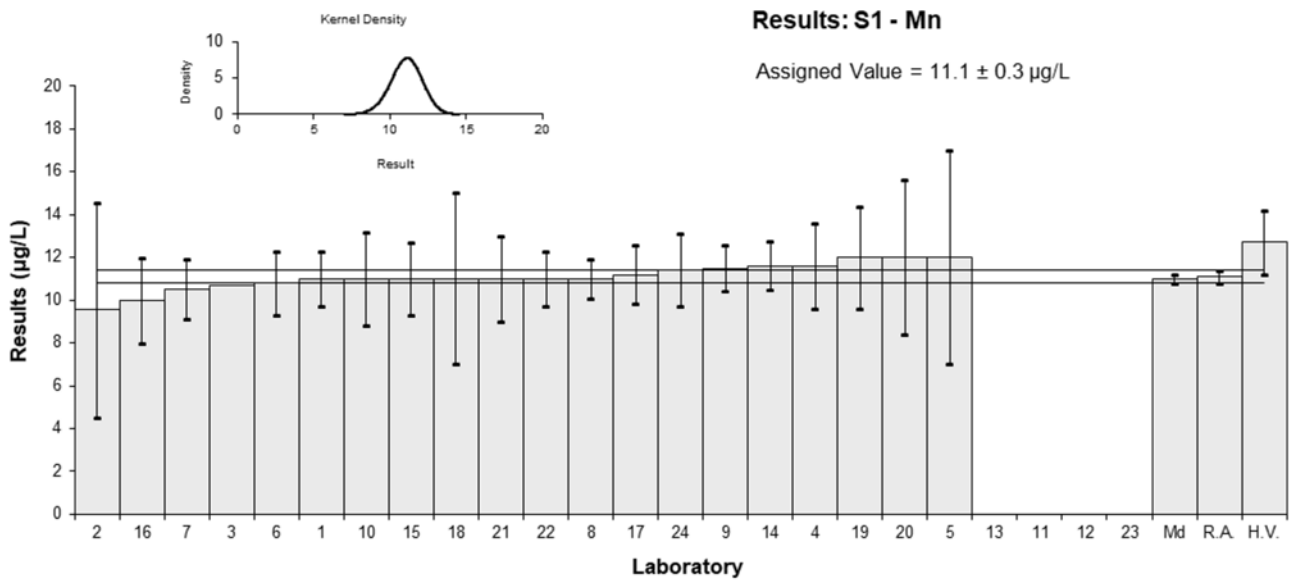
Sample No.	S1
Matrix.	River Water
Analyte.	Mn
Units	µg/L

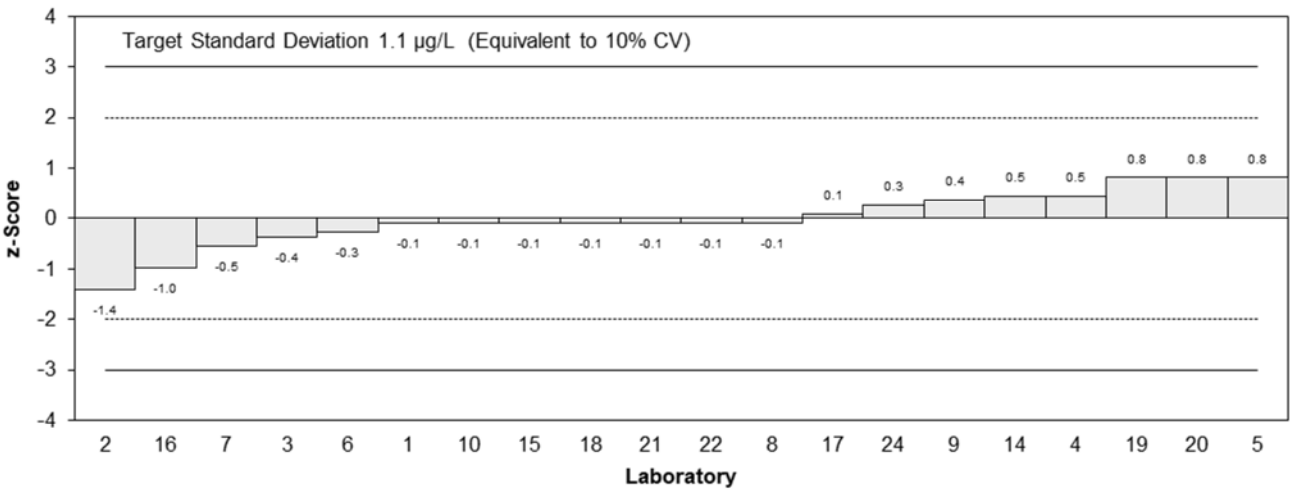
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	11	1.3	-0.09	-0.07
2	9.53	5	-1.41	-0.31
3	10.7	NR	-0.36	-1.33
4	11.6	2.0	0.45	0.25
5	12	5	0.81	0.18
6	10.8	1.5	-0.27	-0.20
7	10.5	1.4	-0.54	-0.42
8	11	0.95	-0.09	-0.10
9	11.5	1.1	0.36	0.35
10	11	2.2	-0.09	-0.05
11	NT	NT		
12	NT	NT		
13	NR	NR		
14	11.6	1.14	0.45	0.42
15	11	1.7	-0.09	-0.06
16	10	2	-0.99	-0.54
17	11.2	1.4	0.09	0.07
18	11	4	-0.09	-0.02
19	12	2.4	0.81	0.37
20	12	3.6	0.81	0.25
21	11	2	-0.09	-0.05
22	11	1.27	-0.09	-0.08
23	NT	NT		
24	11.4	1.7	0.27	0.17

Statistics

Assigned Value	11.1	0.3
Spike	Not Spiked	
Homogeneity Value	12.7	1.5
Robust Average	11.1	0.3
Median	11.0	0.2
Mean	11.1	
N	20	
Max.	12	
Min.	9.53	
Robust SD	0.60	
Robust CV	5.4%	


Kernel Density
Density
Result
Results: S1 - Mn
Assigned Value = 11.1 ± 0.3 µg/L
Results (µg/L)
Laboratory
2 16 7 3 6 1 10 15 18 21 22 8 17 24 9 14 4 19 20 5 13 11 12 23 Md R.A. H.V.


z-Scores: S1 - Mn
Target Standard Deviation 1.1 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
2 16 7 3 6 1 10 15 18 21 22 8 17 24 9 14 4 19 20 5
-1.4 -1.0 -0.5 -0.4 -0.3 -0.1 -0.1 -0.1 -0.1 -0.1 -0.1 -0.1 0.1 0.3 0.4 0.5 0.5 0.8 0.8 0.8

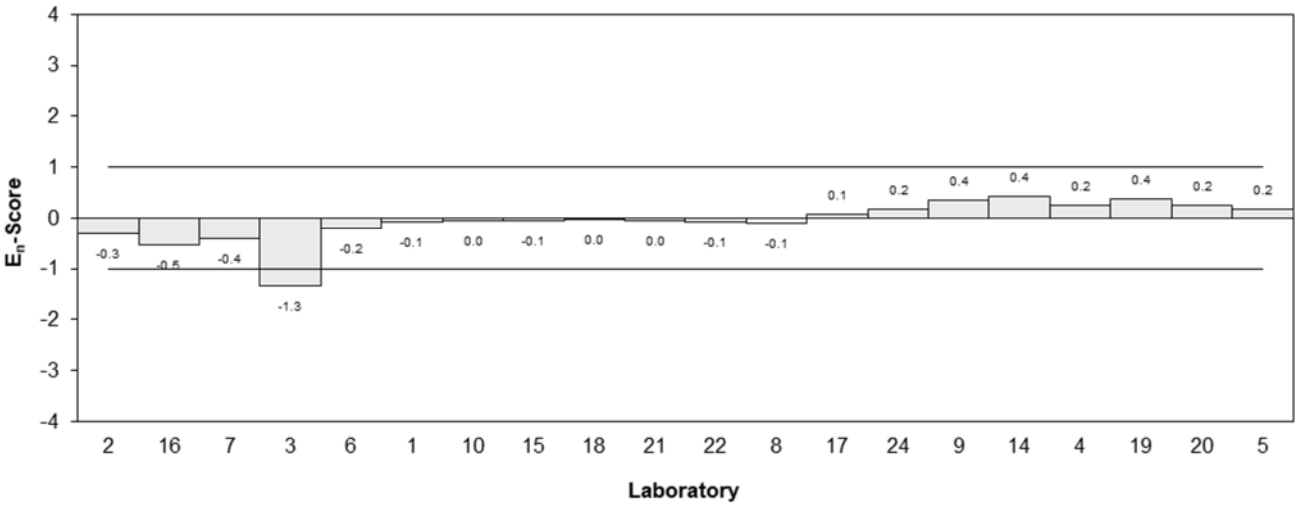

En-Scores: S1 - Mn
En-Score
Laboratory
2 16 7 3 6 1 10 15 18 21 22 8 17 24 9 14 4 19 20 5
-0.3 -0.5 -0.4 -1.3 -0.2 -0.1 0.0 -0.1 0.0 0.0 -0.1 -0.1 0.1 0.2 0.4 0.4 0.2 0.4 0.2 0.2

Figure 14

Table 19

Sample Details

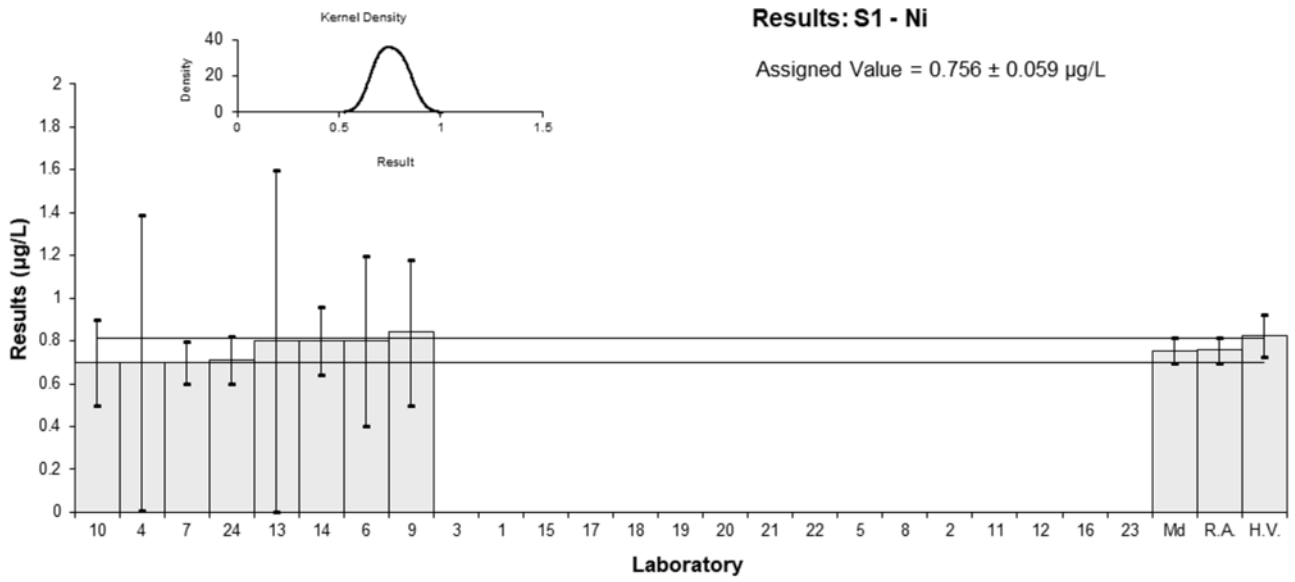
Sample No.	S1
Matrix.	River Water
Analyte.	Ni
Units	µg/L

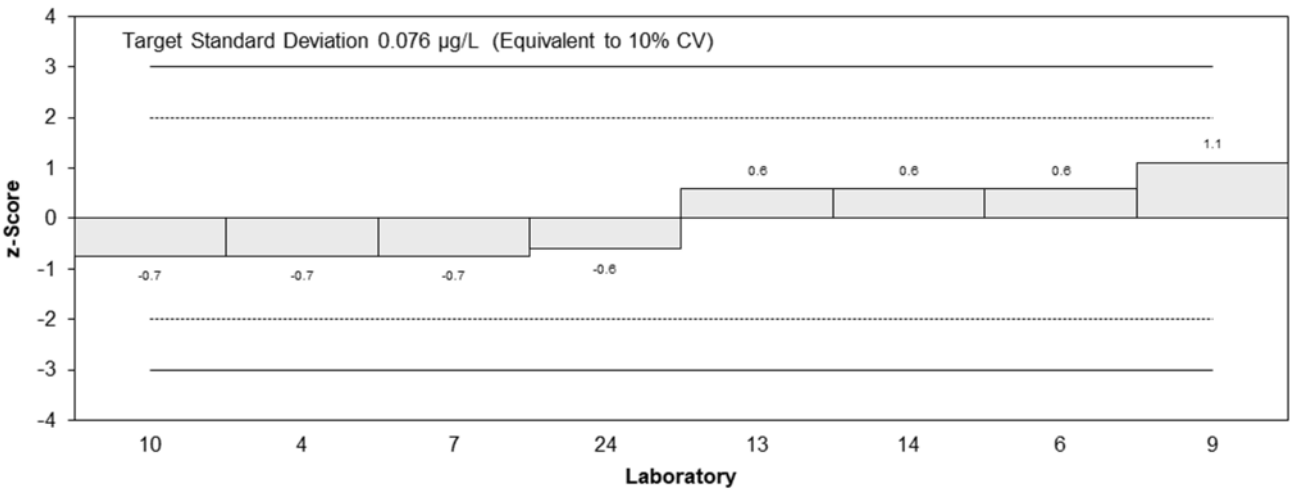
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	<1	0.14		
2	NR	NR		
3	< 1	NR		
4	0.70	0.69	-0.74	-0.08
5	<1	NR		
6	0.8	0.4	0.58	0.11
7	0.7	0.1	-0.74	-0.48
8	<1	NR		
9	0.84	0.34	1.11	0.24
10	0.7	0.2	-0.74	-0.27
11	NT	NT		
12	NT	NT		
13	0.8	0.8	0.58	0.05
14	0.8	0.16	0.58	0.26
15	<1	0.2		
16	NT	NT		
17	<1	0.100		
18	<1	NR		
19	<1	NR		
20	<1	NR		
21	<1	3		
22	<1	0.057		
23	NT	NT		
24	0.71	0.11	-0.61	-0.37

Statistics

Assigned Value	0.756	0.059
Spike	Not Spiked	
Homogeneity Value	0.822	0.099
Robust Average	0.756	0.059
Median	0.755	0.062
Mean	0.756	
N	8	
Max.	0.84	
Min.	0.7	
Robust SD	0.067	
Robust CV	8.9%	


Kernel Density
Density
Result
Results: S1 - Ni
Assigned Value = 0.756 ± 0.059 µg/L
Results (µg/L)
Laboratory
10 4 7 24 13 14 6 9 3 1 15 17 18 19 20 21 22 5 8 2 11 12 16 23 Md R.A. H.V.


z-Scores: S1 - Ni
Target Standard Deviation 0.076 µg/L (Equivalent to 10% CV)
z-Score
-0.7 -0.7 -0.7 -0.6 0.6 0.6 0.6 1.1
Laboratory
10 4 7 24 13 14 6 9

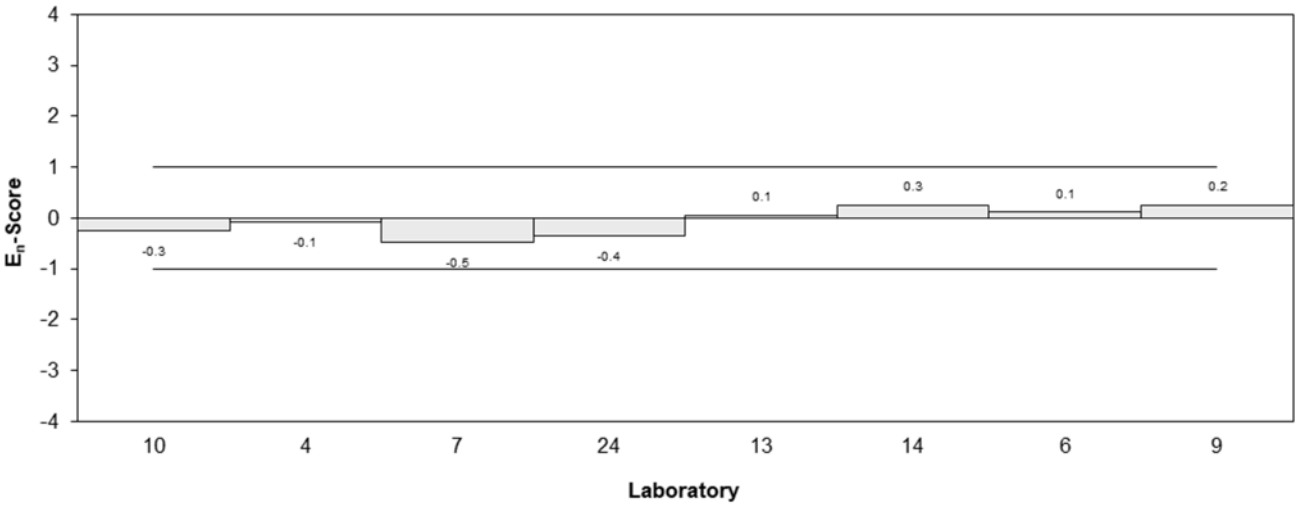

En-Scores: S1 - Ni
En-Score
-0.3 -0.1 -0.5 -0.4 0.1 0.3 0.1 0.2
Laboratory
10 4 7 24 13 14 6 9

Figure 15

Table 20

Sample Details

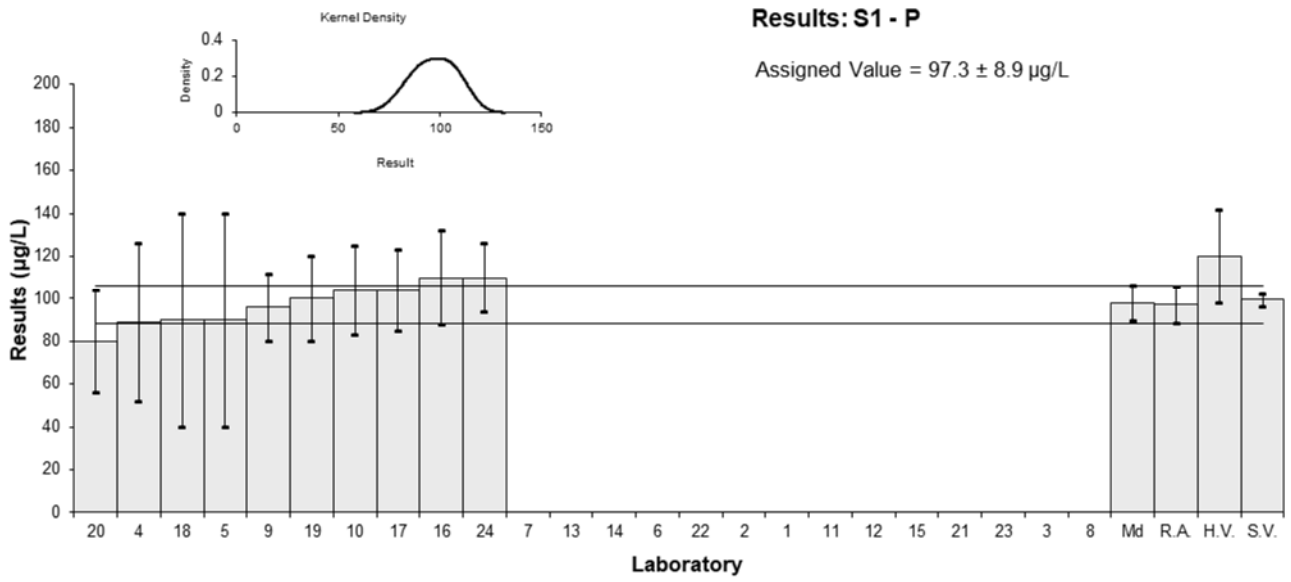
Sample No.	S1
Matrix.	River Water
Analyte.	P
Units	µg/L

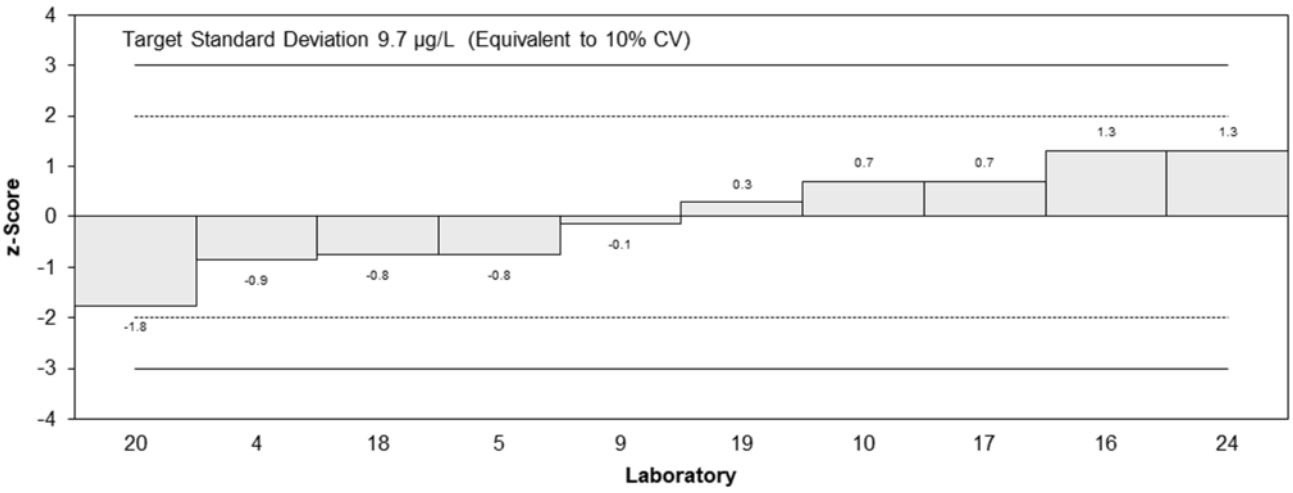
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	NR	NR		
3	NT	NT		
4	89	37	-0.85	-0.22
5	90	50	-0.75	-0.14
6	<1000	NR		
7	<1	NR		
8	NT	NT		
9	96	16	-0.13	-0.07
10	104	21	0.69	0.29
11	NT	NT		
12	NT	NT		
13	<100	100		
14	<1000	NR		
15	NT	NT		
16	110	22	1.31	0.54
17	104	19	0.69	0.32
18	90	50	-0.75	-0.14
19	100	20	0.28	0.12
20	80.0	24	-1.78	-0.68
21	NT	NT		
22	<500	94		
23	NT	NT		
24	110	16	1.31	0.69

Statistics

Assigned Value	97.3	8.9
Spike	99.4	2.9
Homogeneity Value	120	22
Robust Average	97.3	8.9
Median	98.0	8.5
Mean	97.3	
N	10	
Max.	110	
Min.	80	
Robust SD	11	
Robust CV	12%	


Kernel Density
Density
Result
Results: S1 - P
Assigned Value = 97.3 ± 8.9 µg/L
Results (µg/L)
Laboratory
20 4 18 5 9 19 10 17 16 24 7 13 14 6 22 2 1 11 12 15 21 23 3 8 Md R.A. H.V. S.V.


z-Scores: S1 - P
Target Standard Deviation 9.7 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
20 4 18 5 9 19 10 17 16 24
-1.8 -0.9 -0.8 -0.8 -0.1 0.3 0.7 0.7 1.3 1.3

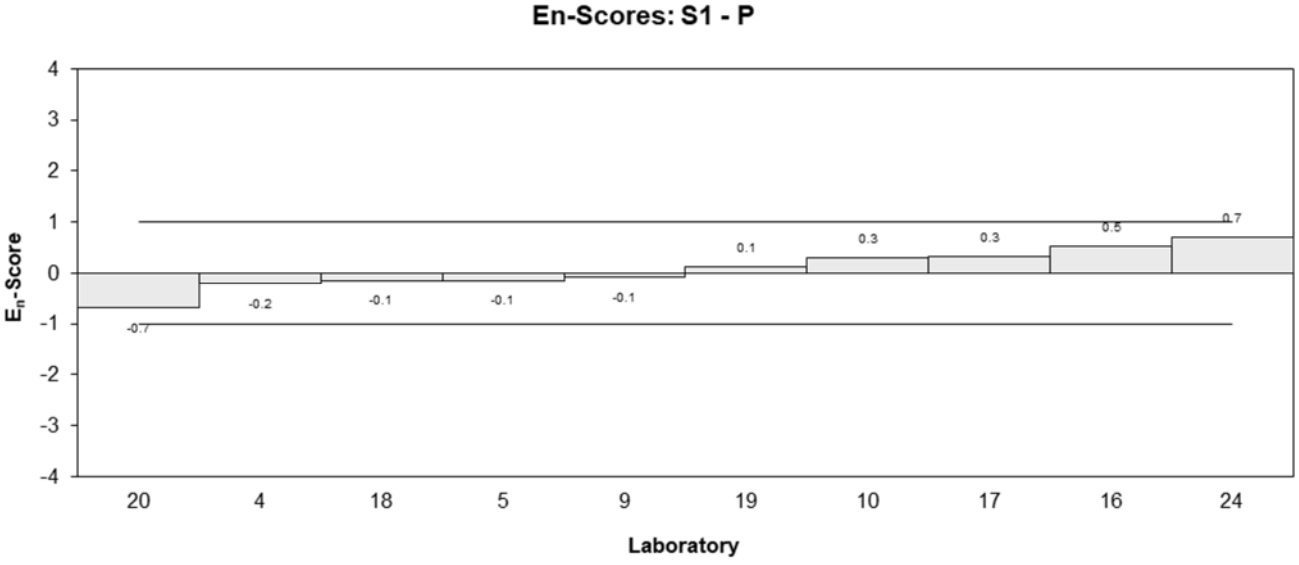

En-Scores: S1 - P
En-Score
Laboratory
20 4 18 5 9 19 10 17 16 24
-0.7 -0.2 -0.1 -0.1 -0.1 0.1 0.3 0.3 0.5 0.7

Figure 16

Table 21

Sample Details

Sample No.	S1
Matrix.	River Water
Analyte.	Pb
Units	µg/L

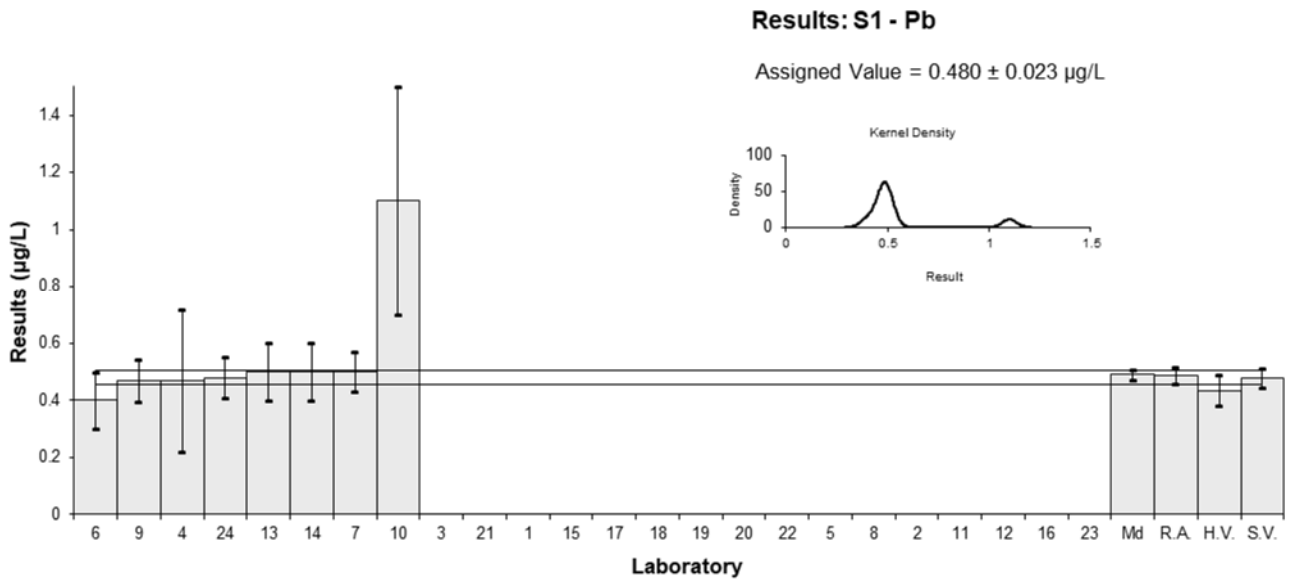
Participant Results

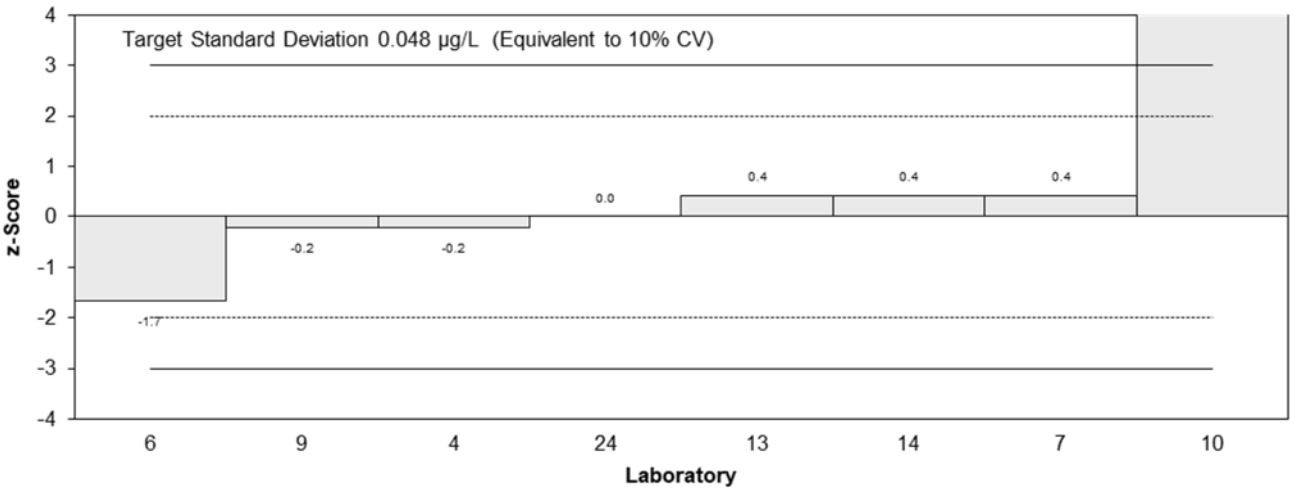
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	<1	0.14		
2	NR	NR		
3	< 1	NR		
4	0.47	0.25	-0.21	-0.04
5	<1	NR		
6	0.4	0.1	-1.67	-0.78
7	0.5	0.07	0.42	0.27
8	<1	NR		
9	0.469	0.074	-0.23	-0.14
10	1.1	0.4	12.92	1.55
11	NT	NT		
12	NT	NT		
13	0.5	0.1	0.42	0.19
14	0.5	0.1	0.42	0.19
15	<1	0.2		
16	NT	NT		
17	<1	0.068		
18	<1	NR		
19	<1	NR		
20	<1	NR		
21	<0.5	3		
22	<1	0.095		
23	NT	NT		
24	0.48	0.07	0.00	0.00

Statistics

Assigned Value*	0.480	0.023
Spike	0.478	0.032
Homogeneity Value	0.435	0.052
Robust Average	0.487	0.031
Median	0.490	0.019
Mean	0.552	
N	8	
Max.	1.1	
Min.	0.4	
Robust SD	0.035	
Robust CV	7.2%	

*Robust Average excluding laboratory 10.


Results: S1 - Pb
Assigned Value = 0.480 ± 0.023 µg/L
Kernel Density
Density
Result
Results (µg/L)
Laboratory
6 9 4 24 13 14 7 10 3 21 1 15 17 18 19 20 22 5 8 2 11 12 16 23 Md R.A. H.V. S.V.


z-Scores: S1 - Pb
Target Standard Deviation 0.048 µg/L (Equivalent to 10% CV)
z-Score
-1.7
-0.2
-0.2
0.0
0.4
0.4
0.4
Laboratory
6 9 4 24 13 14 7 10

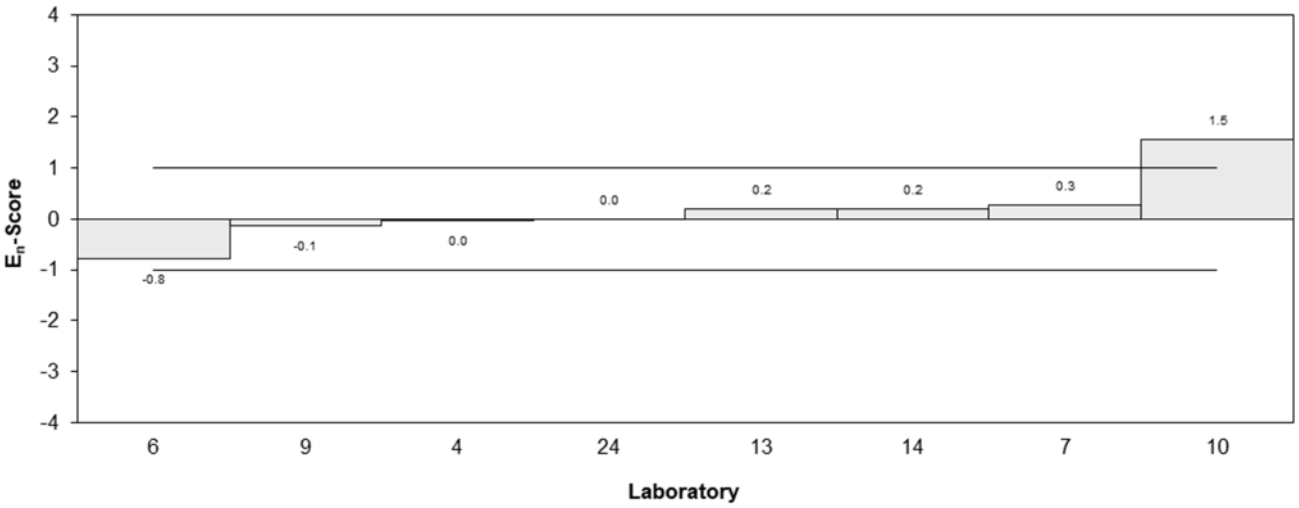

En-Scores: S1 - Pb
En-Score
-0.8
-0.1
0.0
0.0
0.2
0.2
0.3
1.5
Laboratory
6 9 4 24 13 14 7 10

Figure 17

Table 22

Sample Details

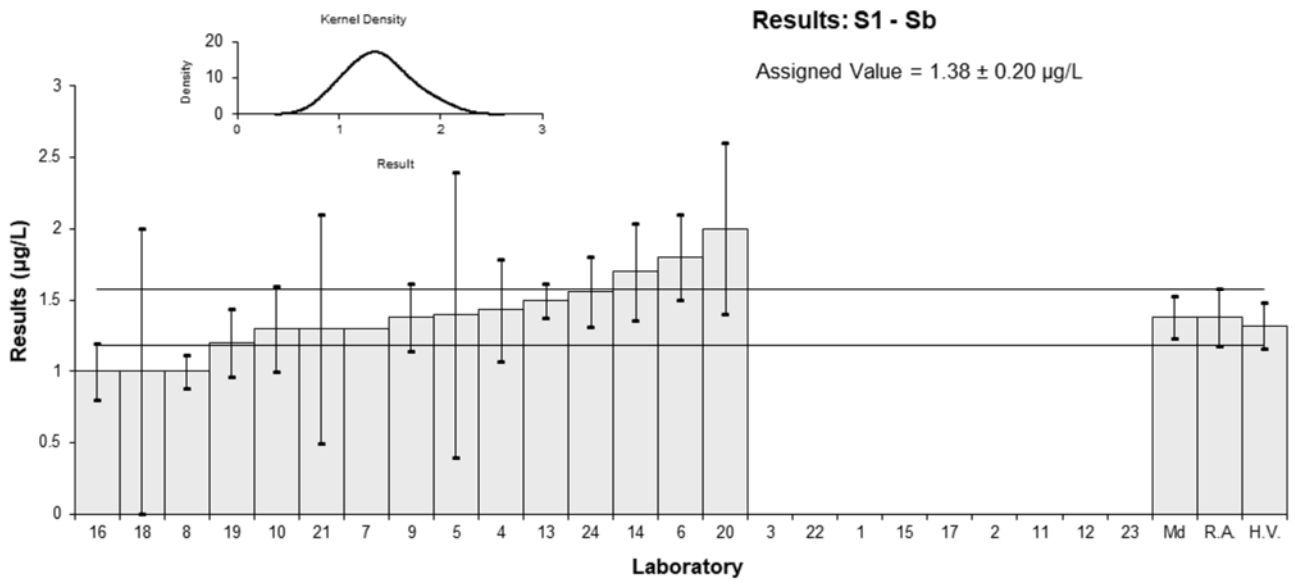
Sample No.	S1
Matrix.	River Water
Analyte.	Sb
Units	µg/L

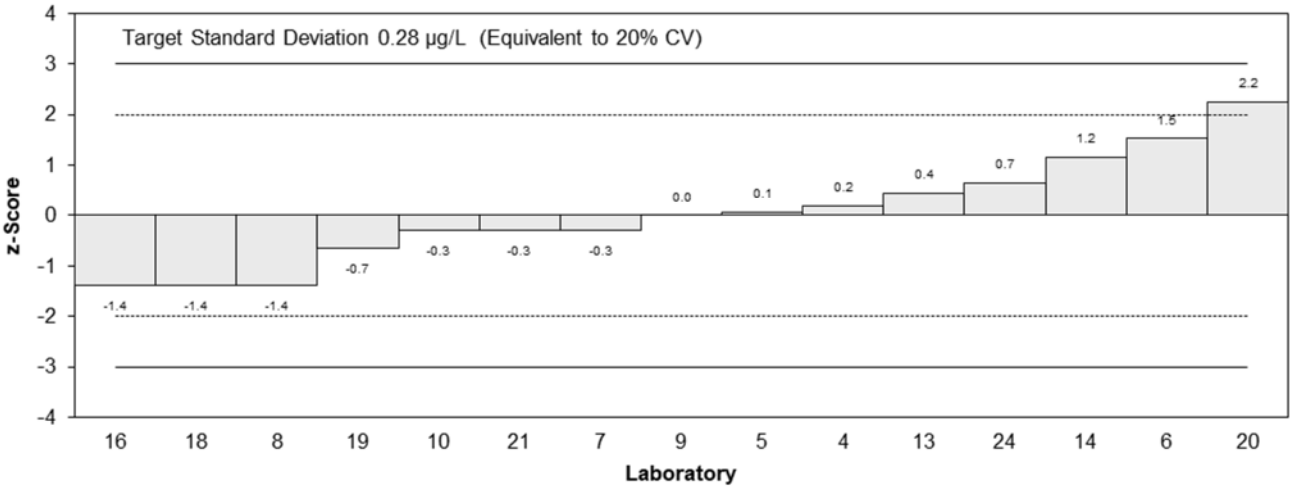
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	<5	0.56		
2	NR	NR		
3	< 5	NR		
4	1.43	0.36	0.18	0.12
5	1.4	1	0.07	0.02
6	1.8	0.3	1.52	1.16
7	1.3	NR	-0.29	-0.40
8	1	0.12	-1.38	-1.63
9	1.38	0.24	0.00	0.00
10	1.3	0.3	-0.29	-0.22
11	NT	NT		
12	NT	NT		
13	1.5	0.12	0.43	0.51
14	1.7	0.34	1.16	0.81
15	<5	1		
16	1	0.2	-1.38	-1.34
17	<5	0.17		
18	1	1	-1.38	-0.37
19	1.2	0.24	-0.65	-0.58
20	2	0.6	2.25	0.98
21	1.3	0.8	-0.29	-0.10
22	<1	0.13		
23	NT	NT		
24	1.56	0.25	0.65	0.56

Statistics

Assigned Value	1.38	0.20
Spike	Not Spiked	
Homogeneity Value	1.32	0.16
Robust Average	1.38	0.20
Median	1.38	0.15
Mean	1.39	
N	15	
Max.	2	
Min.	1	
Robust SD	0.31	
Robust CV	22%	


Kernel Density
Density
Result
Results: S1 - Sb
Assigned Value = 1.38 ± 0.20 µg/L
Results (µg/L)
16 18 8 19 10 21 7 9 5 4 13 24 14 6 20 3 22 1 15 17 2 11 12 23 Md R.A. H.V.
Laboratory


z-Scores: S1 - Sb
Target Standard Deviation 0.28 µg/L (Equivalent to 20% CV)
z-Score
16 18 8 19 10 21 7 9 5 4 13 24 14 6 20
Laboratory

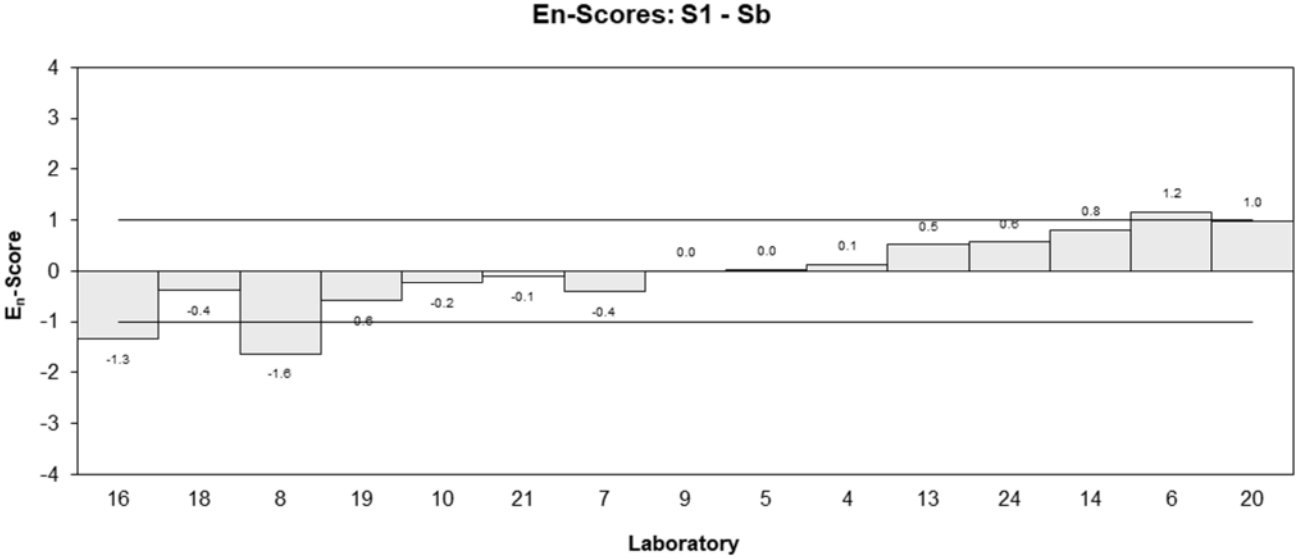

En-Scores: S1 - Sb
En-Score
16 18 8 19 10 21 7 9 5 4 13 24 14 6 20
Laboratory

Figure 18

Table 23

Sample Details

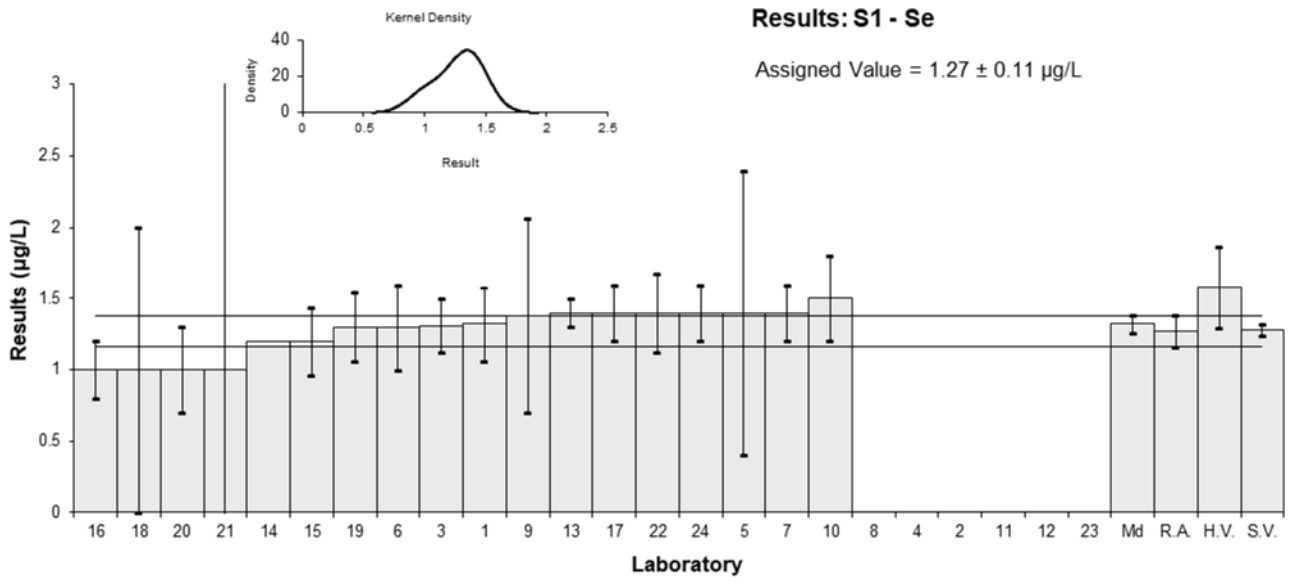
Sample No.	S1
Matrix.	River Water
Analyte.	Se
Units	µg/L

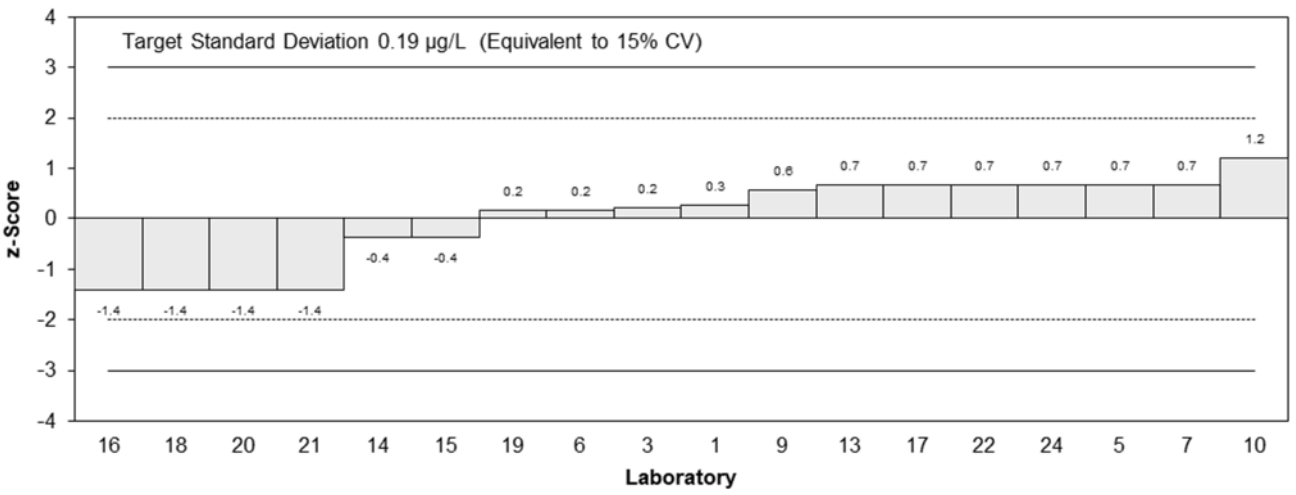
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	1.32	0.26	0.26	0.18
2	NR	NR		
3	1.31	0.185	0.21	0.19
4	<5	NR		
5	1.4	1	0.68	0.13
6	1.3	0.3	0.16	0.09
7	1.4	0.2	0.68	0.57
8	<10	NR		
9	1.38	0.68	0.58	0.16
10	1.5	0.3	1.21	0.72
11	NT	NT		
12	NT	NT		
13	1.4	0.1	0.68	0.87
14	1.2	NR	-0.37	-0.64
15	1.2	0.24	-0.37	-0.27
16	1	0.2	-1.42	-1.18
17	1.40	0.20	0.68	0.57
18	1	1	-1.42	-0.27
19	1.3	0.24	0.16	0.11
20	1	0.3	-1.42	-0.84
21	1	3	-1.42	-0.09
22	1.4	0.28	0.68	0.43
23	NT	NT		
24	1.4	0.2	0.68	0.57

Statistics

Assigned Value	1.27	0.11
Spike	1.28	0.04
Homogeneity Value	1.58	0.19
Robust Average	1.27	0.11
Median	1.32	0.06
Mean	1.27	
N	18	
Max.	1.5	
Min.	1	
Robust SD	0.19	
Robust CV	15%	


Kernel Density
Density
Result
Results: S1 - Se
Assigned Value = 1.27 ± 0.11 µg/L
Results (µg/L)
Laboratory
16 18 20 21 14 15 19 6 3 1 9 13 17 22 24 5 7 10 8 4 2 11 12 23 Md R.A. H.V. S.V.


z-Scores: S1 - Se
Target Standard Deviation 0.19 µg/L (Equivalent to 15% CV)
z-Score
Laboratory
16 18 20 21 14 15 19 6 3 1 9 13 17 22 24 5 7 10

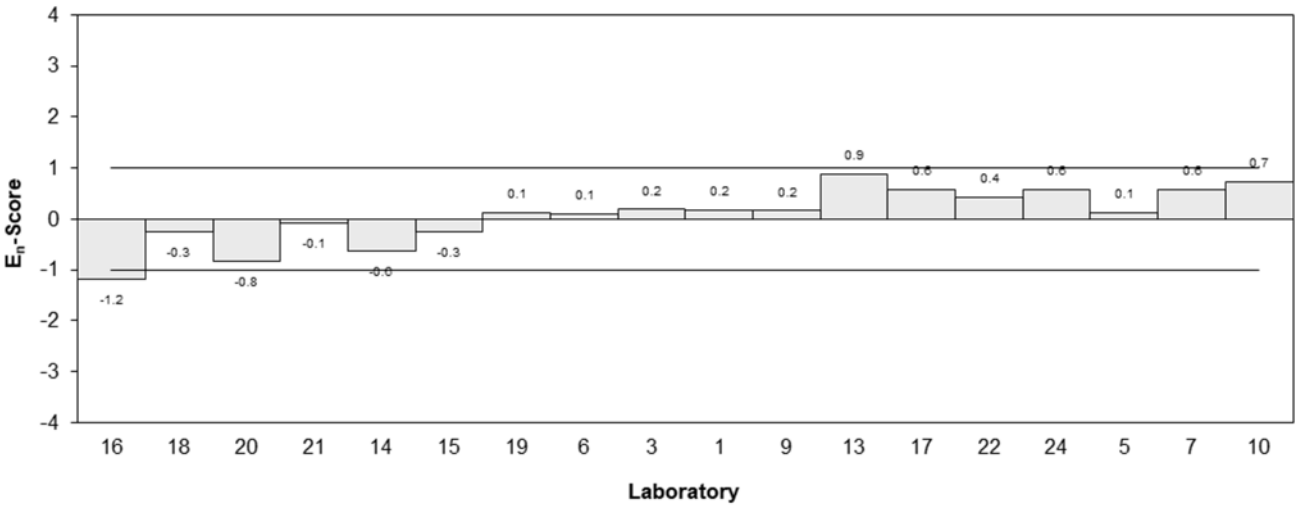

En-Scores: S1 - Se
En-Score
Laboratory
16 18 20 21 14 15 19 6 3 1 9 13 17 22 24 5 7 10

Figure 19

Table 24

Sample Details

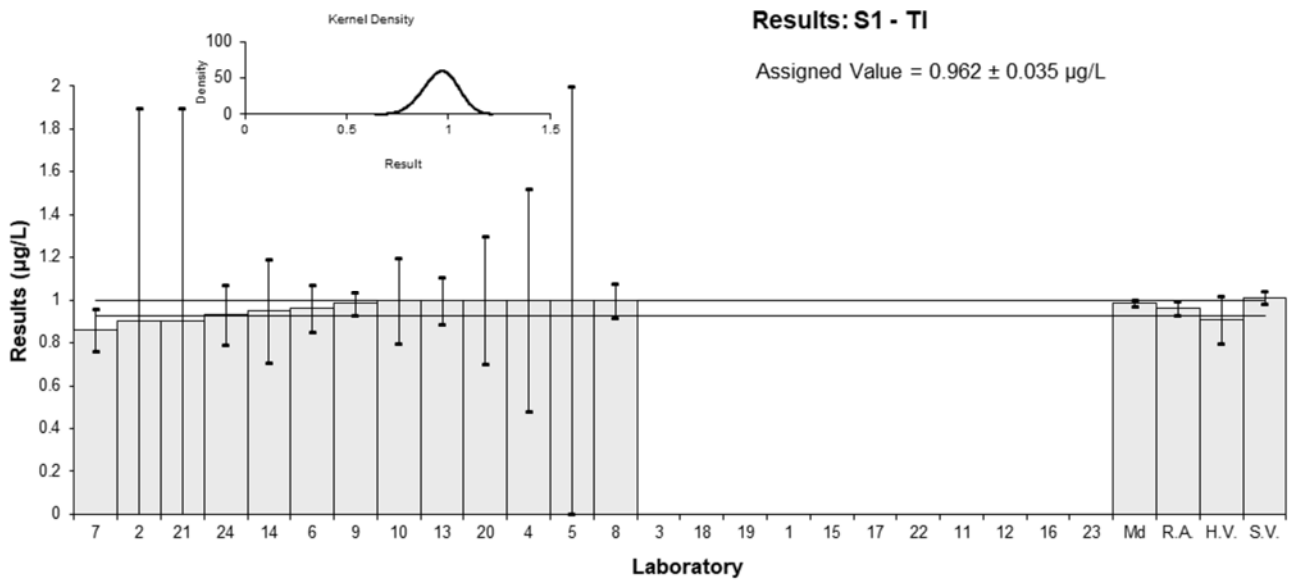
Sample No.	S1
Matrix.	River Water
Analyte.	Tl
Units	µg/L

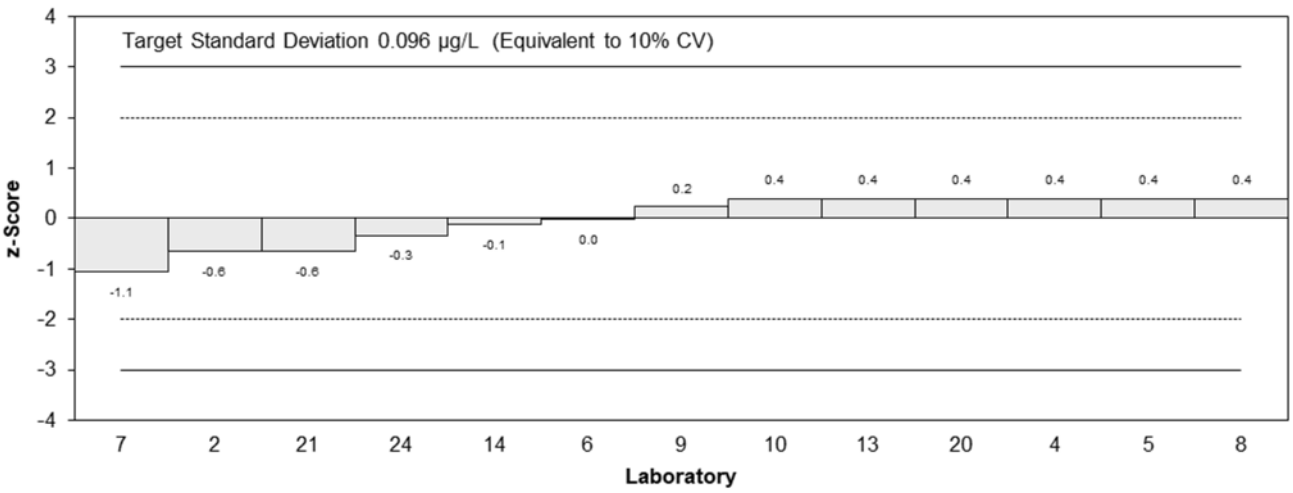
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	<5	1.4		
2	0.9	1	-0.64	-0.06
3	< 5	NR		
4	1.00	0.52	0.40	0.07
5	1	1	0.40	0.04
6	0.96	0.11	-0.02	-0.02
7	0.86	0.1	-1.06	-0.96
8	1	0.08	0.40	0.44
9	0.984	0.055	0.23	0.34
10	1.0	0.2	0.40	0.19
11	NT	NT		
12	NT	NT		
13	1	0.11	0.40	0.33
14	0.95	0.24	-0.12	-0.05
15	<5	1		
16	NT	NT		
17	<5	0.121		
18	<1	1		
19	<1	NR		
20	1	0.3	0.40	0.13
21	0.9	1	-0.64	-0.06
22	<5	0.43		
23	NT	NT		
24	0.93	0.14	-0.33	-0.22

Statistics

Assigned Value	0.962	0.035
Spike	1.01	0.03
Homogeneity Value	0.91	0.11
Robust Average	0.962	0.035
Median	0.984	0.014
Mean	0.960	
N	13	
Max.	1	
Min.	0.86	
Robust SD	0.050	
Robust CV	5.2%	


Results: S1 - Tl
Assigned Value = 0.962 ± 0.035 µg/L
Kernel Density
Density
Result
Results (µg/L)
Laboratory
7 2 21 24 14 6 9 10 13 20 4 5 8 3 18 19 1 15 17 22 11 12 16 23 Md R.A. H.V. S.V.


z-Scores: S1 - Tl
Target Standard Deviation 0.096 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
7 2 21 24 14 6 9 10 13 20 4 5 8
-1.1 -0.6 -0.6 -0.3 -0.1 0.0 0.2 0.4 0.4 0.4 0.4 0.4 0.4

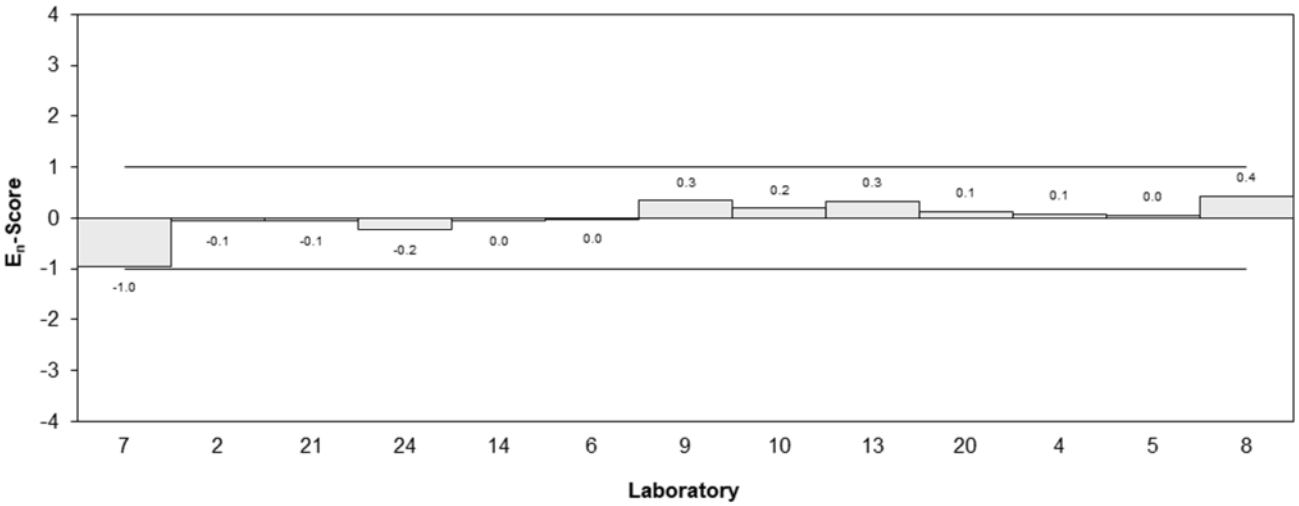

En-Scores: S1 - Tl
En-Score
Laboratory
7 2 21 24 14 6 9 10 13 20 4 5 8
-1.0 -0.1 -0.1 -0.2 0.0 0.0 0.3 0.2 0.3 0.1 0.1 0.0 0.4

Figure 20

Table 25

Sample Details

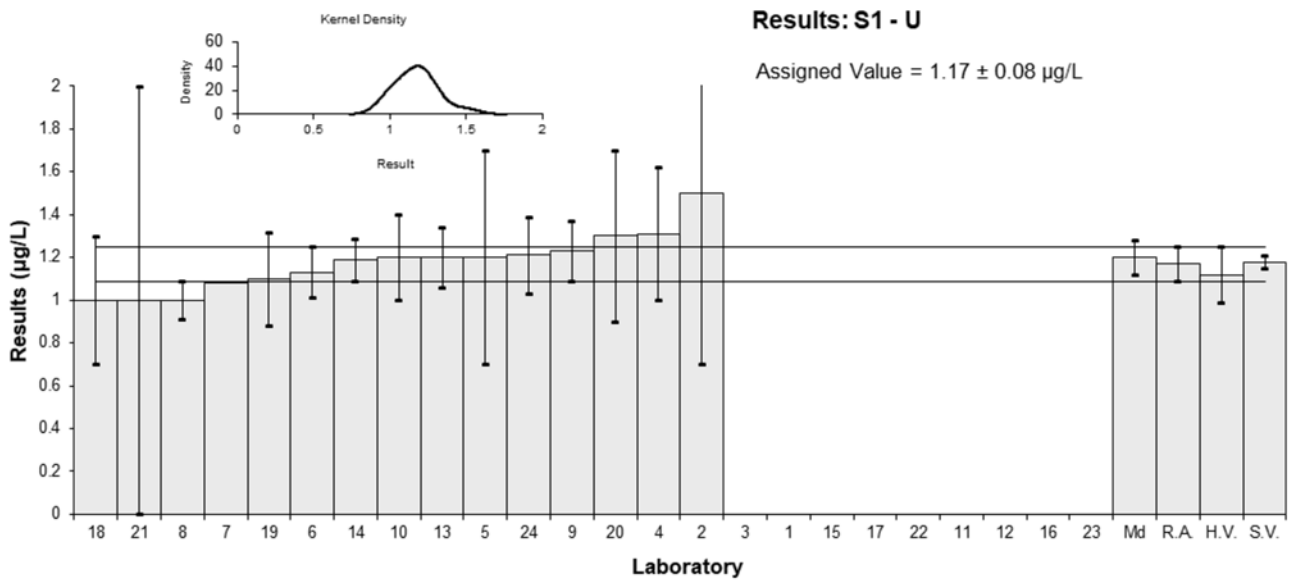
Sample No.	S1
Matrix.	River Water
Analyte.	U
Units	µg/L

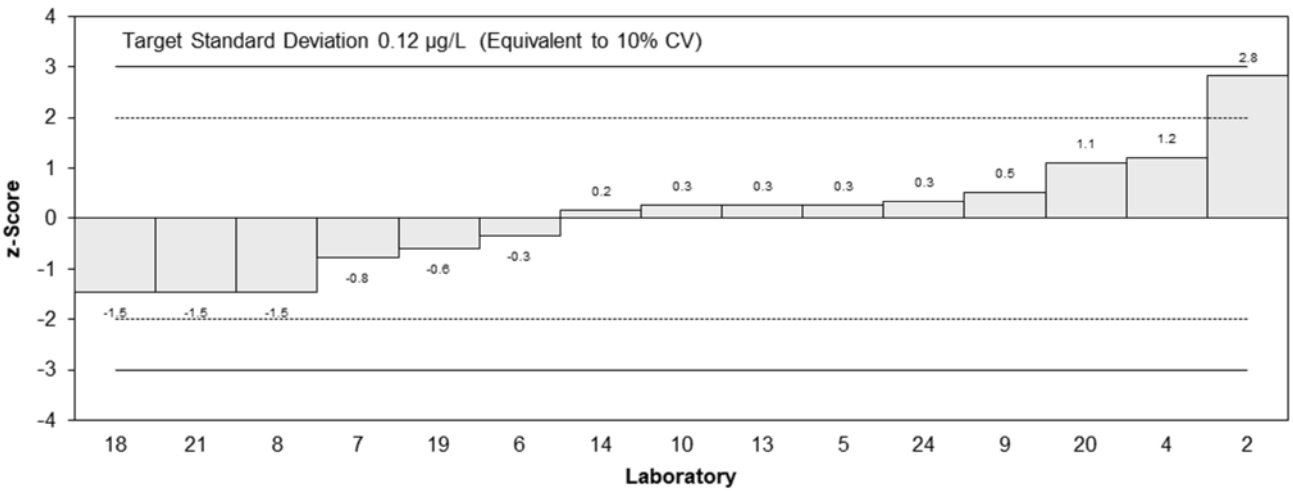
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	<5	NR		
2	1.5	0.8	2.82	0.41
3	< 5	NR		
4	1.31	0.31	1.20	0.44
5	1.2	0.5	0.26	0.06
6	1.13	0.12	-0.34	-0.28
7	1.08	NR	-0.77	-1.12
8	1	0.09	-1.45	-1.41
9	1.23	0.14	0.51	0.37
10	1.2	0.2	0.26	0.14
11	NT	NT		
12	NT	NT		
13	1.2	0.14	0.26	0.19
14	1.19	0.099	0.17	0.16
15	<5	1		
16	NT	NT		
17	<5	0.14		
18	1	0.3	-1.45	-0.55
19	1.1	0.22	-0.60	-0.30
20	1.3	0.4	1.11	0.32
21	1	1	-1.45	-0.17
22	<5	0.49		
23	NT	NT		
24	1.21	0.18	0.34	0.20

Statistics

Assigned Value	1.17	0.08
Spike	1.18	0.03
Homogeneity Value	1.12	0.13
Robust Average	1.17	0.08
Median	1.20	0.08
Mean	1.18	
N	15	
Max.	1.5	
Min.	1	
Robust SD	0.13	
Robust CV	11%	


Results: S1 - U
Assigned Value = 1.17 ± 0.08 µg/L
Kernel Density
Density
Result
Results (µg/L)
Laboratory
18 21 8 7 19 6 14 10 13 5 24 9 20 4 2 3 1 15 17 22 11 12 16 23 Md R.A. H.V. S.V.


z-Scores: S1 - U
Target Standard Deviation 0.12 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
18 21 8 7 19 6 14 10 13 5 24 9 20 4 2

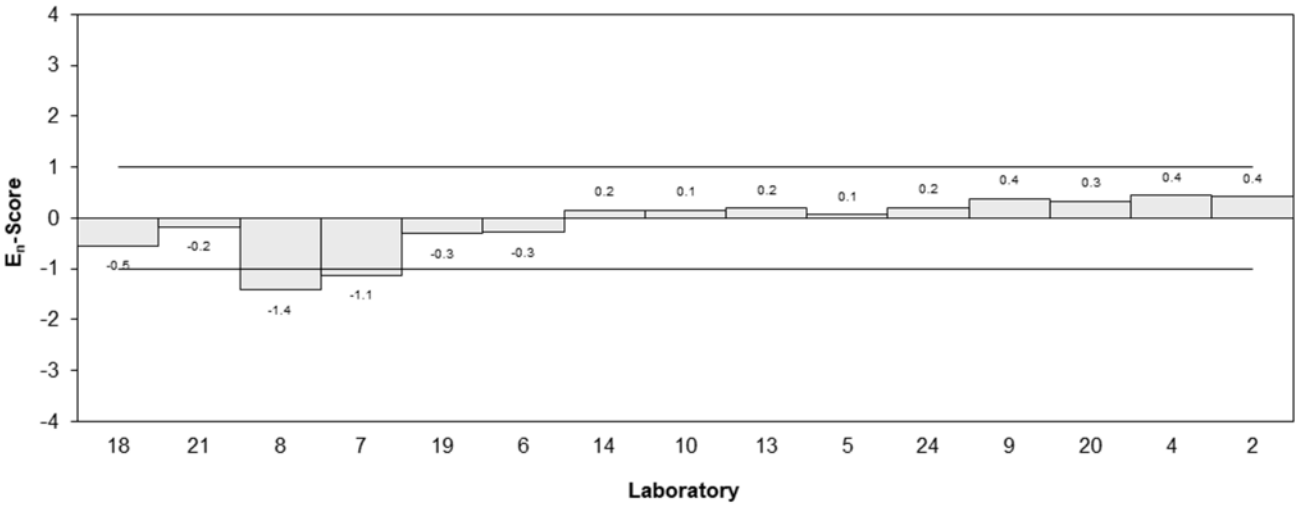

En-Scores: S1 - U
En-Score
Laboratory
18 21 8 7 19 6 14 10 13 5 24 9 20 4 2

Figure 21

Table 26

Sample Details

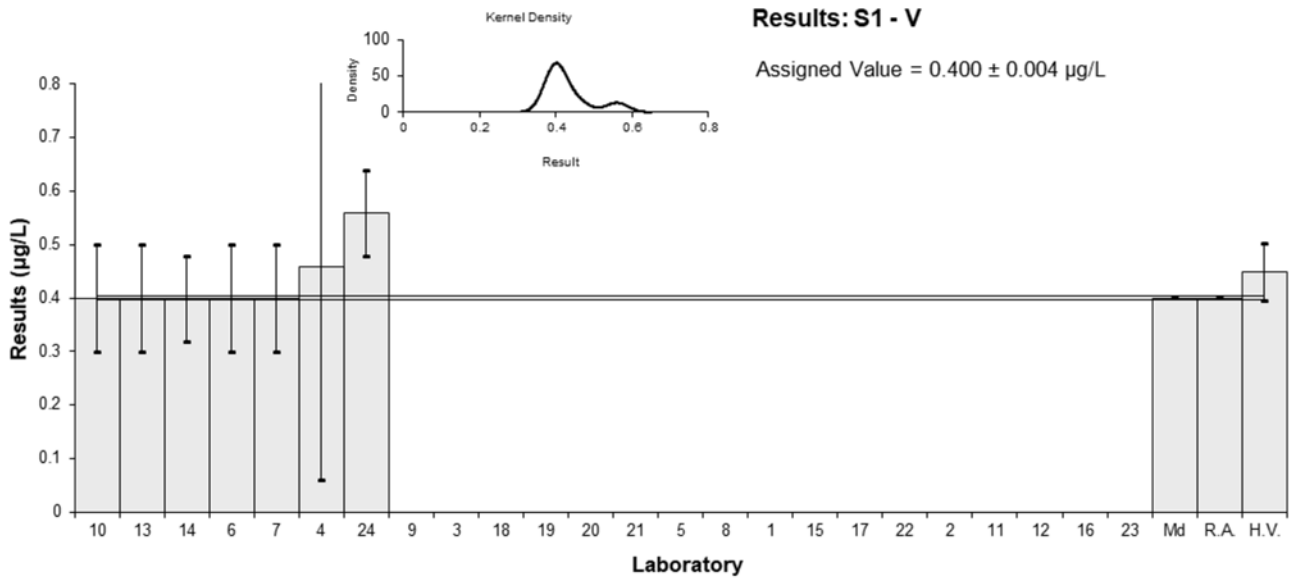
Sample No.	S1
Matrix.	River Water
Analyte.	V
Units	µg/L

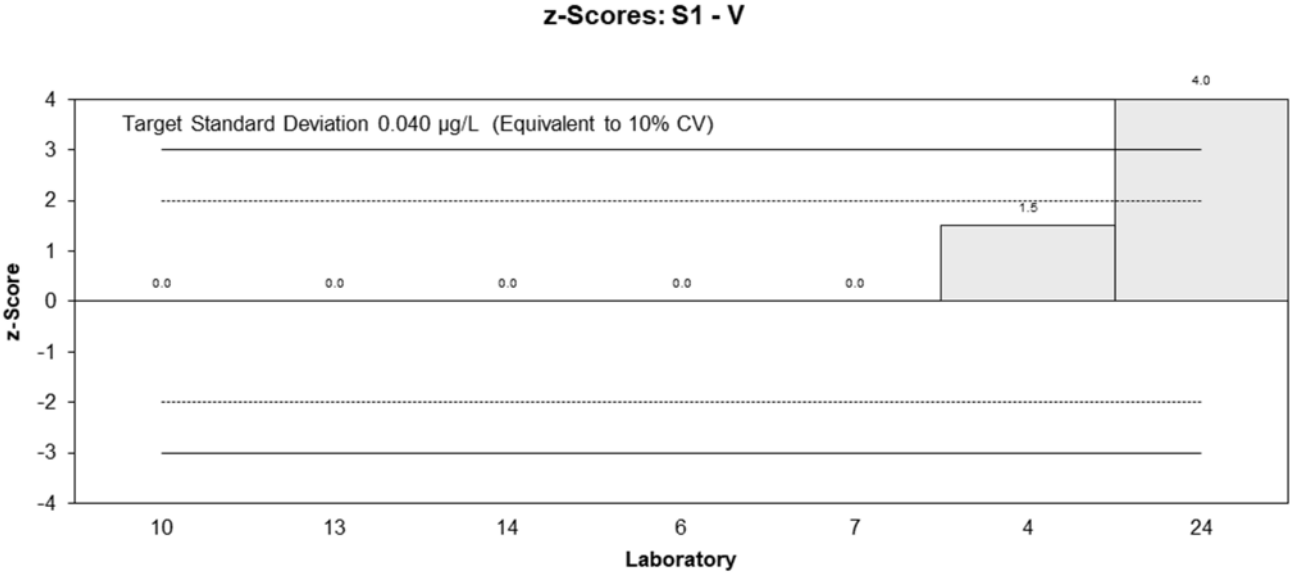
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	<5	0.66		
2	NR	NR		
3	< 5	NR		
4	0.46	0.40	1.50	0.15
5	<1	NR		
6	0.4	0.1	0.00	0.00
7	0.4	0.1	0.00	0.00
8	<10	NR		
9	< 1.0	0.67		
10	0.4	0.1	0.00	0.00
11	NT	NT		
12	NT	NT		
13	0.4	0.1	0.00	0.00
14	0.4	0.08	0.00	0.00
15	<5	1		
16	NT	NT		
17	<5	0.040		
18	<1	NR		
19	<1	NR		
20	<1	NR		
21	<1	2		
22	<5	0.0092		
23	NT	NT		
24	0.56	0.08	4.00	2.00

Statistics

Assigned Value	0.400	0.004
Spike	Not Spiked	
Homogeneity Value	0.450	0.054
Robust Average	0.400	0.004
Median	0.400	0.004
Mean	0.431	
N	7	
Max.	0.56	
Min.	0.4	
Robust SD	0.0004	
Robust CV	0.1%	


Kernel Density
Density
Result
Results: S1 - V
Assigned Value = 0.400 ± 0.004 µg/L
Results (µg/L)
Laboratory
10 13 14 6 7 4 24 9 3 18 19 20 21 5 8 1 15 17 22 2 11 12 16 23 Md R.A. H.V.


z-Scores: S1 - V
Target Standard Deviation 0.040 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
10 13 14 6 7 4 24

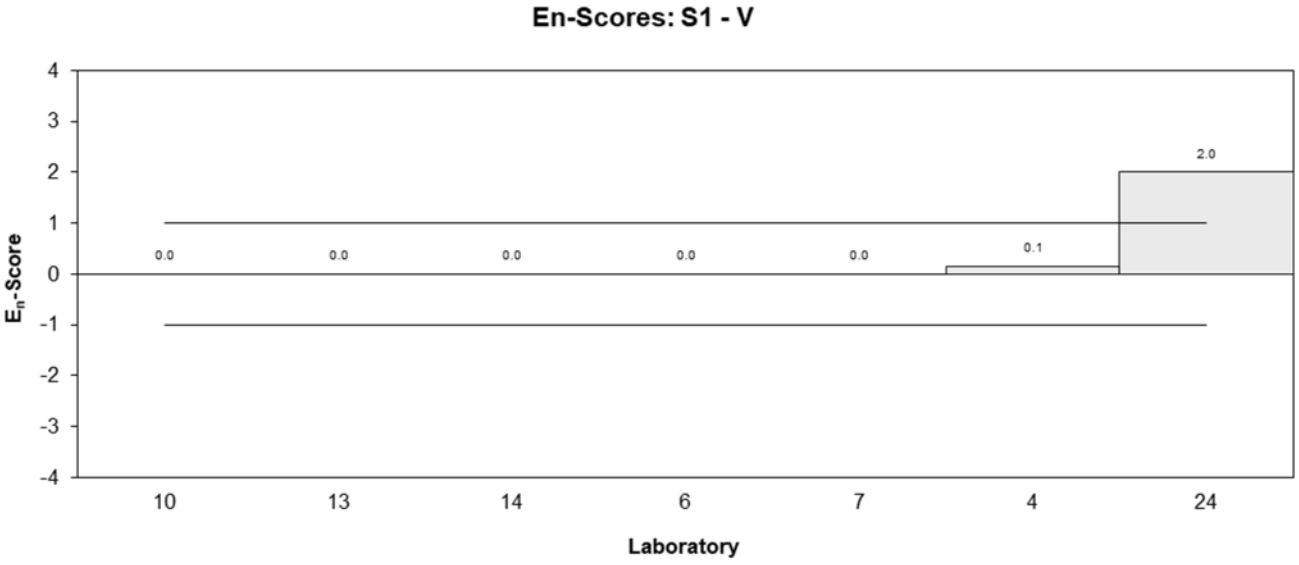

En-Scores: S1 - V
En-Score
Laboratory
10 13 14 6 7 4 24

Figure 22

Table 27

Sample Details

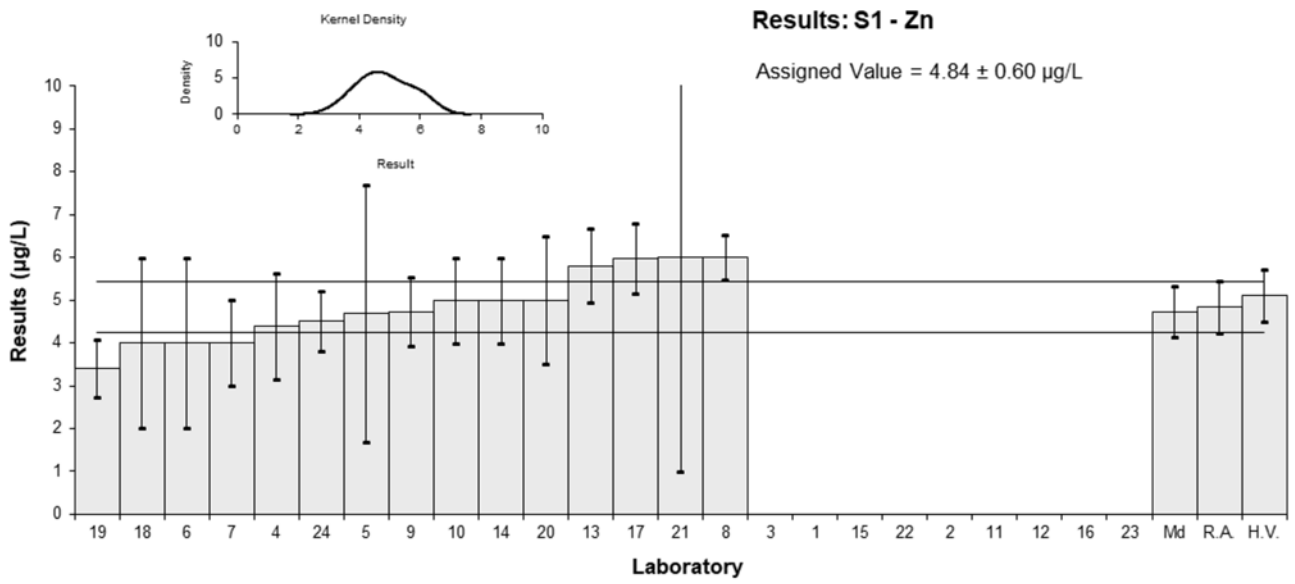
Sample No.	S1
Matrix.	River Water
Analyte.	Zn
Units	µg/L

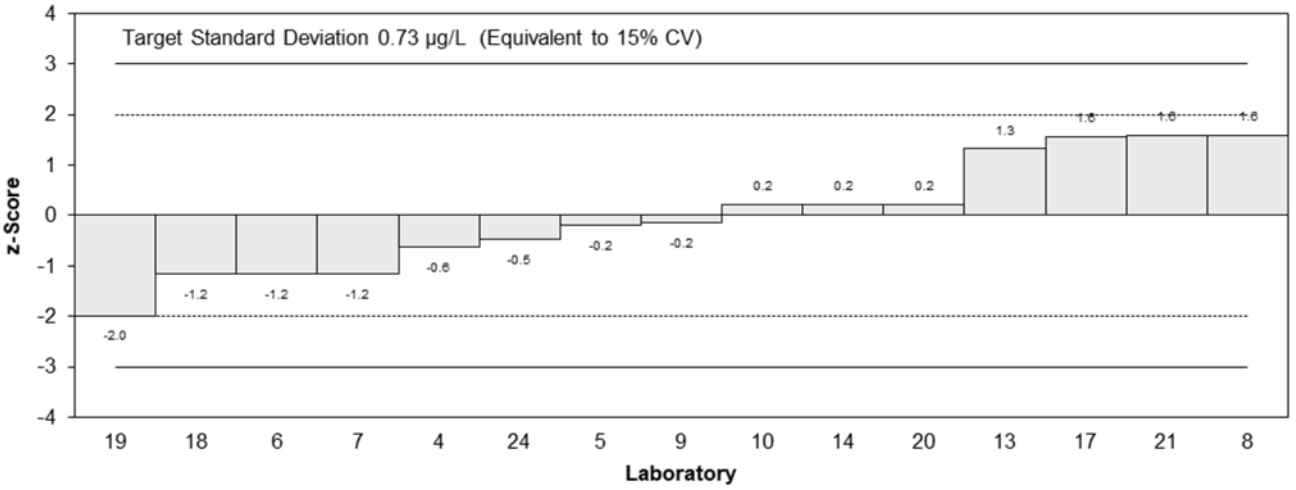
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	<5	0.86		
2	NR	NR		
3	< 5	NR		
4	4.38	1.24	-0.63	-0.33
5	4.7	3	-0.19	-0.05
6	4	2	-1.16	-0.40
7	4	1.0	-1.16	-0.72
8	6	0.52	1.60	1.46
9	4.73	0.80	-0.15	-0.11
10	5.0	1.0	0.22	0.14
11	NT	NT		
12	NT	NT		
13	5.8	0.87	1.32	0.91
14	5	1	0.22	0.14
15	<5	1		
16	NT	NT		
17	5.98	0.82	1.57	1.12
18	4	2	-1.16	-0.40
19	3.4	0.68	-1.98	-1.59
20	5	1.5	0.22	0.10
21	6	5	1.60	0.23
22	<5	0.53		
23	NT	NT		
24	4.5	0.7	-0.47	-0.37

Statistics

Assigned Value	4.84	0.60
Spike	Not Spiked	
Homogeneity Value	5.12	0.61
Robust Average	4.84	0.60
Median	4.73	0.60
Mean	4.83	
N	15	
Max.	6	
Min.	3.4	
Robust SD	0.93	
Robust CV	19%	


Results: S1 - Zn
Assigned Value = 4.84 ± 0.60 µg/L
Kernel Density
Density
Result
Results (µg/L)
19 18 6 7 4 24 5 9 10 14 20 13 17 21 8 3 1 15 22 2 11 12 16 23 Md R.A. H.V.
Laboratory


z-Scores: S1 - Zn
Target Standard Deviation 0.73 µg/L (Equivalent to 15% CV)
z-Score
-2.0 -1.2 -1.2 -1.2 -0.6 -0.5 -0.2 -0.2 0.2 0.2 0.2 1.3 1.6 1.6 1.6
19 18 6 7 4 24 5 9 10 14 20 13 17 21 8
Laboratory

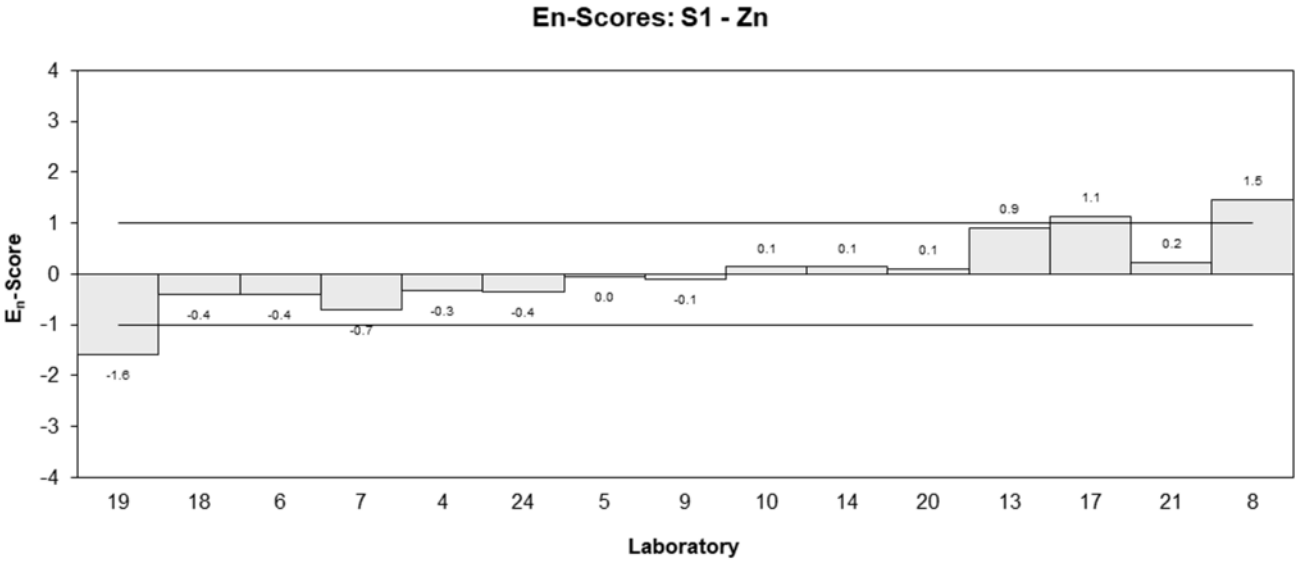

En-Scores: S1 - Zn
En-Score
-1.6 -0.4 -0.4 -0.7 -0.3 -0.4 0.0 -0.1 0.1 0.1 0.1 0.9 1.1 0.2 1.5
19 18 6 7 4 24 5 9 10 14 20 13 17 21 8
Laboratory

Figure 23

Table 28

Sample Details

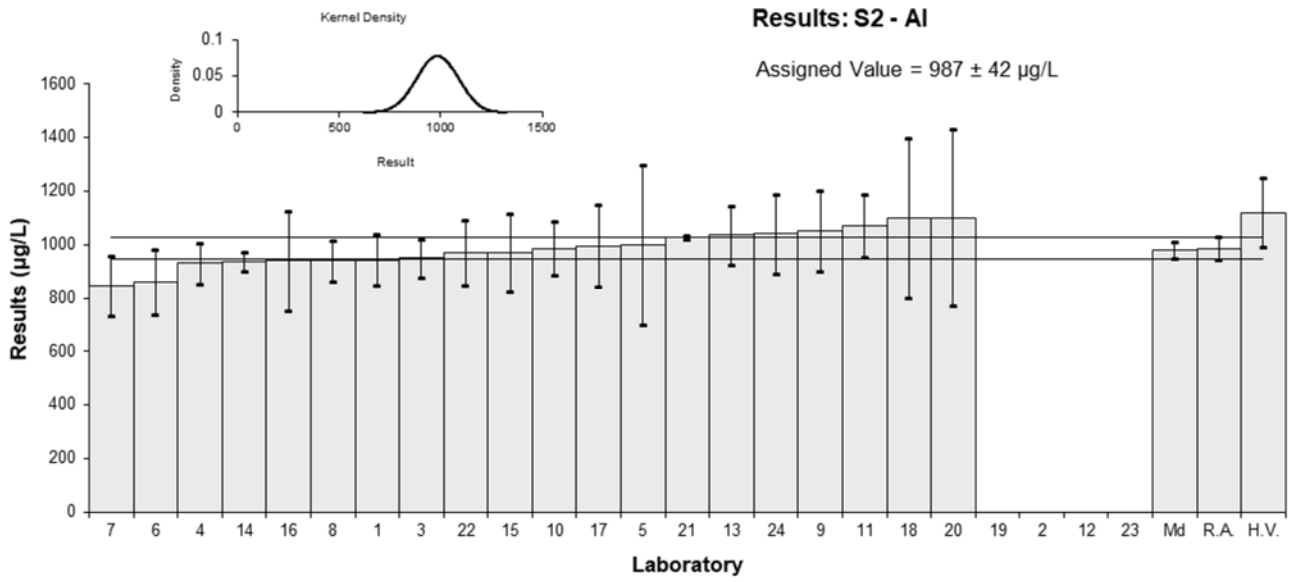
Sample No.	S2
Matrix.	Waste Water
Analyte.	Al
Units	µg/L

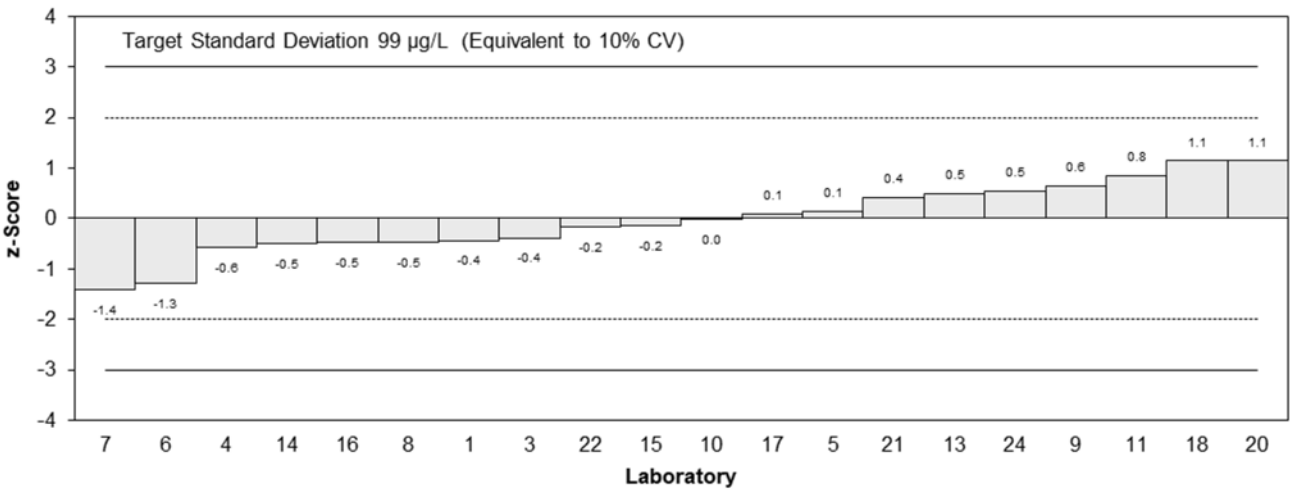
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	944	96	-0.44	-0.41
2	NR	NR		
3	949	70.6	-0.39	-0.46
4	930	77	-0.58	-0.65
5	1000	300	0.13	0.04
6	860	122	-1.29	-0.98
7	848	112	-1.41	-1.16
8	940	75.4	-0.48	-0.54
9	1050	150	0.64	0.40
10	986	100	-0.01	-0.01
11	1070	118	0.84	0.66
12	NT	NT		
13	1036	109	0.50	0.42
14	938	34.8	-0.50	-0.90
15	972	146	-0.15	-0.10
16	940	188	-0.48	-0.24
17	996	154	0.09	0.06
18	1100	300	1.14	0.37
19	NR	NR		
20	1100	330	1.14	0.34
21	1028	9	0.42	0.95
22	970	120	-0.17	-0.13
23	NT	NT		
24	1040	150	0.54	0.34

Statistics

Assigned Value	987	42
Spike	Not Spiked	
Homogeneity Value	1120	130
Robust Average	987	42
Median	979	31
Mean	985	
N	20	
Max.	1100	
Min.	848	
Robust SD	74	
Robust CV	7.5%	


Kernel Density
Density
Result
Results: S2 - Al
Assigned Value = 987 ± 42 µg/L
Results (µg/L)
Laboratory
7 6 4 14 16 8 1 3 22 15 10 17 5 21 13 24 9 11 18 20 19 2 12 23 Md R.A. H.V.


z-Scores: S2 - Al
Target Standard Deviation 99 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
7 6 4 14 16 8 1 3 22 15 10 17 5 21 13 24 9 11 18 20
-1.4 -1.3 -0.6 -0.5 -0.5 -0.5 -0.4 -0.4 -0.2 -0.2 0.0 0.1 0.1 0.4 0.5 0.5 0.6 0.8 1.1 1.1

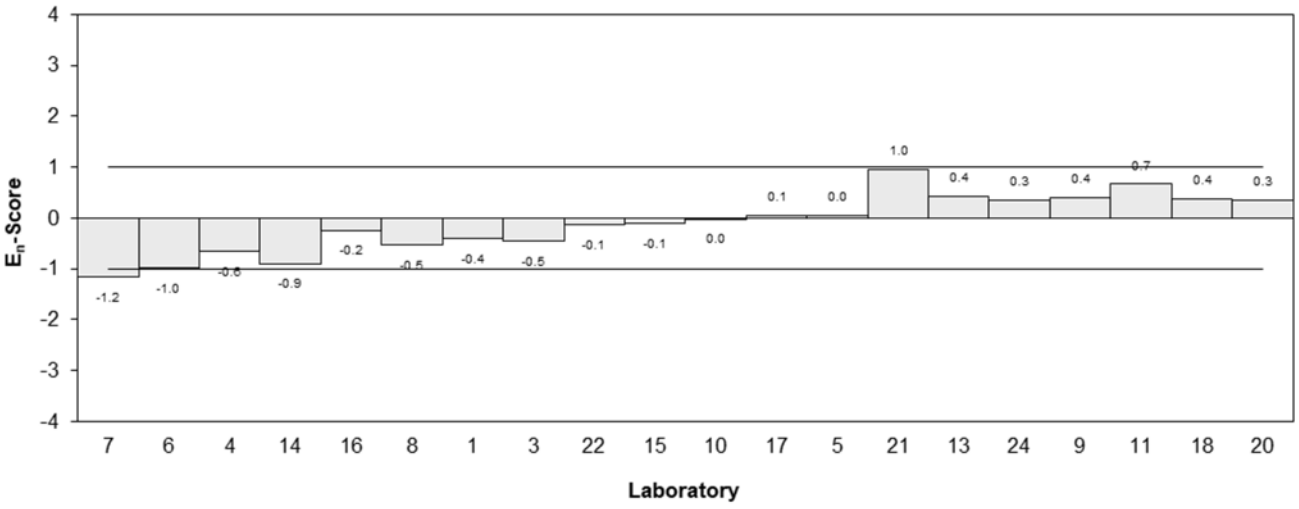

En-Scores: S2 - Al
En-Score
Laboratory
7 6 4 14 16 8 1 3 22 15 10 17 5 21 13 24 9 11 18 20
-1.2 -1.0 -0.6 -0.9 -0.2 -0.5 -0.4 -0.5 -0.1 -0.1 0.0 0.1 0.0 1.0 0.4 0.3 0.4 0.7 0.4 0.3

Figure 24

Table 29

Sample Details

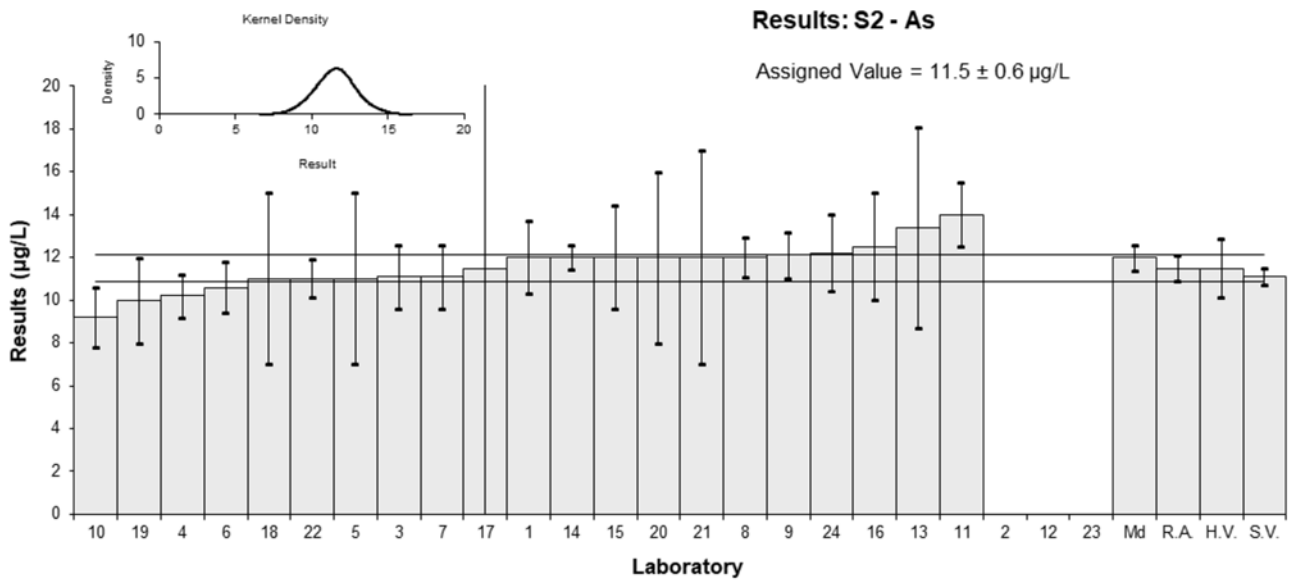
Sample No.	S2
Matrix.	Waste Water
Analyte.	As
Units	µg/L

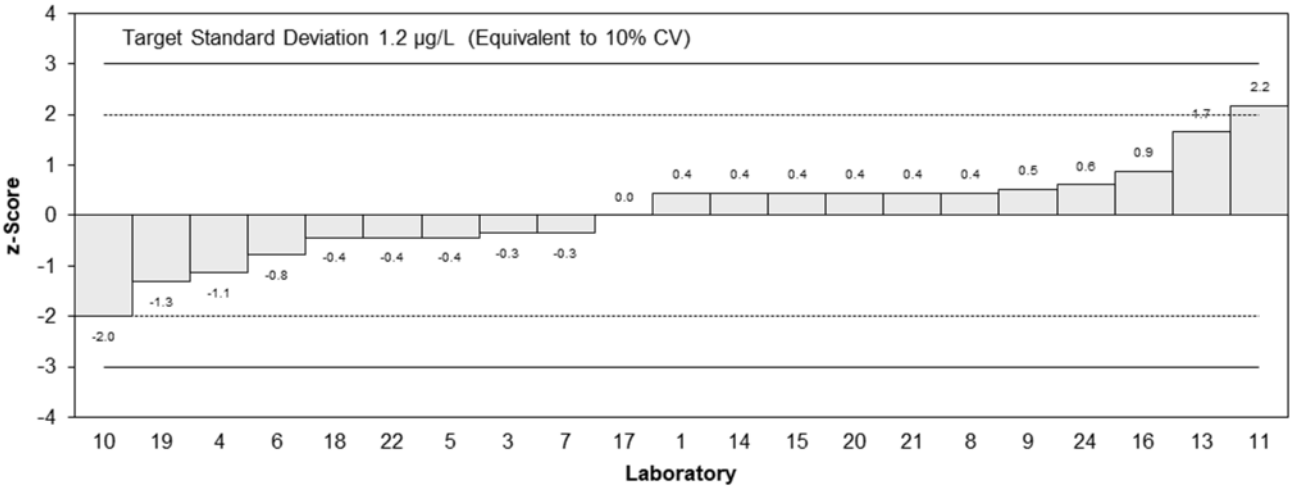
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	12.0	1.7	0.43	0.28
2	NR	NR		
3	11.1	1.5	-0.35	-0.25
4	10.2	1.0	-1.13	-1.11
5	11	4	-0.43	-0.12
6	10.6	1.2	-0.78	-0.67
7	11.1	1.5	-0.35	-0.25
8	12	0.92	0.43	0.46
9	12.1	1.1	0.52	0.48
10	9.2	1.4	-2.00	-1.51
11	14	1.5	2.17	1.55
12	NT	NT		
13	13.4	4.7	1.65	0.40
14	12	0.575	0.43	0.60
15	12	2.42	0.43	0.20
16	12.5	2.5	0.87	0.39
17	11.5	15	0.00	0.00
18	11	4	-0.43	-0.12
19	10	2.0	-1.30	-0.72
20	12	4	0.43	0.12
21	12	5	0.43	0.10
22	11	0.90	-0.43	-0.46
23	NT	NT		
24	12.2	1.8	0.61	0.37

Statistics

Assigned Value	11.5	0.6
Spike	11.1	0.4
Homogeneity Value	11.5	1.4
Robust Average	11.5	0.6
Median	12.0	0.6
Mean	11.6	
N	21	
Max.	14	
Min.	9.2	
Robust SD	1.0	
Robust CV	8.9%	


Kernel Density
Density
Result
Results: S2 - As
Assigned Value = 11.5 ± 0.6 µg/L
Results (µg/L)
Laboratory
10 19 4 6 18 22 5 3 7 17 1 14 15 20 21 8 9 24 16 13 11 2 12 23 Md R.A. H.V. S.V.


z-Scores: S2 - As
Target Standard Deviation 1.2 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
10 19 4 6 18 22 5 3 7 17 1 14 15 20 21 8 9 24 16 13 11
-2.0 -1.3 -1.1 -0.8 -0.4 -0.4 -0.4 -0.3 -0.3 0.0 0.4 0.4 0.4 0.4 0.4 0.4 0.5 0.6 0.9 1.7 2.2

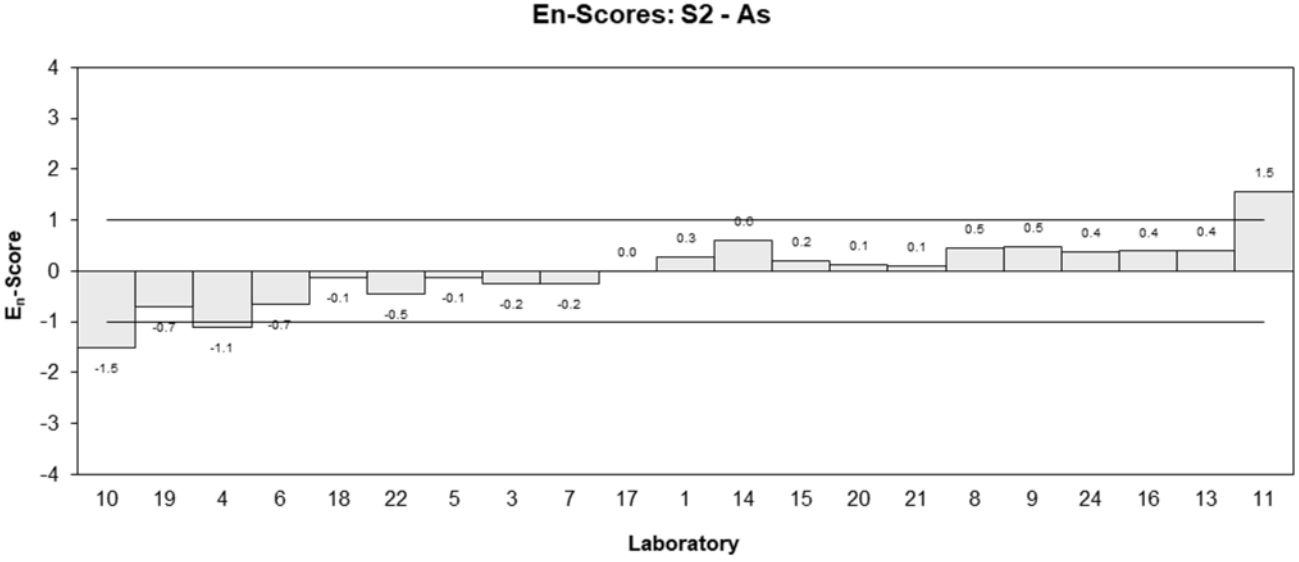

En-Scores: S2 - As
En-Score
Laboratory
10 19 4 6 18 22 5 3 7 17 1 14 15 20 21 8 9 24 16 13 11
-1.5 -0.7 -1.1 -0.7 -0.1 -0.5 -0.1 -0.2 -0.2 0.0 0.3 0.6 0.2 0.1 0.1 0.5 0.5 0.4 0.4 0.4 1.5

Figure 25

Table 30

Sample Details

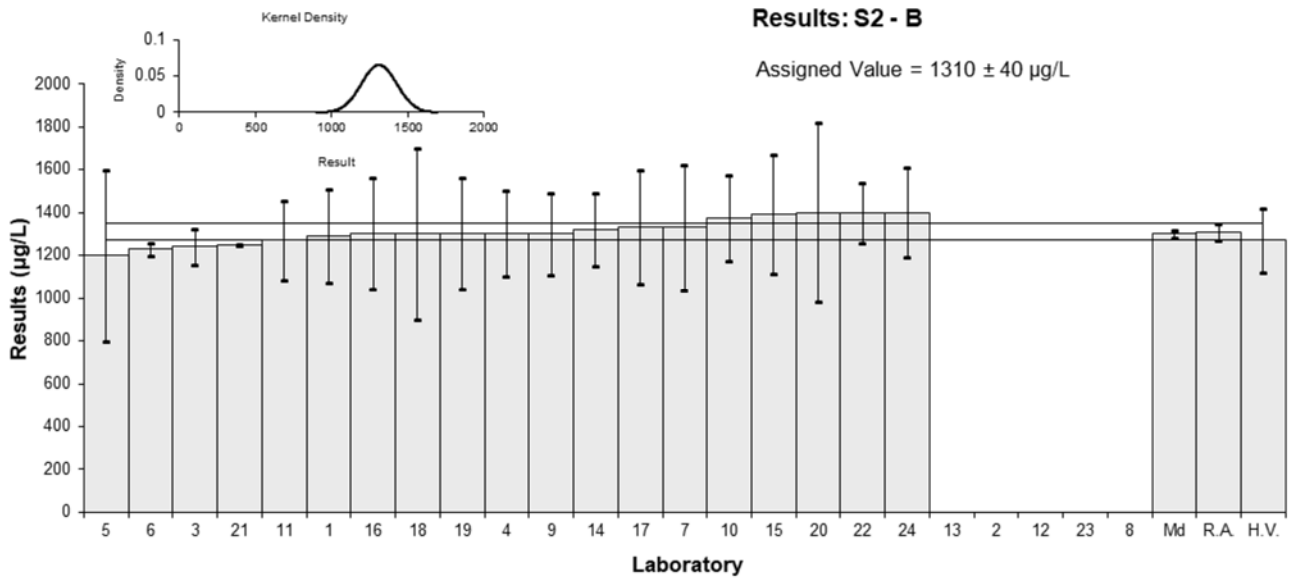
Sample No.	S2
Matrix.	Waste Water
Analyte.	B
Units	µg/L

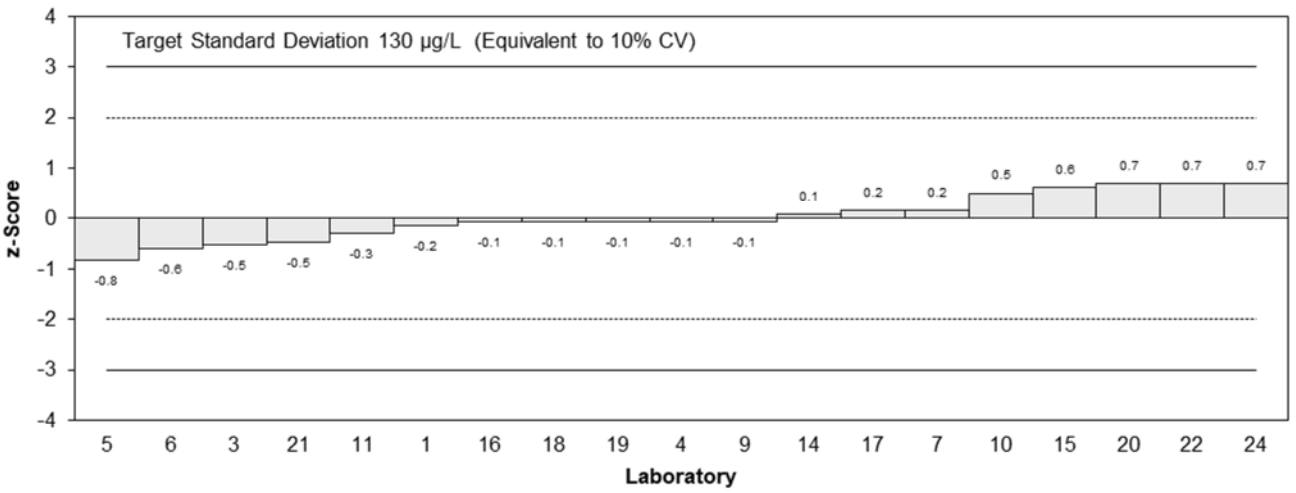
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	1290	220	-0.15	-0.09
2	NR	NR		
3	1240	85.9	-0.53	-0.74
4	1300	200	-0.08	-0.05
5	1200	400	-0.84	-0.27
6	1230	30	-0.61	-1.60
7	1330	293	0.15	0.07
8	NT	NT		
9	1300	190	-0.08	-0.05
10	1374	200	0.49	0.31
11	1270	187	-0.31	-0.21
12	NT	NT		
13	NR	NR		
14	1320	171	0.08	0.06
15	1390	278	0.61	0.28
16	1300	260	-0.08	-0.04
17	1330	266.0	0.15	0.07
18	1300	400	-0.08	-0.02
19	1300	260	-0.08	-0.04
20	1400	420	0.69	0.21
21	1249	2	-0.47	-1.52
22	1400	140	0.69	0.62
23	NT	NT		
24	1400	210	0.69	0.42

Statistics

Assigned Value	1310	40
Spike	Not Spiked	
Homogeneity Value	1270	150
Robust Average	1310	40
Median	1300	20
Mean	1310	
N	19	
Max.	1400	
Min.	1200	
Robust SD	70	
Robust CV	5.1%	


Kernel Density
Density
Result
Results: S2 - B
Assigned Value = 1310 ± 40 µg/L
Results (µg/L)
Laboratory
5 6 3 21 11 1 16 18 19 4 9 14 17 7 10 15 20 22 24 13 2 12 23 8 Md R.A. H.V.


z-Scores: S2 - B
Target Standard Deviation 130 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
5 6 3 21 11 1 16 18 19 4 9 14 17 7 10 15 20 22 24
-0.8 -0.6 -0.5 -0.5 -0.3 -0.2 -0.1 -0.1 -0.1 -0.1 -0.1 0.1 0.2 0.2 0.5 0.6 0.7 0.7 0.7

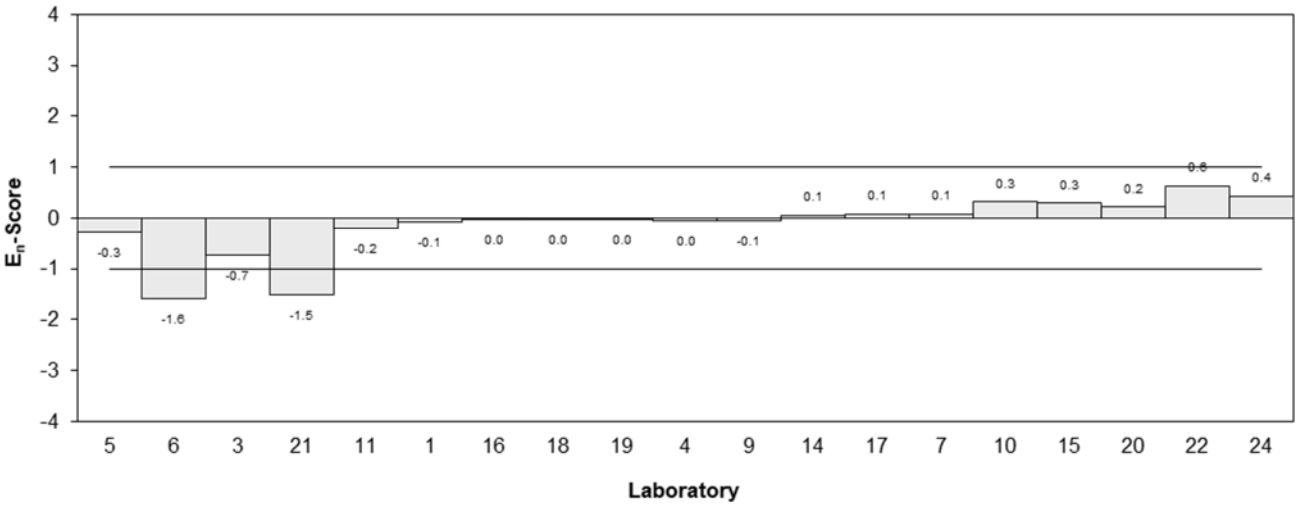

En-Scores: S2 - B
En-Score
Laboratory
5 6 3 21 11 1 16 18 19 4 9 14 17 7 10 15 20 22 24
-0.3 -1.6 -0.7 -1.5 -0.2 -0.1 0.0 0.0 0.0 0.0 -0.1 0.1 0.1 0.1 0.3 0.3 0.2 0.6 0.4

Figure 26

Table 31

Sample Details

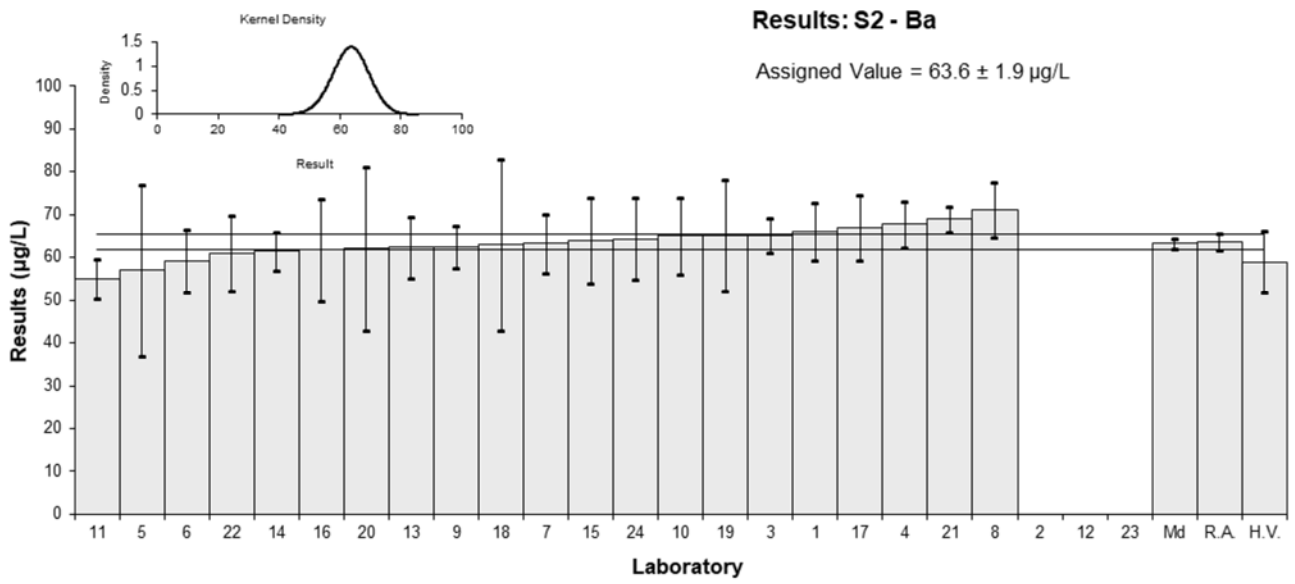
Sample No.	S2
Matrix.	Waste Water
Analyte.	Ba
Units	µg/L

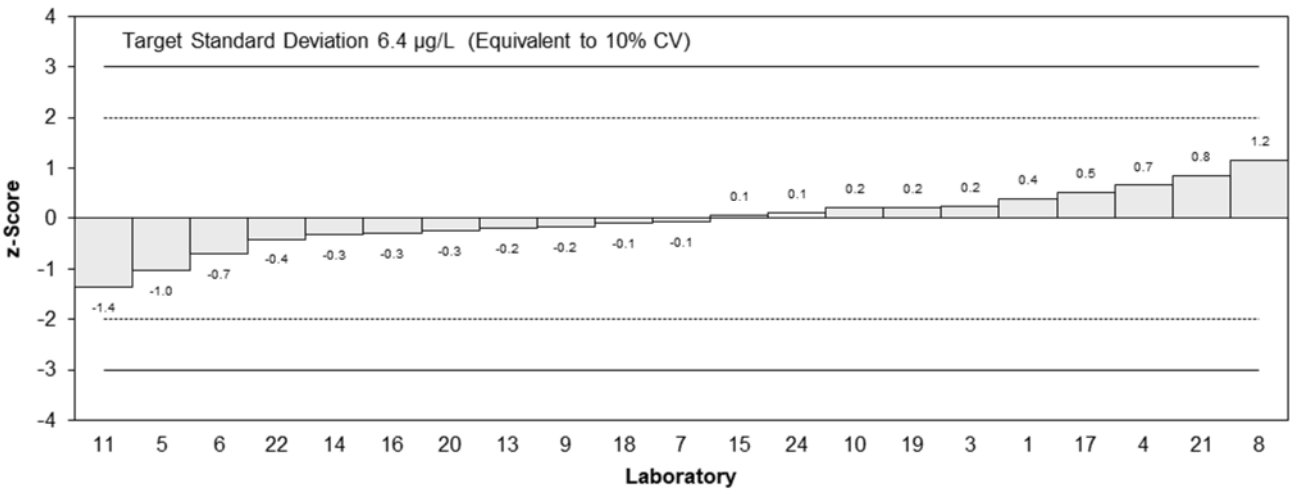
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	66.1	6.7	0.39	0.36
2	NR	NR		
3	65.1	4.08	0.24	0.33
4	67.8	5.4	0.66	0.73
5	57	20	-1.04	-0.33
6	59.2	7.4	-0.69	-0.58
7	63.2	6.8	-0.06	-0.06
8	71	6.45	1.16	1.10
9	62.5	5.0	-0.17	-0.21
10	65	9.0	0.22	0.15
11	55	4.7	-1.35	-1.70
12	NT	NT		
13	62.4	7.2	-0.19	-0.16
14	61.5	4.47	-0.33	-0.43
15	64	10	0.06	0.04
16	61.7	12	-0.30	-0.16
17	66.9	7.7	0.52	0.42
18	63	20	-0.09	-0.03
19	65	13	0.22	0.11
20	62	19	-0.25	-0.08
21	69	3	0.85	1.52
22	61	8.8	-0.41	-0.29
23	NT	NT		
24	64.3	9.6	0.11	0.07

Statistics

Assigned Value	63.6	1.9
Spike	Not Spiked	
Homogeneity Value	59.0	7.1
Robust Average	63.6	1.9
Median	63.2	1.2
Mean	63.5	
N	21	
Max.	71	
Min.	55	
Robust SD	3.5	
Robust CV	5.5%	


Kernel Density
Density
Result
Results: S2 - Ba
Assigned Value = 63.6 ± 1.9 µg/L
Results (µg/L)
Laboratory
11 5 6 22 14 16 20 13 9 18 7 15 24 10 19 3 1 17 4 21 8 2 12 23 Md R.A. H.V.


z-Scores: S2 - Ba
Target Standard Deviation 6.4 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
11 5 6 22 14 16 20 13 9 18 7 15 24 10 19 3 1 17 4 21 8
-1.4 -1.0 -0.7 -0.4 -0.3 -0.3 -0.3 -0.2 -0.2 -0.1 -0.1 0.1 0.1 0.2 0.2 0.2 0.4 0.5 0.7 0.8 1.2

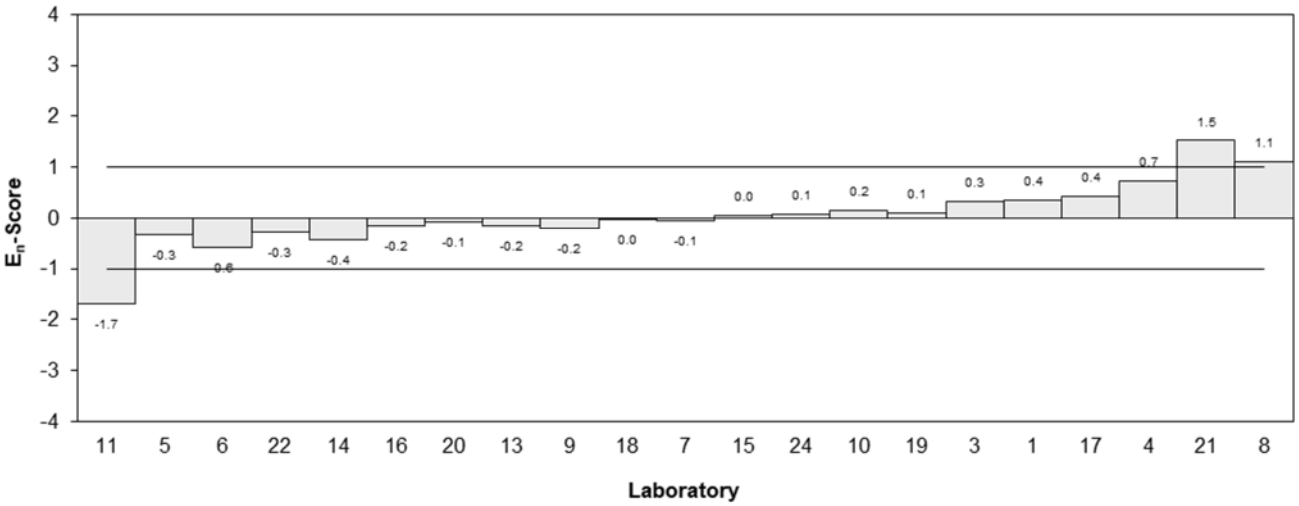

En-Scores: S2 - Ba
En-Score
Laboratory
11 5 6 22 14 16 20 13 9 18 7 15 24 10 19 3 1 17 4 21 8
-1.7 -0.3 -0.6 -0.3 -0.4 -0.2 -0.1 -0.2 -0.2 0.0 -0.1 0.0 0.1 0.2 0.1 0.3 0.4 0.4 0.7 1.5 1.1

Figure 27

Table 32

Sample Details

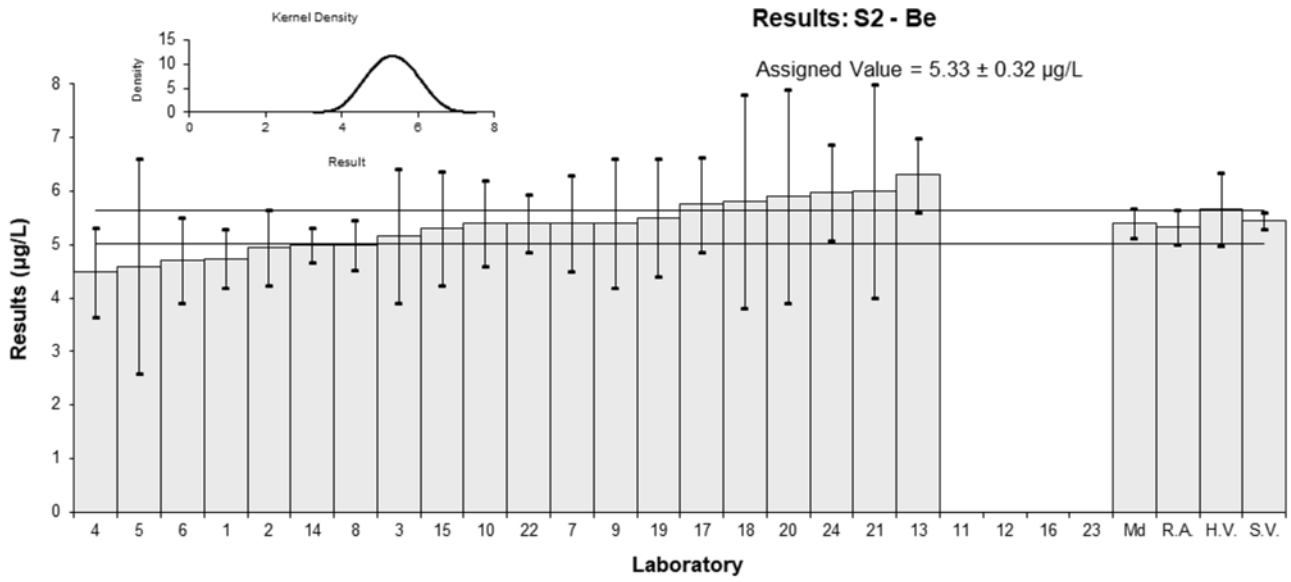
Sample No.	S2
Matrix.	Waste Water
Analyte.	Be
Units	µg/L

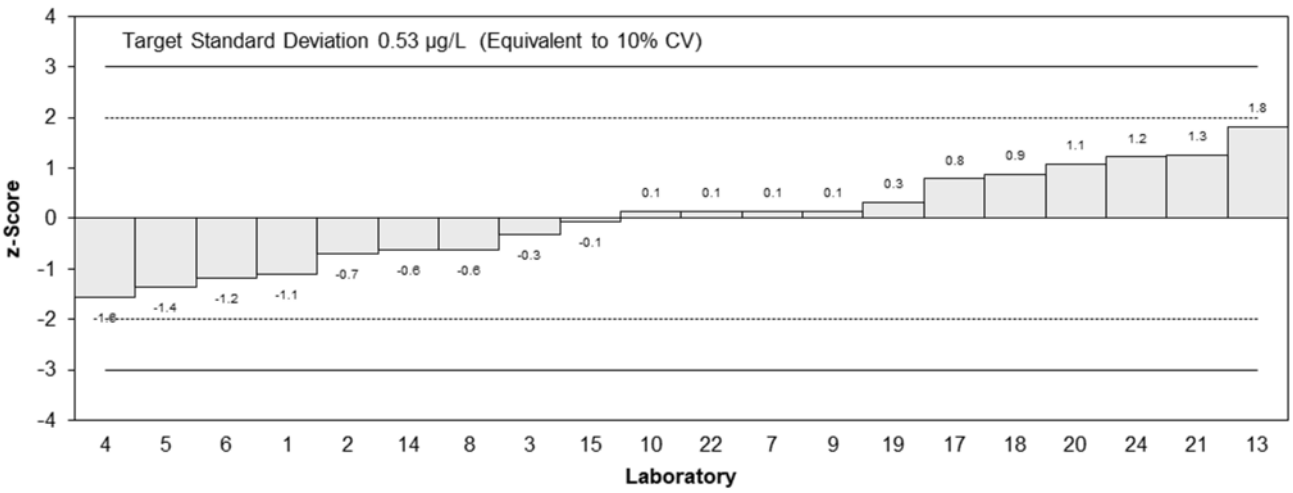
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	4.74	0.55	-1.11	-0.93
2	4.95	0.7	-0.71	-0.49
3	5.16	1.26	-0.32	-0.13
4	4.49	0.84	-1.58	-0.93
5	4.6	2	-1.37	-0.36
6	4.7	0.8	-1.18	-0.73
7	5.4	0.9	0.13	0.07
8	5	0.47	-0.62	-0.58
9	5.4	1.2	0.13	0.06
10	5.4	0.8	0.13	0.08
11	<0.01	NR		
12	NT	NT		
13	6.3	0.7	1.82	1.26
14	5	0.317	-0.62	-0.73
15	5.3	1.06	-0.06	-0.03
16	NT	NT		
17	5.75	0.89	0.79	0.44
18	5.8	2	0.88	0.23
19	5.5	1.1	0.32	0.15
20	5.9	2	1.07	0.28
21	6	2	1.26	0.33
22	5.4	0.54	0.13	0.11
23	NT	NT		
24	5.98	0.9	1.22	0.68

Statistics

Assigned Value	5.33	0.32
Spike	5.45	0.16
Homogeneity Value	5.66	0.68
Robust Average	5.33	0.32
Median	5.40	0.28
Mean	5.34	
N	20	
Max.	6.3	
Min.	4.49	
Robust SD	0.57	
Robust CV	11%	


Kernel Density
Density
Result
Results: S2 - Be
Assigned Value = 5.33 ± 0.32 µg/L
Results (µg/L)
Laboratory
4 5 6 1 2 14 8 3 15 10 22 7 9 19 17 18 20 24 21 13 11 12 16 23 Md R.A. H.V. S.V.


z-Scores: S2 - Be
Target Standard Deviation 0.53 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
4 5 6 1 2 14 8 3 15 10 22 7 9 19 17 18 20 24 21 13
-1.6 -1.4 -1.2 -1.1 -0.7 -0.6 -0.6 -0.3 -0.1 0.1 0.1 0.1 0.1 0.3 0.8 0.9 1.1 1.2 1.3 1.8

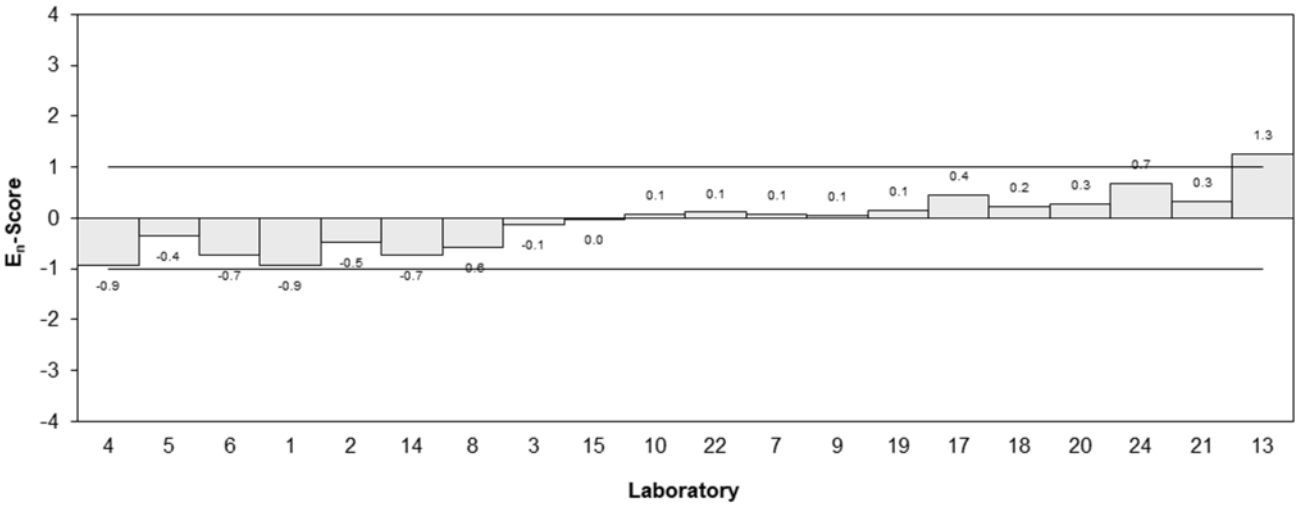

En-Scores: S2 - Be
En-Score
Laboratory
4 5 6 1 2 14 8 3 15 10 22 7 9 19 17 18 20 24 21 13
-0.9 -0.4 -0.7 -0.9 -0.5 -0.7 -0.6 -0.1 0.0 0.1 0.1 0.1 0.1 0.1 0.4 0.2 0.3 0.7 0.3 1.3

Figure 28

Table 33

Sample Details

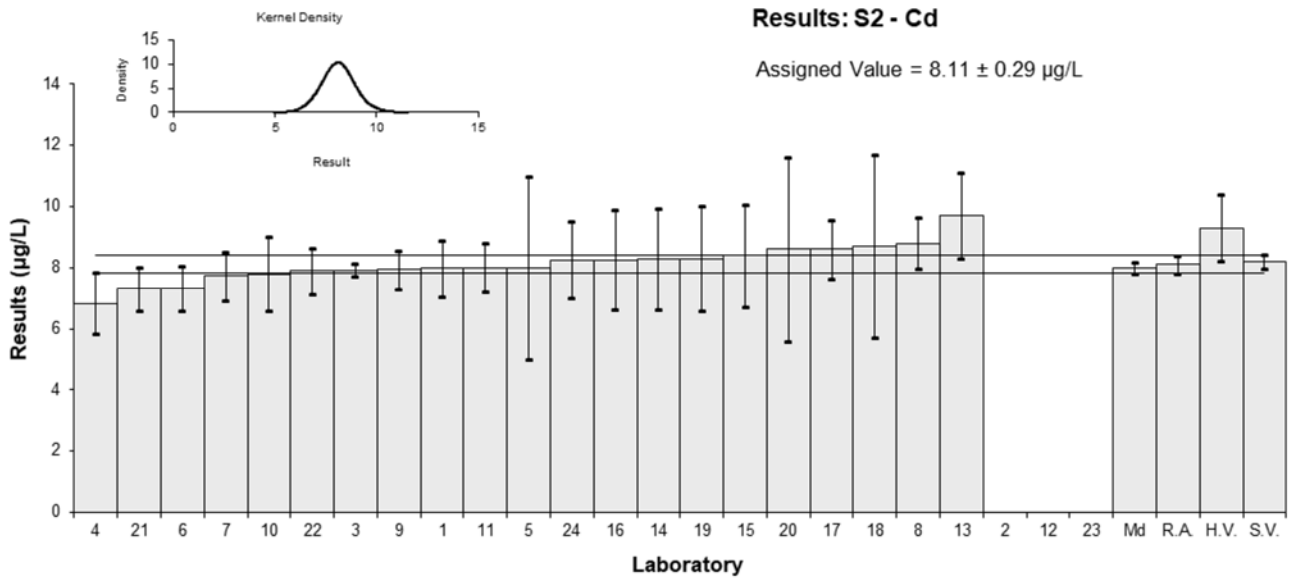
Sample No.	S2
Matrix.	Waste Water
Analyte.	Cd
Units	µg/L

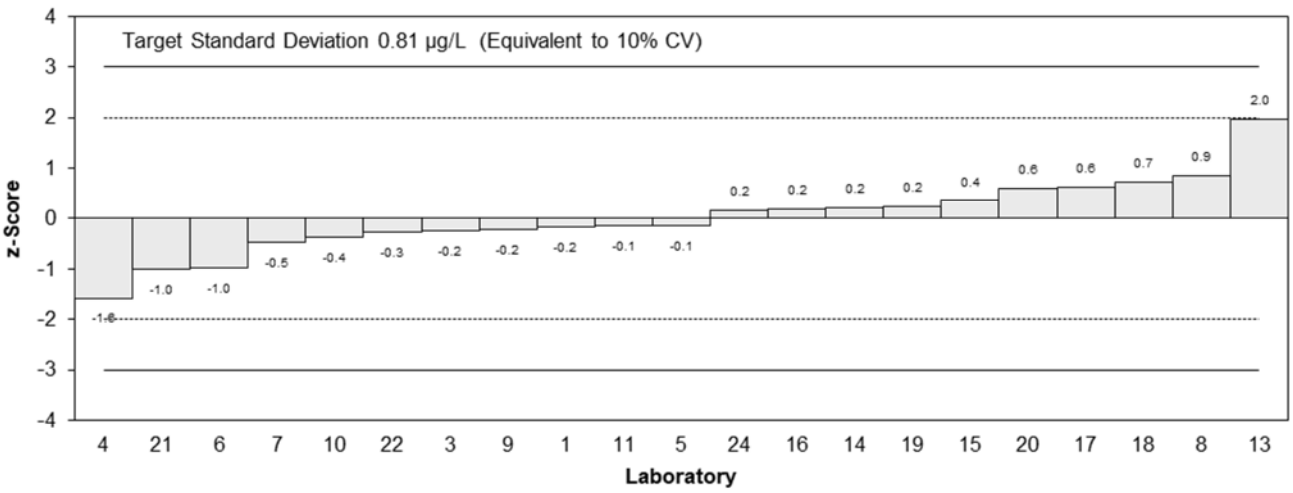
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	7.97	0.92	-0.17	-0.15
2	NR	NR		
3	7.92	0.22	-0.23	-0.52
4	6.83	1.0	-1.58	-1.23
5	8	3	-0.14	-0.04
6	7.32	0.72	-0.97	-1.02
7	7.72	0.8	-0.48	-0.46
8	8.8	0.84	0.85	0.78
9	7.93	0.64	-0.22	-0.26
10	7.8	1.2	-0.38	-0.25
11	8.0	0.8	-0.14	-0.13
12	NT	NT		
13	9.7	1.4	1.96	1.11
14	8.28	1.656	0.21	0.10
15	8.4	1.68	0.36	0.17
16	8.26	1.65	0.18	0.09
17	8.61	0.96	0.62	0.50
18	8.7	3	0.73	0.20
19	8.3	1.7	0.23	0.11
20	8.6	3	0.60	0.16
21	7.3	0.7	-1.00	-1.07
22	7.9	0.75	-0.26	-0.26
23	NT	NT		
24	8.25	1.25	0.17	0.11

Statistics

Assigned Value	8.11	0.29
Spike	8.18	0.23
Homogeneity Value	9.3	1.1
Robust Average	8.11	0.29
Median	8.00	0.19
Mean	8.12	
N	21	
Max.	9.7	
Min.	6.83	
Robust SD	0.54	
Robust CV	6.6%	


Kernel Density
Density
Result
Results: S2 - Cd
Assigned Value = 8.11 ± 0.29 µg/L
Results (µg/L)
Laboratory
4 21 6 7 10 22 3 9 1 11 5 24 16 14 19 15 20 17 18 8 13 2 12 23 Md R.A. H.V. S.V.


z-Scores: S2 - Cd
Target Standard Deviation 0.81 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
4 21 6 7 10 22 3 9 1 11 5 24 16 14 19 15 20 17 18 8 13

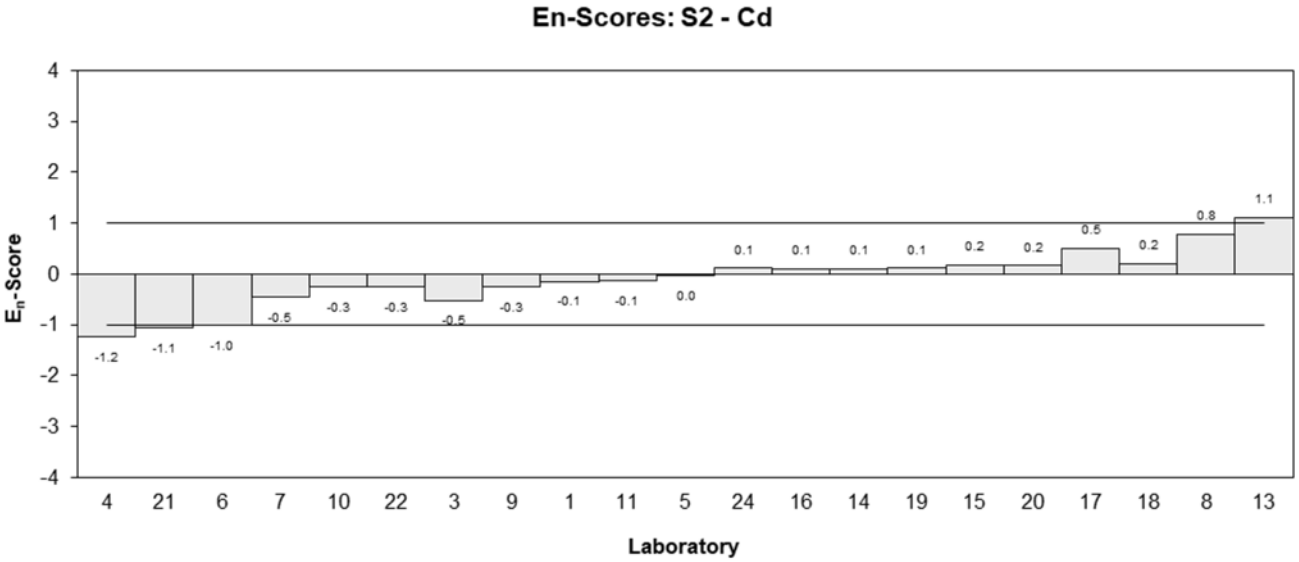

En-Scores: S2 - Cd
En-Score
Laboratory
4 21 6 7 10 22 3 9 1 11 5 24 16 14 19 15 20 17 18 8 13

Figure 29

Table 34

Sample Details

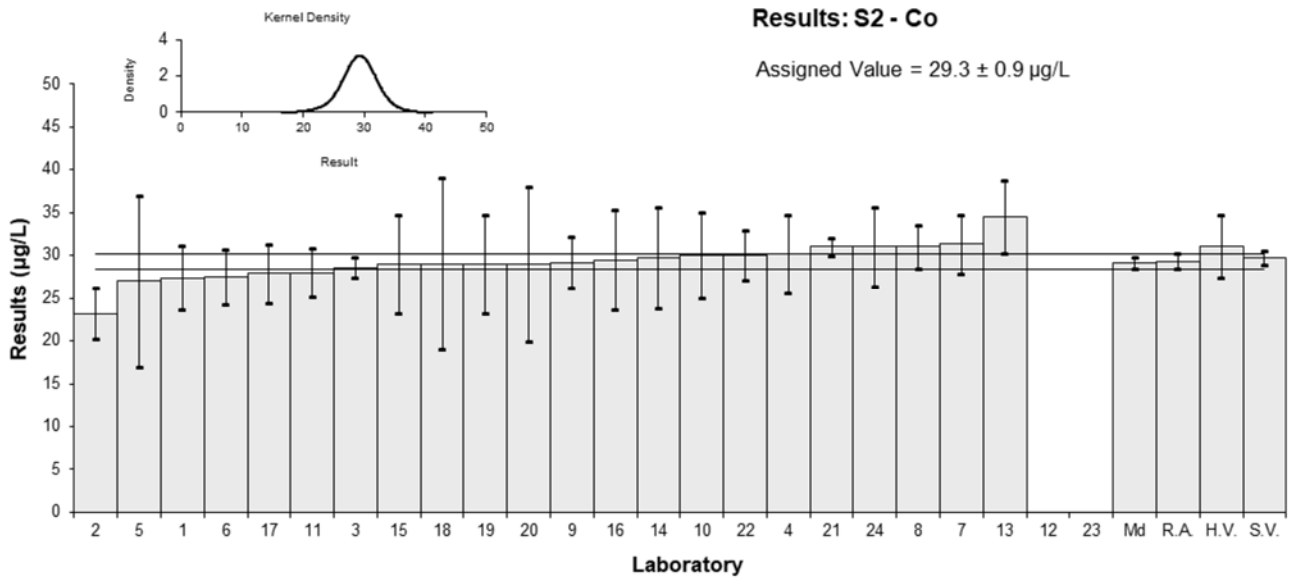
Sample No.	S2
Matrix.	Waste Water
Analyte.	Co
Units	µg/L

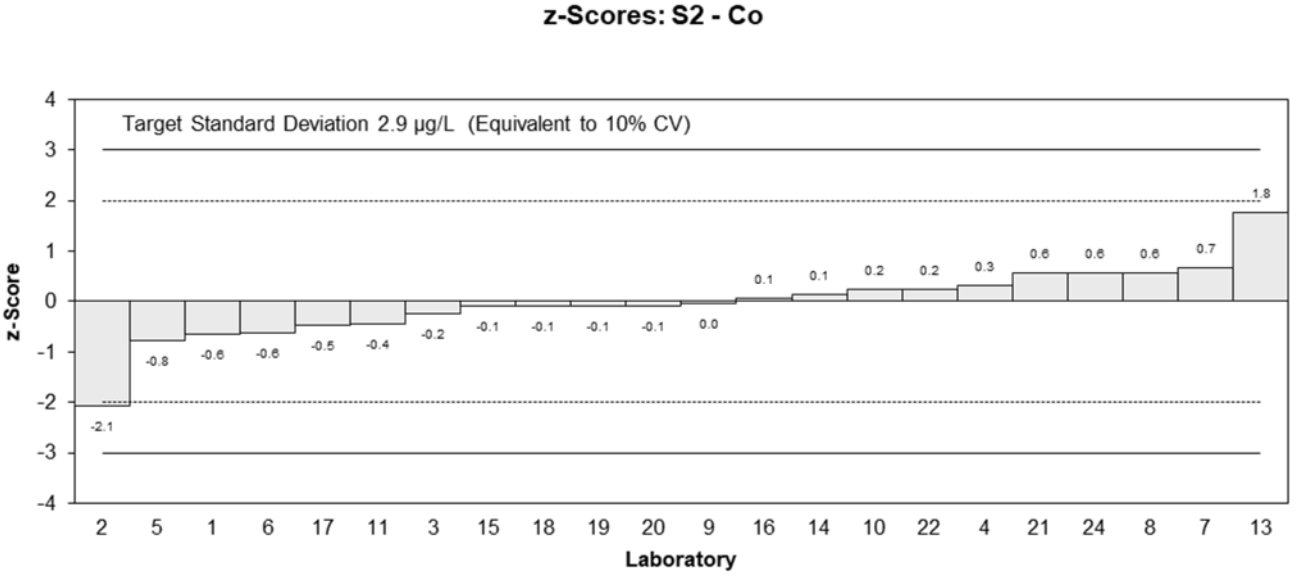
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	27.4	3.7	-0.65	-0.50
2	23.2	3	-2.08	-1.95
3	28.6	1.2	-0.24	-0.47
4	30.2	4.6	0.31	0.19
5	27	10	-0.78	-0.23
6	27.5	3.2	-0.61	-0.54
7	31.3	3.5	0.68	0.55
8	31	2.54	0.58	0.63
9	29.2	3.0	-0.03	-0.03
10	30	5.0	0.24	0.14
11	28	2.8	-0.44	-0.44
12	NT	NT		
13	34.5	4.3	1.77	1.18
14	29.7	5.94	0.14	0.07
15	29	5.77	-0.10	-0.05
16	29.5	5.9	0.07	0.03
17	27.9	3.46	-0.48	-0.39
18	29	10	-0.10	-0.03
19	29	5.8	-0.10	-0.05
20	29	9	-0.10	-0.03
21	31	1	0.58	1.26
22	30	2.9	0.24	0.23
23	NT	NT		
24	31.0	4.6	0.58	0.36

Statistics

Assigned Value	29.3	0.9
Spike	29.7	0.8
Homogeneity Value	31.1	3.7
Robust Average	29.3	0.9
Median	29.1	0.7
Mean	29.2	
N	22	
Max.	34.5	
Min.	23.2	
Robust SD	1.6	
Robust CV	5.6%	


Kernel Density
Density
Result
Results: S2 - Co
Assigned Value = 29.3 ± 0.9 µg/L
Results (µg/L)
Laboratory
2 5 1 6 17 11 3 15 18 19 20 9 16 14 10 22 4 21 24 8 7 13 12 23 Md R.A. H.V. S.V.


z-Scores: S2 - Co
Target Standard Deviation 2.9 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
2 5 1 6 17 11 3 15 18 19 20 9 16 14 10 22 4 21 24 8 7 13
-2.1 -0.8 -0.6 -0.6 -0.5 -0.4 -0.2 -0.1 -0.1 -0.1 -0.1 0.0 0.1 0.1 0.2 0.2 0.3 0.6 0.6 0.6 0.7 1.8

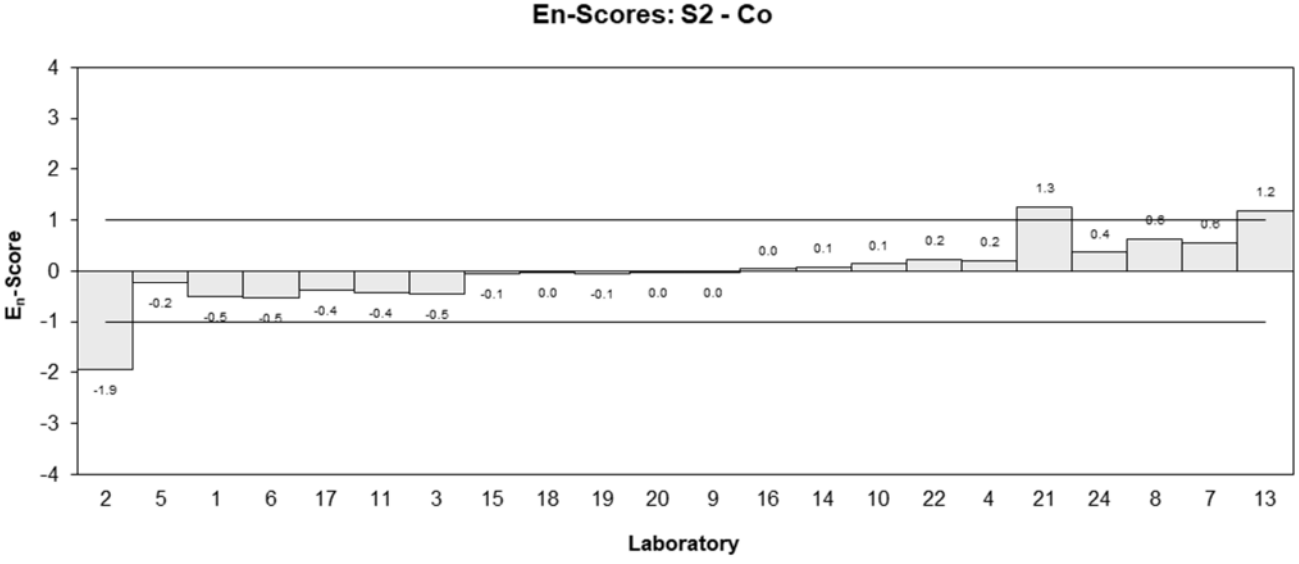

En-Scores: S2 - Co
En-Score
Laboratory
2 5 1 6 17 11 3 15 18 19 20 9 16 14 10 22 4 21 24 8 7 13
-1.9 -0.2 -0.5 -0.5 -0.4 -0.4 -0.5 -0.1 0.0 -0.1 0.0 0.0 0.0 0.1 0.1 0.2 0.2 1.3 0.4 0.6 0.6 1.2

Figure 30

Table 35

Sample Details

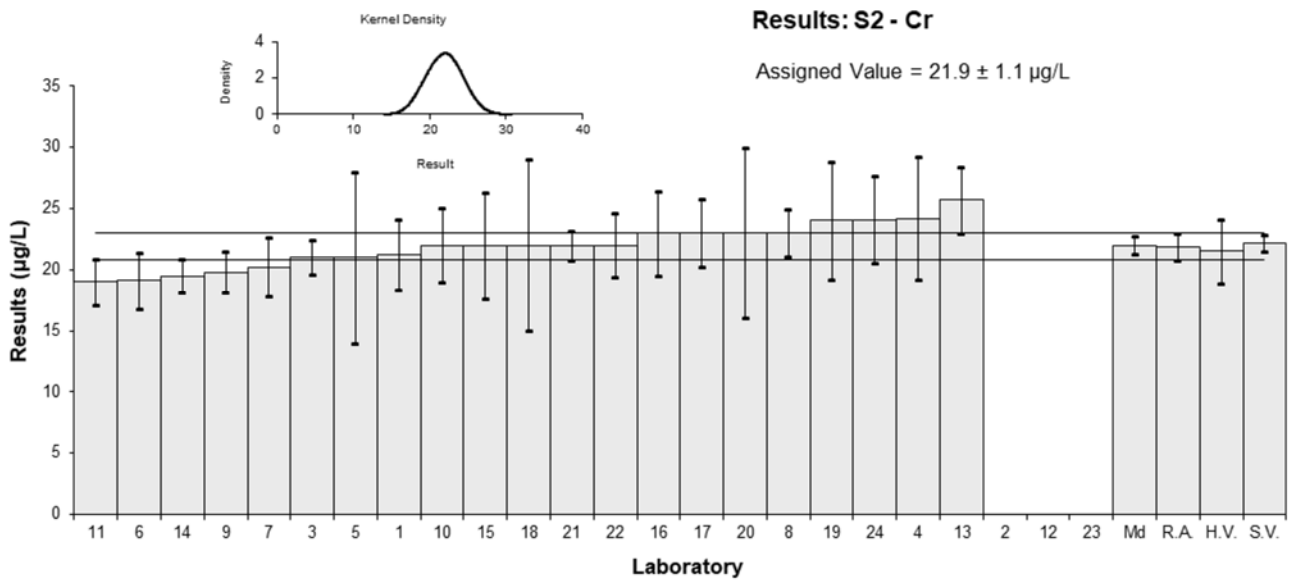
Sample No.	S2
Matrix.	Waste Water
Analyte.	Cr
Units	µg/L

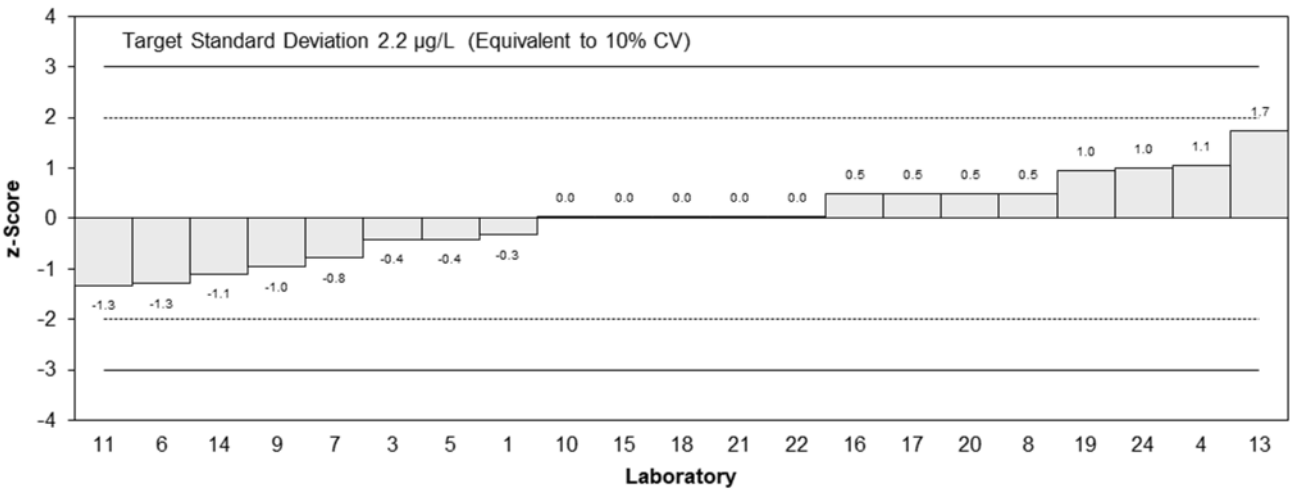
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	21.2	2.9	-0.32	-0.23
2	NR	NR		
3	21.0	1.38	-0.41	-0.51
4	24.2	5.0	1.05	0.45
5	21	7	-0.41	-0.13
6	19.1	2.3	-1.28	-1.10
7	20.2	2.4	-0.78	-0.64
8	23	1.98	0.50	0.49
9	19.8	1.7	-0.96	-1.04
10	22	3.0	0.05	0.03
11	19	1.9	-1.32	-1.32
12	NT	NT		
13	25.7	2.7	1.74	1.30
14	19.5	1.31	-1.10	-1.40
15	22	4.33	0.05	0.02
16	23.0	3.45	0.50	0.30
17	23.0	2.8	0.50	0.37
18	22	7	0.05	0.01
19	24	4.8	0.96	0.43
20	23	7	0.50	0.16
21	22	1.2	0.05	0.06
22	22	2.6	0.05	0.04
23	NT	NT		
24	24.1	3.6	1.00	0.58

Statistics

Assigned Value	21.9	1.1
Spike	22.2	0.7
Homogeneity Value	21.5	2.6
Robust Average	21.9	1.1
Median	22.0	0.7
Mean	21.9	
N	21	
Max.	25.7	
Min.	19	
Robust SD	2.0	
Robust CV	8.9%	


Kernel Density
Density
Result
Results: S2 - Cr
Assigned Value = 21.9 ± 1.1 µg/L
Results (µg/L)
Laboratory
11 6 14 9 7 3 5 1 10 15 18 21 22 16 17 20 8 19 24 4 13 2 12 23 Md R.A. H.V. S.V.


z-Scores: S2 - Cr
Target Standard Deviation 2.2 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
11 6 14 9 7 3 5 1 10 15 18 21 22 16 17 20 8 19 24 4 13

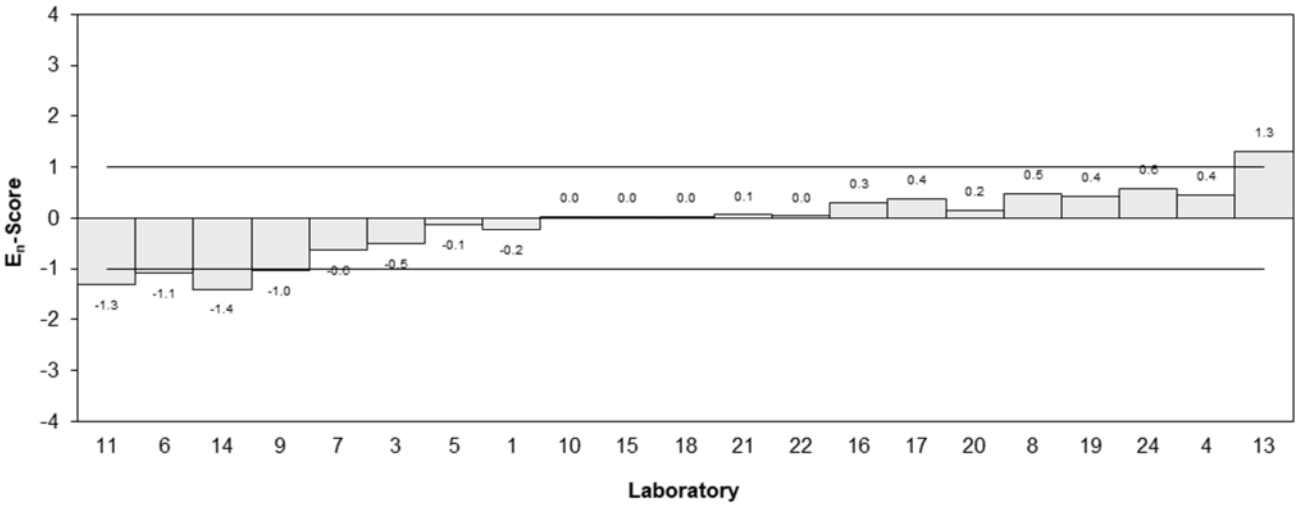

En-Scores: S2 - Cr
En-Score
Laboratory
11 6 14 9 7 3 5 1 10 15 18 21 22 16 17 20 8 19 24 4 13

Figure 31

Table 36

Sample Details

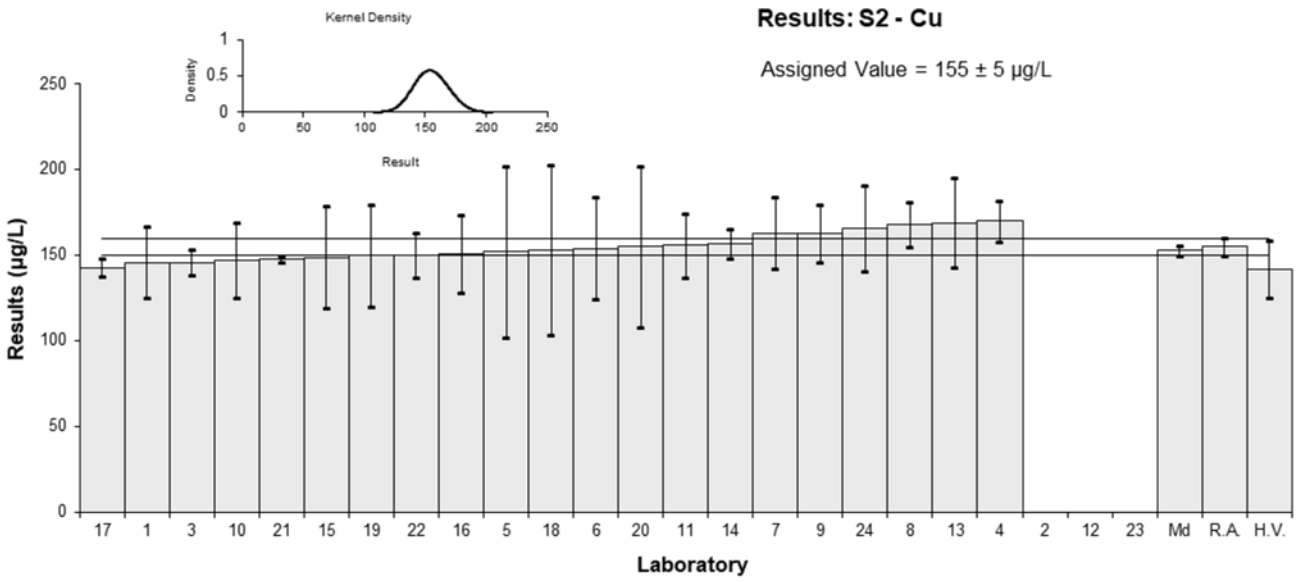
Sample No.	S2
Matrix.	Waste Water
Analyte.	Cu
Units	µg/L

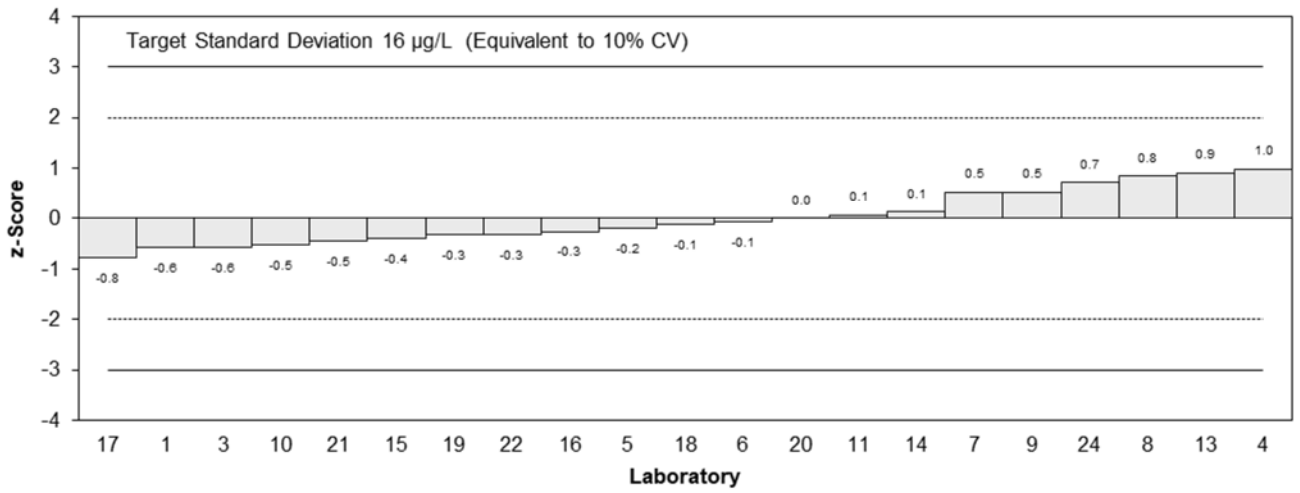
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	146	21	-0.58	-0.42
2	NR	NR		
3	146	7.31	-0.58	-1.02
4	170	12	0.97	1.15
5	152	50	-0.19	-0.06
6	154	30	-0.06	-0.03
7	163	21	0.52	0.37
8	168	13.3	0.84	0.91
9	163	17	0.52	0.45
10	147	22	-0.52	-0.35
11	156	18.7	0.06	0.05
12	NT	NT		
13	169	26	0.90	0.53
14	157	8.43	0.13	0.20
15	149	30	-0.39	-0.20
16	151	22.7	-0.26	-0.17
17	143	5	-0.77	-1.70
18	153.1	50	-0.12	-0.04
19	150	30	-0.32	-0.16
20	155	47	0.00	0.00
21	148	2	-0.45	-1.30
22	150	13	-0.32	-0.36
23	NT	NT		
24	166	25	0.71	0.43

Statistics

Assigned Value	155	5
Spike	Not Spiked	
Homogeneity Value	142	17
Robust Average	155	5
Median	153	3
Mean	155	
N	21	
Max.	170	
Min.	143	
Robust SD	9.3	
Robust CV	6%	


Kernel Density
Density
Result
Results: S2 - Cu
Assigned Value = 155 ± 5 µg/L
Results (µg/L)
Laboratory
17 1 3 10 21 15 19 22 16 5 18 6 20 11 14 7 9 24 8 13 4 2 12 23 Md R.A. H.V.


z-Scores: S2 - Cu
Target Standard Deviation 16 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
17 1 3 10 21 15 19 22 16 5 18 6 20 11 14 7 9 24 8 13 4

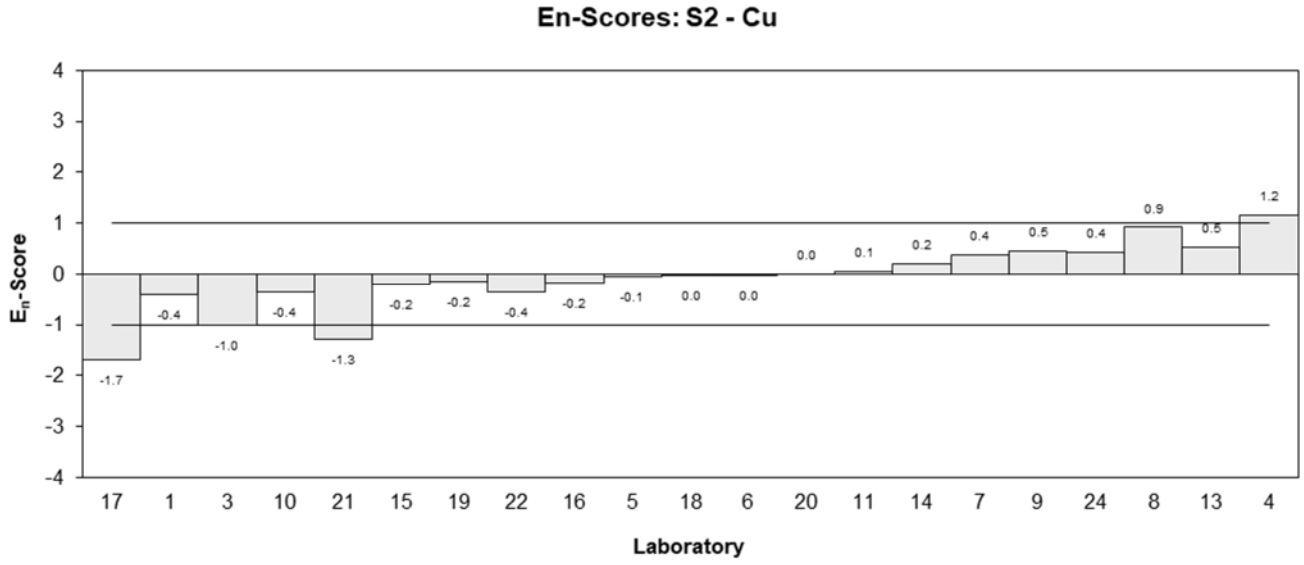

En-Scores: S2 - Cu
En-Score
Laboratory
17 1 3 10 21 15 19 22 16 5 18 6 20 11 14 7 9 24 8 13 4

Figure 32

Table 37

Sample Details

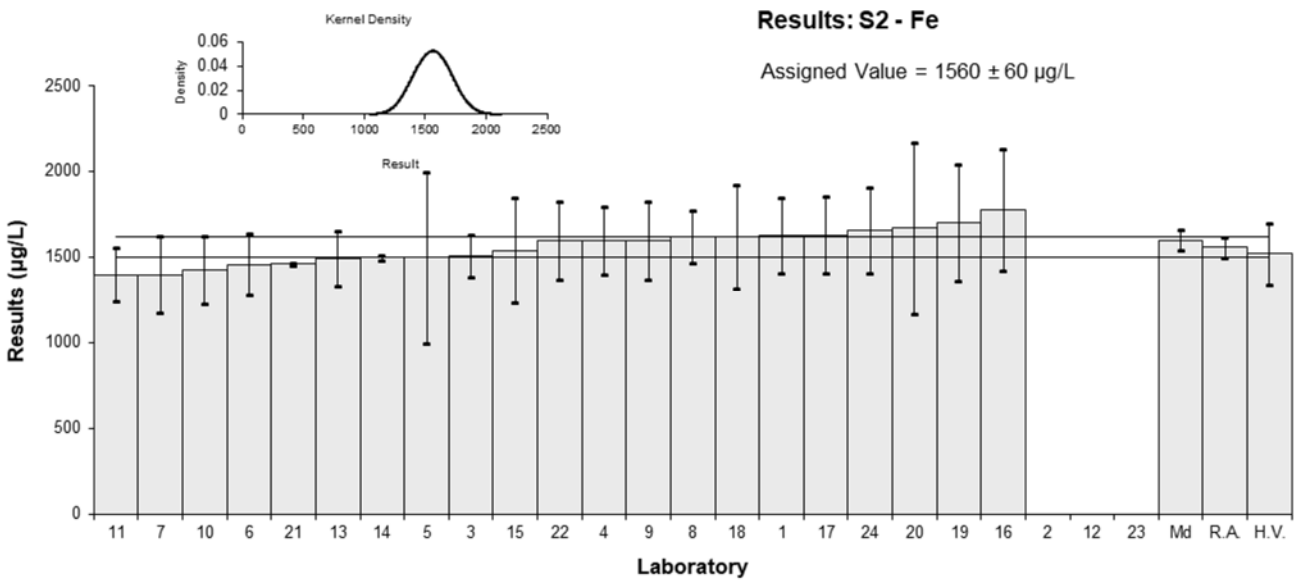
Sample No.	S2
Matrix.	Waste Water
Analyte.	Fe
Units	µg/L

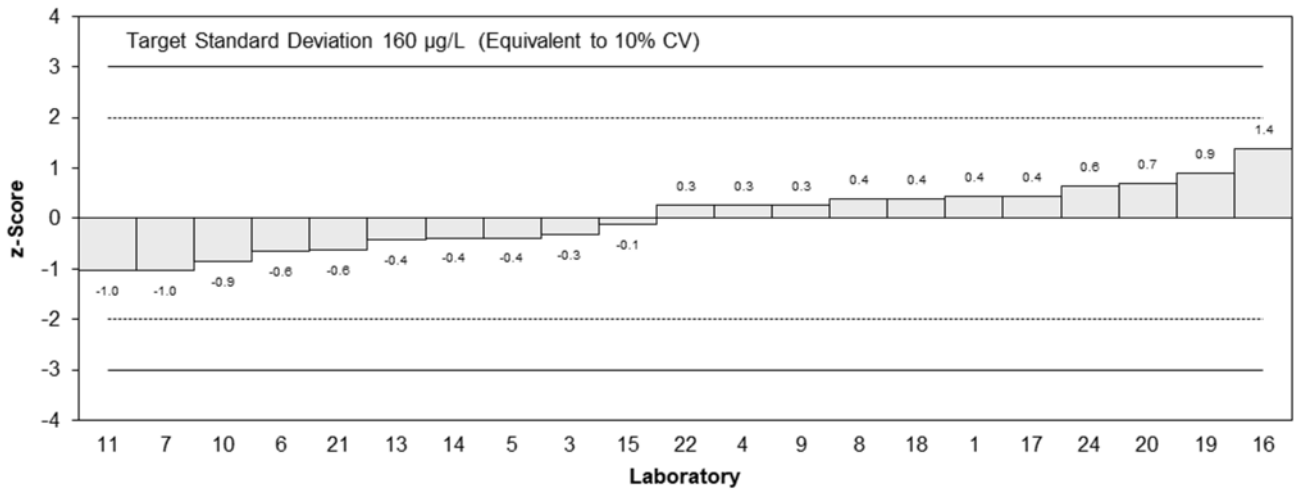
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	1630	220	0.45	0.31
2	NR	NR		
3	1510	122	-0.32	-0.37
4	1600	200	0.26	0.19
5	1500	500	-0.38	-0.12
6	1460	180	-0.64	-0.53
7	1400	221	-1.03	-0.70
8	1620	152	0.38	0.37
9	1600	230	0.26	0.17
10	1427	200	-0.85	-0.64
11	1400	154	-1.03	-0.97
12	NT	NT		
13	1495	160	-0.42	-0.38
14	1500	14.8	-0.38	-0.97
15	1541	308	-0.12	-0.06
16	1775	355	1.38	0.60
17	1630	225	0.45	0.30
18	1621	300	0.39	0.20
19	1700	340	0.90	0.41
20	1670	501	0.71	0.22
21	1462	7	-0.63	-1.62
22	1600	230	0.26	0.17
23	NT	NT		
24	1660	250	0.64	0.39

Statistics

Assigned Value	1560	60
Spike	Not Spiked	
Homogeneity Value	1520	180
Robust Average	1560	60
Median	1600	61
Mean	1560	
N	21	
Max.	1775	
Min.	1400	
Robust SD	110	
Robust CV	7.2%	


Kernel Density
Density
Result
Results: S2 - Fe
Assigned Value = 1560 ± 60 µg/L
Results (µg/L)
Laboratory
11 7 10 6 21 13 14 5 3 15 22 4 9 8 18 1 17 24 20 19 16 2 12 23 Md R.A. H.V.


z-Scores: S2 - Fe
Target Standard Deviation 160 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
11 7 10 6 21 13 14 5 3 15 22 4 9 8 18 1 17 24 20 19 16

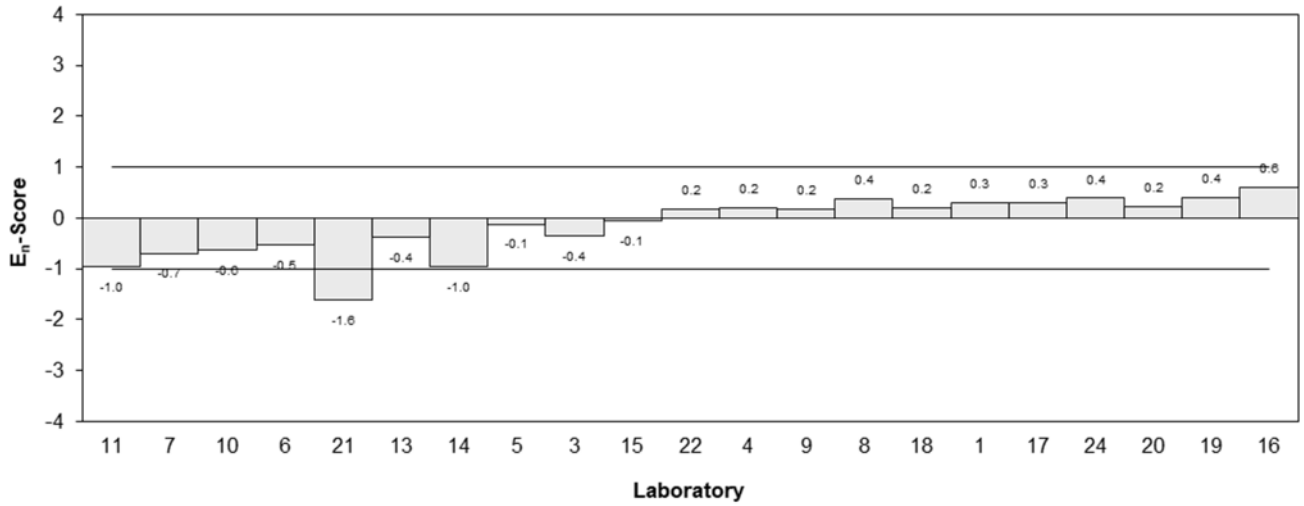

En-Scores: S2 - Fe
En-Score
Laboratory
11 7 10 6 21 13 14 5 3 15 22 4 9 8 18 1 17 24 20 19 16

Figure 33

Table 38

Sample Details

Sample No.	S2
Matrix.	Waste Water
Analyte.	Hg
Units	µg/L

Participant Results

Lab Code	Result	Uncertainty
1	0.86	0.11
2	1.12	1
3	0.913	0.222
4	1.0	0.1
5	0.84	0.3
6	0.9	0.1
7	0.8	0.1
8	0.6	0.1
9	< 2.1	1.4
10	0.8	0.2
11	0.8	0.14
12	NT	NT
13	1.1	0.1
14	0.8	0.16
15	0.96	0.19
16	0.935	.187
17	0.927	0.159
18	0.86	0.3
19	NR	NR
20	0.98	0.4
21	0.54	0.08
22	0.85	0.14
23	NT	NT
24	0.86	0.12

Statistics

Assigned Value	Not Set	
Spike	2.18	0.06
Homogeneity Value	0.88	0.11
Robust Average	0.880	0.060
Median	0.860	0.042
Mean	0.872	
N	20	
Max.	1.12	
Min.	0.54	
Robust SD	0.11	
Robust CV	12%	

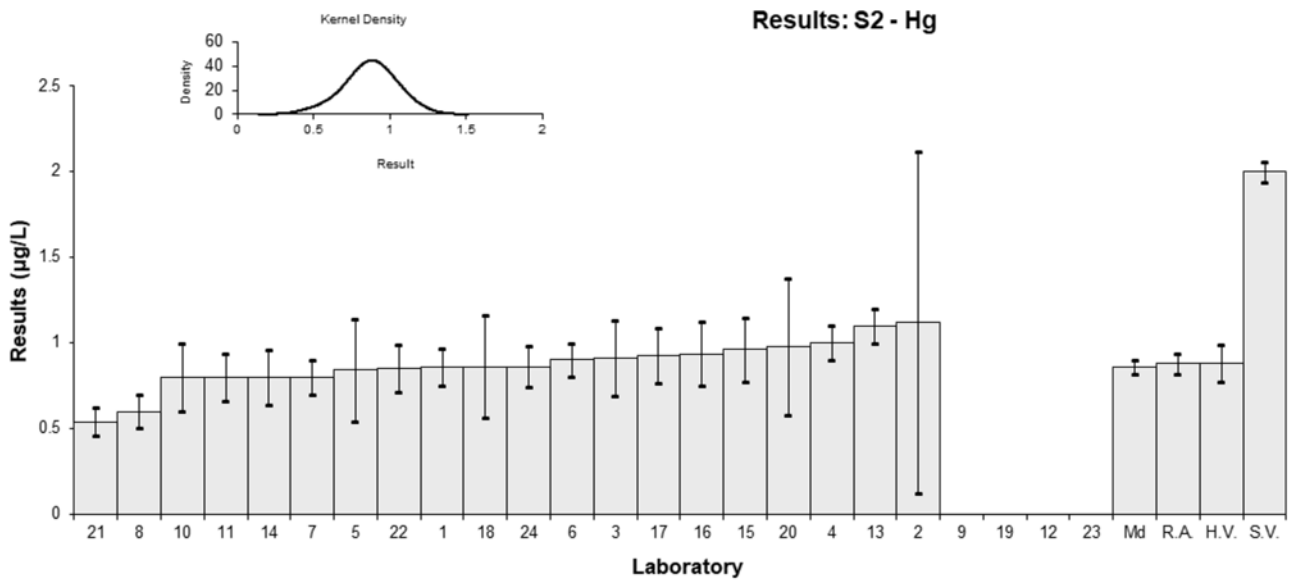

Results: S2 - Hg
Kernel Density
Density
Result
Results (µg/L)
Laboratory
21 8 10 11 14 7 5 22 1 18 24 6 3 17 16 15 20 4 13 2 9 19 12 23 Md R.A. H.V. S.V.

Figure 34

Table 39

Sample Details

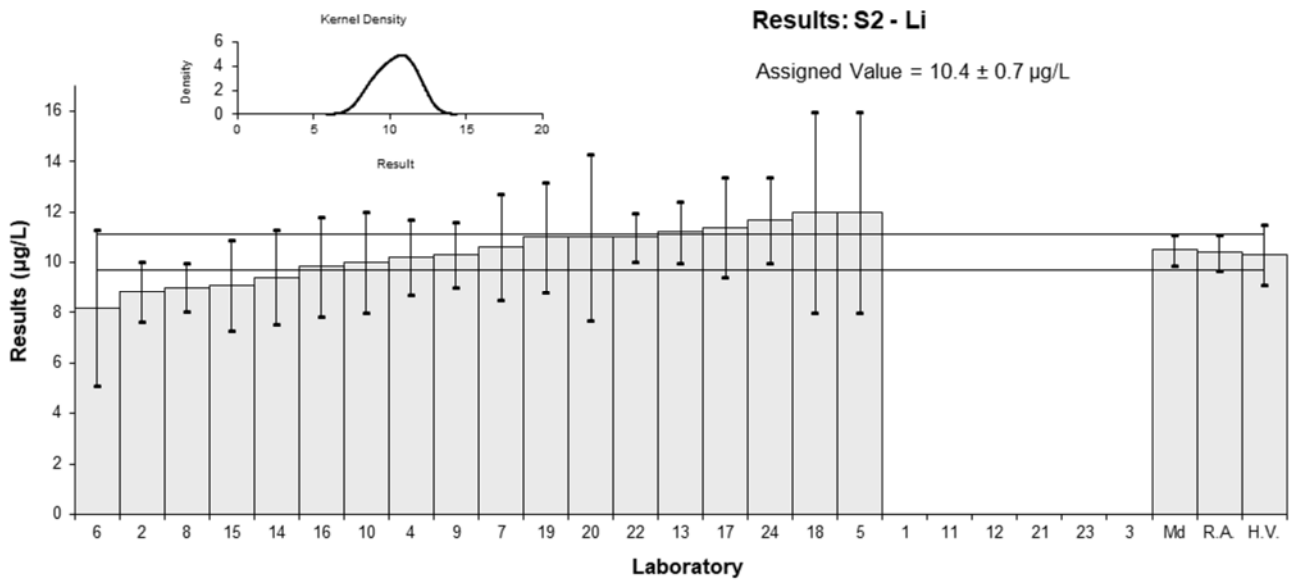
Sample No.	S2
Matrix.	Waste Water
Analyte.	Li
Units	µg/L

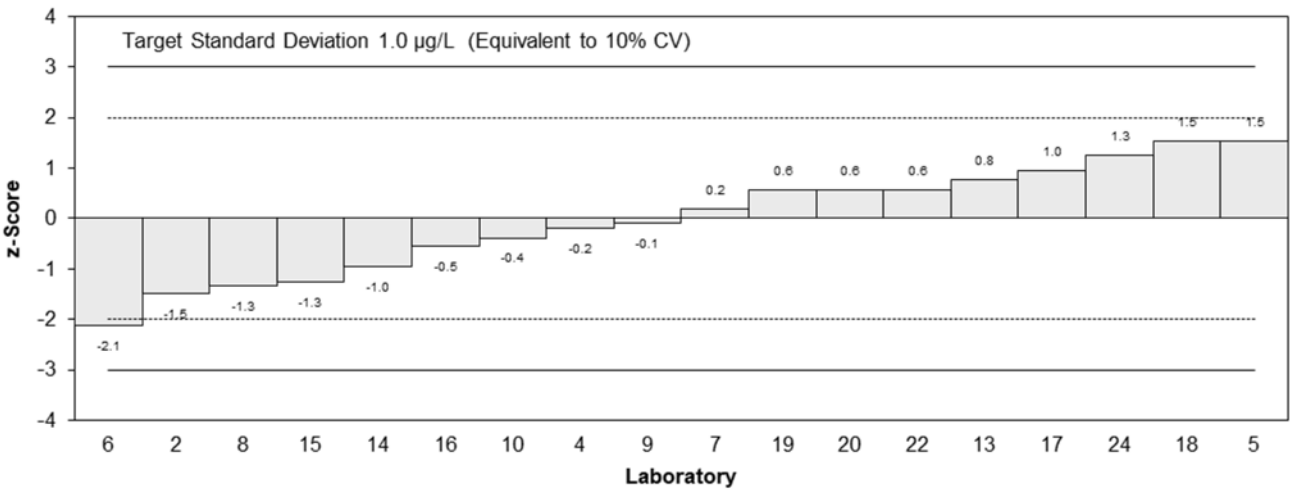
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	8.85	1.2	-1.49	-1.12
3	NT	NT		
4	10.2	1.5	-0.19	-0.12
5	12	4	1.54	0.39
6	8.2	3.1	-2.12	-0.69
7	10.6	2.1	0.19	0.09
8	9	0.97	-1.35	-1.17
9	10.3	1.3	-0.10	-0.07
10	10	2.0	-0.38	-0.19
11	NT	NT		
12	NT	NT		
13	11.2	1.2	0.77	0.58
14	9.4	1.88	-0.96	-0.50
15	9.1	1.8	-1.25	-0.67
16	9.83	1.97	-0.55	-0.27
17	11.4	2.0	0.96	0.47
18	12	4	1.54	0.39
19	11	2.2	0.58	0.26
20	11	3.3	0.58	0.18
21	NT	NT		
22	11	0.95	0.58	0.51
23	NT	NT		
24	11.7	1.7	1.25	0.71

Statistics

Assigned Value	10.4	0.7
Spike	Not Spiked	
Homogeneity Value	10.3	1.2
Robust Average	10.4	0.7
Median	10.5	0.6
Mean	10.4	
N	18	
Max.	12	
Min.	8.2	
Robust SD	1.3	
Robust CV	12%	


Kernel Density
Density
Result
Results: S2 - Li
Assigned Value = 10.4 ± 0.7 µg/L
Results (µg/L)
Laboratory
6 2 8 15 14 16 10 4 9 7 19 20 22 13 17 24 18 5 1 11 12 21 23 3 Md R.A. H.V.


z-Scores: S2 - Li
Target Standard Deviation 1.0 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
6 2 8 15 14 16 10 4 9 7 19 20 22 13 17 24 18 5
-2.1 -1.5 -1.3 -1.3 -1.0 -0.5 -0.4 -0.2 -0.1 0.2 0.6 0.6 0.6 0.8 1.0 1.3 1.5 1.5

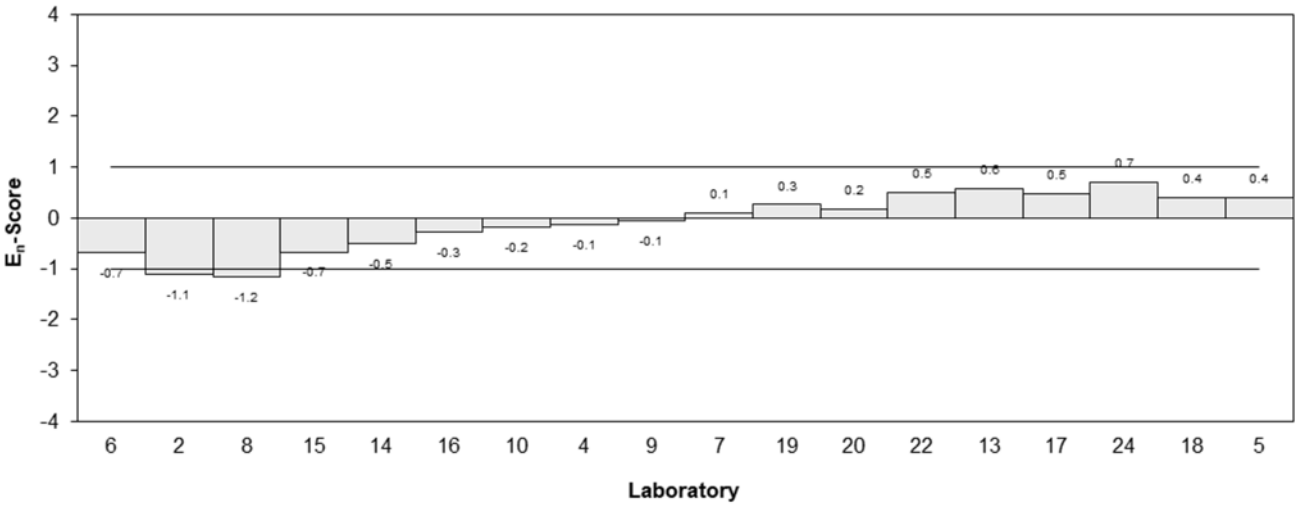

En-Scores: S2 - Li
En-Score
Laboratory
6 2 8 15 14 16 10 4 9 7 19 20 22 13 17 24 18 5
-0.7 -1.1 -1.2 -0.7 -0.5 -0.3 -0.2 -0.1 -0.1 0.1 0.3 0.2 0.5 0.6 0.5 0.7 0.4 0.4

Figure 35

Table 40

Sample Details

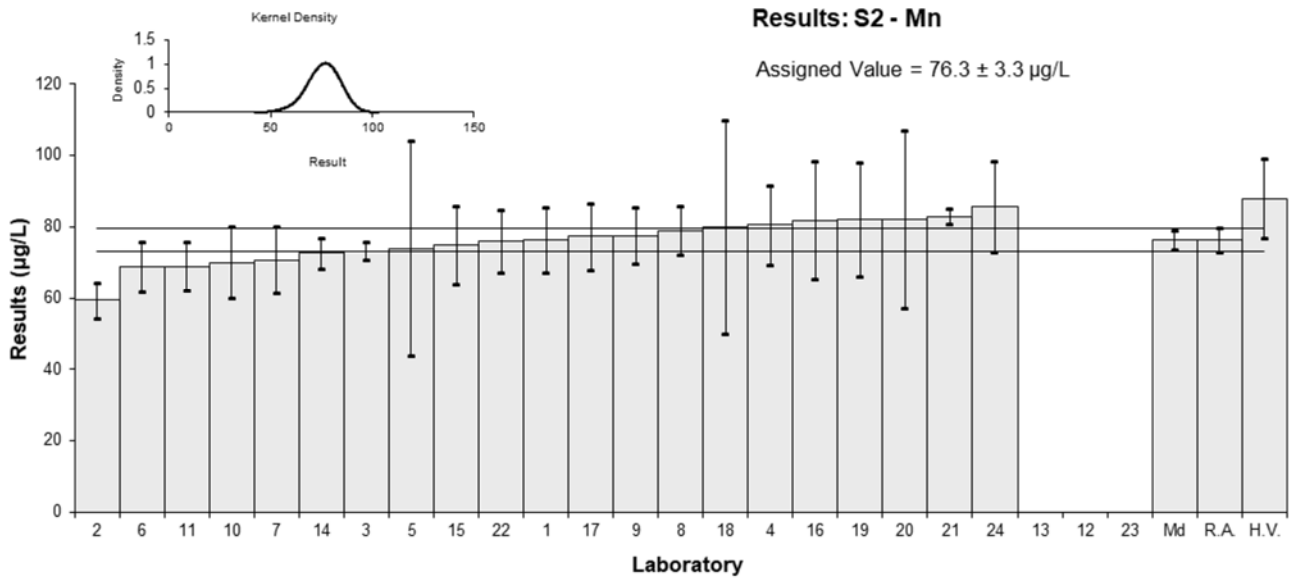
Sample No.	S2
Matrix.	Waste Water
Analyte.	Mn
Units	µg/L

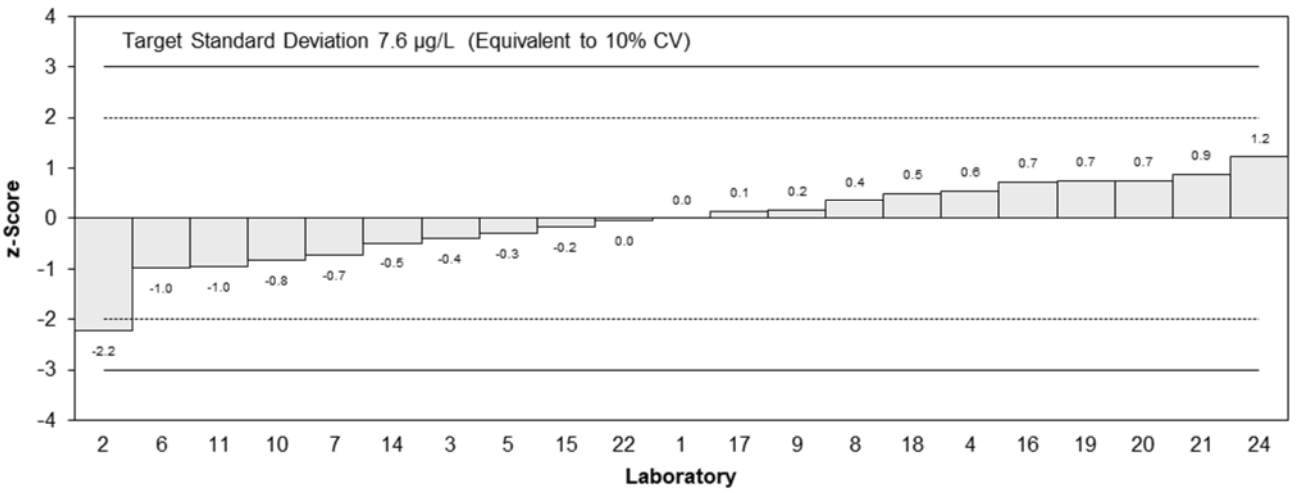
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	76.3	9.2	0.00	0.00
2	59.4	5	-2.21	-2.82
3	73.3	2.57	-0.39	-0.72
4	80.5	11	0.55	0.37
5	74	30	-0.30	-0.08
6	68.8	6.9	-0.98	-0.98
7	70.7	9.3	-0.73	-0.57
8	79	6.83	0.35	0.36
9	77.6	7.8	0.17	0.15
10	70	10	-0.83	-0.60
11	69	6.9	-0.96	-0.95
12	NT	NT		
13	NR	NR		
14	72.6	4.45	-0.48	-0.67
15	75	11	-0.17	-0.11
16	81.9	16.4	0.73	0.33
17	77.3	9.4	0.13	0.10
18	80	30	0.48	0.12
19	82	16	0.75	0.35
20	82	25	0.75	0.23
21	83	2	0.88	1.74
22	76	8.9	-0.04	-0.03
23	NT	NT		
24	85.6	12.8	1.22	0.70

Statistics

Assigned Value	76.3	3.3
Spike	Not Spiked	
Homogeneity Value	88	11
Robust Average	76.3	3.3
Median	76.3	2.8
Mean	75.9	
N	21	
Max.	85.6	
Min.	59.4	
Robust SD	6.0	
Robust CV	7.8%	


Results: S2 - Mn
Assigned Value = 76.3 ± 3.3 µg/L
Kernel Density
Density
Result
Results (µg/L)
Laboratory
2 6 11 10 7 14 3 5 15 22 1 17 9 8 18 4 16 19 20 21 24 13 12 23 Md R.A. H.V.


z-Scores: S2 - Mn
Target Standard Deviation 7.6 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
2 6 11 10 7 14 3 5 15 22 1 17 9 8 18 4 16 19 20 21 24

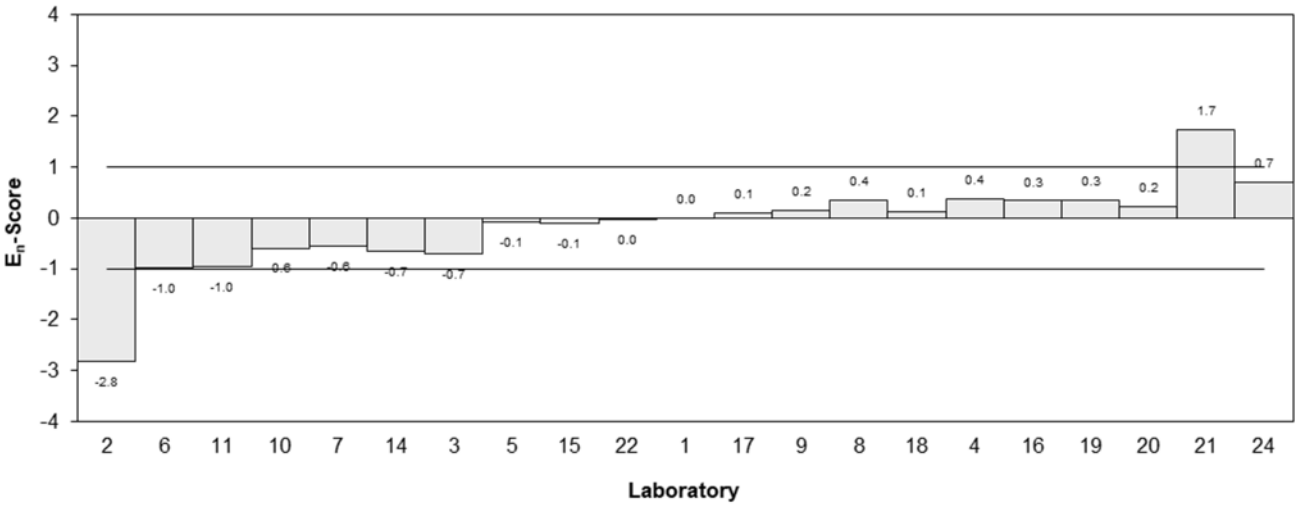

En-Scores: S2 - Mn
En-Score
Laboratory
2 6 11 10 7 14 3 5 15 22 1 17 9 8 18 4 16 19 20 21 24

Figure 36

Table 41

Sample Details

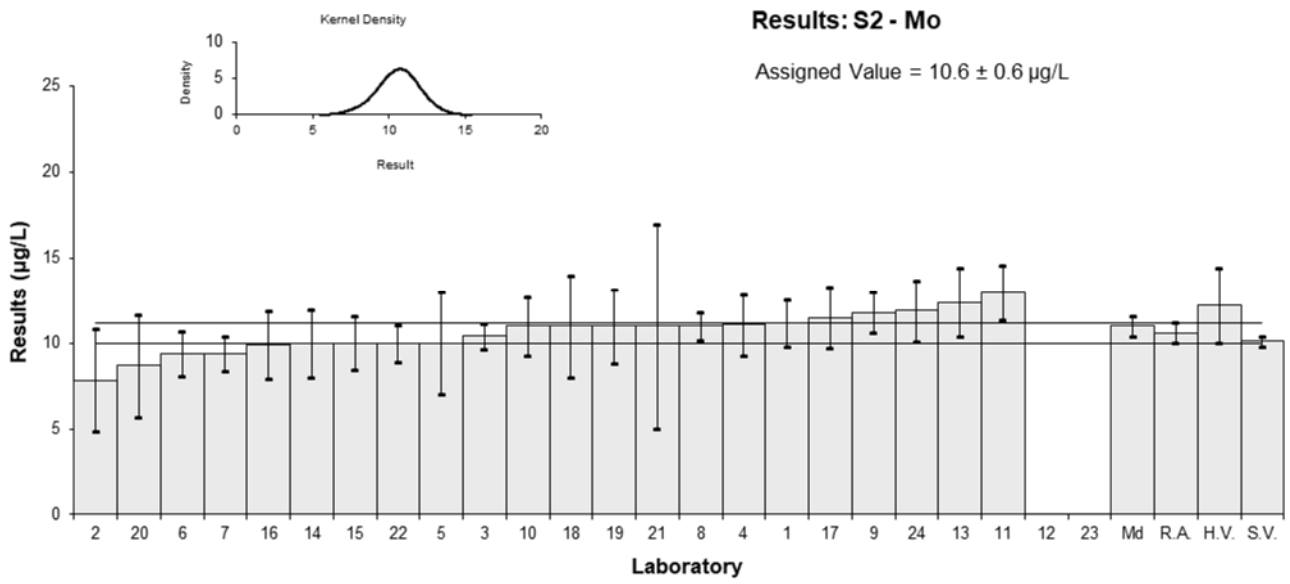
Sample No.	S2
Matrix.	Waste Water
Analyte.	Mo
Units	µg/L

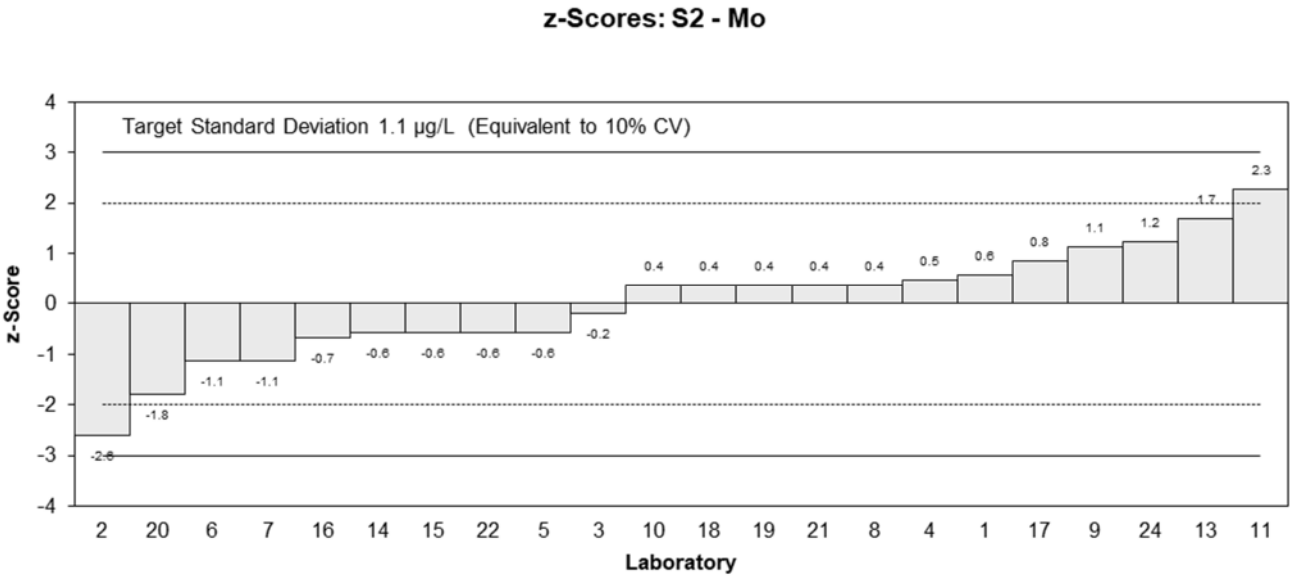
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	11.2	1.4	0.57	0.39
2	7.83	3	-2.61	-0.91
3	10.4	0.744	-0.19	-0.21
4	11.1	1.8	0.47	0.26
5	10	3	-0.57	-0.20
6	9.4	1.3	-1.13	-0.84
7	9.4	1.0	-1.13	-1.03
8	11	0.84	0.38	0.39
9	11.8	1.2	1.13	0.89
10	11	1.7	0.38	0.22
11	13	1.6	2.26	1.40
12	NT	NT		
13	12.4	2.0	1.70	0.86
14	10	2	-0.57	-0.29
15	10	1.56	-0.57	-0.36
16	9.88	1.98	-0.68	-0.35
17	11.5	1.8	0.85	0.47
18	11	3	0.38	0.13
19	11	2.2	0.38	0.18
20	8.7	3	-1.79	-0.62
21	11	6	0.38	0.07
22	10	1.1	-0.57	-0.48
23	NT	NT		
24	11.9	1.8	1.23	0.69

Statistics

Assigned Value	10.6	0.6
Spike	10.1	0.3
Homogeneity Value	12.2	2.2
Robust Average	10.6	0.6
Median	11.0	0.6
Mean	10.6	
N	22	
Max.	13	
Min.	7.83	
Robust SD	1.2	
Robust CV	11%	


Kernel Density
Density
Result
Results: S2 - Mo
Assigned Value = 10.6 ± 0.6 µg/L
Results (µg/L)
2 20 6 7 16 14 15 22 5 3 10 18 19 21 8 4 1 17 9 24 13 11 12 23 Md R.A. H.V. S.V.
Laboratory


z-Scores: S2 - Mo
Target Standard Deviation 1.1 µg/L (Equivalent to 10% CV)
z-Score
2 20 6 7 16 14 15 22 5 3 10 18 19 21 8 4 1 17 9 24 13 11
Laboratory

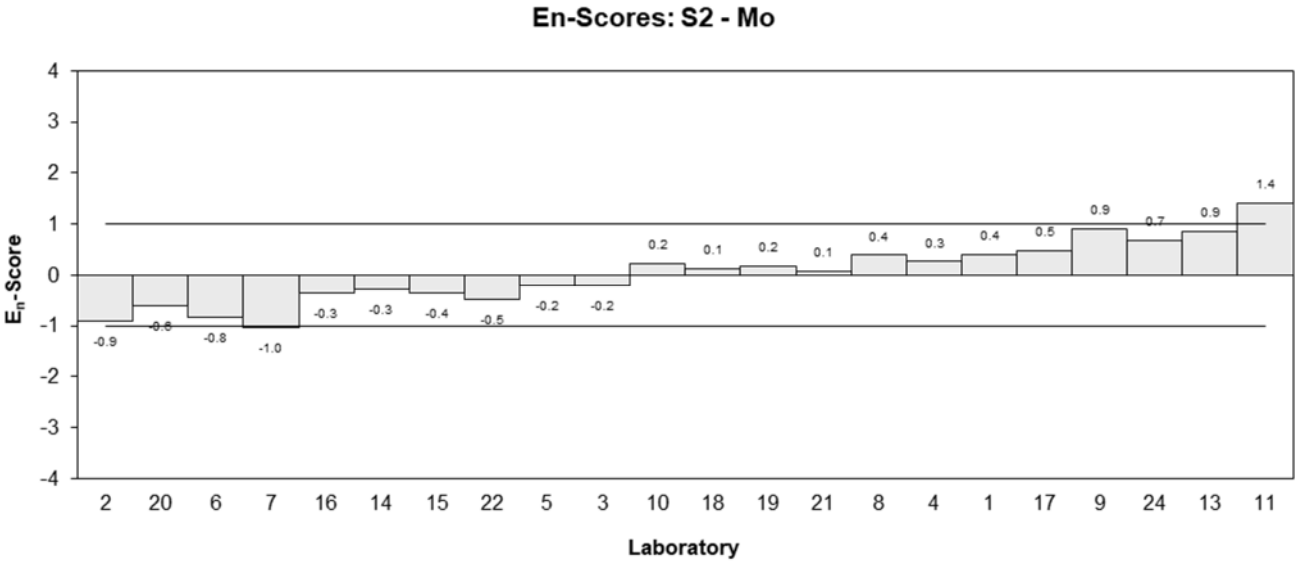

En-Scores: S2 - Mo
En-Score
2 20 6 7 16 14 15 22 5 3 10 18 19 21 8 4 1 17 9 24 13 11
Laboratory

Figure 37

Table 42

Sample Details

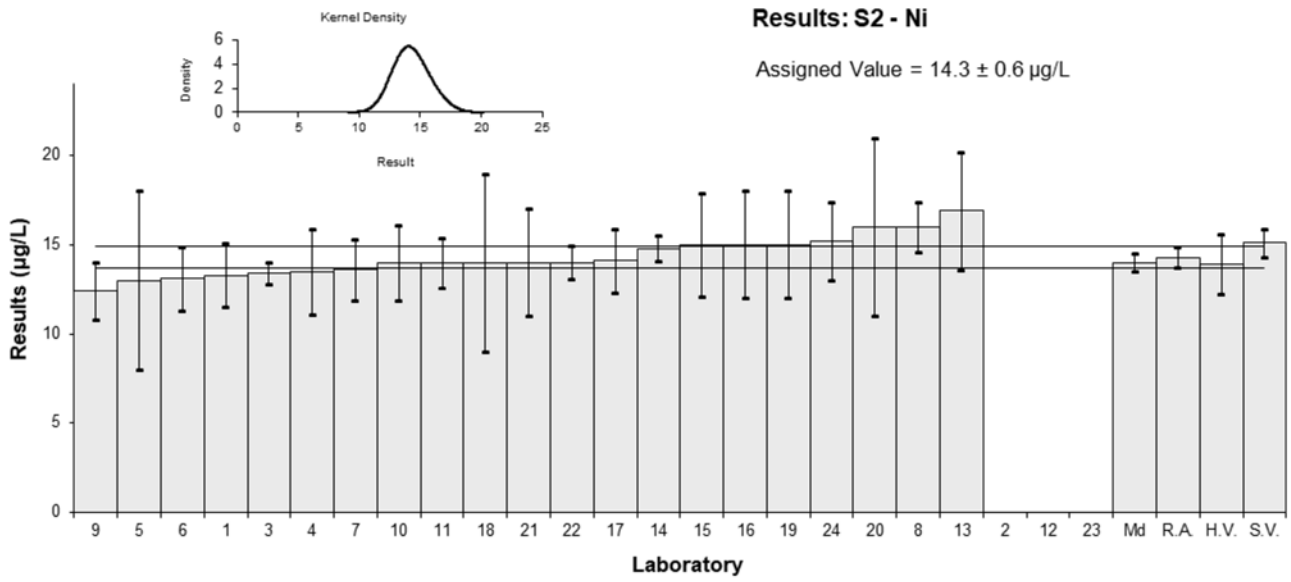
Sample No.	S2
Matrix.	Waste Water
Analyte.	Ni
Units	µg/L

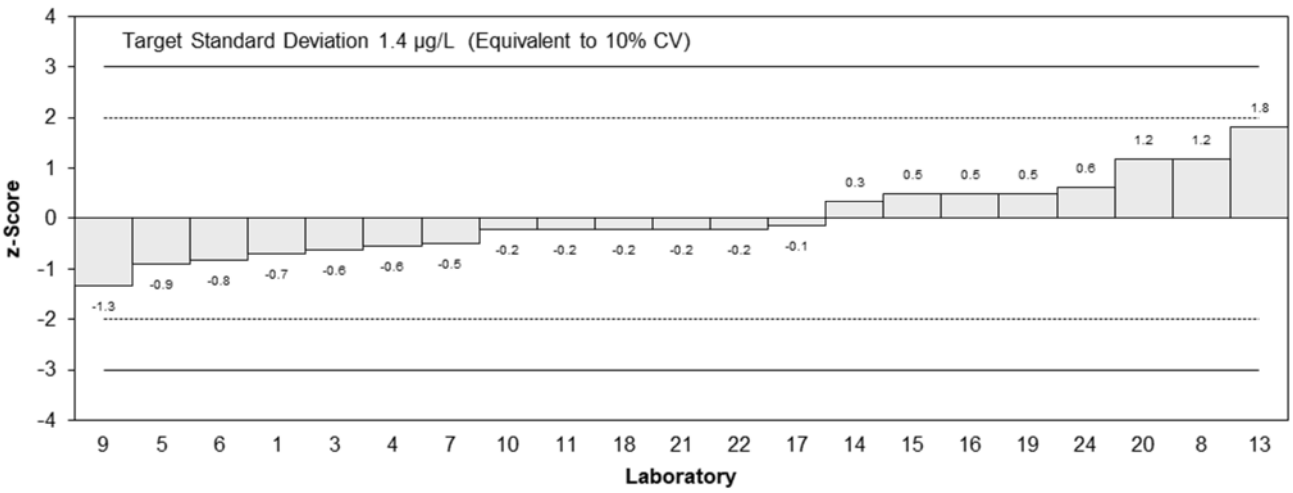
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	13.3	1.8	-0.70	-0.53
2	NR	NR		
3	13.4	0.606	-0.63	-1.06
4	13.5	2.4	-0.56	-0.32
5	13	5	-0.91	-0.26
6	13.1	1.8	-0.84	-0.63
7	13.6	1.7	-0.49	-0.39
8	16	1.42	1.19	1.10
9	12.4	1.6	-1.33	-1.11
10	14	2.1	-0.21	-0.14
11	14	1.4	-0.21	-0.20
12	NT	NT		
13	16.9	3.3	1.82	0.78
14	14.8	0.739	0.35	0.53
15	15	2.92	0.49	0.23
16	15	3.0	0.49	0.23
17	14.1	1.8	-0.14	-0.11
18	14	5	-0.21	-0.06
19	15	3.0	0.49	0.23
20	16	5	1.19	0.34
21	14	3	-0.21	-0.10
22	14	0.93	-0.21	-0.27
23	NT	NT		
24	15.2	2.2	0.63	0.39

Statistics

Assigned Value	14.3	0.6
Spike	15.1	0.8
Homogeneity Value	13.9	1.7
Robust Average	14.3	0.6
Median	14.0	0.5
Mean	14.3	
N	21	
Max.	16.9	
Min.	12.4	
Robust SD	1.2	
Robust CV	8.1%	


Kernel Density
Density
Result
Results: S2 - Ni
Assigned Value = 14.3 ± 0.6 µg/L
Results (µg/L)
Laboratory
9 5 6 1 3 4 7 10 11 18 21 22 17 14 15 16 19 24 20 8 13 2 12 23 Md R.A. H.V. S.V.


z-Scores: S2 - Ni
Target Standard Deviation 1.4 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
9 5 6 1 3 4 7 10 11 18 21 22 17 14 15 16 19 24 20 8 13

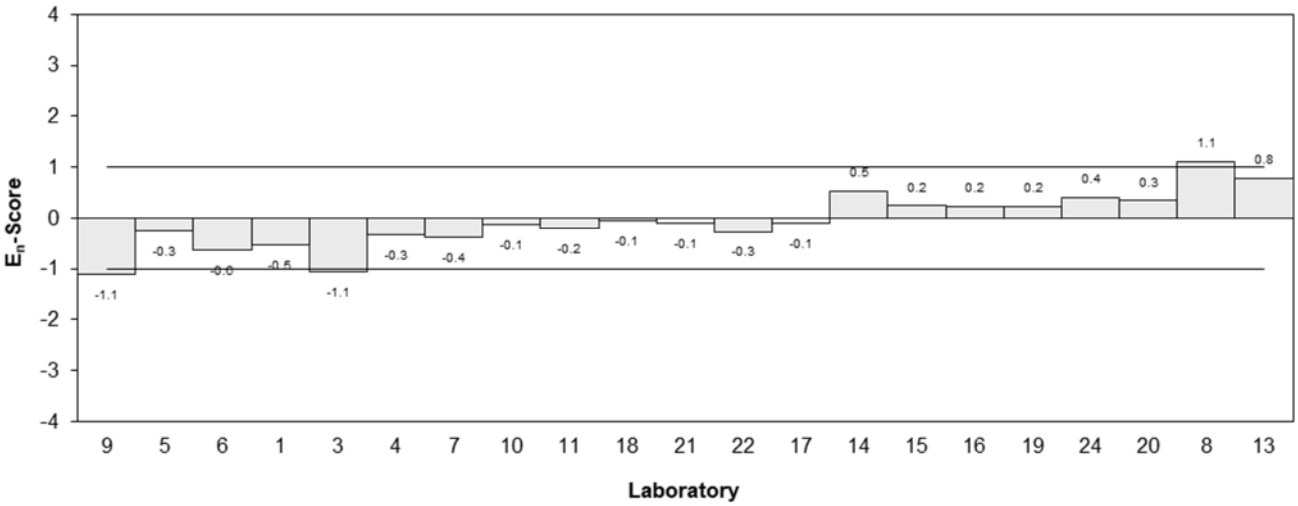

En-Scores: S2 - Ni
En-Score
Laboratory
9 5 6 1 3 4 7 10 11 18 21 22 17 14 15 16 19 24 20 8 13

Figure 38

Table 43

Sample Details

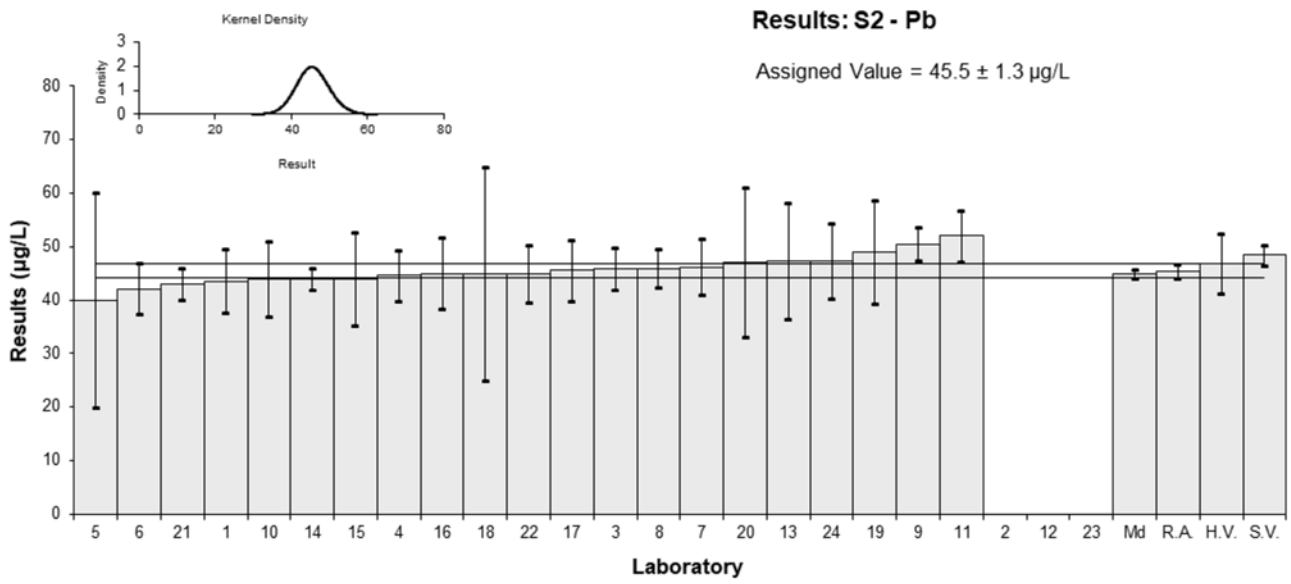
Sample No.	S2
Matrix.	Waste Water
Analyte.	Pb
Units	µg/L

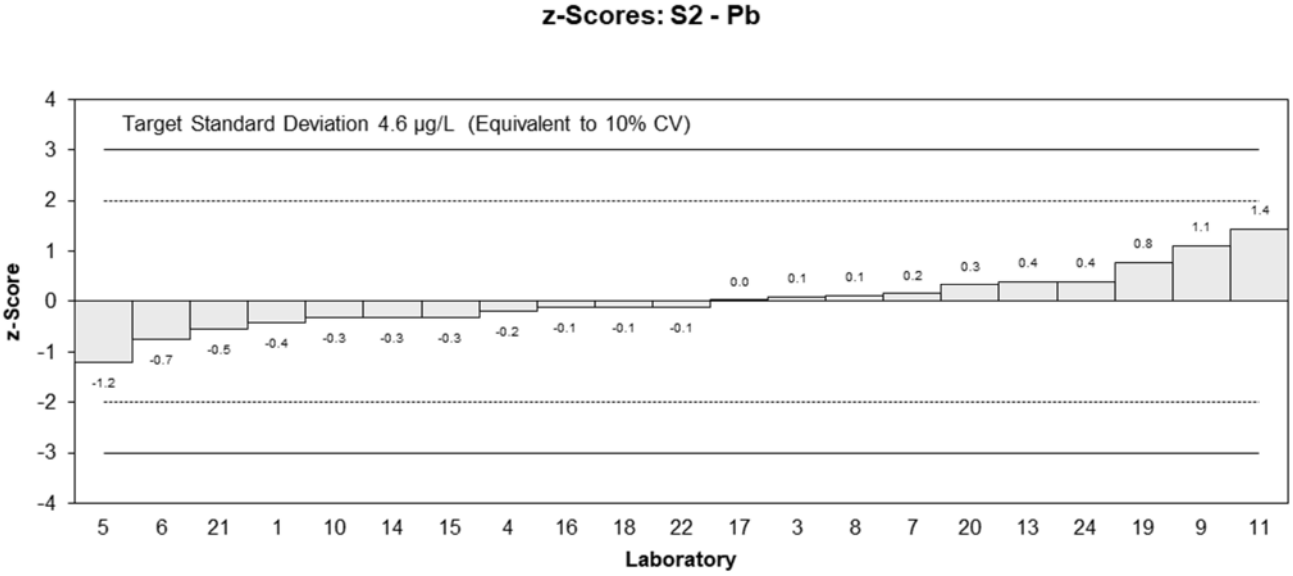
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	43.6	5.9	-0.42	-0.31
2	NR	NR		
3	45.9	3.93	0.09	0.10
4	44.6	4.7	-0.20	-0.18
5	40	20	-1.21	-0.27
6	42.1	4.8	-0.75	-0.68
7	46.2	5.3	0.15	0.13
8	46	3.66	0.11	0.13
9	50.5	3.1	1.10	1.49
10	44	7.0	-0.33	-0.21
11	52	4.7	1.43	1.33
12	NT	NT		
13	47.3	10.8	0.40	0.17
14	44	2.03	-0.33	-0.62
15	44	8.76	-0.33	-0.17
16	45.0	6.75	-0.11	-0.07
17	45.6	5.7	0.02	0.02
18	45	20	-0.11	-0.02
19	49	9.8	0.77	0.35
20	47	14	0.33	0.11
21	43	3	-0.55	-0.76
22	45	5.4	-0.11	-0.09
23	NT	NT		
24	47.3	7.1	0.40	0.25

Statistics

Assigned Value	45.5	1.3
Spike	48.4	1.9
Homogeneity Value	46.8	5.6
Robust Average	45.5	1.3
Median	45.0	0.8
Mean	45.6	
N	21	
Max.	52	
Min.	40	
Robust SD	2.4	
Robust CV	5.3%	


Kernel Density
Density
Result
Results: S2 - Pb
Assigned Value = 45.5 ± 1.3 µg/L
Results (µg/L)
Laboratory
5 6 21 1 10 14 15 4 16 18 22 17 3 8 7 20 13 24 19 9 11 2 12 23 Md R.A. H.V. S.V.


z-Scores: S2 - Pb
Target Standard Deviation 4.6 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
5 6 21 1 10 14 15 4 16 18 22 17 3 8 7 20 13 24 19 9 11
-1.2 -0.7 -0.5 -0.4 -0.3 -0.3 -0.3 -0.2 -0.1 -0.1 -0.1 0.0 0.1 0.1 0.2 0.3 0.4 0.4 0.8 1.1 1.4

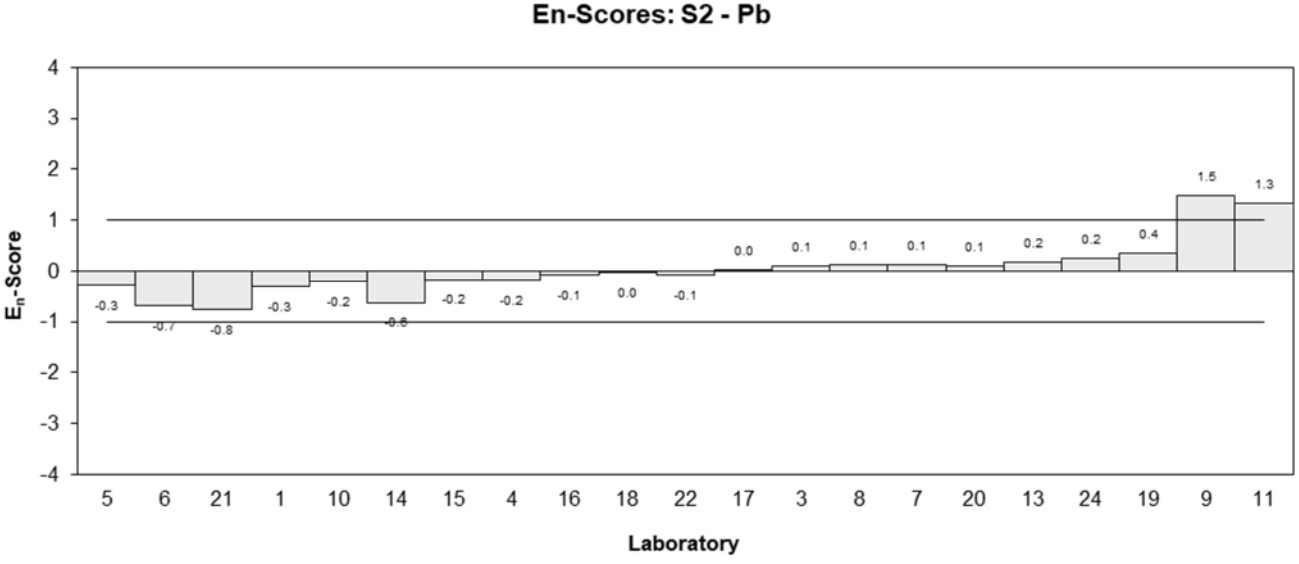

En-Scores: S2 - Pb
En-Score
Laboratory
5 6 21 1 10 14 15 4 16 18 22 17 3 8 7 20 13 24 19 9 11
-0.3 -0.7 -0.8 -0.3 -0.2 -0.6 -0.2 -0.2 -0.1 0.0 -0.1 0.0 0.1 0.1 0.1 0.1 0.2 0.2 0.4 1.5 1.3

Figure 39

Table 44

Sample Details

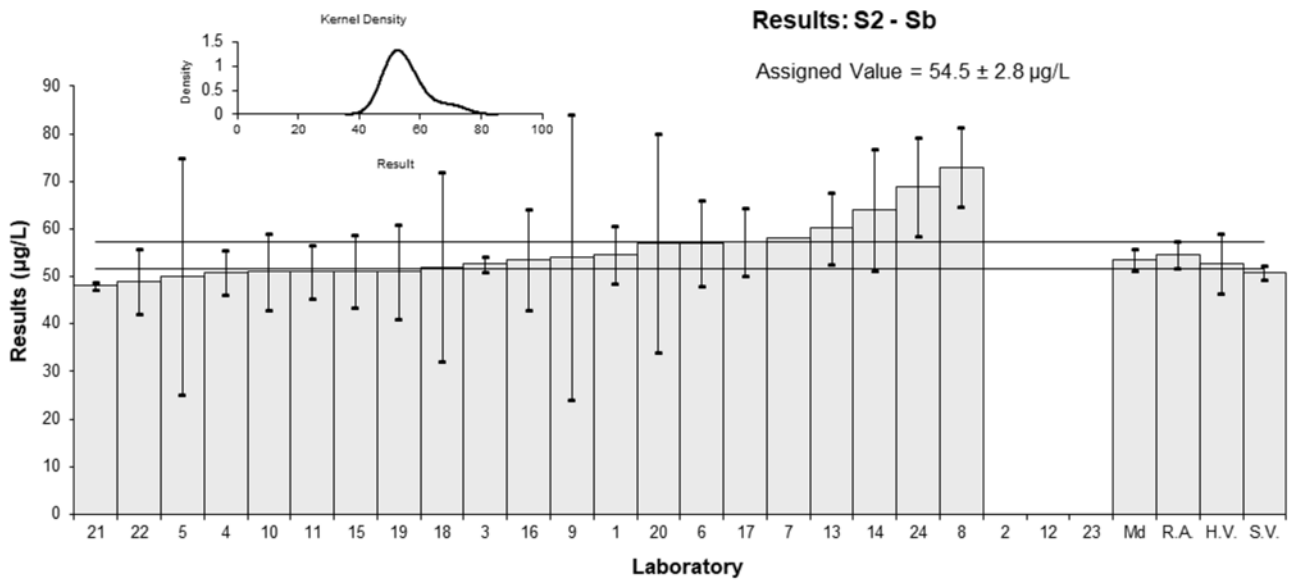
Sample No.	S2
Matrix.	Waste Water
Analyte.	Sb
Units	µg/L

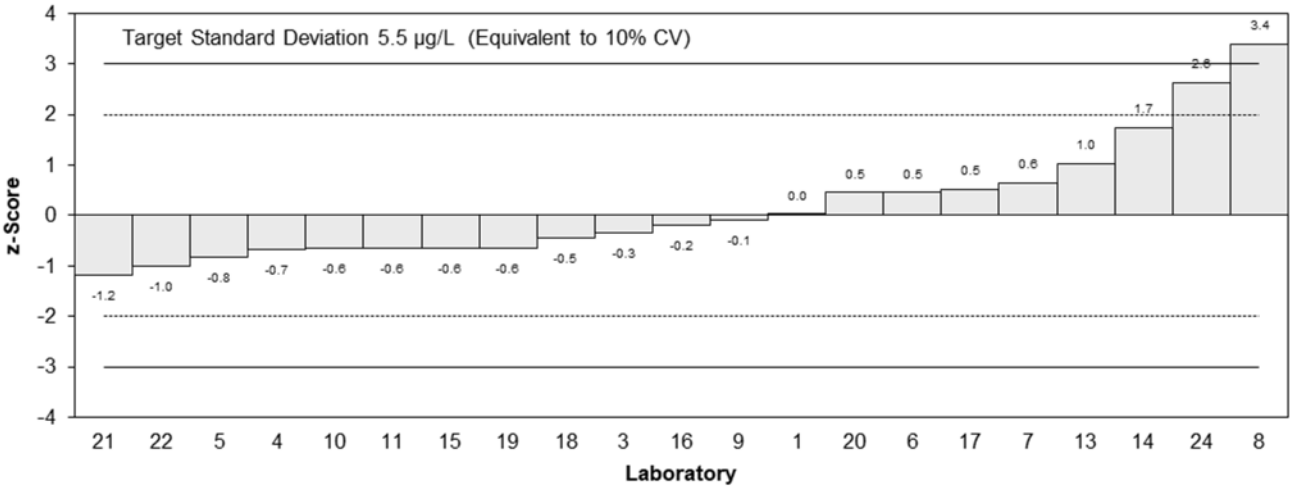
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	54.6	6.1	0.02	0.01
2	NR	NR		
3	52.6	1.6	-0.35	-0.59
4	50.8	4.8	-0.68	-0.67
5	50	25	-0.83	-0.18
6	57.0	9.1	0.46	0.26
7	58	NR	0.64	1.25
8	73	8.4	3.39	2.09
9	54	30	-0.09	-0.02
10	51	8.0	-0.64	-0.41
11	51	5.6	-0.64	-0.56
12	NT	NT		
13	60.1	7.6	1.03	0.69
14	64	12.8	1.74	0.73
15	51	7.71	-0.64	-0.43
16	53.5	10.7	-0.18	-0.09
17	57.3	7.1	0.51	0.37
18	52	20	-0.46	-0.12
19	51	10	-0.64	-0.34
20	57	23	0.46	0.11
21	48	0.80	-1.19	-2.23
22	49	6.9	-1.01	-0.74
23	NT	NT		
24	68.8	10.3	2.62	1.34

Statistics

Assigned Value	54.5	2.8
Spike	50.8	1.4
Homogeneity Value	52.7	6.3
Robust Average	54.5	2.8
Median	53.5	2.4
Mean	55.4	
N	21	
Max.	73	
Min.	48	
Robust SD	5.1	
Robust CV	9.4%	


Results: S2 - Sb
Assigned Value = 54.5 ± 2.8 µg/L
Kernel Density
Density
Result
Results (µg/L)
Laboratory
21 22 5 4 10 11 15 19 18 3 16 9 1 20 6 17 7 13 14 24 8 2 12 23 Md R.A. H.V. S.V.


z-Scores: S2 - Sb
Target Standard Deviation 5.5 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
21 22 5 4 10 11 15 19 18 3 16 9 1 20 6 17 7 13 14 24 8

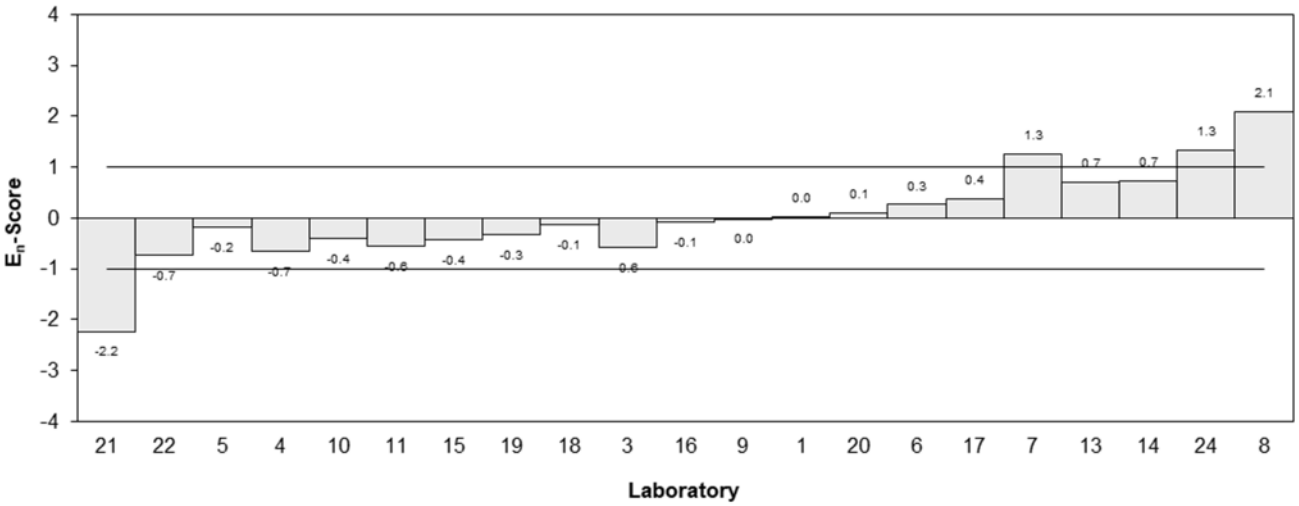

En-Scores: S2 - Sb
En-Score
Laboratory
21 22 5 4 10 11 15 19 18 3 16 9 1 20 6 17 7 13 14 24 8

Figure 40

Table 45

Sample Details

Sample No.	S2
Matrix.	Waste Water
Analyte.	Se
Units	µg/L

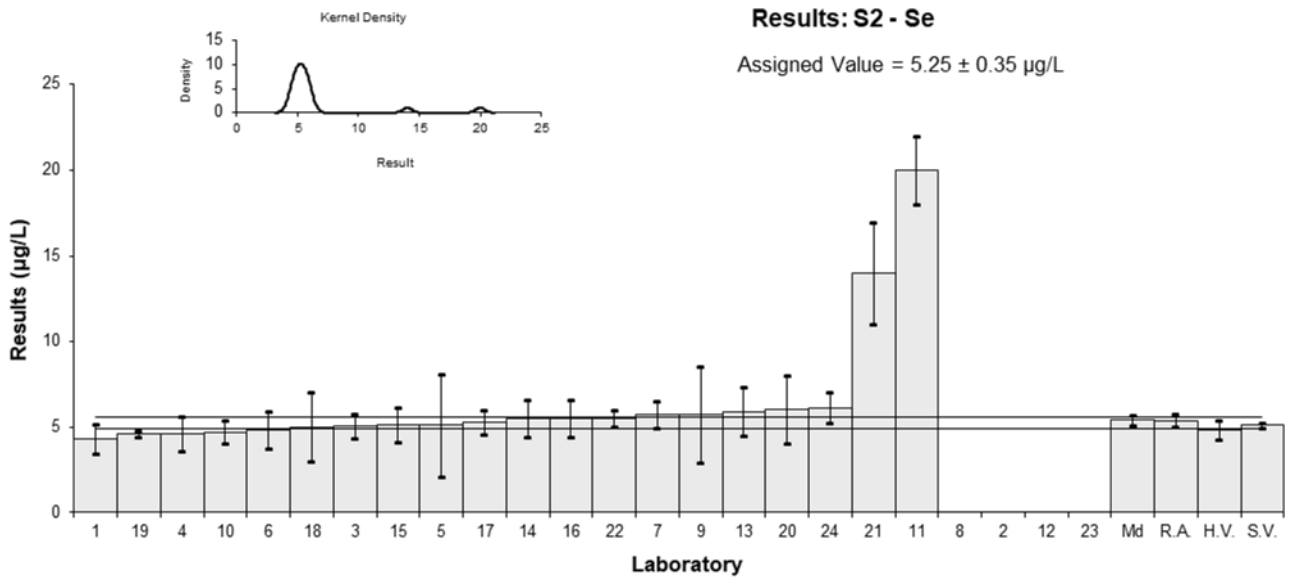
Participant Results

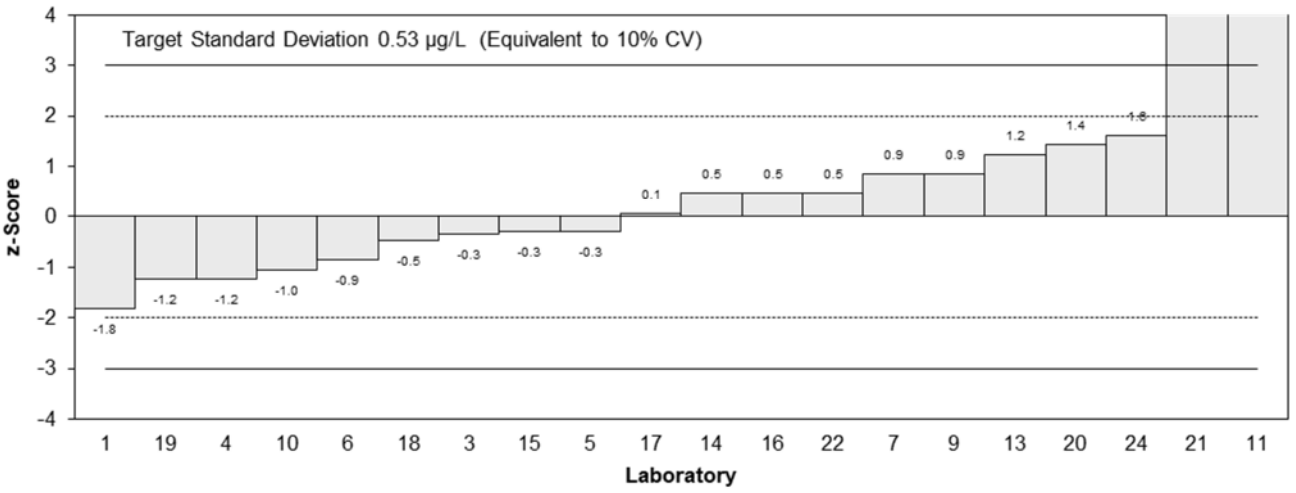
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	4.3	0.86	-1.81	-1.02
2	NR	NR		
3	5.07	0.715	-0.34	-0.23
4	4.6	1	-1.24	-0.61
5	5.1	3	-0.29	-0.05
6	4.8	1.1	-0.86	-0.39
7	5.7	0.8	0.86	0.52
8	<10	NR		
9	5.7	2.8	0.86	0.16
10	4.7	0.7	-1.05	-0.70
11	20	2.0	28.10	7.26
12	NT	NT		
13	5.9	1.4	1.24	0.45
14	5.5	1.1	0.48	0.22
15	5.1	1.01	-0.29	-0.14
16	5.5	1.1	0.48	0.22
17	5.28	0.70	0.06	0.04
18	5	2	-0.48	-0.12
19	4.6	0.20	-1.24	-1.61
20	6	2	1.43	0.37
21	14	3	16.67	2.90
22	5.5	0.50	0.48	0.41
23	NT	NT		
24	6.1	0.9	1.62	0.88

Statistics

Assigned Value*	5.25	0.35
Spike	5.10	0.14
Homogeneity Value	4.82	0.58
Robust Average	5.36	0.38
Median	5.39	0.31
Mean	6.42	
N	20	
Max.	20	
Min.	4.3	
Robust SD	0.69	
Robust CV	13%	

*Robust Average excluding laborarories 11 and 21.


Kernel Density
Density
Result
Results: S2 - Se
Assigned Value = 5.25 ± 0.35 µg/L
Results (µg/L)
Laboratory
1 19 4 10 6 18 3 15 5 17 14 16 22 7 9 13 20 24 21 11 8 2 12 23 Md R.A. H.V. S.V.


z-Scores: S2 - Se
Target Standard Deviation 0.53 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
1 19 4 10 6 18 3 15 5 17 14 16 22 7 9 13 20 24 21 11

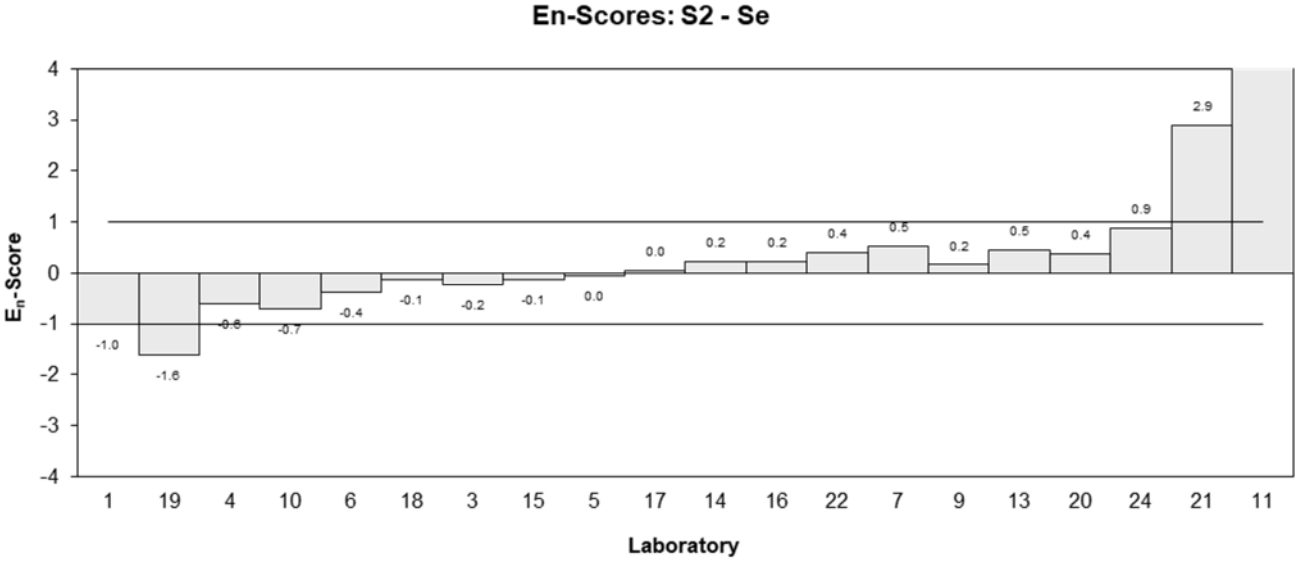

En-Scores: S2 - Se
En-Score
Laboratory
1 19 4 10 6 18 3 15 5 17 14 16 22 7 9 13 20 24 21 11

Figure 41

Table 46

Sample Details

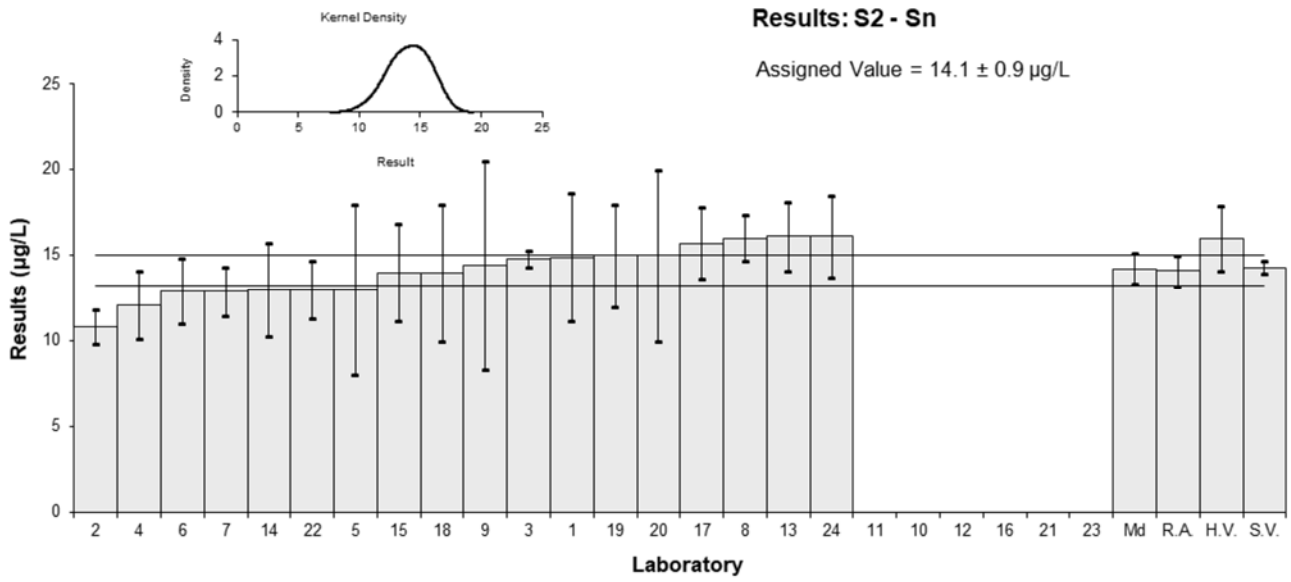
Sample No.	S2
Matrix.	Waste Water
Analyte.	Sn
Units	µg/L

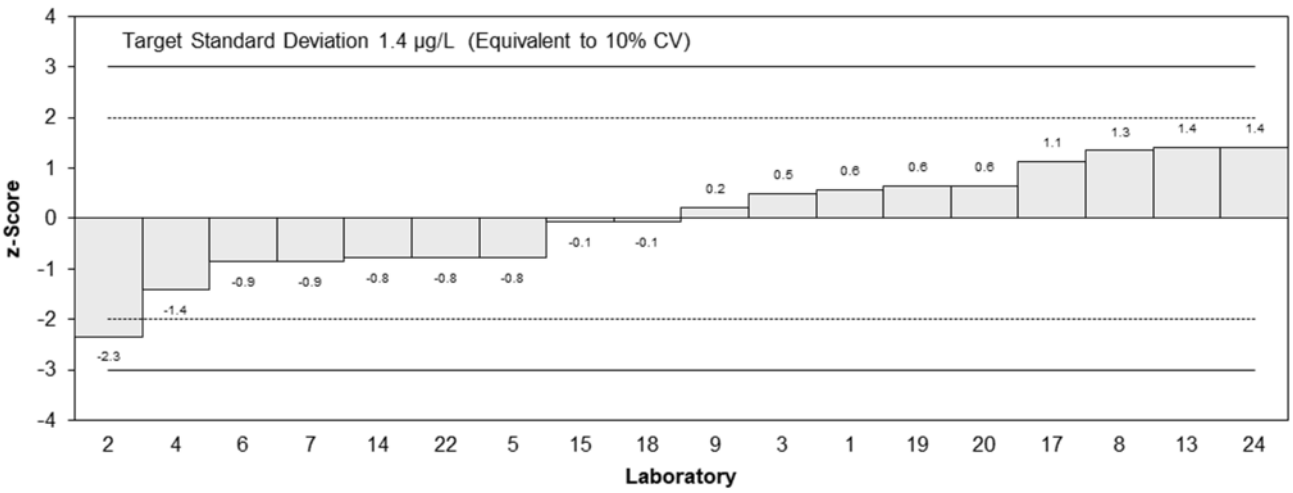
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	14.9	3.7	0.57	0.21
2	10.8	1	-2.34	-2.45
3	14.8	0.462	0.50	0.69
4	12.1	2.0	-1.42	-0.91
5	13	5	-0.78	-0.22
6	12.9	1.9	-0.85	-0.57
7	12.9	1.4	-0.85	-0.72
8	16	1.34	1.35	1.18
9	14.4	6.1	0.21	0.05
10	NT	NT		
11	<0.01	NR		
12	NT	NT		
13	16.1	2	1.42	0.91
14	13	2.76	-0.78	-0.38
15	14	2.87	-0.07	-0.03
16	NT	NT		
17	15.7	2.1	1.13	0.70
18	14	4	-0.07	-0.02
19	15	3.0	0.64	0.29
20	15	5	0.64	0.18
21	NT	NT		
22	13	1.7	-0.78	-0.57
23	NT	NT		
24	16.1	2.4	1.42	0.78

Statistics

Assigned Value	14.1	0.9
Spike	14.3	0.4
Homogeneity Value	16.0	1.9
Robust Average	14.1	0.9
Median	14.2	0.9
Mean	14.1	
N	18	
Max.	16.1	
Min.	10.8	
Robust SD	1.6	
Robust CV	11%	


Kernel Density
Density
Result
Results: S2 - Sn
Assigned Value = 14.1 ± 0.9 µg/L
Results (µg/L)
Laboratory
2 4 6 7 14 22 5 15 18 9 3 1 19 20 17 8 13 24 11 10 12 16 21 23 Md R.A. H.V. S.V.


z-Scores: S2 - Sn
Target Standard Deviation 1.4 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
2 4 6 7 14 22 5 15 18 9 3 1 19 20 17 8 13 24
-2.3 -1.4 -0.9 -0.9 -0.8 -0.8 -0.8 -0.1 -0.1 0.2 0.5 0.6 0.6 0.6 1.1 1.3 1.4 1.4

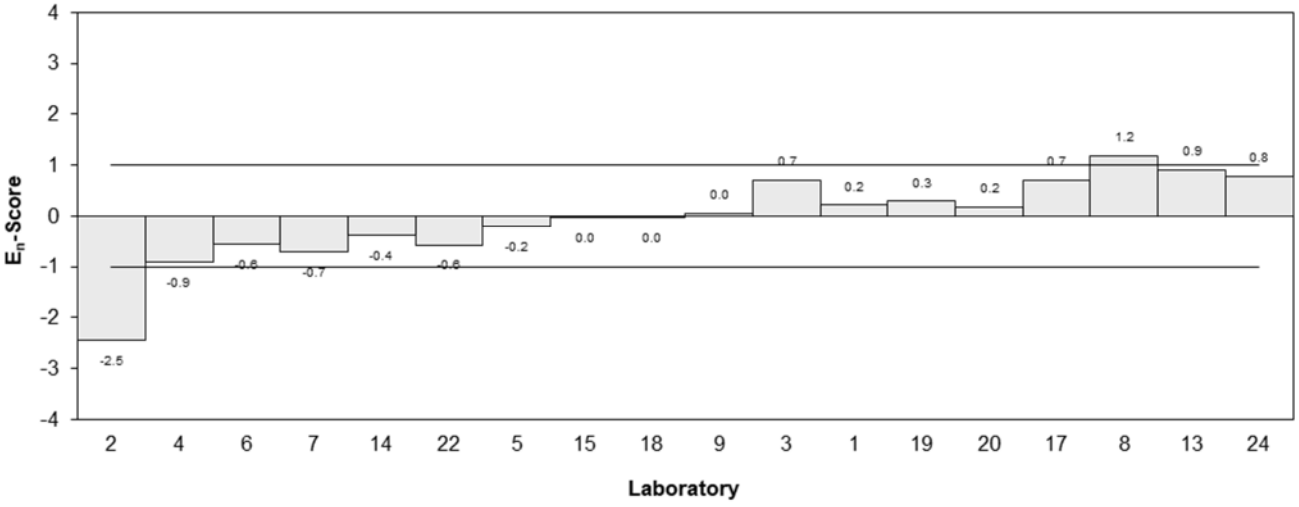

En-Scores: S2 - Sn
En-Score
Laboratory
2 4 6 7 14 22 5 15 18 9 3 1 19 20 17 8 13 24
-2.5 -0.9 -0.6 -0.7 -0.4 -0.6 -0.2 0.0 0.0 0.0 0.7 0.2 0.3 0.2 0.7 1.2 0.9 0.8

Figure 42

Table 47

Sample Details

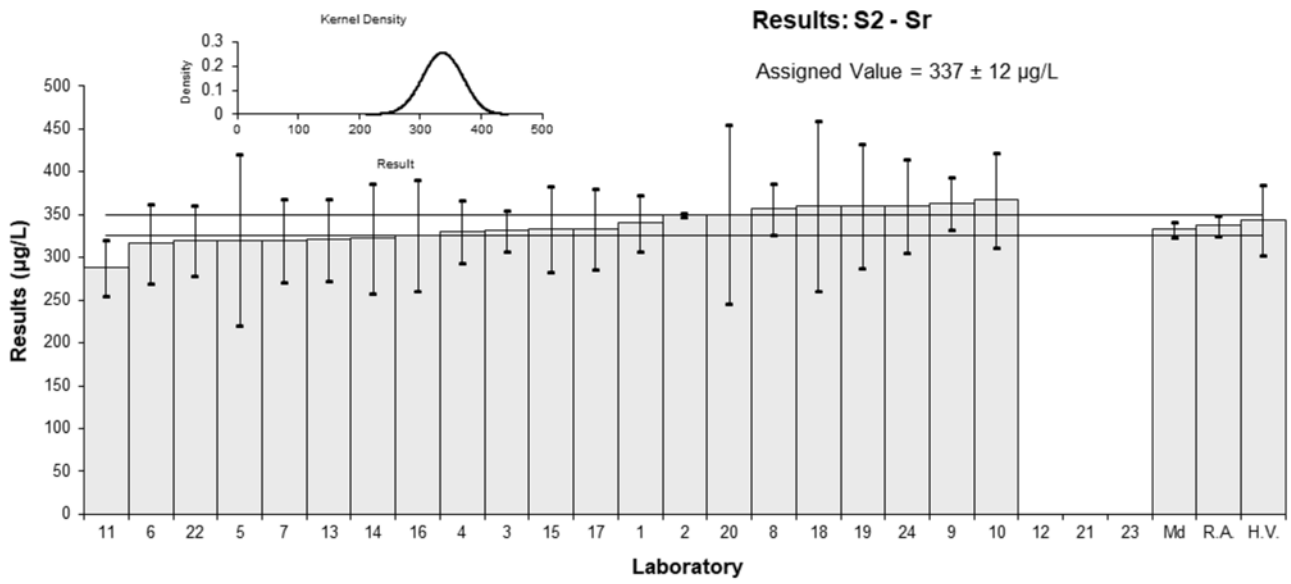
Sample No.	S2
Matrix.	Waste Water
Analyte.	Sr
Units	µg/L

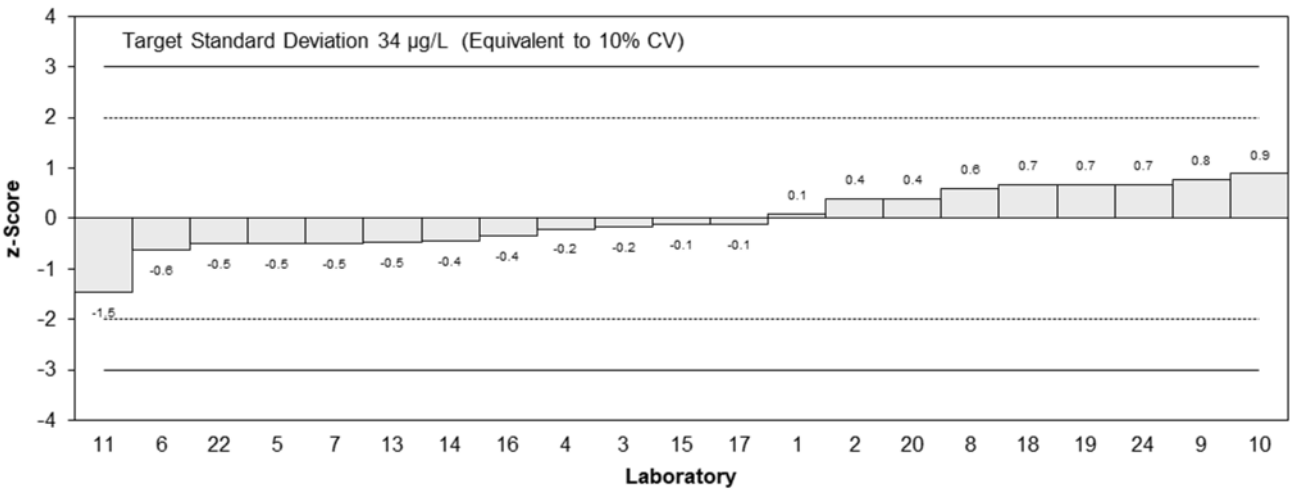
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	340	33	0.09	0.09
2	350	2	0.39	1.07
3	331	23.4	-0.18	-0.23
4	330	37	-0.21	-0.18
5	320	100	-0.50	-0.17
6	316	46	-0.62	-0.44
7	320	49	-0.50	-0.34
8	357	29.9	0.59	0.62
9	363	30	0.77	0.80
10	367	55	0.89	0.53
11	288	33	-1.45	-1.40
12	NT	NT		
13	321	48	-0.47	-0.32
14	322	64.4	-0.45	-0.23
15	333	50	-0.12	-0.08
16	325	65	-0.36	-0.18
17	333	47	-0.12	-0.08
18	360	100	0.68	0.23
19	360	72	0.68	0.32
20	350	105	0.39	0.12
21	NT	NT		
22	320	41	-0.50	-0.40
23	NT	NT		
24	360	54	0.68	0.42

Statistics

Assigned Value	337	12
Spike	Not Spiked	
Homogeneity Value	343	41
Robust Average	337	12
Median	333	9
Mean	336	
N	21	
Max.	367	
Min.	288	
Robust SD	21	
Robust CV	6.3%	


Kernel Density
Density
Result
Results: S2 - Sr
Assigned Value = 337 ± 12 µg/L
Results (µg/L)
Laboratory
11 6 22 5 7 13 14 16 4 3 15 17 1 2 20 8 18 19 24 9 10 12 21 23 Md R.A. H.V.


z-Scores: S2 - Sr
Target Standard Deviation 34 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
11 6 22 5 7 13 14 16 4 3 15 17 1 2 20 8 18 19 24 9 10

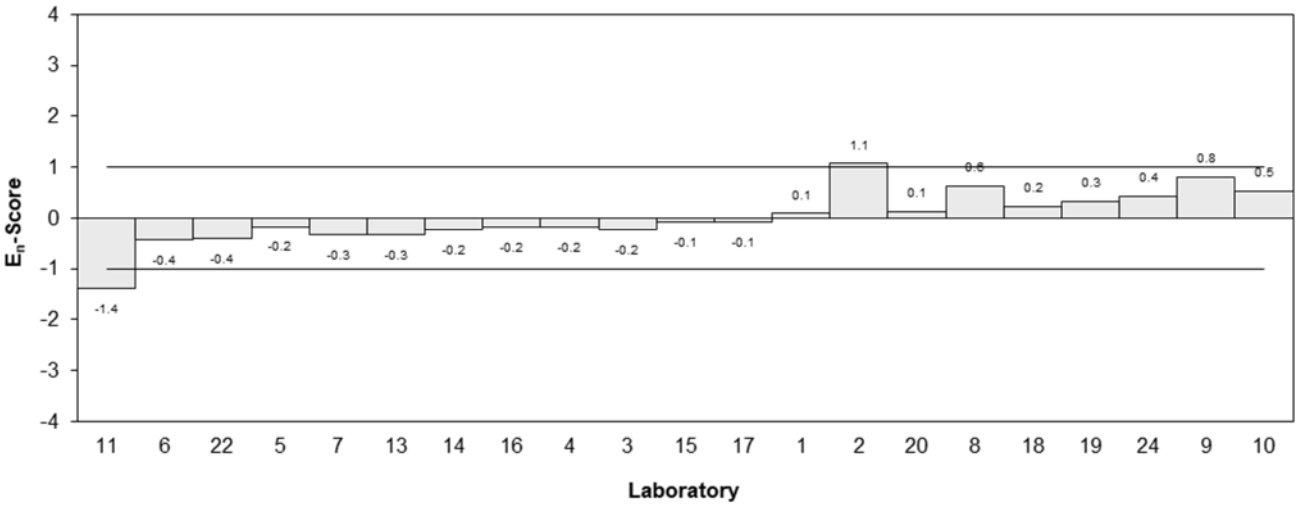

En-Scores: S2 - Sr
En-Score
Laboratory
11 6 22 5 7 13 14 16 4 3 15 17 1 2 20 8 18 19 24 9 10

Figure 43

Table 48

Sample Details

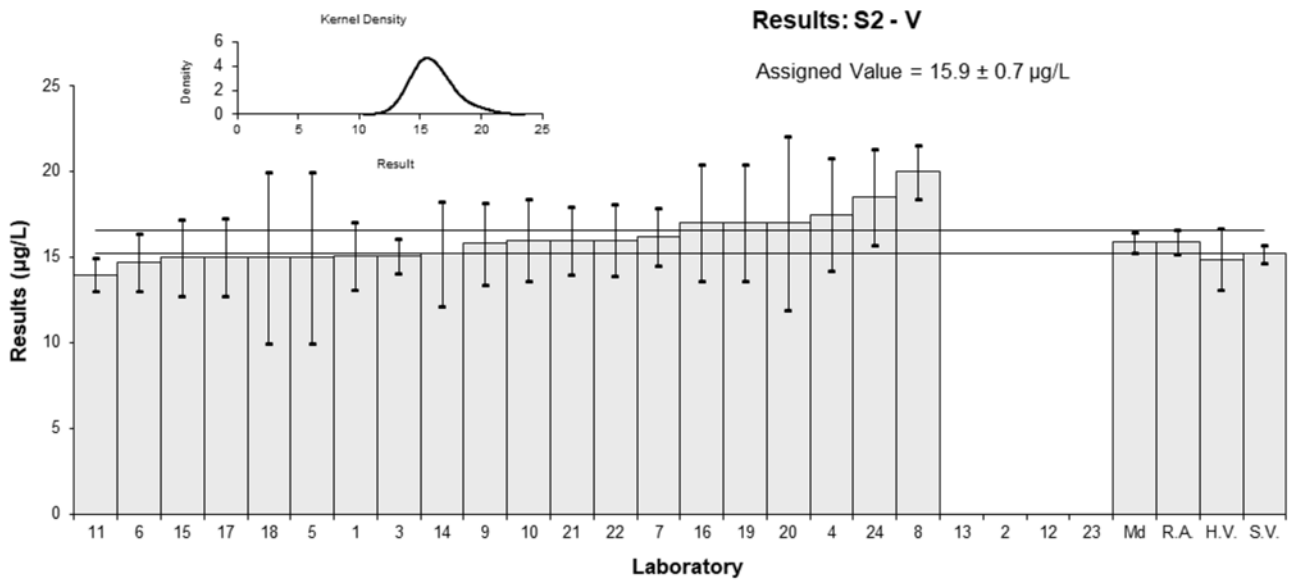
Sample No.	S2
Matrix.	Waste Water
Analyte.	V
Units	µg/L

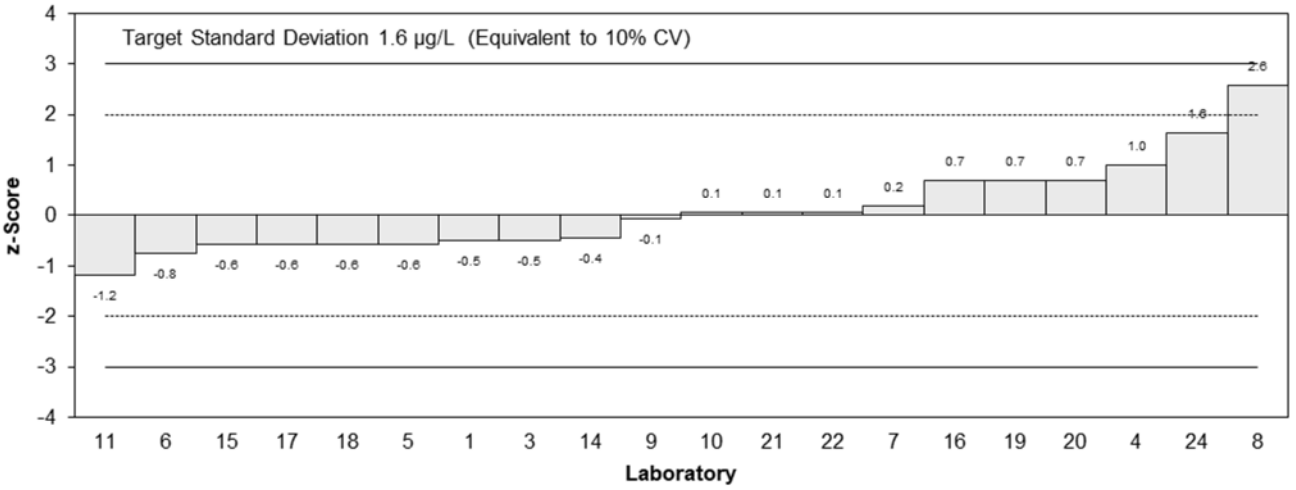
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	15.1	2.0	-0.50	-0.38
2	NR	NR		
3	15.1	1.00	-0.50	-0.66
4	17.5	3.3	1.01	0.47
5	15	5	-0.57	-0.18
6	14.7	1.7	-0.75	-0.65
7	16.2	1.7	0.19	0.16
8	20	1.56	2.58	2.40
9	15.8	2.4	-0.06	-0.04
10	16	2.4	0.06	0.04
11	14	1.0	-1.19	-1.56
12	NT	NT		
13	NR	NR		
14	15.2	3.04	-0.44	-0.22
15	15	2.25	-0.57	-0.38
16	17	3.4	0.69	0.32
17	15.0	2.3	-0.57	-0.37
18	15	5	-0.57	-0.18
19	17	3.4	0.69	0.32
20	17	5.1	0.69	0.21
21	16	2	0.06	0.05
22	16	2.1	0.06	0.05
23	NT	NT		
24	18.5	2.8	1.64	0.90

Statistics

Assigned Value	15.9	0.7
Spike	15.2	0.5
Homogeneity Value	14.9	1.8
Robust Average	15.9	0.7
Median	15.9	0.6
Mean	16.1	
N	20	
Max.	20	
Min.	14	
Robust SD	1.3	
Robust CV	8%	


Kernel Density
Density
Result
Results: S2 - V
Assigned Value = 15.9 ± 0.7 µg/L
Results (µg/L)
Laboratory
11 6 15 17 18 5 1 3 14 9 10 21 22 7 16 19 20 4 24 8 13 2 12 23 Md R.A. H.V. S.V.


z-Scores: S2 - V
Target Standard Deviation 1.6 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
11 6 15 17 18 5 1 3 14 9 10 21 22 7 16 19 20 4 24 8
-1.2 -0.8 -0.6 -0.6 -0.6 -0.6 -0.5 -0.5 -0.4 -0.1 0.1 0.1 0.1 0.2 0.7 0.7 0.7 1.0 1.6 2.6

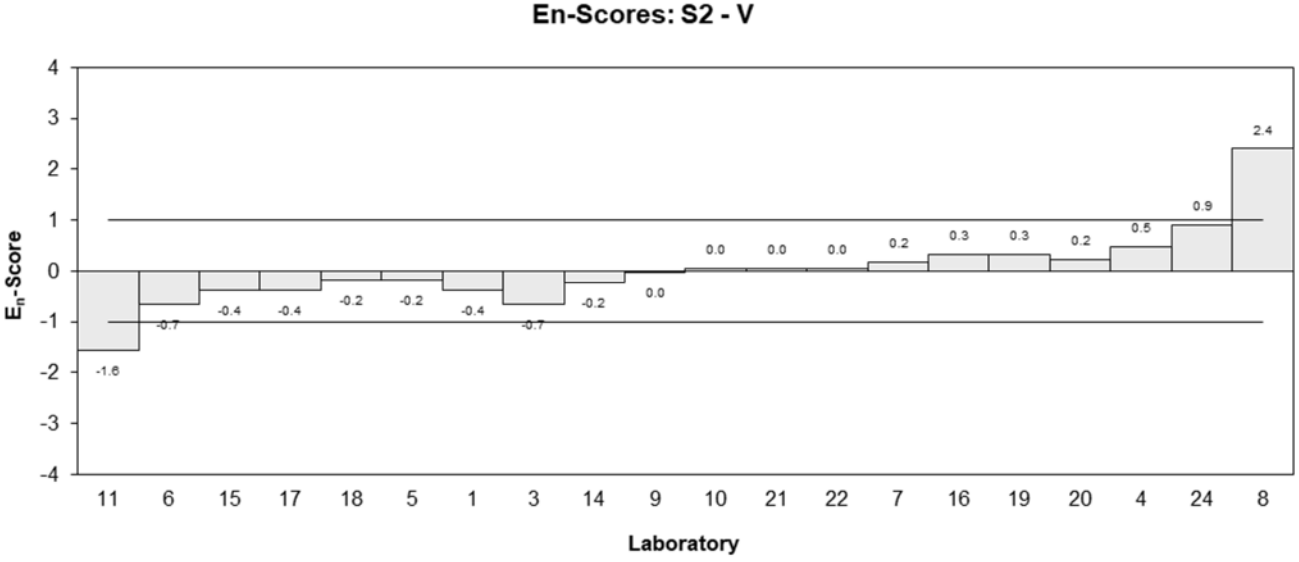

En-Scores: S2 - V
En-Score
Laboratory
11 6 15 17 18 5 1 3 14 9 10 21 22 7 16 19 20 4 24 8
-1.6 -0.7 -0.4 -0.4 -0.2 -0.2 -0.4 -0.7 -0.2 0.0 0.0 0.0 0.0 0.2 0.3 0.3 0.2 0.5 0.9 2.4

Figure 44

Table 49

Sample Details

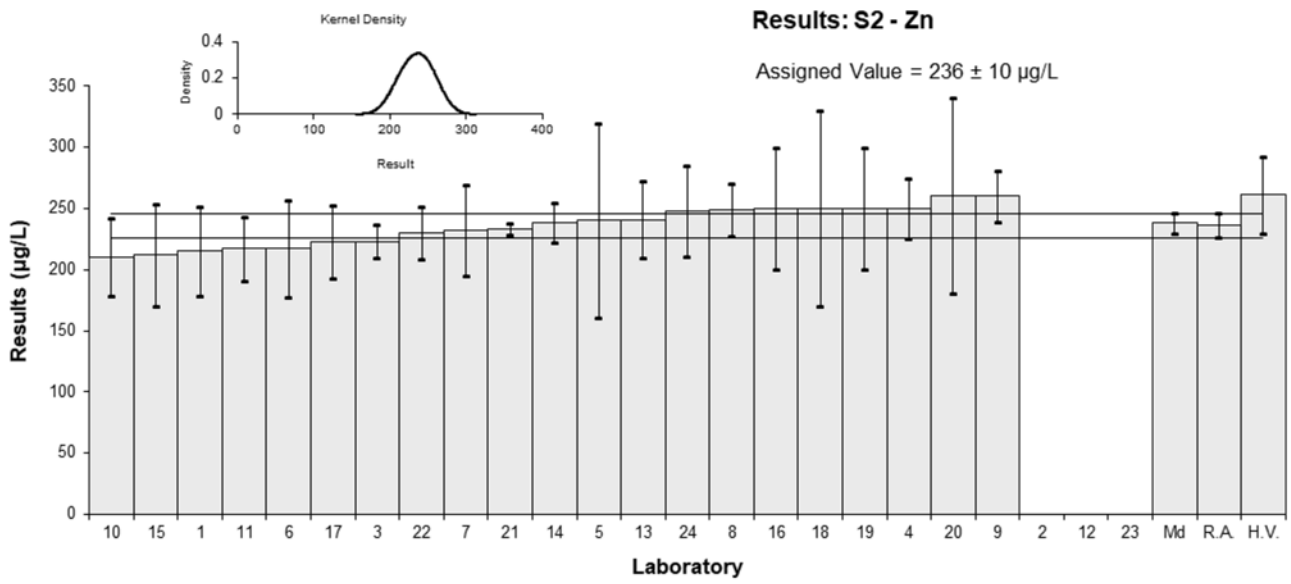
Sample No.	S2
Matrix.	Waste Water
Analyte.	Zn
Units	µg/L

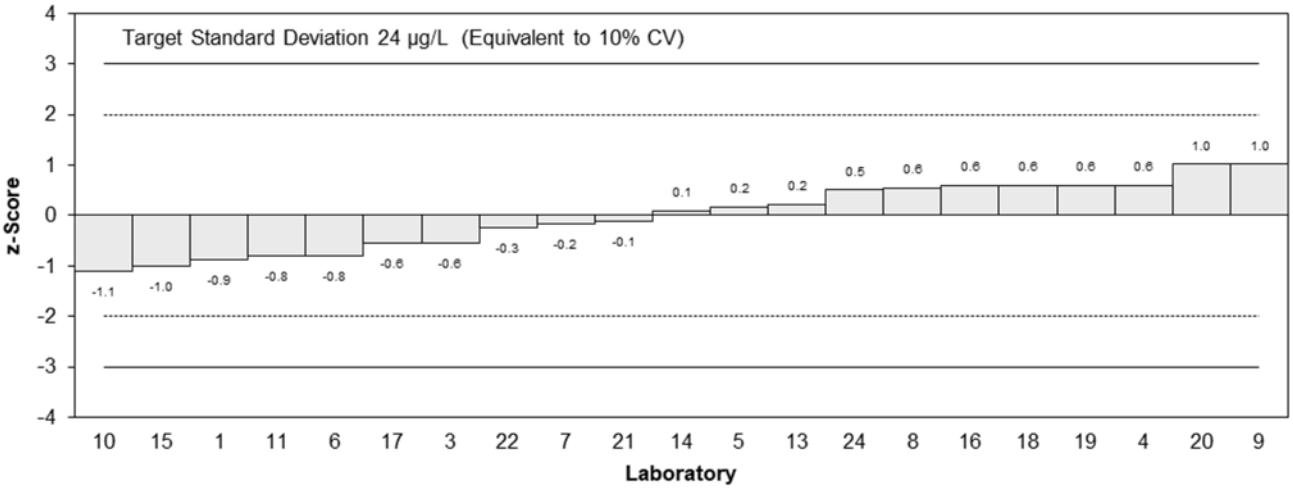
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	215	37	-0.89	-0.55
2	NR	NR		
3	223	13.6	-0.55	-0.77
4	250	25	0.59	0.52
5	240	80	0.17	0.05
6	217	40	-0.81	-0.46
7	232	37	-0.17	-0.10
8	249	21.4	0.55	0.55
9	260	21	1.02	1.03
10	210	32	-1.10	-0.78
11	217	26	-0.81	-0.68
12	NT	NT		
13	241	31	0.21	0.15
14	238	16.3	0.08	0.10
15	212	42	-1.02	-0.56
16	250	50.0	0.59	0.27
17	223	30	-0.55	-0.41
18	250	80	0.59	0.17
19	250	50	0.59	0.27
20	260	80	1.02	0.30
21	233	5	-0.13	-0.27
22	230	21	-0.25	-0.26
23	NT	NT		
24	248	37	0.51	0.31

Statistics

Assigned Value	236	10
Spike	Not Spiked	
Homogeneity Value	261	31
Robust Average	236	10
Median	238	8
Mean	236	
N	21	
Max.	260	
Min.	210	
Robust SD	18	
Robust CV	7.7%	


Kernel Density
Density
Result
Results: S2 - Zn
Assigned Value = 236 ± 10 µg/L
Results (µg/L)
Laboratory
10 15 1 11 6 17 3 22 7 21 14 5 13 24 8 16 18 19 4 20 9 2 12 23 Md R.A. H.V.


z-Scores: S2 - Zn
Target Standard Deviation 24 µg/L (Equivalent to 10% CV)
z-Score
Laboratory
10 15 1 11 6 17 3 22 7 21 14 5 13 24 8 16 18 19 4 20 9

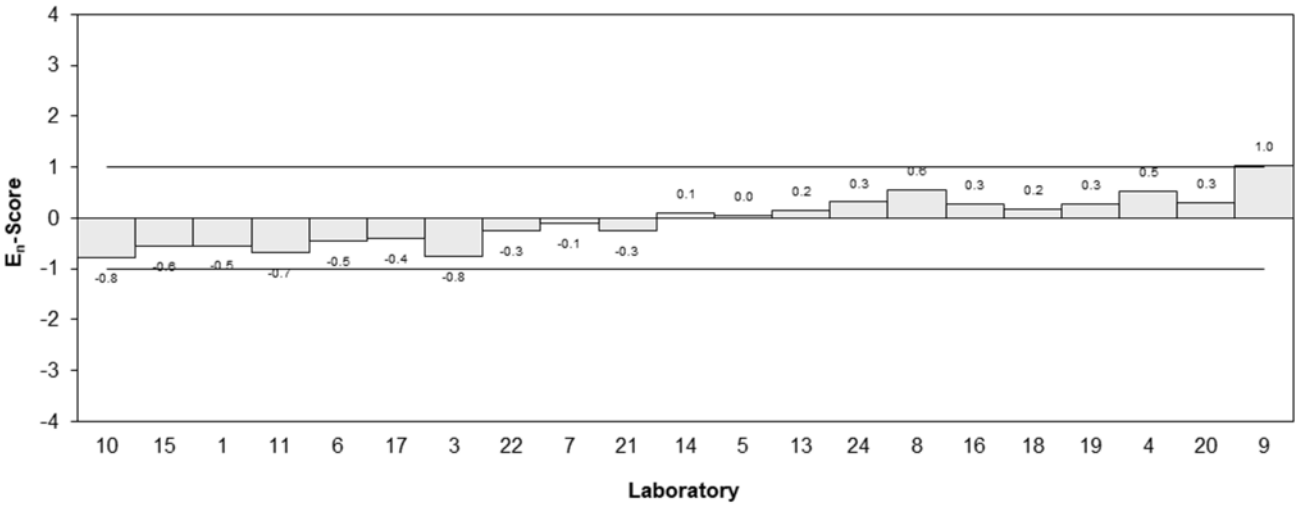

En-Scores: S2 - Zn
En-Score
Laboratory
10 15 1 11 6 17 3 22 7 21 14 5 13 24 8 16 18 19 4 20 9

Figure 45

Table 50

Sample Details

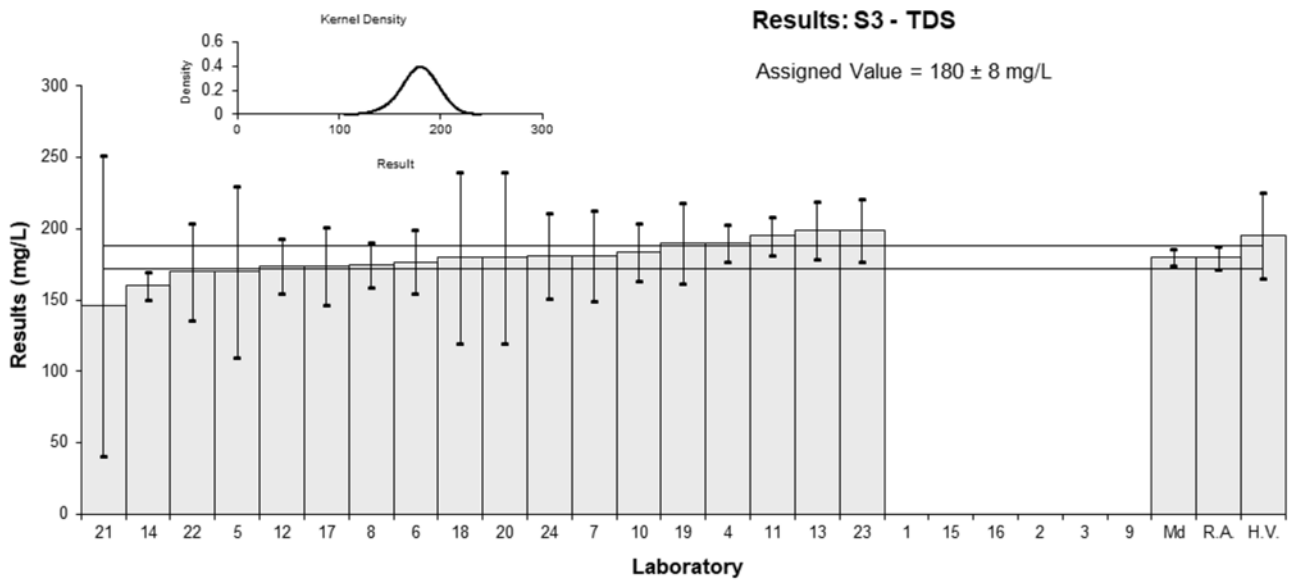
Sample No.	S3
Matrix.	River Water
Analyte.	TDS
Units	mg/L

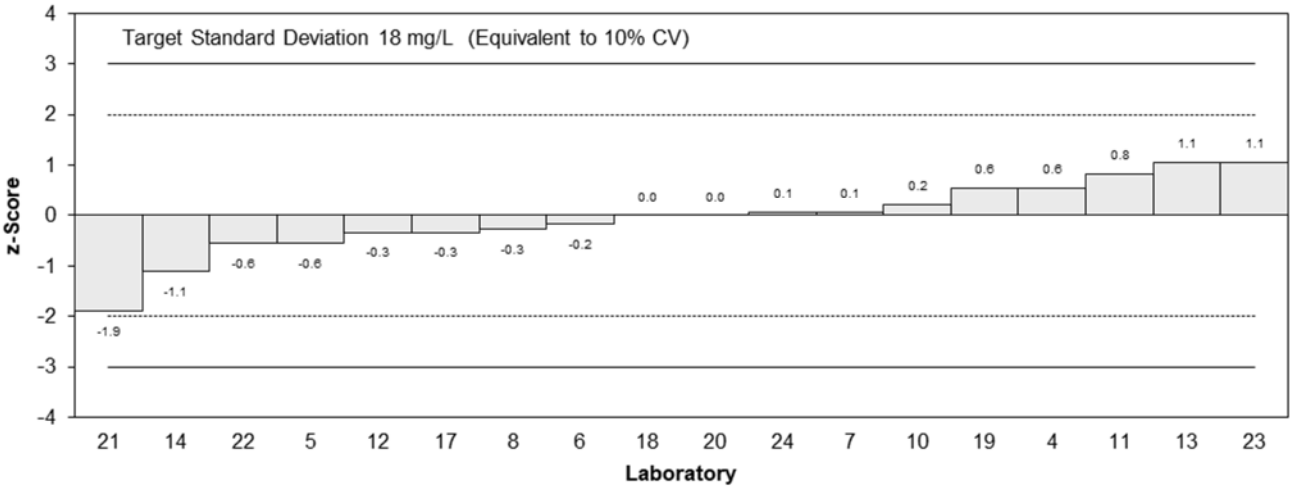
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	NT	NT		
3	NT	NT		
4	190	13	0.56	0.66
5	170	60	-0.56	-0.17
6	177	22	-0.17	-0.13
7	181	32	0.06	0.03
8	175	15.5	-0.28	-0.29
9	NT	NT		
10	184	20	0.22	0.19
11	195	13.7	0.83	0.95
12	174	19.6	-0.33	-0.28
13	199	20	1.06	0.88
14	160	10	-1.11	-1.56
15	NT	NT		
16	NT	NT		
17	174	27.6	-0.33	-0.21
18	180	60	0.00	0.00
19	190	28	0.56	0.34
20	180	60	0.00	0.00
21	146	105	-1.89	-0.32
22	170	34	-0.56	-0.29
23	199	22	1.06	0.81
24	181	30	0.06	0.03

Statistics

Assigned Value	180	8
Spike	Not Spiked	
Homogeneity Value	195	30
Robust Average	180	8
Median	180	6
Mean	179	
N	18	
Max.	199	
Min.	146	
Robust SD	13	
Robust CV	7.2%	


Kernel Density
Density
Result
Results: S3 - TDS
Assigned Value = 180 ± 8 mg/L
Results (mg/L)
Laboratory
21 14 22 5 12 17 8 6 18 20 24 7 10 19 4 11 13 23 1 15 16 2 3 9 Md R.A. H.V.


z-Scores: S3 - TDS
Target Standard Deviation 18 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
21 14 22 5 12 17 8 6 18 20 24 7 10 19 4 11 13 23
-1.9 -1.1 -0.6 -0.6 -0.3 -0.3 -0.3 -0.2 0.0 0.0 0.1 0.1 0.2 0.6 0.6 0.8 1.1 1.1

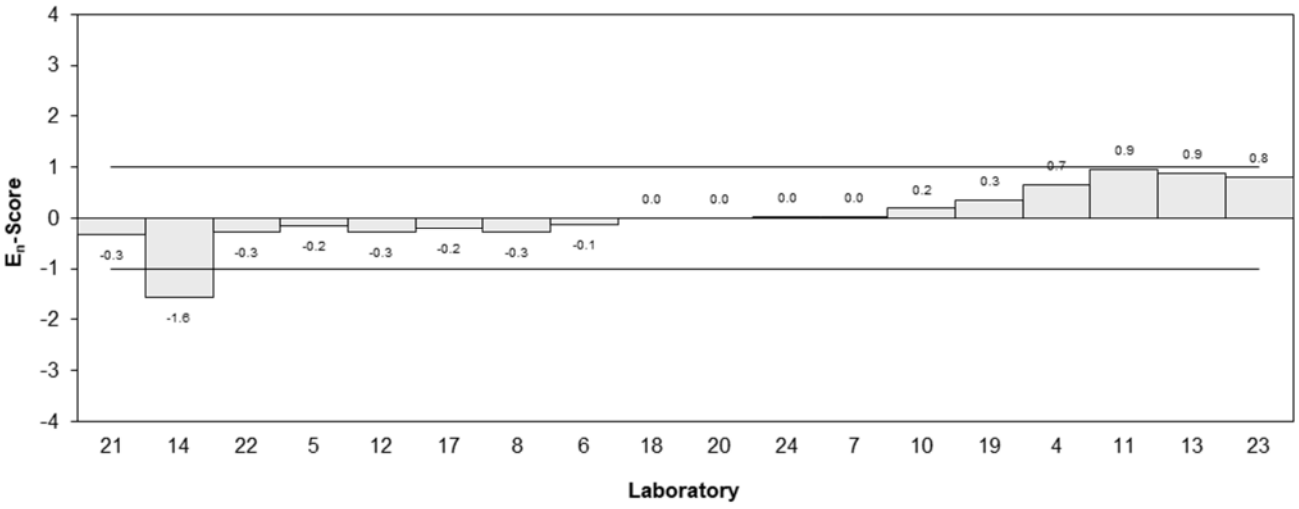

En-Scores: S3 - TDS
En-Score
Laboratory
21 14 22 5 12 17 8 6 18 20 24 7 10 19 4 11 13 23
-0.3 -1.6 -0.3 -0.2 -0.3 -0.2 -0.3 -0.1 0.0 0.0 0.0 0.0 0.2 0.3 0.7 0.9 0.9 0.8

Figure 46

Table 51

Sample Details

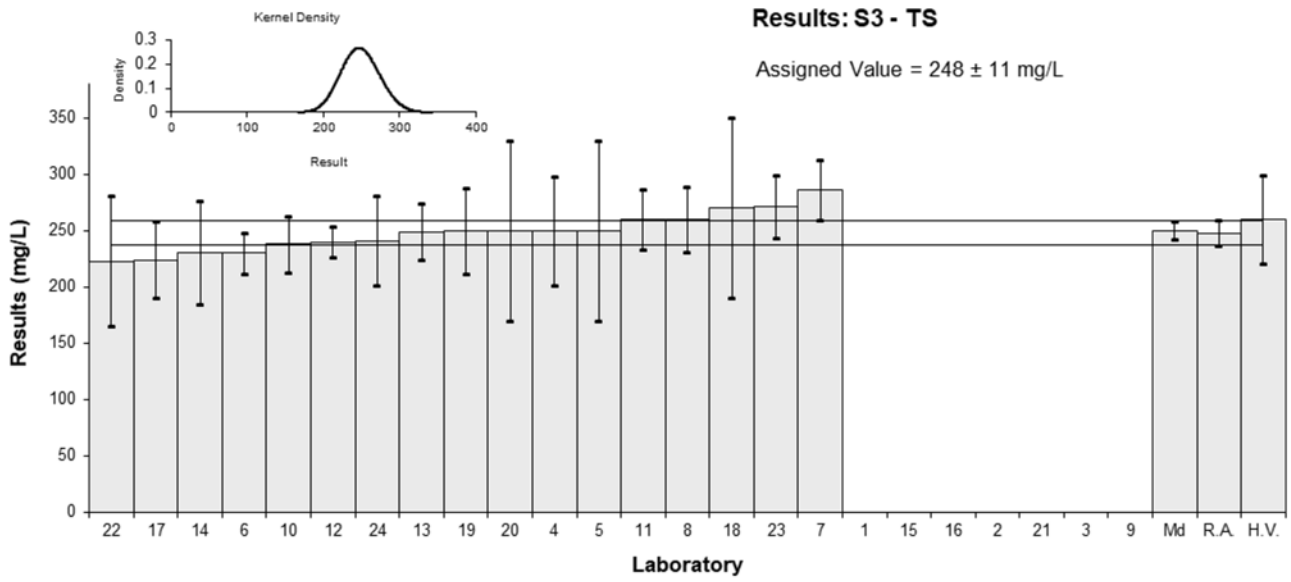
Sample No.	S3
Matrix.	River Water
Analyte.	TS
Units	mg/L

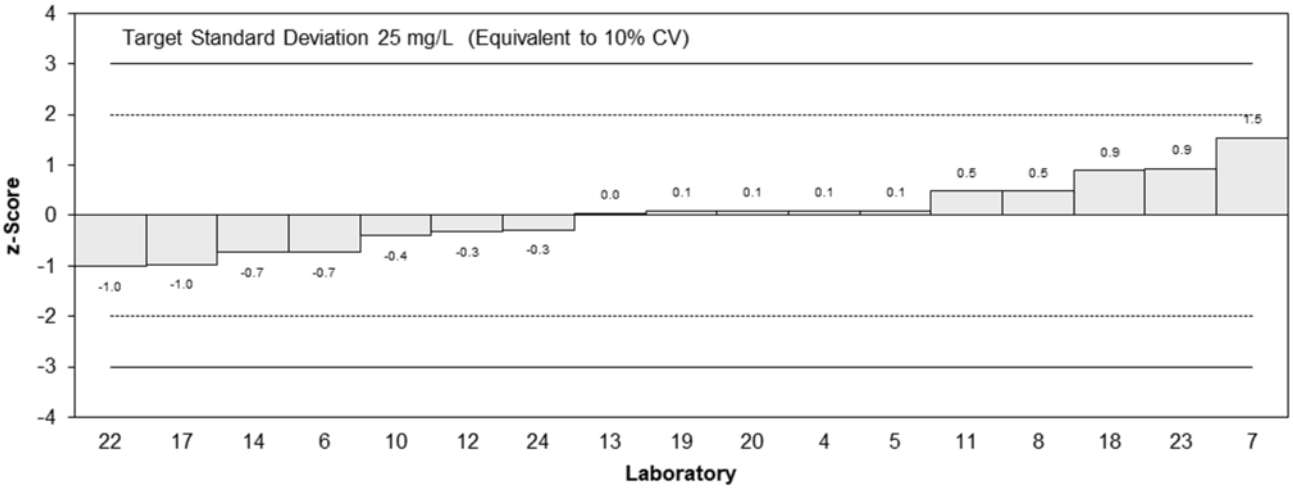
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	NT	NT		
3	NT	NT		
4	250	48	0.08	0.04
5	250	80	0.08	0.02
6	230	18	-0.73	-0.85
7	286	27	1.53	1.30
8	260	28.8	0.48	0.39
9	NT	NT		
10	238	25	-0.40	-0.37
11	260	27	0.48	0.41
12	240	13.2	-0.32	-0.47
13	249	24.9	0.04	0.04
14	230	46	-0.73	-0.38
15	NT	NT		
16	NT	NT		
17	224	33.9	-0.97	-0.67
18	270	80	0.89	0.27
19	250	38	0.08	0.05
20	250	80	0.08	0.02
21	NT	NT		
22	223	58	-1.01	-0.42
23	271	28	0.93	0.76
24	241	40	-0.28	-0.17

Statistics

Assigned Value	248	11
Spike	Not Spiked	
Homogeneity Value	260	39
Robust Average	248	11
Median	250	8
Mean	248	
N	17	
Max.	286	
Min.	223	
Robust SD	18	
Robust CV	7.3%	


Kernel Density
Density
Result
Results: S3 - TS
Assigned Value = 248 ± 11 mg/L
Results (mg/L)
Laboratory
22 17 14 6 10 12 24 13 19 20 4 5 11 8 18 23 7 1 15 16 2 21 3 9 Md R.A. H.V.


z-Scores: S3 - TS
Target Standard Deviation 25 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
22 17 14 6 10 12 24 13 19 20 4 5 11 8 18 23 7
-1.0 -1.0 -0.7 -0.7 -0.4 -0.3 -0.3 0.0 0.1 0.1 0.1 0.1 0.5 0.5 0.9 0.9 1.5

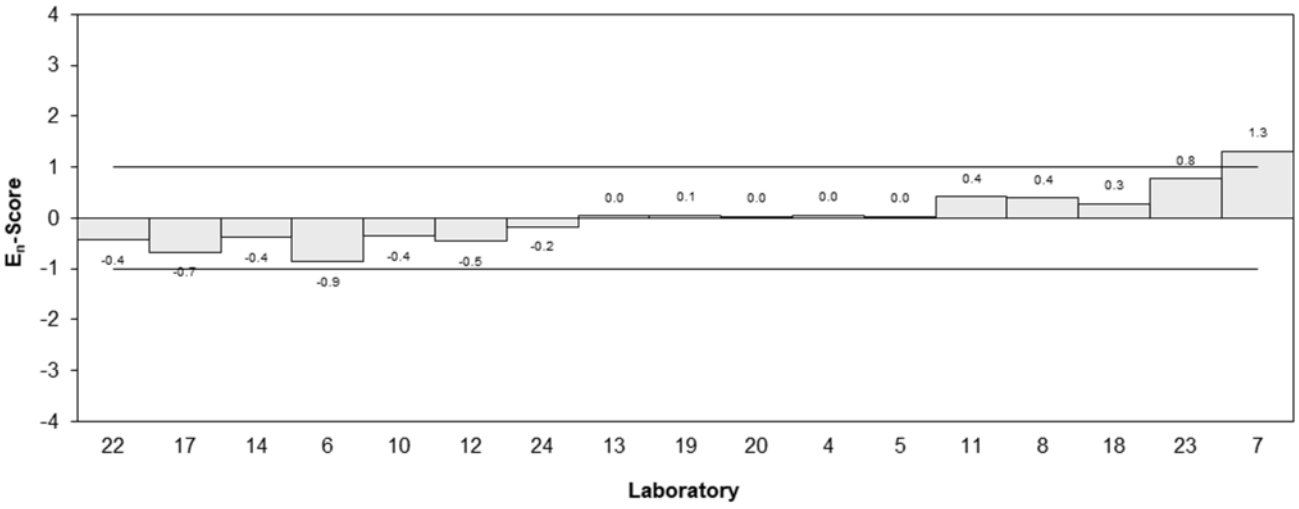

En-Scores: S3 - TS
En-Score
Laboratory
22 17 14 6 10 12 24 13 19 20 4 5 11 8 18 23 7
-0.4 -0.7 -0.4 -0.9 -0.4 -0.5 -0.2 0.0 0.1 0.0 0.0 0.0 0.4 0.4 0.3 0.8 1.3

Figure 47

Table 52

Sample Details

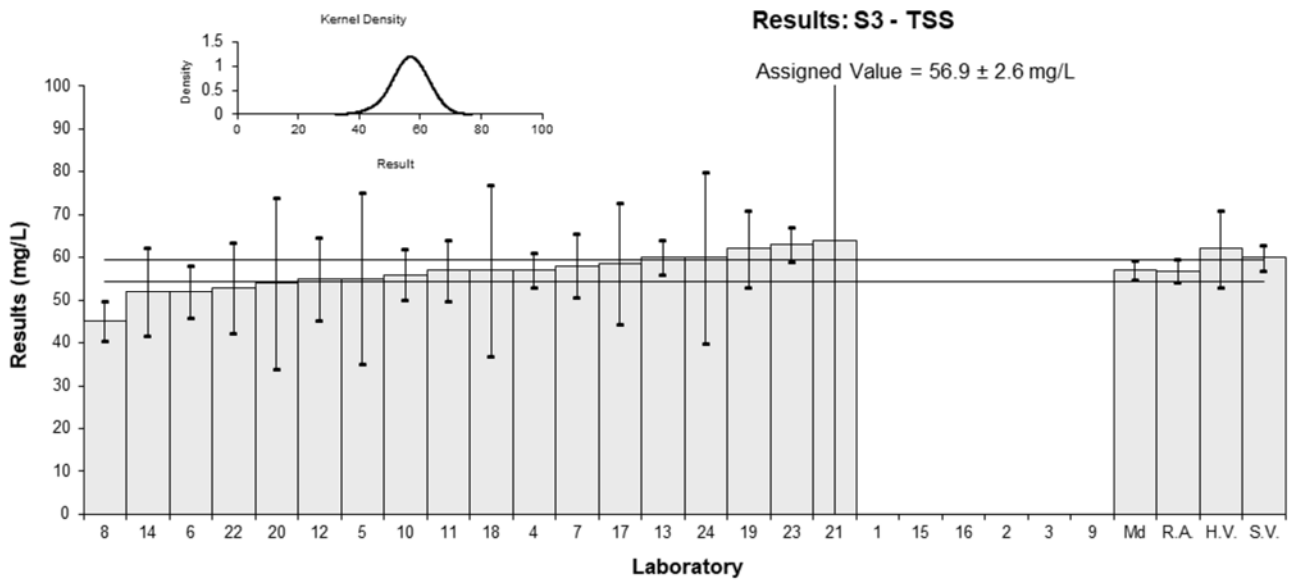
Sample No.	S3
Matrix.	River Water
Analyte.	TSS
Units	mg/L

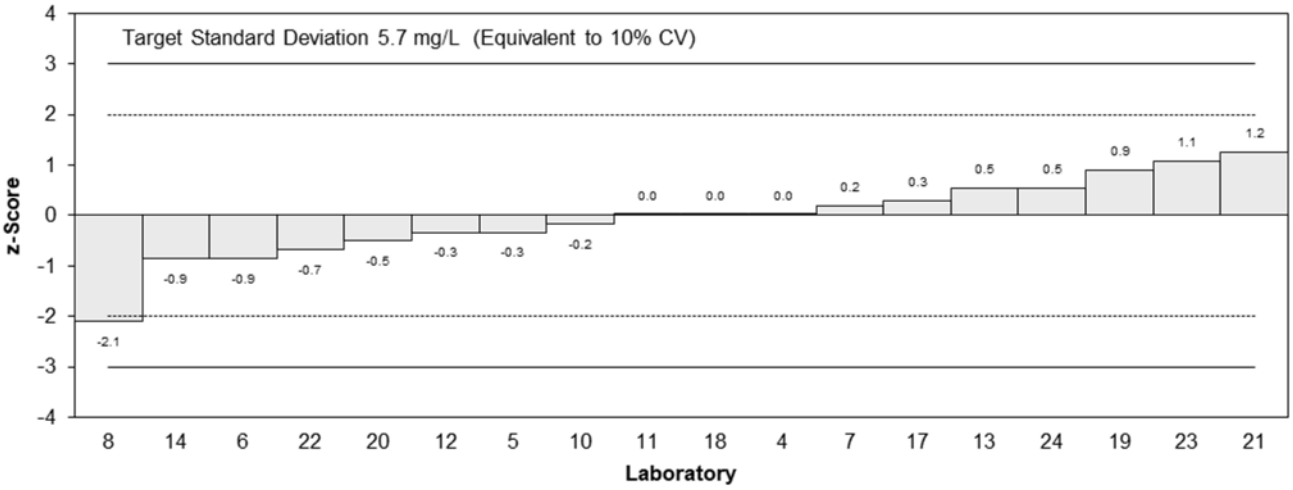
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	NT	NT		
3	NT	NT		
4	57	4	0.02	0.02
5	55	20	-0.33	-0.09
6	52	6	-0.86	-0.75
7	58	7.5	0.19	0.14
8	45	4.66	-2.09	-2.23
9	NT	NT		
10	56	6.0	-0.16	-0.14
11	57.0	7.18	0.02	0.01
12	55	9.7	-0.33	-0.19
13	60	4	0.54	0.65
14	52	10.4	-0.86	-0.46
15	NT	NT		
16	NT	NT		
17	58.6	14.3	0.30	0.12
18	57	20	0.02	0.00
19	62	9	0.90	0.54
20	54	20	-0.51	-0.14
21	64	88	1.25	0.08
22	53	10.6	-0.69	-0.36
23	63	4	1.07	1.28
24	60	20	0.54	0.15

Statistics

Assigned Value	56.9	2.6
Spike	60.1	2.6
Homogeneity Value	62.0	9.0
Robust Average	56.9	2.6
Median	57.0	2.2
Mean	56.6	
N	18	
Max.	64	
Min.	45	
Robust SD	4.4	
Robust CV	7.7%	


Kernel Density
Density
Result
Results: S3 - TSS
Assigned Value = 56.9 ± 2.6 mg/L
Results (mg/L)
Laboratory
8 14 6 22 20 12 5 10 11 18 4 7 17 13 24 19 23 21 1 15 16 2 3 9 Md R.A. H.V. S.V.


z-Scores: S3 - TSS
Target Standard Deviation 5.7 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
8 14 6 22 20 12 5 10 11 18 4 7 17 13 24 19 23 21
-2.1 -0.9 -0.9 -0.7 -0.5 -0.3 -0.3 -0.2 0.0 0.0 0.0 0.2 0.3 0.5 0.5 0.9 1.1 1.2

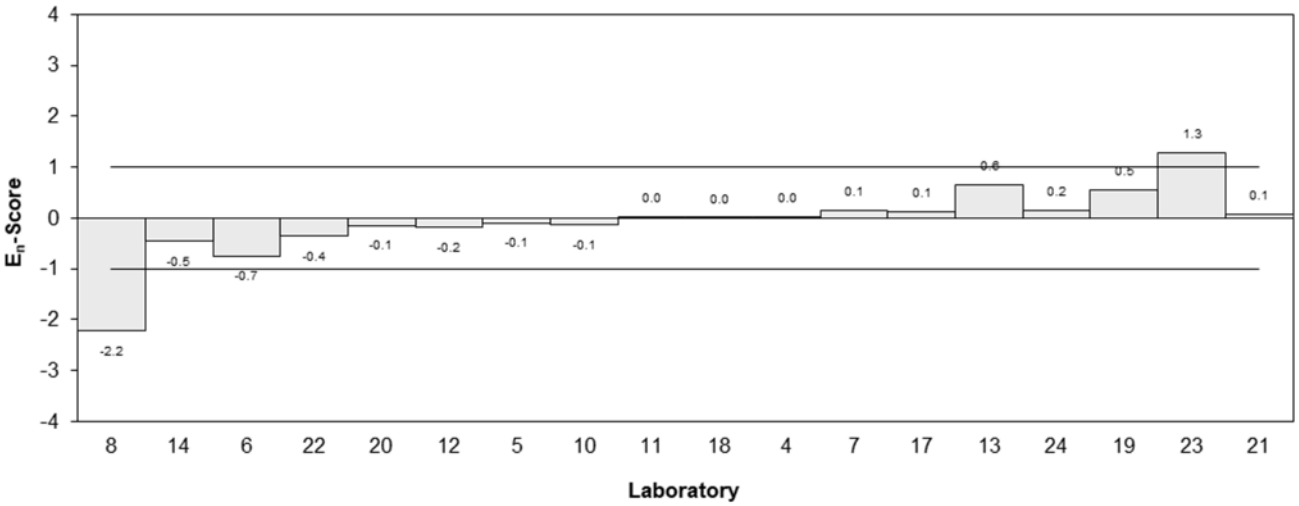

En-Scores: S3 - TSS
En-Score
Laboratory
8 14 6 22 20 12 5 10 11 18 4 7 17 13 24 19 23 21
-2.2 -0.5 -0.7 -0.4 -0.1 -0.2 -0.1 -0.1 0.0 0.0 0.0 0.1 0.1 0.6 0.2 0.5 1.3 0.1

Figure 48

Table 53

Sample Details

Sample No.	S3
Matrix.	River Water
Analyte.	Turbidity
Units	NTU

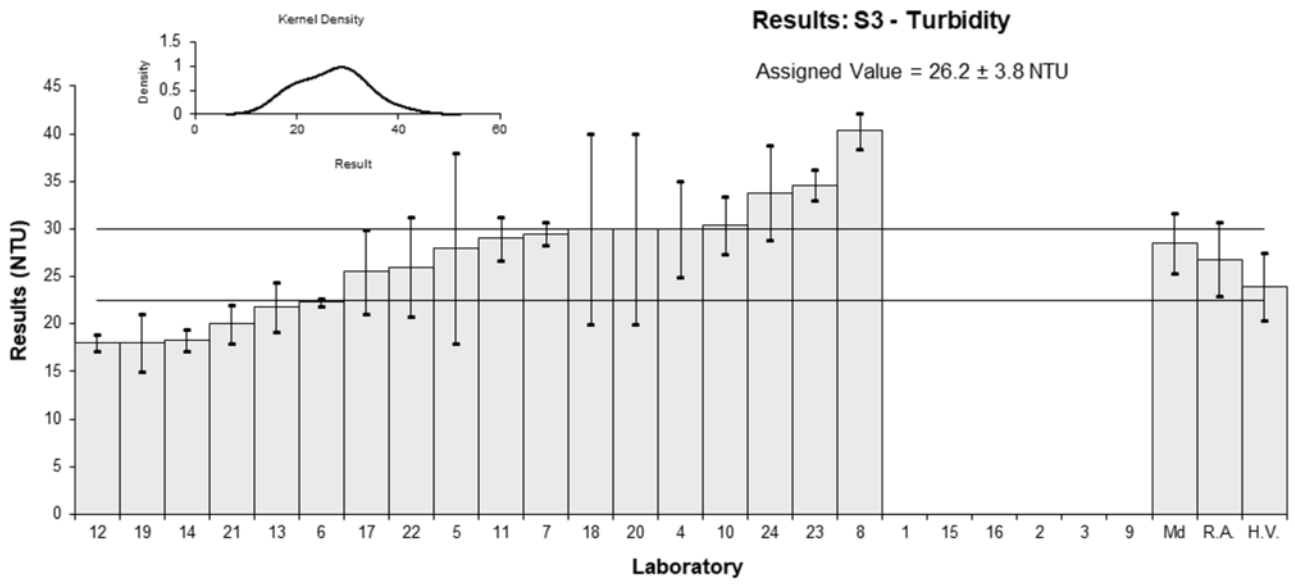
Participant Results

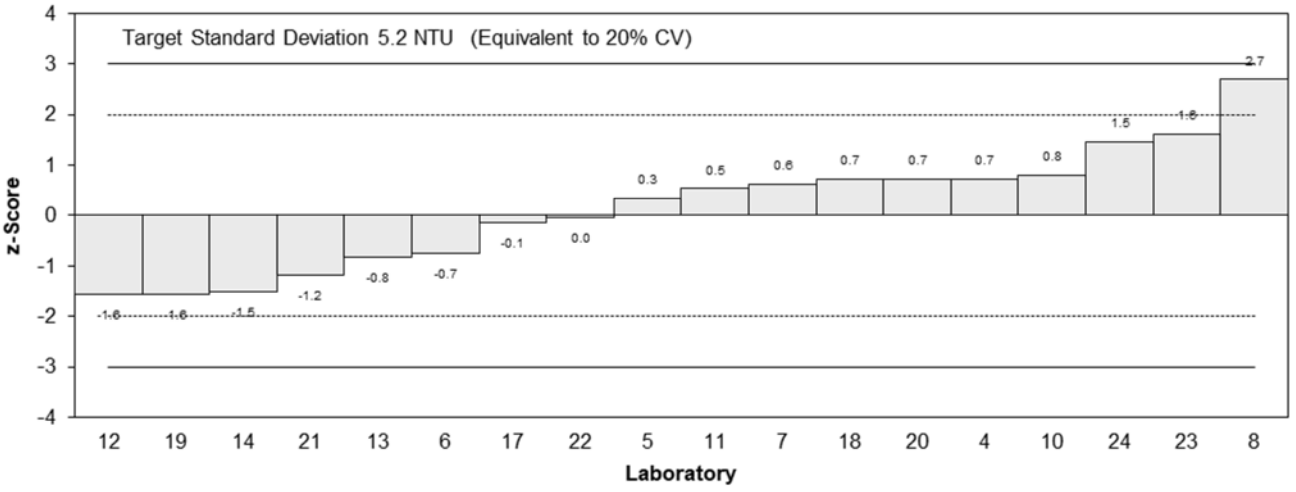
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	NT	NT		
2	NT	NT		
3	NT	NT		
4	30	5	0.73	0.61
5	28	10	0.34	0.17
6	22.3	0.4	-0.74	-1.02
7	29.5	1.2	0.63	0.83
8	40.3	1.9	2.69	3.32
9	NT	NT		
10	30.4	3.0	0.80	0.87
11	29	2.3	0.53	0.63
12	18.0	0.9	-1.56	-2.10
13	21.8	2.6	-0.84	-0.96
14	18.3	1.1	-1.51	-2.00
15	NT	NT		
16	NT	NT		
17	25.5	4.4	-0.13	-0.12
18	30	10	0.73	0.36
19	18	3	-1.56	-1.69
20	30	10	0.73	0.36
21	20	2	-1.18	-1.44
22	26	5.2	-0.04	-0.03
23	34.6	1.6	1.60	2.04
24	33.8	5	1.45	1.21

Statistics

Assigned Value*	26.2	3.8
Spike	Not Spiked	
Homogeneity Value	23.9	3.6
Robust Average	26.8	3.9
Median	28.5	3.1
Mean	27.0	
N	18	
Max.	40.3	
Min.	18	
Robust SD	6.7	
Robust CV	25%	

*Robust Average excluding laboratory 8.


Kernel Density
Density
Result
Results: S3 - Turbidity
Assigned Value = 26.2 ± 3.8 NTU
Results (NTU)
12 19 14 21 13 6 17 22 5 11 7 18 20 4 10 24 23 8 1 15 16 2 3 9 Md R.A. H.V.
Laboratory


z-Scores: S3 - Turbidity
Target Standard Deviation 5.2 NTU (Equivalent to 20% CV)
z-Score
12 19 14 21 13 6 17 22 5 11 7 18 20 4 10 24 23 8
Laboratory

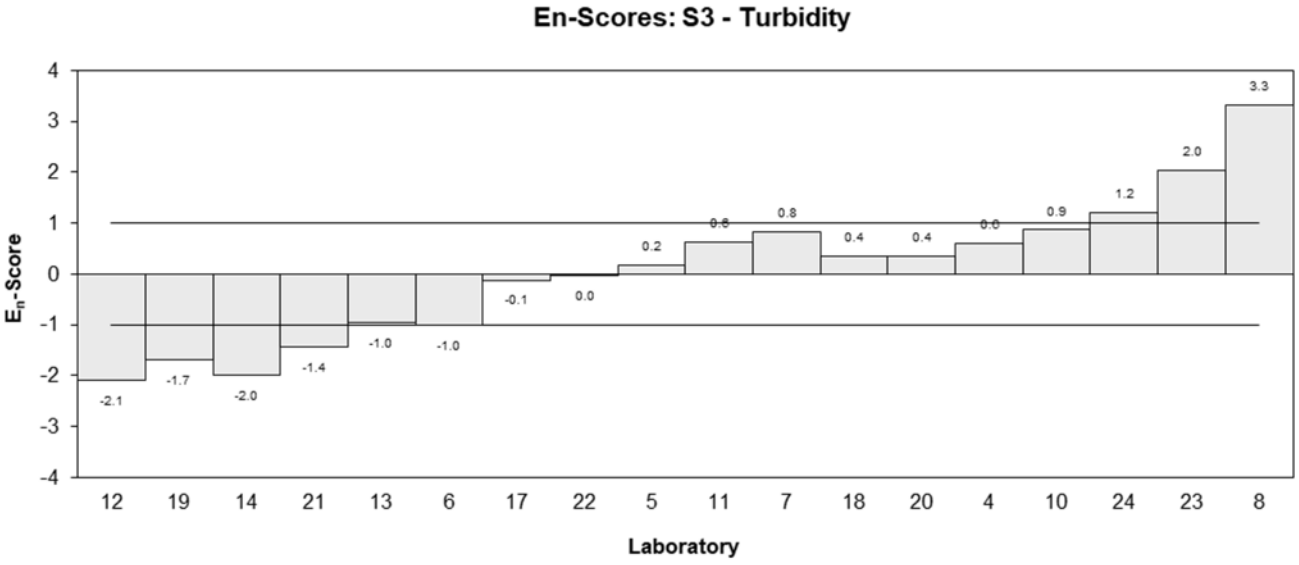

En-Scores: S3 - Turbidity
En-Score
12 19 14 21 13 6 17 22 5 11 7 18 20 4 10 24 23 8
Laboratory

Figure 49

7 DISCUSSION OF RESULTS

7.1 Assigned Value

Sample S1 was 100 mL of filtered, river water collected from Brown's Waterhole Turramurra. Participants were asked to report for this sample results for dissolved: Ag, Al, As, Be, Bi, Cd, Co, Cr, Cu, Fe, Hg, La, Mn, Ni, P, Pb, Sb, Se, Tl, U, V and Zn.

Sample S2 was unfiltered, autoclaved waste water. Participants were asked to report results for total: Al, As, B, Ba, Be, Cd, Cr, Co, Cu, Fe, Hg, Li, Mn, Mo, Ni, Pb, Sb, Se, Sn, Sr, V and Zn.

Sample S3 was 750 mL of unfiltered water collected from Lane Cove River. Participants were asked to report results for: total solids (TS) dried at 103-105°C, total suspended solids (TSS) dried at 103-105°C, total dissolved solids (TDS) dried at 180°C and turbidity (NTU).

Assigned Values for the 45 tests were the robust average of participants' results. The robust averages used as assigned values and their associated expanded uncertainties were calculated using the procedure described in 'ISO13528:2015(E), Statistical methods for use in proficiency testing by interlaboratory comparisons'. Results less than 50% and more than 150% of the robust average were removed before calculation of each assigned value.[6] No assigned value was set for Bi and La in S1 because the reported results were either too few or too variable. In addition, no assigned value was also set for Hg in S2 because there was no agreement between the spiked value and the robust average of participants' results. Appendix 2 sets out the calculation of the robust average and assigned value for As in Sample S1 and its associated uncertainty.

Spiked Values for each test of interest includes both the incurred value and the fortified value.

With the exception of Hg in S2, assigned values, spike values and homogeneity values were all in agreement with each other within their estimates of uncertainty for all elements of interest.

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. All but 7 numerical results were reported with an expanded measurement uncertainty, indicating that laboratories have addressed this requirement of ISO/IEC 17025.[8] The magnitude of these expanded uncertainties was within the range 0.16% to 11967% of the reported value. The participants used a wide variety of procedures to estimate the expanded measurement uncertainty. These are presented in Table 4.

Approaches to estimating measurement uncertainty include: standard deviation of replicate analysis, Horwitz formula, long term reproducibility, professional judgement, bottom up approach, top down approach using precision and estimates of method and laboratory bias, and top down approach using only the reproducibility from inter-laboratory comparison studies.[9 – 15]

Participation in proficiency testing programs allows participants to check how reasonable their estimates of uncertainty are. Results and the expanded MU are presented in the bar charts for each analyte (Figures 2 to 49). As a simple rule of thumb, when the uncertainty estimate is smaller than uncertainty of the assigned value, or larger than the uncertainty of the assigned value plus twice the target standard deviation, then this should be reviewed as

suspect. For example, 20 laboratories reported results for Fe in S1. The uncertainty of the assigned value estimated from the robust standard deviation of the 20 laboratories' results is 14 µg/L (see equation 4, page 128). Laboratories 5, 18 and 20 might have under-estimated their expanded measurement uncertainties reported for Fe in S1 as an uncertainty estimated from one measurement cannot be smaller than the uncertainty estimated from 20 measurements. Alternatively, estimates of uncertainties for Fe larger than 25.2 µg/L (the uncertainty of the assigned value, 14 µg/L plus the allowable variation from the assigned value, the target standard deviation of 5.6 µg/L, multiplied by 2, the coverage factor for a confidence interval of 95%), should also be viewed as suspect. For example, the expanded measurement uncertainties reported by Laboratories 5, 18 and 20 for Fe in S1 have been over-estimated.

Laboratory 21 should review the procedure they have used for estimating measurement uncertainty as most of their estimated uncertainties were over or under-estimated.

Laboratories 5 and 18 should also review their procedure for estimating measurement uncertainty as most of their estimated uncertainties were over-estimated.

Double counting the precision uncertainty components and overestimation of the laboratory or method bias are the most common errors seen in the laboratories' estimated uncertainty budgets. According 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.[12] An example of estimating measurement uncertainty using proficiency testing data only is given in Appendix 3.

Some laboratories estimated uncertainties for measurement results larger than the reported results themselves.

Laboratories 1, 9, 13, 15, 17, 18, 21 and 22 attached estimates of the expanded measurement uncertainty to results reported as less than their limit of detection. An estimate of uncertainty expressed as a numerical value cannot be attached to a result expressed as a range.[9]

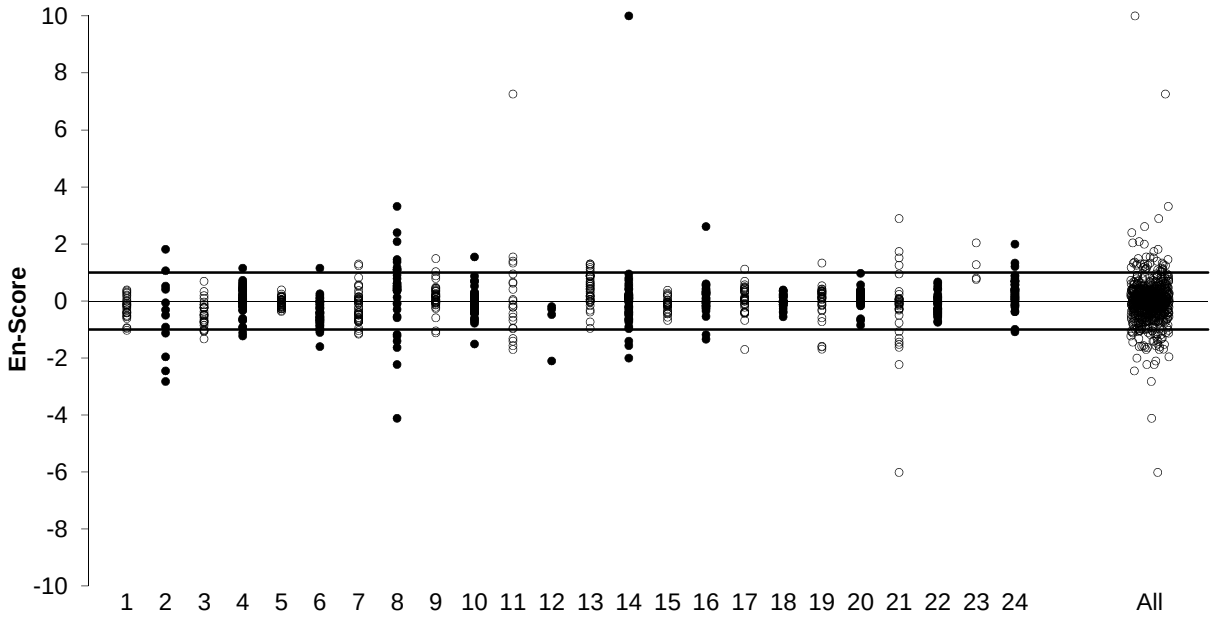
In some cases the results were reported with an inappropriate number of significant figures. The recommended format is to write uncertainty to no more than two significant figures and then to write the result with the corresponding number of decimal places. For example, instead of 18.44 ± 3.4 µg/L, it is better to report 18.4 ± 3.4 µg/L or instead of 0.0023 ± 0.00048 µg/L, it is better to report 0.0023 ± 0.0005 µg/L.[9]

7.3 E_n-score

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

The dispersal of participants' E_n-scores is graphically presented in Figure 50. 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 789 results for which E_n-scores were calculated, 699 (89%) returned a satisfactory score of $|E_n| \leq 1.0$ indicating agreement of the participants' results with the assigned values within their respective expanded measurement uncertainties.



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

Figure 50 E_n-Score Dispersal by Laboratory

7.4 z-Score

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

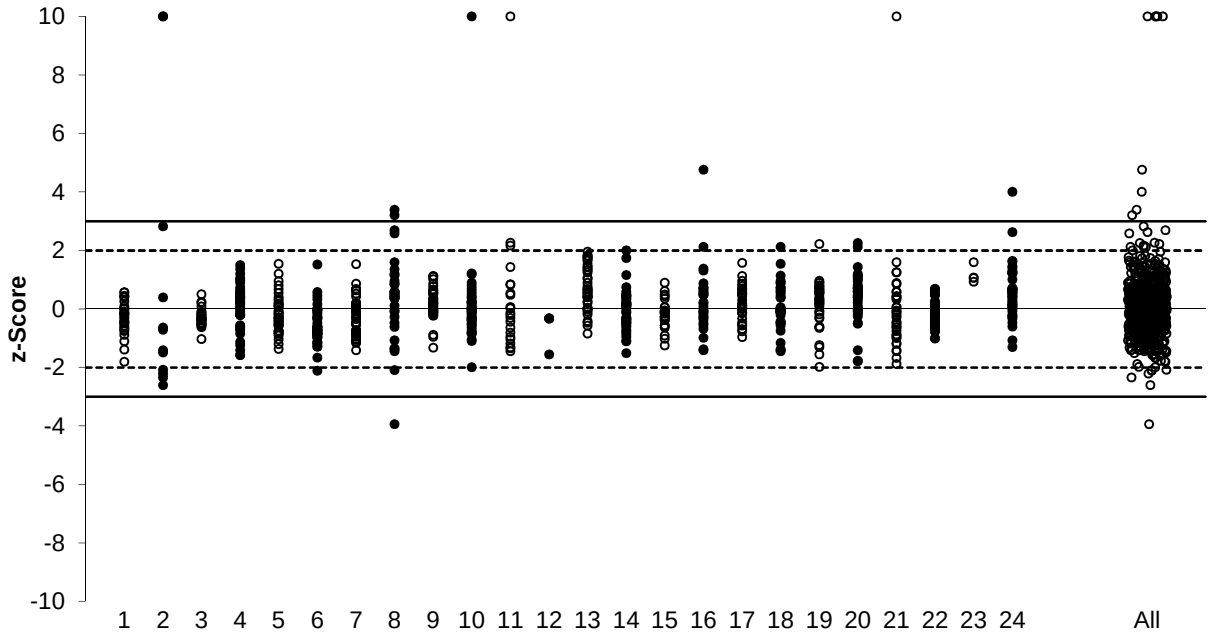
The target standard deviation defines satisfactory performance in a proficiency test. Target standard deviations equivalent to 10%, 15% and 20% PCV were used to calculate z-scores. Unlike the standard deviation based on between laboratories CV, setting the target standard deviation as a realistic, set value enables z-scores to be used as fixed reference value points for assessment of laboratory performance, independent of group performance.

The between laboratories coefficient of variation predicted by the Thompson equation[7] and the between laboratories coefficient of variation resulted in this study are presented for comparison in Table 54.

The dispersal of participants' z-scores is presented in Figure 51 (by laboratory code) and in Figure 52 (by test). Of 789 results for which z-scores were calculated, 761 (96%) returned a satisfactory score of $|z| \leq 2.0$ and 18 (2%) were questionable with a score of $2.0 < |z| < 3.0$. Participants with multiple z-scores larger than 2.0 or smaller than -2.0 should check for laboratory bias.

Laboratories 5, 7 and 14 reported results for all analytes for which a z-score was calculated. All results reported by them returned satisfactory z-scores.

Laboratories 4 and 17 also reported results for all analytes except for one or two and all were satisfactory.



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

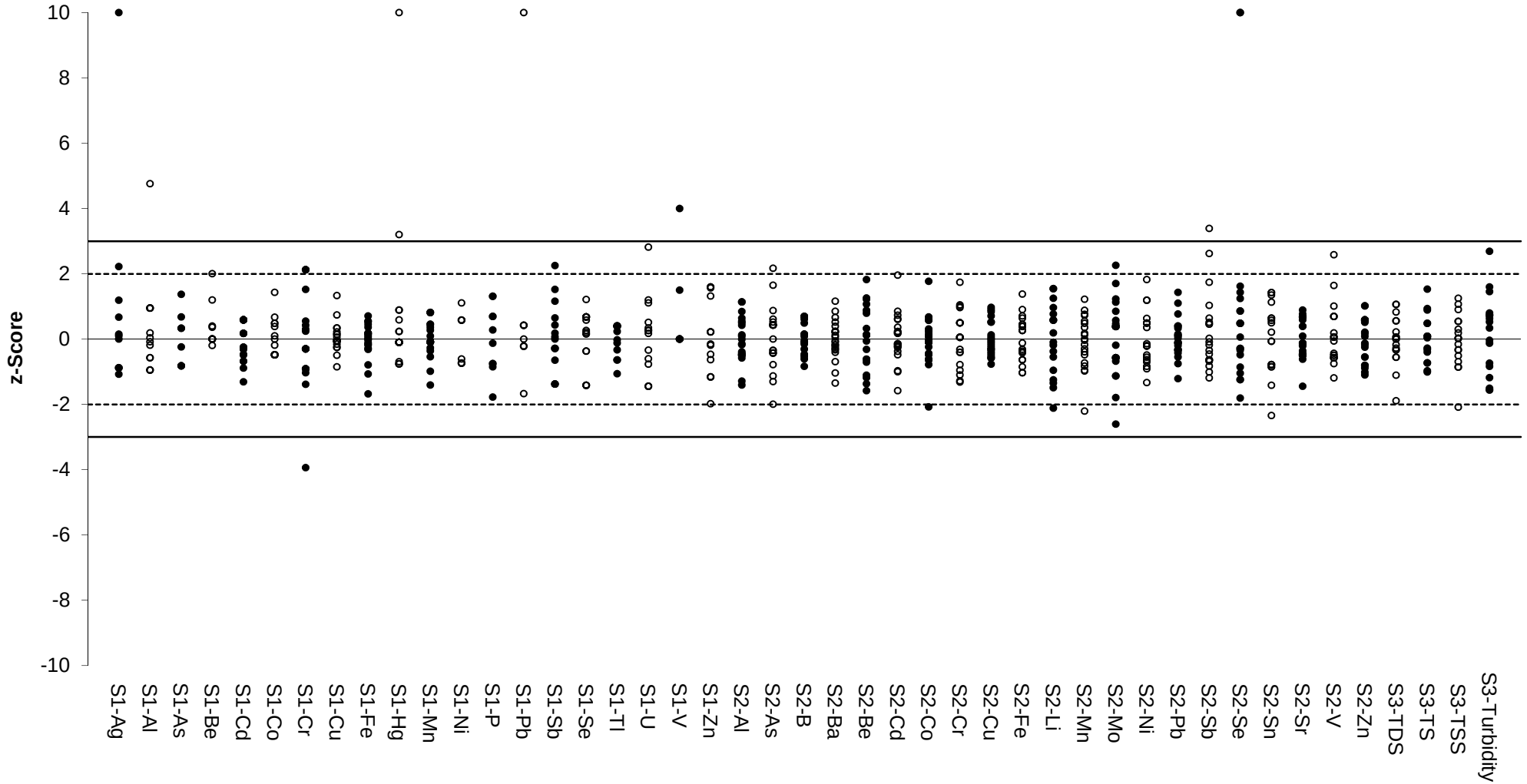
Figure 51 z-Score Dispersal by Laboratory

Table 54 Between Laboratories CV of this study, Thompson CV and Set Target CV

Sample	Test	Assigned value (µg/L)	Between Laboratories CV*	Thompson/ Horwitz CV	Target SD (as PCV)
S1	Ag	0.97	21%	22%	20%
S1	Al	17.5	13%	22%	15%
S1	As	0.871	9.2%	22%	10%
S1	Be	0.500	0.1%	22%	10%
S1	Bi	Not Set	29%	NA	Not Set
S1	Cd	0.472	6.3%	22%	10%
S1	Co	1.05	5.5%	22%	10%
S1	Cr	1.65	13%	22%	10%
S1	Cu	5.03	3%	22%	10%
S1	Fe	560	4.6%	22%	10%
S1	Hg	0.303	6.1%	22%	10%
S1	La	Not Set	NA	NA	Not Set
S1	Mn	11.1	5.4%	22%	10%
S1	Ni	0.756	8.9%	22%	10%
S1	P	97.3	12%	22%	10%

Sample	Test	Assigned value (µg/L)	Between Laboratories CV*	Thompson/ Horwitz CV	Target SD (as PCV)
S1	Pb	0.480	5%	22%	10%
S1	Sb	1.38	22%	22%	20%
S1	Se	1.27	15%	22%	15%
S1	Tl	0.962	5.2%	22%	10%
S1	U	1.17	11%	22%	10%
S1	V	0.400	0.1%	22%	10%
S1	Zn	4.84	19%	22%	15%
S2	Al	987	7.5%	16%	10%
S2	As	11.5	8.9%	22%	10%
S2	B	1310	5.1%	15%	10%
S2	Ba	63.6	5.5%	22%	10%
S2	Be	5.33	11%	22%	10%
S2	Cd	8.11	6.6%	22%	10%
S2	Co	29.3	5.6%	22%	10%
S2	Cr	21.9	8.9%	22%	10%
S2	Cu	155	6%	21%	10%
S2	Fe	1560	7.2%	15%	10%
S2	Hg	Not Set	12%	NA	Not Set
S2	Li	10.4	12%	22%	10%
S2	Mn	76.3	7.8%	22%	10%
S2	Mo	10.6	11%	22%	10%
S2	Ni	14.3	8.1%	22%	10%
S2	Pb	45.5	5.3%	22%	10%
S2	Sb	54.5	9.4%	22%	10%
S2	Se	5.25	11%	22%	10%
S2	Sn	14.1	11%	22%	10%
S2	Sr	337	6.3%	19%	10%
S2	V	15.9	8%	22%	10%
S2	Zn	236	7.7%	20%	10%
S3	TDS	180 mg/L	7.2%	7.3%	10%
S3	TS	248 mg/L	7.3%	7%	10%
S3	TSS	56.9 mg/L	7.7%	8.7%	10%
S3	Turbidity	26.2 NTU	24%	9.8%	20%

*Robust between -laboratory CV outliers removed; NA = Not Available.



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

Figure 52 z-Score Dispersal by Test

Table 55 Summary of Participants' Results and Performance for S1

Lab Code	Ag (µg/L)	Al (µg/L)	As (µg/L)	Be (µg/L)	Bi (µg/L)	Cd (µg/L)	Co (µg/L)	Cr (µg/L)	Cu (µg/L)	Fe (µg/L)	Hg (µg/L)
A.V.	0.97	17.5	0.871	0.500	Not Set	0.472	1.05	1.65	5.03	560	0.303
H.V.	0.95	20.7	1.00	0.510	0.338	0.475	1.18	1.88	5.50	564	0.305
S.V.	1.00	Not Spiked	0.800	0.502	0.378	0.465	1.00	1.73	4.99	Not Spiked	0.306
1	<5	<50	<1	<1	NT	0.45	1.03	1.42	4.9	551	0.28
2	3.17	NR	NR	NR	0.2	NR	NR	NR	NR	NR	0.83
3	< 5	< 50	< 1	< 1	< 5	0.457	1.00	1.48	4.78	554	0.300
4	0.97	<40	0.99	0.52	NT	0.48	1.09	1.69	4.95	580	0.33
5	<1	20	<1	0.56	<1	0.48	1.0	1.6	5	590	0.3
6	0.8	15	0.8	0.5	0.36	0.44	1.0	1.6	5.2	542	0.3
7	0.8	15	0.8	0.5	0.36	0.46	1.0	1.5	4.6	563	0.3
8	<1	20	<1	<1	4	0.5	<1	1	5	500	0.4
9	0.99	17.6	< 1.0	0.518	NT	0.430	1.12	1.70	5.14	569	0.321
10	1.2	16	0.8	0.5	1.6	0.5	1.0	1.6	5.0	516	0.3
11	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
12	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
13	1.1	16	0.93	0.5	0.3	0.5	1.2	1.9	5.7	558.7	0.3
14	1	18	0.9	0.6	0.36	0.48	1.1	1.6	5.4	566	0.3
15	<5	<50	<1	<1	<5	0.46	<1	1.5	4.9	544	0.33
16	NT	30	NT	NT	NT	0.5	NT	2	5	600	0.31
17	<5	<50	<1	<1	<5	0.449	1.05	1.74	5.06	570	0.282
18	<1	20	<1	0.5	<1	0.5	1	2	5	560	0.3
19	1.4	17	<1	<1	<1	0.48	<1	1.6	5.2	590	NR
20	<1	20	<1	0.5	<1	0.5	1	2	5	550	0.3
21	0.8	15	0.9	<1	<1	0.5	<1	1.5	5	466	0.28
22	<5	<50	<1	<1	<5	0.44	1.1	<1	5.1	570	0.28
23	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
24	0.76	17.3	0.85	0.49	0.34	0.41	1.06	1.72	5.10	585	0.31

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 55 Summary of Participants' Results and Performance for S1 (Continued)

Lab Code	La (µg/L)	Mn (µg/L)	Ni (µg/L)	P (µg/L)	Pb (µg/L)	Sb (µg/L)	Se (µg/L)	Tl (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
A.V.	Not Set	11.1	0.756	97.3	0.480	1.38	1.27	0.962	1.17	0.400	4.84
H.V.	0.473	12.7	0.822	120	0.435	1.32	1.58	0.91	1.12	0.450	5.12
S.V.	0.444	Not Spiked	Not Spiked	99.4	0.478	Not Spiked	1.28	1.01	1.18	Not Spiked	Not Spiked
1	NT	11	<1	NT	<1	<5	1.32	<5	<5	<5	<5
2	NR	9.53	NR	NR	NR	NR	NR	0.9	1.5	NR	NR
3	NT	10.7	< 1	NT	< 1	< 5	1.31	< 5	< 5	< 5	< 5
4	NT	11.6	0.70	89	0.47	1.43	<5	1.00	1.31	0.46	4.38
5	<0.5	12	<1	90	<1	1.4	1.4	1	1.2	<1	4.7
6	<1	10.8	0.8	<1000	0.4	1.8	1.3	0.96	1.13	0.4	4
7	<1	10.5	0.7	<1	0.5	1.3	1.4	0.86	1.08	0.4	4
8	<1	11	<1	NT	<1	1	<10	1	1	<10	6
9	0.450	11.5	0.84	96	0.469	1.38	1.38	0.984	1.23	< 1.0	4.73
10	NT	11	0.7	104	1.1	1.3	1.5	1.0	1.2	0.4	5.0
11	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
12	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
13	0.4	NR	0.8	<100	0.5	1.5	1.4	1	1.2	0.4	5.8
14	<1	11.6	0.8	<1000	0.5	1.7	1.2	0.95	1.19	0.4	5
15	NT	11	<1	NT	<1	<5	1.2	<5	<5	<5	<5
16	NT	10	NT	110	NT	1	1	NT	NT	NT	NT
17	NT	11.2	<1	104	<1	<5	1.40	<5	<5	<5	5.98
18	<0.5	11	<1	90	<1	1	1	<1	1	<1	4
19	<1	12	<1	100	<1	1.2	1.3	<1	1.1	<1	3.4
20	<0.5	12	<1	80.0	<1	2	1	1	1.3	<1	5
21	NT	11	<1	NT	<0.5	1.3	1	0.9	1	<1	6
22	NT	11	<1	<500	<1	<1	1.4	<5	<5	<5	<5
23	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
24	0.45	11.4	0.71	110	0.48	1.56	1.4	0.93	1.21	0.56	4.5

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 56 Summary of Participants' Results and Performance for S2 and S3

Lab Code	S2-Al (µg/L)	S2-As (µg/L)	S2-B (µg/L)	S2-Ba (µg/L)	S2-Be (µg/L)	S2-Cd (µg/L)	S2-Co (µg/L)	S2-Cr (µg/L)	S2-Cu (µg/L)	S2-Fe (µg/L)	S2-Hg (µg/L)	S2-Li (µg/L)	S2-Mn (µg/L)
A.V.	987	11.5	1310	63.6	5.33	8.11	29.3	21.9	155	1560	Not Set	10.4	76.3
H.V.	1120	11.5	1270	59.0	5.66	9.3	31.1	21.5	142	1520	0.88	10.3	88
S.V.	Not Spiked	11.1	Not Spiked	Not Spiked	5.45	8.18	29.7	22.2	Not Spiked	Not Spiked	2.18	Not Spiked	Not Spiked
1	944	12.0	1290	66.1	4.74	7.97	27.4	21.2	146	1630	0.86	NT	76.3
2	NR	NR	NR	NR	4.95	NR	23.2	NR	NR	NR	1.12	8.85	59.4
3	949	11.1	1240	65.1	5.16	7.92	28.6	21.0	146	1510	0.913	NT	73.3
4	930	10.2	1300	67.8	4.49	6.83	30.2	24.2	170	1600	1.0	10.2	80.5
5	1000	11	1200	57	4.6	8	27	21	152	1500	0.84	12	74
6	860	10.6	1230	59.2	4.7	7.32	27.5	19.1	154	1460	0.9	8.2	68.8
7	848	11.1	1330	63.2	5.4	7.72	31.3	20.2	163	1400	0.8	10.6	70.7
8	940	12	NT	71	5	8.8	31	23	168	1620	0.6	9	79
9	1050	12.1	1300	62.5	5.4	7.93	29.2	19.8	163	1600	< 2.1	10.3	77.6
10	986	9.2	1374	65	5.4	7.8	30	22	147	1427	0.8	10	70
11	1070	14	1270	55	<0.01	8.0	28	19	156	1400	0.8	NT	69
12	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
13	1036	13.4	NR	62.4	6.3	9.7	34.5	25.7	169	1495	1.1	11.2	NR
14	938	12	1320	61.5	5	8.28	29.7	19.5	157	1500	0.8	9.4	72.6
15	972	12	1390	64	5.3	8.4	29	22	149	1541	0.96	9.1	75
16	940	12.5	1300	61.7	NT	8.26	29.5	23.0	151	1775	0.935	9.83	81.9
17	996	11.5	1330	66.9	5.75	8.61	27.9	23.0	143	1630	0.927	11.4	77.3
18	1100	11	1300	63	5.8	8.7	29	22	153.1	1621	0.86	12	80
19	NR	10	1300	65	5.5	8.3	29	24	150	1700	NR	11	82
20	1100	12	1400	62	5.9	8.6	29	23	155	1670	0.98	11	82
21	1028	12	1249	69	6	7.3	31	22	148	1462	0.54	NT	83
22	970	11	1400	61	5.4	7.9	30	22	150	1600	0.85	11	76
23	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
24	1040	12.2	1400	64.3	5.98	8.25	31.0	24.1	166	1660	0.86	11.7	85.6

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

Table 56 Summary of Participants' Results and Performance for S2 and S3 (Continued)

Lab Code	S2-Mo (µg/L)	S2-Ni (µg/L)	S2-Pb (µg/L)	S2-Sb (µg/L)	S2-Se (µg/L)	S2-Sn (µg/L)	S2-Sr (µg/L)	S2-V (µg/L)	S2-Zn (µg/L)	S3-TDS (mg/L)	S3-TS (mg/L)	S3-TSS (mg/L)	S3-Tubidity (NTU)
A.V.	10.6	14.3	45.5	54.5	5.25	14.1	337	15.9	236	180	248	56.9	26.2
H.V.	12.2	13.9	46.8	52.7	4.82	16.0	343	14.9	261	195	260	62.0	23.9
S.V.	10.1	15.1	48.4	50.8	5.10	14.3	Not Spiked	15.2	Not Spiked	Not Spiked	Not Spiked	60.0	Not Spiked
1	11.2	13.3	43.6	54.6	4.3	14.9	340	15.1	215	NT	NT	NT	NT
2	7.83	NR	NR	NR	NR	10.8	350	NR	NR	NT	NT	NT	NT
3	10.4	13.4	45.9	52.6	5.07	14.8	331	15.1	223	NT	NT	NT	NT
4	11.1	13.5	44.6	50.8	4.6	12.1	330	17.5	250	190	250	57	30
5	10	13	40	50	5.1	13	320	15	240	170	250	55	28
6	9.4	13.1	42.1	57.0	4.8	12.9	316	14.7	217	177	230	52	22.3
7	9.4	13.6	46.2	58	5.7	12.9	320	16.2	232	181	286	58	29.5
8	11	16	46	73	<10	16	357	20	249	175	260	45	40.3
9	11.8	12.4	50.5	54	5.7	14.4	363	15.8	260	NT	NT	NT	NT
10	11	14	44	51	4.7	NT	367	16	210	184	238	56	30.4
11	13	14	52	51	20	<0.01	288	14	217	195	260	57.0	29
12	NT	NT	NT	NT	NT	NT	NT	NT	NT	174	240	55	18.0
13	12.4	16.9	47.3	60.1	5.9	16.1	321	NR	241	199	249	60	21.8
14	10	14.8	44	64	5.5	13	322	15.2	238	160	230	52	18.3
15	10	15	44	51	5.1	14	333	15	212	NT	NT	NT	NT
16	9.88	15	45.0	53.5	5.5	NT	325	17	250	NT	NT	NT	NT
17	11.5	14.1	45.6	57.3	5.28	15.7	333	15.0	223	174	224	58.6	25.5
18	11	14	45	52	5	14	360	15	250	180	270	57	30
19	11	15	49	51	4.6	15	360	17	250	190	250	62	18
20	8.7	16	47	57	6	15	350	17	260	180	250	54	30
21	11	14	43	48	14	NT	NT	16	233	146	NT	64	20
22	10	14	45	49	5.5	13	320	16	230	170	223	53	26
23	NT	NT	NT	NT	NT	NT	NT	NT	NT	199	271	63	34.6
24	11.9	15.2	47.3	68.8	6.1	16.1	360	18.5	248	181	241	60	33.8

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

7.5 Participants' Results and Analytical Methods

A summary of participants' results and performance is presented in Tables 55 and 56 and in Figures 51 and 52.

Rounding of results and reporting results with an insufficient number of significant figures was one of the main causes for unsatisfactory results.
We conduct our studies in accordance with the requirements of ISO/IEC 17043, one of which is to "assess laboratories' performance as they will normally perform in their routine life". For laboratories, this involves not only using their routine method and treating the "check sample" as a routine sample, but also reporting results as "you would normally report to a client." Reporting a results with too many significant figures can give an inaccurate perception of the precision of the measurement. This may be one of the reasons for which laboratories choose to report results with fewer significant figures. However, most of the instrumental techniques used by participants in the present study should be capable of producing results with up to two significant figures to a reasonable degree of certainty at a parts per billion level for most tests. River water is a less challenging matrix than sea water; while participants reported test results with 2 - 3 significant figures in the previous PT study in seawater, the same participants reported some results with only one significant figure in the present study. The level of analytes in the two studies were comparable.
While the vast majority of numerical guideline values in the Australian and New Zealand Guidelines for fresh and marine water quality are rounded to a single significant figure, the general rule as per Eurachem/CITAC Guide is: "The reported result has to provide enough information in case a decision has to be made" (e.g. when the result is close to the accepted guideline).[5,9] The ASTM E29-13 also states that: "The level of rounding should be carefully considered because any retention of significant digits of necessity involves some loss of information."[16]
Some laboratories should consider revising their calculation/reporting procedure as we did not have enough information to assess their result against "the accepted guideline" (the assigned value). Caution should be exercised when a rounding protocol is designed by a laboratory in order to avoid inadvertent losses of important information. Eurachem/CITAC Guide recommends to first consider the uncertainty of the measurement result (the uncertainty of the method used - once it has been validated and proven to be accurate over time, as requested in ISO17025) and then to express this uncertainty in a way that provides enough information.

Low level Ag, Bi and Sb were the tests that presented the most analytical difficulty to participating laboratories.

Participants were requested to analyse the waste water sample S2 for total elements. The method descriptions provided by participants are presented in Tables 1 and 2 and the instrumental conditions are presented in Appendix 5.

No relationship was evident between the performance of participants and the digestion procedure used for total elements in samples S2. The instrumental measurement was one of the main factors that influenced the results. However, participants' performance does not reflect only instrument performance, but also the performance of the analyst and of the analytical method used by the testing laboratory. Thus, these results should not be construed as an evaluation of a particular instrument.

Participants used a wide variety of instrumental techniques, collision/reaction cells and cell gases. Most laboratories reported using ICP-MS with a collision/reaction cell, some used ICP-OES and some only ICP-MS. One participant reported using GFAAS. Plots of

participants' results and performance versus instrumental techniques used are presented in Figures 53.

Individual Element Commentary

Aluminium level in S1 was 17.5 µg/L below the reporting level of 6 laboratories, however Al measurements at low level did not pose significant problems to those who reported results. The between-laboratory CV was smaller than the CV predicted by the Thomson and Horwitz equation, at 13%. With the exception of one, all participants used ICP-MS in collision mode; one laboratory reported using ICP-MS in standard mode (Figure 53).

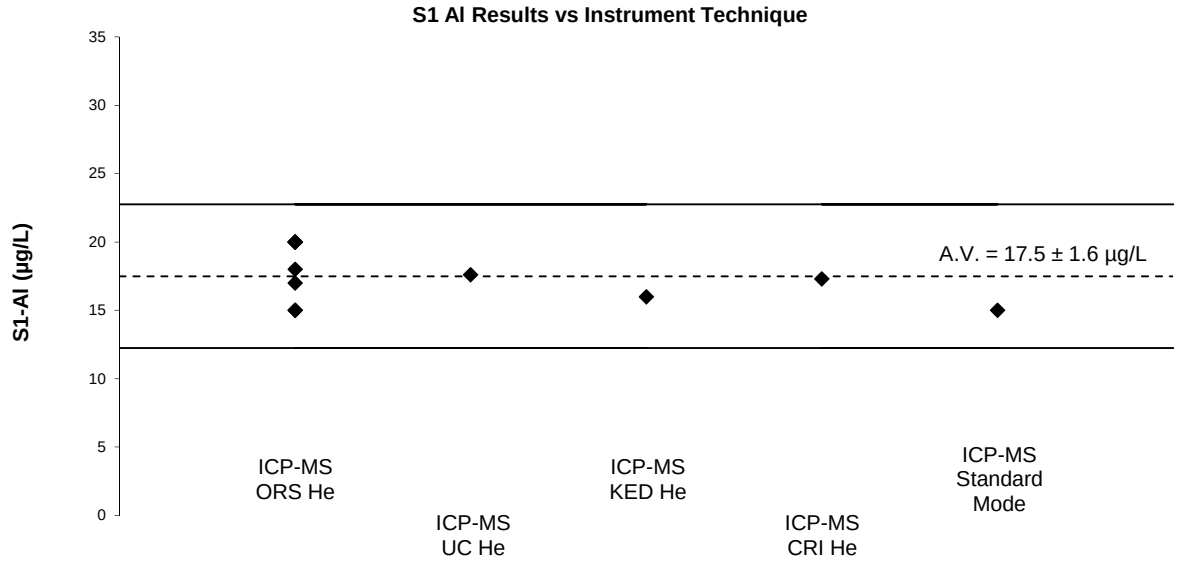


Figure 53 S1-Al Results vs Instrumental Technique

Arsenic level in the river water samples was 0.871 µg/L and in the waste water sample was 11.5 µg/L. Of 24 participants, 8 reported results for As in S1 and 21 in S2. All reported results returned satisfactory z-scores except for one. Measurement of As at a parts per billion level in S2 by ICP-OES may have presented difficulty to laboratory 11 (Figure 54).

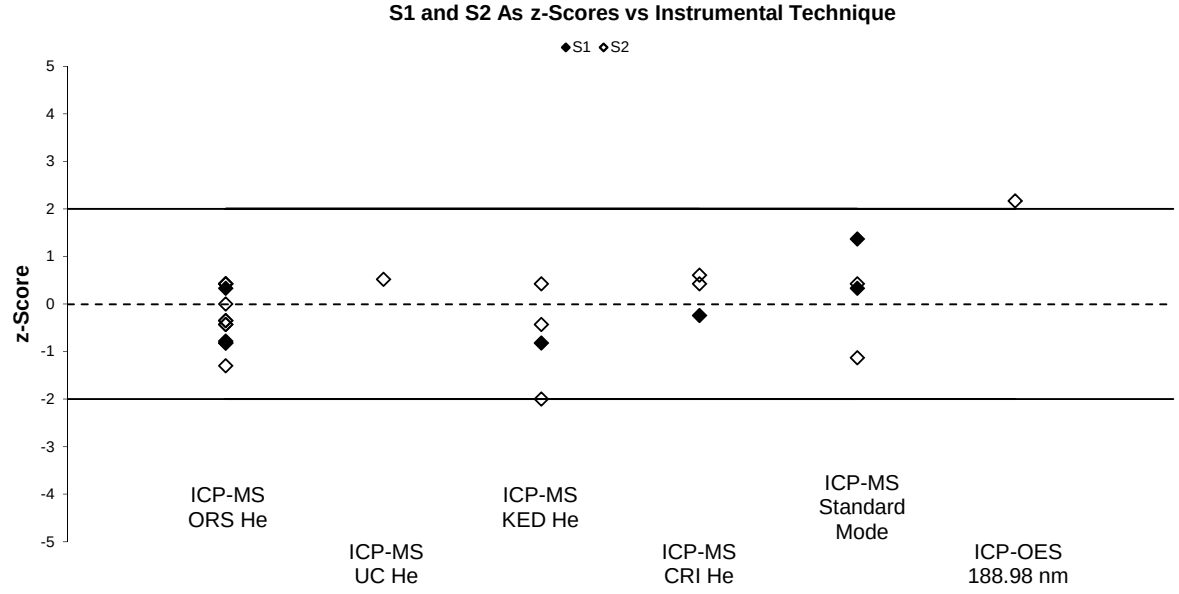


Figure 54 S1 and S2-As z-Scores vs Instrumental Technique

Beryllium measurements did not present analytical difficulty to participating laboratories. Beryllium level in S1 and S2 was 0.500 µg/L and 5.33 µg/L respectively. All reported results returned satisfactory z-scores (Figure 55).

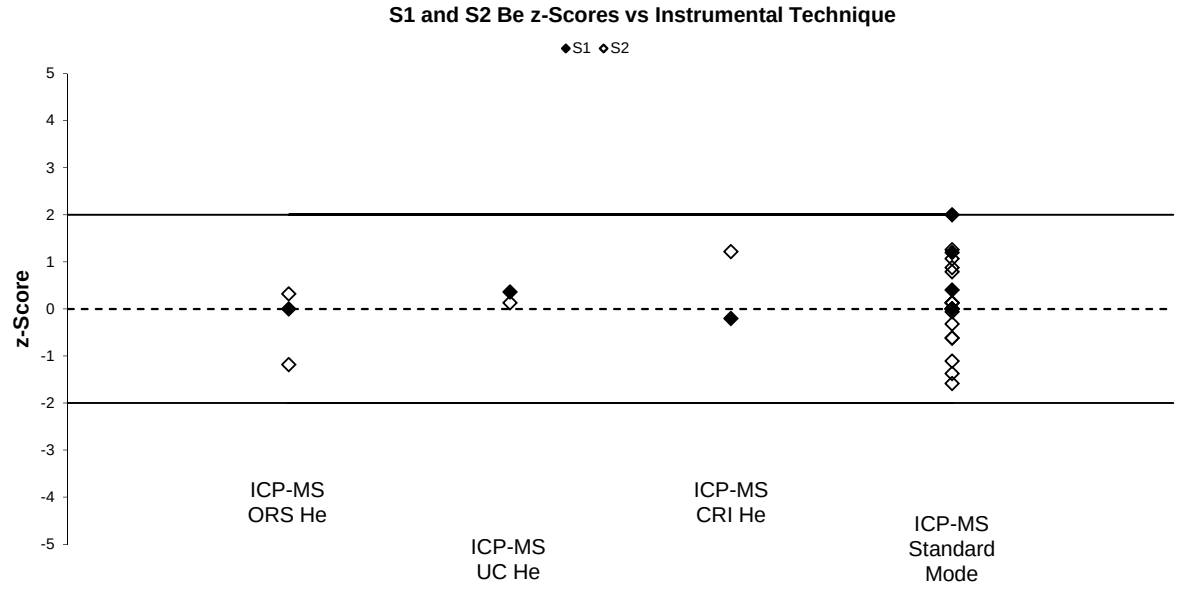


Figure 55 S1 and S2-Be z-Scores vs Instrumental Technique

Bismuth Measurements of low level Bi in river water might have presented difficulties to participating laboratories. Only 8 laboratories reported results for this analyte; 6 of them were compatible to each other.

Chromium in S1 was one of the analytes with the largest number of unsatisfactory z-scores. All results reported for Cr with only one significant figure were unsatisfactory. There was no evident relationship between participants' performance and instrumental technique used (Figure 56).

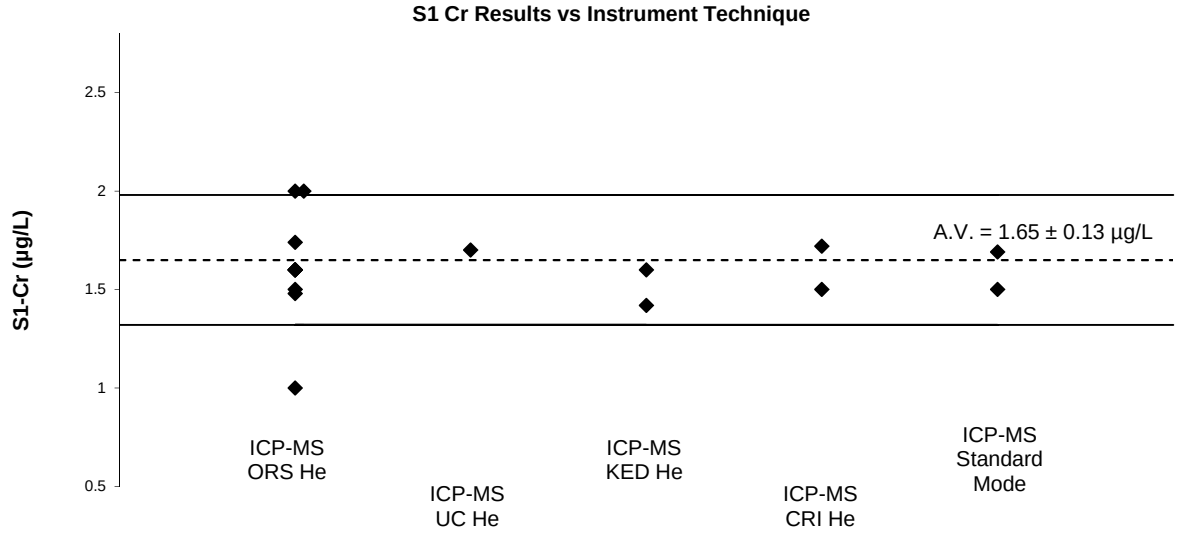
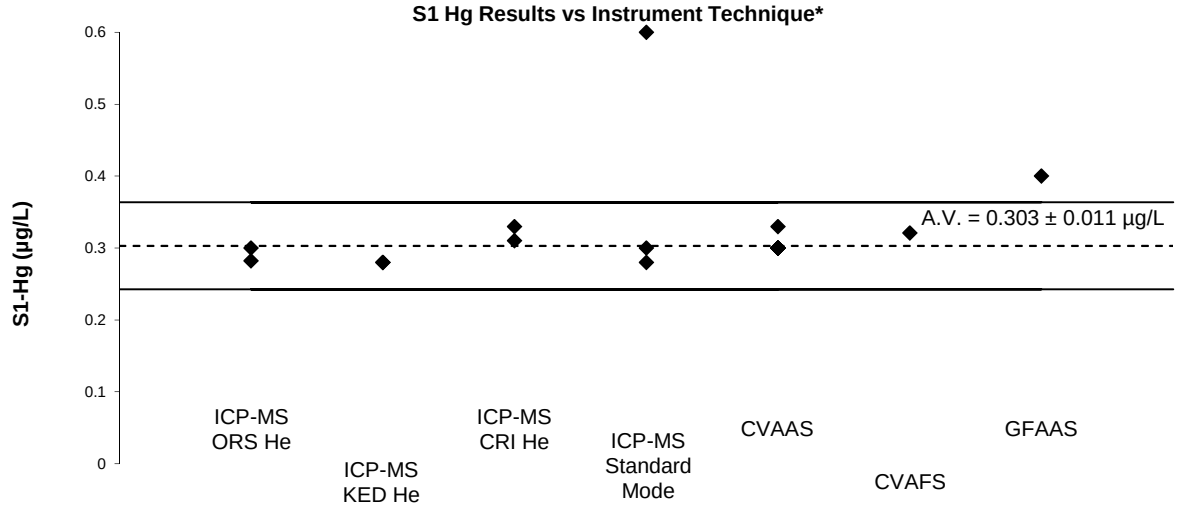


Figure 56 S1 Cr Results vs Instrumental Technique

Mercury Although the Hg level in S1 was low (0.303 µg/L) the between- laboratory CV (6.1%) was smaller than that predicted by Thomson and Horwitz (22%). There was excellent agreement between the reported results for Hg, regardless of instrumental technique used

(Figure 57) with the exception of two results. Some results have been rounded up and/or reported with an inappropriate number of significant figures.



*Laboratory 2 result of 0.83 µg/L has been plotted as 0.6 µg/L

Figure 57 S1 Hg Results vs Instrumental Technique

Lanthanum Only 3 results were reported for La in S1, and all were in agreement with each other and with the homogeneity value (0.473 mg/kg) and with the spike value (0.473 mg/kg). One participant used Th as internal standard for the measurement of La.

Phosphorus level in S1 was 97.3 µg/L. A limited number of laboratories had the capability to measure P in water at this level. Only 10 participants reported results for this analyte and all were compatible with the assigned value.

Plots of participants results versus the instrumental technique used are presented in Figure 58.

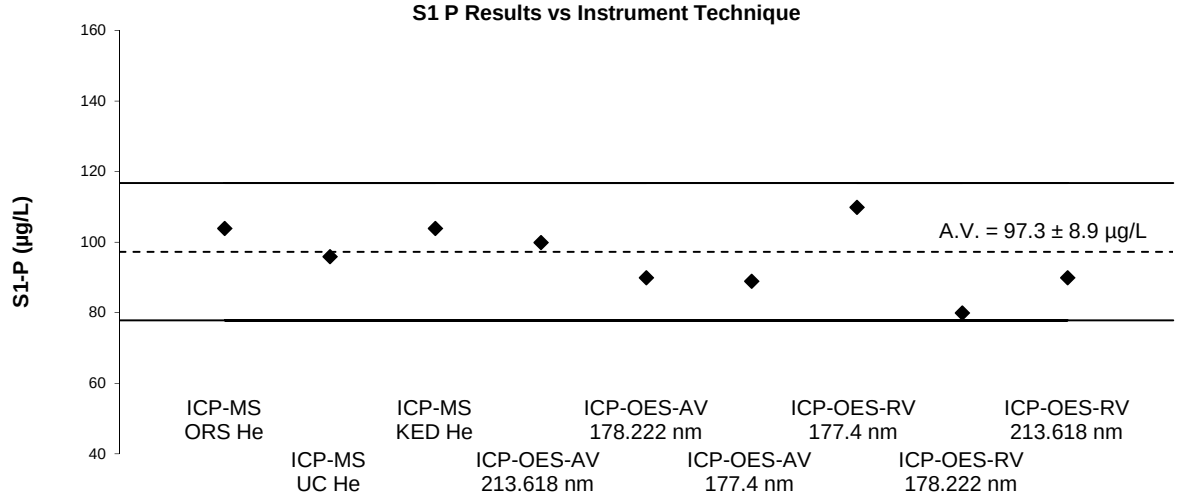


Figure 58 S1 Hg Results vs Instrumental Technique

Antimony level in S1 was 1.38 µg/L and in S2 was 54.5 µg/L. All reported results returned satisfactory z-scores except for one in S1 and two in S2. Reporting results with an insufficient number of significant figures might explain some of these unsatisfactory z-scores. All participants except one used ICP-MS for their Sb measurements. Laboratory 11 reported using ICP-OES with a wavelength of 206.834 nm to measure Sb in S2 (Figure 59).

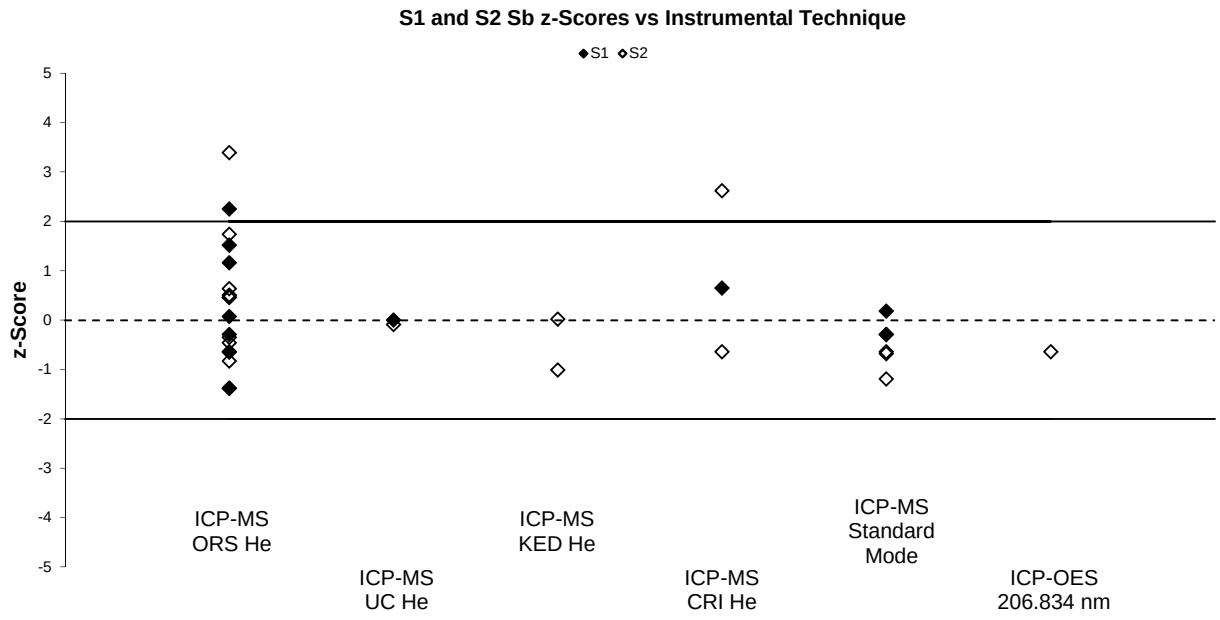


Figure 59 S1 and S2 Sb Performance vs Instrumental Technique

Selenium All participants reported satisfactory results for Se in the two study sample, with the exception of two. Participants used 8 different instrumental techniques: ICP-MS in standard, collision or reaction mode and with various collision/reaction gases: He, high energy He, NH_3 or H_2, (Figure 60).

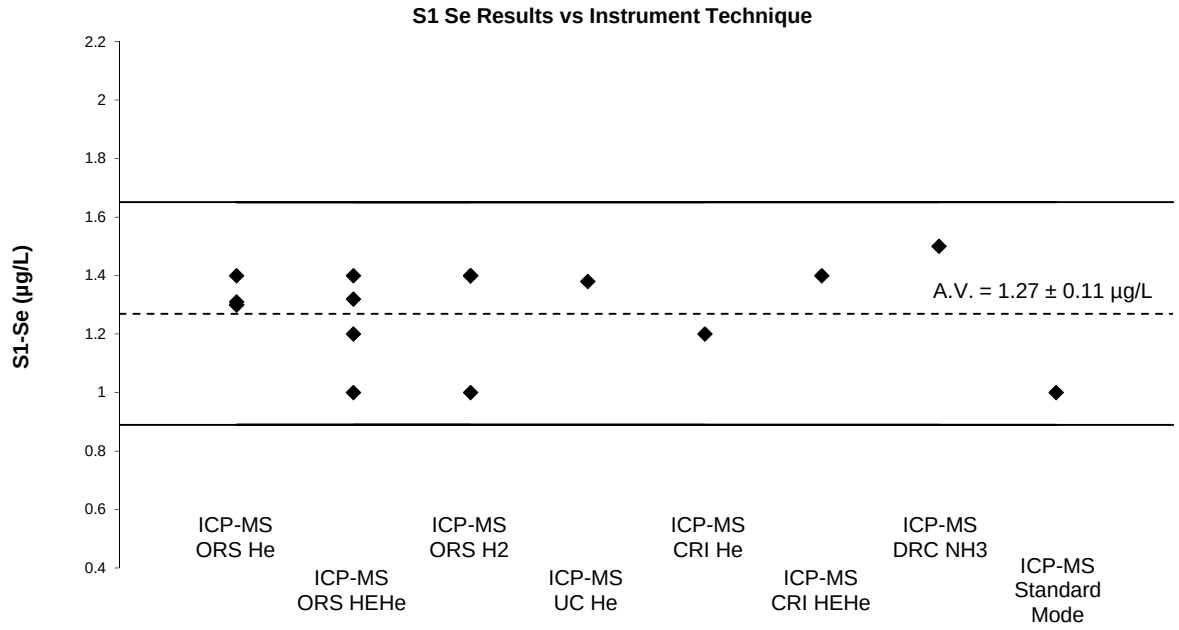


Figure 60 S1 and S2 Se Performance vs Instrumental Technique

Vanadium Of 24 participants, 7 reported results for low level V in S1. Plots of participants' performance in S1 and S2 versus instrumental techniques are presented in Figure 61.

Zinc is an element known to be ubiquitous in the environment (e.g. often contained within nitrile gloves) and controlling Zn contamination is a challenge for laboratories. All the results reported for Zn in the two study samples returned satisfactory z-scores. Plots of participants' performance versus instrumental technique are presented in Figure 62.

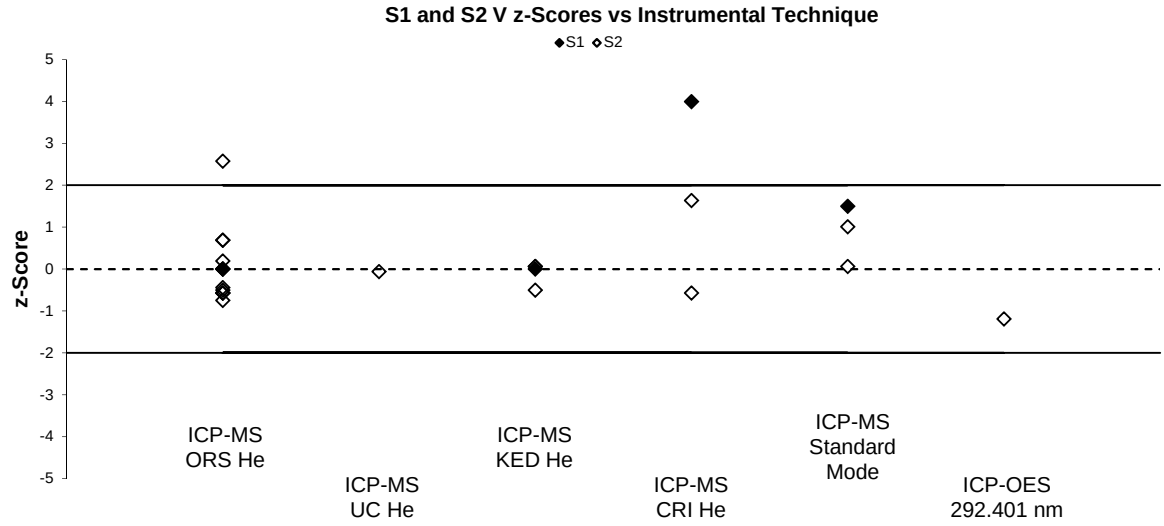


Figure 61 S1 and S2 V Performance vs Instrumental Technique

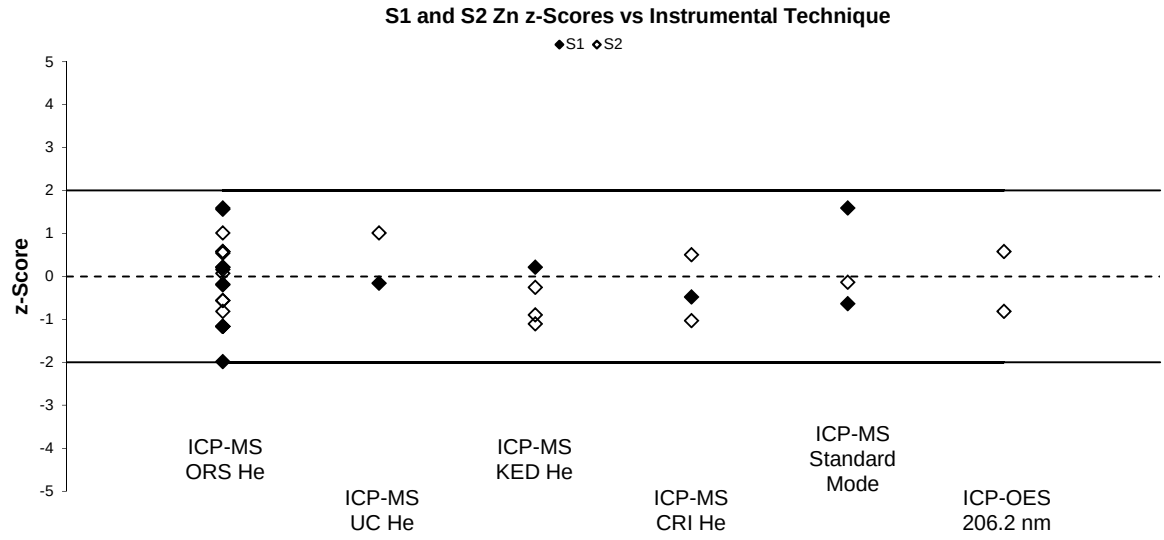


Figure 62 S1 and S2 Zn Performance vs Instrumental Technique

Solids measurements in the river water have not presented analytical difficulties to participating laboratories, the between laboratories CVs were low, around 7%. The method description provided by participants is presented in Table 2. Most participants used APHA Method 2540.

7.6 Comparison with Previous NMI Proficiency Tests of Metals in Water

AQA 21-09 is the 28th NMI proficiency test of metals in water. For most analytes, the same fixed target standard deviation was used in the present study as in previous studies of metals in water. This allowed for a comparison of participants' performance (z-score) over time and provided a benchmark for progressive improvement.

Despite different analyte concentrations, on average participants' performance has remained consistent with a percentage of satisfactory z-scores ranging from 87% to 96% (Figure 63).

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 $|z| \leq 2.0$. Scores in the range $2.0 < |z| < 3.0$ 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.

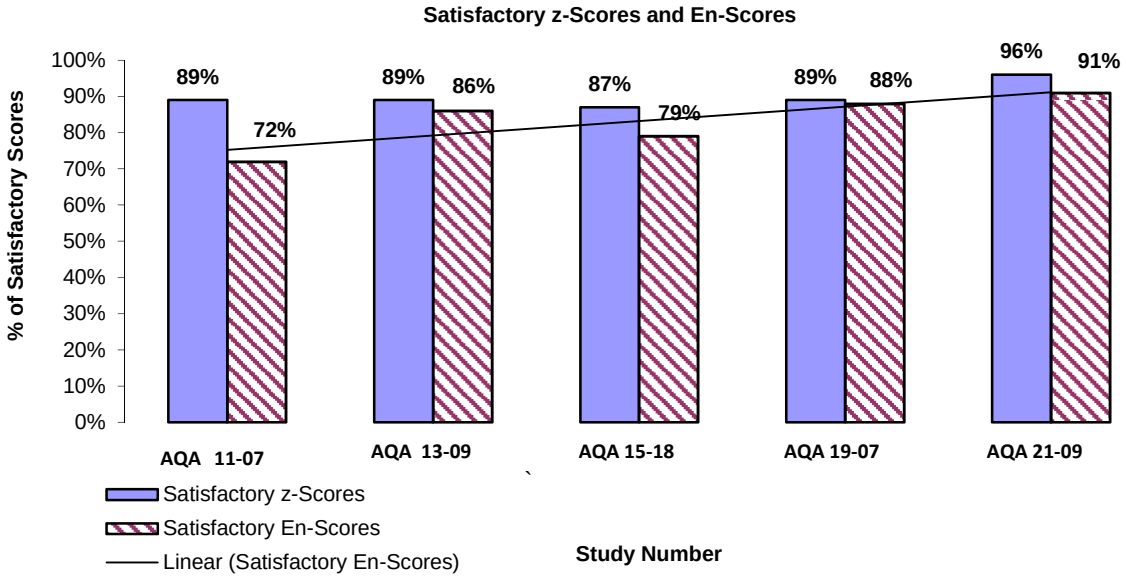


Figure 63 Participant's Performance in Metals in River Water over Time

7.7 Reference Materials and Certified Reference Materials

Participants reported whether control samples (spiked samples, certified reference materials-CRMs or matrix reference materials-RMs) had been used (Table 57).

Table 57 Control Samples Used by Participants

Lab. Code	Description of Control Samples
1	AGAL-10 & AGAL-12
2	CRM
3	CRM - CCV-1-A-100, CCV-1-B-100
4	CRM - CWW-TMA, CWW-TMC
6	CRM - High Purity CRMs
7	RM
8	CRM
9	SS
10	CRM - CWW-TM-A, B and C
11	SS
13	LPCS
15	SS
16	CRM
17	CRM - ICPMS CRM, ICV1-2, ICV3-1, HG CRM, ICV1-1, TDS CRM, TURBIDITY CRM
19	SS
21	CRM - TMDW Trace metals in Drinking Water #2025917
22	RM
23	SS

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'*[17]

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APPENDIX 1 - SAMPLE PREPARATION, ANALYSIS AND HOMOGENEITY TESTING

Sample Preparation

Samples S1– was filtered and acidified river water collected from Brown's Waterhole Turramurra. The water was further fortified with 15 of the elements of interest.

Sample S2– was unfiltered and acidified waste water from a water treatment station. The water was further fortified with 13 of the elements of interest.

Sample S3– was unfiltered river water collected from Lane Cove River. The water was then further fortified with a known amount of glass fibre filter and turbidity standard.

Sample Analysis and Homogeneity Testing

A partial homogeneity test was conducted for all analytes of interest. Three bottles were analysed in duplicate and the average of the results was reported as the homogeneity value.

Methodology for Dissolved and Total Elements

Measurements for total and dissolved elements were made using NMI Method for which NMI holds third party (NATA) accreditation for this method. For analysis of total elements in S2, a test portion of 30 mL was transferred to a 50 mL graduated polypropylene centrifuge tube. The samples were digested using 2 mL of nitric on a hot block at 90±100^{o}C for 90 min.

Testing involved measurements using ICP-MS. The measurement instrument was calibrated using external standards for targeted analytes. A set of quality control samples consisting of blanks, blank matrix spike, duplicates and sample matrix spikes was carried out through the same set of procedures and analysed at the same time as the samples. A summary of instrumental technique used for each analyte is given in Table 58.

Table 58 Instrumental Technique used for Total and Dissolved Elements

Analyte	Instrument	Internal Standard	Reaction/ Collision Cell (if applicable)	Cell Mode/Gas (if applicable)	S1 Final Dilution Factor	S2 Final Dilution Factor	Ion (m/z)
Ag	ICP-MS	Rh	ORS	He	1	NA	107
Al	ICP-MS	Rh	NA	NA	1	2	27
As	ICP-MS	Rh	ORS	He	1	2	75
B	ICP-MS	Rh	NA	NA	NA	2	11
Ba	ICP-MS	Rh	ORS	He	NA	2	137
Be	ICP-MS	Rh	NA	NA	1	2	9
Bi	ICP-MS	Ir	ORS	He	1	NA	209
Cd	ICP-MS	Rh	NA	NA	1	2	111
Co	ICP-MS	Rh	ORS	He	1	2	59
Cr	ICP-MS	Rh	ORS	He	1	2	52
Cu	ICP-MS	Rh	ORS	He	1	2	63
Fe	ICP-MS	Rh	NA	NA	1	NA	56
Hg	ICP-MS	Rh	NA	NA	1	2	201
La	ICP-MS	Rh	ORS	He	1	NA	139
Li	ICP-MS	Rh	ORS	He	NA	2	7
Mn	ICP-MS	Rh	ORS	He	1	2	55
Mo	ICP-MS	Rh	ORS	He	NA	2	95
Ni	ICP-MS	Rh	ORS	He	1	2	60
P	ICP-MS	Rh	ORS	HEHe	1	NA	31
Pb	ICP-MS	Ir	NA	NA	1	2	Average of 206, 207, 208
Sb	ICP-MS	Rh	ORS	He	1	2	121
Se	ICP-MS	Rh	ORS	HEHe	1	2	78

Sn	ICP-MS	Rh	NA	NA	NA	2	118
Sr	ICP-MS	Rh	ORS	He	NA	2	88
Tl	ICP-MS	Rh	ORS	He	1	NA	205
U	ICP-MS	Ir	NA	NA	1	NA	238
V	ICP-MS	Rh	ORS	He	1	2	51
Zn	ICP-MS	Rh	ORS	He	1	2	64

Methodology for Tests in S3

A well-mixed sample was filtered through a pre-weighed glass fibre filter; the residue retained on the filter was dried at 104°C weighed and reported as TSS. The filtrate was collected in a pre-weighed container then dried at 180ºC weighed and reported as TDS.

For TS measurements, the unfiltered sample was dried at 104ºC into a pre-weighed container. After drying the residue was weighed and reported as TS. Measurements for turbidity were obtained using a turbidimeter.

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

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

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

where:

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

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

A worked example is set out below in Table 59.

Table 59 Uncertainty of Assigned Value for As in Sample S1

No. results (p)	8
Robust Average	0.871 µg/L
$S_{rob\ av}$	0.080 µg/L
$u_{rob\ av}$	0.035 µg/L
k	2
$U_{rob\ av}$	0.071 µg/L

The assigned value for As in Sample S1 is **0.871 ± 0.071 µg/L.**

z-Score and E_n-score

For each participant's result a z-score and E_n-score are calculated according to Equation 2 and Equation 3 respectively (see page 10).

A worked example is set out below in Table 60.

Table 60 z-Score and E_n-score for As result reported by Laboratory 6 in S1

As Result µg/L	Assigned Value µg/L	Set Target Standard Deviation	z-Score	E_n-Score
0.8±0.1	0.871±0.071	10% as CV or 0.10x0.871= =0.0871 µg/L	$z = \frac{(0.8 - 0.871)}{0.0871}$ z = -0.82	$En = \frac{(0.8 - 0.871)}{\sqrt{0.1^2 + 0.071^2}}$ E_n=-0.58

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 be used to estimate the uncertainty of their measurement results.[12] Between 2007 and 2021, NMI carried out 28 proficiency tests of metals in water. These studies involved analyses of dissolved or total elements at low and high levels in potable, fresh (river), saline water, ground water and waste water. Laboratory 10 participated and submitted satisfactory results in 20 of these PTs. This data can be separated into two ranges of results: 0.0005 to 0.01 mg/L and 0.01 to 0.10 mg/L. Results are presented in Tables 61 and 62.

Table 61 Laboratory 10 Reported Results for Ni at 0.0005 to 0.01 mg/L Level.

Study No.	Sample	Laboratory result* mg/L	Assigned value mg/L	Robust CV of all results (%)	Number of Results
AQA 11-07	Fresh	0.0015 ± 0.0003	0.00100 ± 0.00001	24	15
	Fresh	0.0039 ± 0.00078	0.00306 ± 0.00016	18	19
	Fresh	0.0039 ± 0.00078	0.00306 ± 0.00016	9.6	19
AQA 12-20	Saline	0.0039 ± 0.0008	0.00370 ± 0.00028	13	19
AQA 13-09	Fresh	0.0044 ± 0.0009	0.00409 ± 0.00017	7.9	15
AQA 13-22	Saline	0.00170 ± 0.00034	0.00165 ± 0.00014	13	14
	Saline	0.00384 ± 0.00077	0.00378 ± 0.00012	13	14
AQA 15-06	Sea	0.00180 ±0.0004	0.00177 ± 0.00021	28	12
	Sea	0.00172 ± 0.0004	0.00177 ± 0.00021	28	11
AQA 15-18	Surface	0.002 ± 0.0003	0.00196 ± 0.00013	7.8	10
AQA 16-03	Waste	0.0041 ± 0.0008	0.00398 ± 0.00031	8.6	9
AQA 16-15	Sea	0.0070 ± 0.0010	0.00652 ± 0.00038	9.4	16
AQA 17-16	Sea	0.0015 ± 0.0003	0.00143 ± 0.00029	22	10
AQA 18-16	Sea	0.0022 ± 0.0005	0.00206 ± 0.00015	11	14
AQA 19-07	Fresh	0.0018 ± 0.0004	0.00187 ± 0.00009	5.3	10
AQA 19-16	Sea	0.0021 ± 0.0004	0.00168 ± 0.00037	25	8
AQA 20-16	Sea	0.0013 ± 0.0003	0.00178 ± 0.00034	24	10
AQA 21-09	River	0.0007 ± 0.0002	0.000756 ± 0.000059	8.9	8
Average				15**	

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

Table 62 Laboratory 10 Reported Results for Ni at 0.01 to 0.10 mg/L Level.

Study No.	Sample	Laboratory result* mg/L	Assigned value mg/L	Robust CV of all results (%)	Number of Results
AQA 11-17	Waste	0.10 ± 0.009	0.099 ± 0.001	2	15
	Waste	0.10 ± 0.009	0.098 ± 0.001	2	15
AQA 12-09	Potable	0.047 ± 0.007	0.045 ± 0.002	6.7	19
	Potable	0.055 ± 0.008	0.053 ± 0.002	7.4	19
AQA 12-20	Saline	0.0415 ± 0.0083	0.0384 ± 0.0021	11	22
AQA 13-09	Fresh	0.0393 ± 0.0040	0.0361 ± 0.0010	4.8	16
	Fresh	0.0258 ± 0.0030	0.0272 ± 0.0025	15	15
AQA 14-08	Ground	0.019 ± 0.004	0.0191 ± 0.0007	7.9	13
AQA 14-19	Potable	0.019 ± 0.004	0.0183 ± 0.0013	11	14
AQA 15-18	Surface	0.036 ± 0.0035	0.0336 ± 0.0013	5.1	13
AQA 16-03	Waste	0.042 ± 0.0045	0.0352 ± 0.0050	19	11
AQA 16-15	Sea	0.0456 ± 0.0060	0.0409 ± 0.0029	12	17
AQA 17-16	Sea	0.0116 ± 0.0012	0.0101 ± 0.0023	27	9
AQA 18-05	Potable	0.017 ± 0.002	0.0172 ± 0.0010	8.7	16
AQA 18-16	Sea	0.015 ± 0.0030	0.0138 ± 0.0014	15	15
AQA 19-07	Fresh	0.029 ± 0.0035	0.0283 ± 0.0009	4.3	11
AQA 20-07	Potable	0.010 ± 0.002	0.0106 ± 0.0004	6	16
AQA 21-09	Waste	0.014 ± 0.0021	0.0143 ± 0.0006	8.1	21
Average				9.6**	

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

Taking the average of the robust CVs over these PT samples for each concentration range gives estimates of the relative standard uncertainty of 15% and 9.6% respectively. Using a coverage factor of two gives relative expanded uncertainties of 30% and 20% respectively, at a level of confidence of 95% level.

Table 63 sets out the expanded uncertainty for results of the measurement of Ni in fresh, saline, waste or potable water over the ranges 0.0005 – 0.01 mg/L and 0.01 – 0.10 mg/L.

Table 63 Uncertainty of Ni results estimated using PT data.

Results mg/L	Uncertainty mg/L
0.00050	0.00015
0.00100	0.00030
0.0100	0.0020
0.100	0.020
0.150	0.030

The estimates of 30% and 20% relative passes the test of being reasonable, and the analysis of the thirty-three different PT samples over ten years can be assumed to include all the relevant uncertainty components (different matrices, operators, reagents, calibrators etc.), and so complies with ISO/IEC 17025.[8]

APPENDIX 4 - ACRONYMS AND ABBREVIATIONS

APHA	American Public Health Association
ASNZS	Standards Australia and Standards New Zealand
CITAC	Cooperation on International Traceability in Analytical Chemistry
CRI	Collision Reaction Interface
CRM	Certified Reference Material
CV	Coefficient of Variation
CVAAS	Cold Vapour-Atomic Absorption Spectrometry
CVAFS	Cold Vapour-Atomic Fluorescence Spectroscopy
DRC	Dynamic Reaction Cell
GUM	Guide to the Expression of Uncertainty in Measurement
HEHe	High Energy He Mode
KED	Kinetic energy discremination
ICP-MS	Inductively Coupled Plasma - Mass Spectrometry
ICP-MS/MS	Inductively Coupled Plasma - Tandem 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
ISO	International Organisation for Standardisation
Max	Maximum Value in a Set of Results
Md	Median
Min	Minimum Value in a Set of Results
MU	Measurement Uncertainty
NATA	National Association of Testing Authorities
NIST	National Institute of Standards and Technology
NMI	National Measurement Institute (of Australia)
NR	Not Reported
NT	Not Tested
ORC	Octopole Reaction Cell
ORS	Octopole Reaction System
PCV	Performance Coefficient of Variation
PT	Proficiency Test
RM	Reference Material
Robust CV	Robust Coefficient of Variation
Robust SD	Robust Standard Deviation
S.V.	Spiked or Formulated Concentration of a PT Sample
SI	The International System of Units
s^2_{sam}	Sampling Variance
s_a/σ	Analytical Standard Deviation Divided by the Target Standard Deviation
SRM	Standard Reference Material (Trademark of NIST)
Target SD	Target Standard Deviation
σ	Target Standard Deviation
UC	Universal Cell
USEPA	United States Environmental Protection Agency

APPENDIX 5 - INSTRUMENT DETAILS FOR TOTAL AND DISSOLVED ELEMENTS

Table 64 Instrument Conditions Ag

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	89 Y	KED	He	1	NA	NA
2	ICP-MS	Y	KED			NA	
3	ICP-MS			He		NA	
4	ICP-MS				1	NA	107
5	ICP-MS	103 Rh	ORS	standard mode	NA	NA	107
6	ORC ICPMS	Ir, Rh & Sc	ORS	He	1	NA	328.069nm
7	ICP-MS	Rh	ORS	He		NA	107
8	ICP-MS	Rh, Sc, Ir	ORS	He		NA	107
9	ICP-MS	Rh	UC	He	1	NA	109
10	ICP-MS	Rh	NA	NA	1	NA	109
11	NA	NA	NA	NA	NA	NA	NA
12	NA	NA	NA	NA	NA	NA	NA
13						NA	
14	ICP-MS	Rh	ORS	He	1	1	107
15	ICP-MS	Rh	CRI	He	1	NA	107
16						NA	
17	ICP-MS	Rh	ORS	He	1	NA	107
18	ICP-MS	103 Rh	ORS	standard mode	NA	NA	107
19	ICP-MS	Rh/Ir	ORS	He	1.25	NA	
20	ICP-MS	103 Rh	ORS	standard mode	NA	NA	107
21	ICP-MS	Ir, Rh				NA	
22	ICP-MS	89 Y	KED	He	1	NA	NA
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-MS		CRI	He		NA	109

Table 65 Instrument Conditions Al

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	45 Sc	KED	He	1	1	NA
2							
3	ICP-MS			He			
4	ICP-OES-AV-buffer	Y			1	1	934.401nm
5	ICP-MS	74 Ge	ORS	He	NA	NA	27
6	ORC ICPMS	Ir, Rh & Sc	ORS	He	1	1	27 (m/z)
7	ICP-MS	Sc	ORS	He			27
8	ICP-MS	Rh, Sc, Ir	ORS	He	NA	NA	27
9	ICP-MS	Sc	UC	He	1	20	27
10	ICP-MS	Sc	KED	He	1	1	27
11	ICP-OES-AV	NA	NA	NA	NA	neat	396.152
12	NA	NA	NA	NA	NA	NA	NA
13							
14	ICP-MS	Sc	ORS	He	1	1	27
15	ICP-MS	Sc	CRI	He	1	1	27
16							
17	ICP-MS	Sc	ORS	He	1	1	27
18	ICP-MS	72 Ge	ORS	He	NA	NA	27
19	ICP-MS	Rh/Ir	ORS	He	1.25	1.25	
20	ICP-MS	72 Ge	ORS	He	NA	NA	27
21	ICP-MS	Ir, Rh					
22	ICP-MS	45 Sc	KED	He	1	1	NA
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-MS		CRI	He			27

Table 66 Instrument Conditions As

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	89 Y	KED	He	1	1	NA
2							
3	ICP-MS			He			
4	ICP-MS		KED		1	1	75
5	ICP-MS	74 Ge	ORS	He	NA	NA	75
6	ORC ICPMS	Ir, Rh & Sc	ORS	He	1	1	75 (m/z)
7	ICP-MS	Sc	ORS	He			75
8	ICP-MS	Rh, Sc, Ir	ORS	He	NA	NA	75
9	ICP-MS	Te	UC	He	1	20	75
10	ICP-MS	Ge	KED	He	1	1	75
11	ICP-OES-AV	NA	NA	NA	NA	neat	188.98
12	NA	NA	NA	NA	NA	NA	NA
13							
14	ICP-MS	Rh	ORS	He	1	1	75
15	ICP-MS	Rh	CRI	He	1	1	75
16							
17	ICP-MS	Rh	ORS	He	1	1	75
18	ICP-MS	72 Ge	ORS	He	NA	NA	75
19	ICP-MS	Rh/Ir	ORS	He	1.25	1.25	
20	ICP-MS	72 Ge	ORS	He	NA	NA	75
21	ICP-MS	Ir, Rh	KED				
22	ICP-MS	89 Y	KED	He	1	1	NA
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-MS		CRI	He			75

Table 67 Instrument Conditions B

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	45 Sc	NA	NA	NA	1	NA
2					NA		
3	ICP-MS			He	NA		
4	ICP-OES-AV-buffer	Y			NA	1	208.957nm
5	ICP-MS	6 Li	ORS	He	NA	NA	11
6	ORC ICPMS	Ir, Rh & Sc	ORS	He	NA	1	11 (m/z)
7	ICP-MS	Ir	ORS		NA		11
8							
9	ICP-MS	Sc	UC	He	NA	20	10
10	ICP-MS	Sc	NA	NA	NA	1	10
11	ICP-OES-AV	NA	NA	NA	NA	neat	249.772
12	NA	NA	NA	NA	NA	NA	NA
13					NA		
14	ICP-MS	Sc	ORS	standard mode	1	1	11
15	ICP-MS	Sc	CRI	NA	NA	1	11
16					NA		
17	ICP-MS	Sc	ORS	He	NA	1	11
18	ICP-MS	6 Li	ORS	He	NA	NA	11
19					NA		
20	ICP-MS	6 Li	ORS	He	NA	NA	11
21	ICP-MS	Ir, Rh			NA		
22	ICP-MS	45 Sc	NA	NA	NA	1	NA
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-MS		CRI	He	NA		11

Table 68 Instrument Conditions Ba

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	175 Lu	KED	He	NA	1	NA
2					NA		
3	ICP-MS			He	NA		
4	ICP-MS				NA	1	137
5	ICP-MS	175 Lu	ORS	He	NA	NA	137
6	ORC ICPMS	Ir, Rh & Sc	ORS	He	NA	1	137 (m/z)
7	ICP-MS	Ir	ORS	He	NA		137
8	ICP-MS	Rh, Sc, Ir	ORS	He	NA	NA	137
9	ICP-MS	Tb	UC	He	NA	20	137
10	ICP-MS	Rh	NA	NA	NA	1	138
11	ICP-OES-AV	NA	NA	NA	NA	neat	455.403
12	NA	NA	NA	NA	NA	NA	NA
13					NA		
14	ICP-MS	Rh	ORS	He	1	1	137
15	ICP-MS	Rh	CRI	He	NA	1	135
16					NA		
17	ICP-MS	Rh	ORS	He	NA	1	135
18	ICP-MS	175 Lu	ORS	He	NA	NA	137
19					NA		
20	ICP-MS	175 Lu	ORS	He	NA	NA	137
21	ICP-MS	Ir, Rh			NA		
22	ICP-MS	175 Lu	KED	He	NA	1	NA
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-MS		CRI	He	NA		137

Table 69 Instrument Conditions Be

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	45 Sc	NA	NA	1	1	NA
2							
3	ICP-MS						
4	ICP-MS				1	1	9
5	ICP-MS	6 Li	ORS	standard mode	NA	NA	9
6	ORC ICPMS	Ir, Rh & Sc	ORS	He	1	1	9 (m/z)
7	ICP-MS	Sc	ORS				9
8	ICP-MS	Rh, Sc, Ir	ORS		NA	NA	9
9	ICP-MS	Sc	UC	He	1	20	9
10	ICP-MS	Sc	NA	NA	1	1	9
11	ICP-OES-AV	NA	NA	NA	NA	neat	234.861
12	NA	NA	NA	NA	NA	NA	NA
13							
14	ICP-MS	Sc	ORS	standard mode	1	1	9
15	ICP-MS	Sc	CRI	NA	1	1	9
16							
17	ICP-MS	Sc	ORS	NA	1	1	9
18	ICP-MS	6 Li	ORS	standard mode	NA	NA	9
19	ICP-MS	Rh/Ir	ORS	He	1.25	1.25	
20	ICP-MS	6 Li	ORS	standard mode	NA	NA	9
21	ICP-MS	Ir, Rh					
22	ICP-MS	45 Sc	NA	NA	1	1	NA
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-MS		CRI	He			9

Table 70 Instrument Conditions Bi

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1							
2	ICP-MS	Y	KED			NA	
3	ICP-MS			He		NA	
4						NA	
5	ICP-MS	175 Lu	ORS	standard mode	NA	NA	209
6	ORC ICPMS	Ir, Rh & Sc	ORS	He	1	NA	209 (m/z)
7	ICP-MS	Ir	ORS	He		NA	209
8	ICP-MS	Rh, Sc, Ir	ORS		NA	NA	209
9	NA	NA	NA	NA	NA	NA	NA
10	ICP-MS	Ir	NA	NA	1	NA	209
11	NA	NA	NA	NA	NA	NA	NA
12	NA	NA	NA	NA	NA	NA	NA
13						NA	
14	ICP-MS	Ir	ORS	He	1	1	209
15	ICP-MS	Lu	CRI	He	1	NA	209
16						NA	
17	ICP-MS	Lu	ORS	He	1	NA	209
18	ICP-MS	175 Lu	ORS	standard mode	NA	NA	209
19	ICP-MS	Rh/Ir	ORS	He	1.25	NA	
20	ICP-MS	175 Lu	ORS	standard mode	NA	NA	209
21	ICP-MS	Ir, Rh				NA	
22	ICP-MS	175 Lu	KED	He	1	NA	NA
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-MS		CRI	He		NA	209

Table 71 Instrument Conditions Cd

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	89 Y	KED	He	1	1	NA
2							
3	ICP-MS			He			
4	ICP-MS				1	1	111
5	ICP-MS	115 In	ORS	He	NA	NA	111
6	ORC ICPMS	Ir, Rh & Sc	ORS	He	1	1	111 (m/z)
7	ICP-MS	Rh	ORS	He			111
8	ICP-MS	Rh, Sc, Ir	ORS	He	NA	NA	111
9	ICP-MS	Rh	UC	He	1	20	111
10	ICP-MS	Rh	NA	NA	1	1	111
11	ICP-OES-AV	NA	NA	NA	NA	neat	226.502
12	NA	NA	NA	NA	NA	NA	NA
13							
14	ICP-MS	Rh	ORS	He	1	1	111
15	ICP-MS	Rh	CRI	He	1	1	111
16							
17	ICP-MS	Rh	ORS	He	1	1	111
18	ICP-MS	115 In	ORS	He	NA	NA	111
19	ICP-MS	Rh/Ir	ORS	He	1.25	1.25	
20	ICP-MS	115 In	ORS	He	NA	NA	111
21	ICP-MS	Ir, Rh					
22	ICP-MS	89 Y	KED	He	1	1	NA
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-MS		CRI	He			111

Table 72 Instrument Conditions Co

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	89 Y	KED	He	1	1	NA
2	ICP-MS	Y	KED				
3	ICP-MS			He			
4	ICP-MS		KED		1	1	59
5	ICP-MS	74 Ge	ORS	He	NA	NA	59
6	ORC ICPMS	Ir, Rh & Sc	ORS	He	1	1	59 (m/z)
7	ICP-MS	Sc	ORS	He			59
8	ICP-MS	Rh, Sc, Ir	ORS	He	NA	NA	59
9	ICP-MS	Ga	UC	He	1	20	59
10	ICP-MS	Ge	KED	He	1	1	59
11	ICP-OES-AV	NA	NA	NA	NA	neat	231.16
12	NA	NA	NA	NA	NA	NA	NA
13							
14	ICP-MS	Rh	ORS	He	1	1	59
15	ICP-MS	Sc	CRI	He	1	1	59
16							
17	ICP-MS	Sc	ORS	He	1	1	59
18	ICP-MS	72 Ge	ORS	He	NA	NA	59
19	ICP-MS	Rh/Ir	ORS	He	1.25	1.25	
20	ICP-MS	72 Ge	ORS	He	NA	NA	59
21	ICP-MS	Ir, Rh	KED				
22	ICP-MS	89 Y	KED	He	1	1	NA
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-MS		CRI	He			59

Table 73 Instrument Conditions Cr

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	89 Y	KED	He	1	1	NA
2							
3	ICP-MS			He			
4	ICP-MS		DRC		1	1	52
5	ICP-MS	74 Ge	ORS	He	NA	NA	52
6	ORC ICPMS	Ir, Rh & Sc	ORS	He	1	1	52 (m/z)
7	ICP-MS	Sc	ORS	He			52
8	ICP-MS	Rh, Sc, Ir	ORS	He	NA	NA	52
9	ICP-MS	Sc	UC	He	1	20	52
10	ICP-MS	Sc	KED	He	1	1	52
11	ICP-OES-AV	NA	NA	NA	NA	neat	283.563
12	NA	NA	NA	NA	NA	NA	NA
13							
14	ICP-MS	Sc	ORS	He	1	1	52
15	ICP-MS	Sc	CRI	He	1	1	52
16							
17	ICP-MS	Sc	ORS	He	1	1	52
18	ICP-MS	72 Ge	ORS	He	NA	NA	52
19	ICP-MS	Rh/Ir	ORS	He	1.25	1.25	
20	ICP-MS	72 Ge	ORS	He	NA	NA	52
21	ICP-MS	Ir, Rh	KED				
22	ICP-MS	89 Y	KED	He	1	1	NA
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-MS		CRI	He			52

Table 74 Instrument Conditions Cu

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	89 Y	KED	He	1	1	NA
2							
3	ICP-MS			He			
4	S1: ICP-MS/S2: ICP-OES-AV-buffer		KED		1	1	63/324.752nm
5	ICP-MS	74 Ge	ORS	He	NA	NA	65
6	ORC ICPMS	Ir, Rh & Sc	ORS	He	1	1	63 (m/z)
7	ICP-MS	Sc	ORS	He			53
8	ICP-MS	Rh, Sc, Ir	ORS	He	NA	NA	63
9	ICP-MS	Ga	UC	He	1	20	63
10	ICP-MS	Ge	KED	He	1	1	63
11	ICP-OES-AV	NA	NA	NA	NA	neat	324.754
12	NA	NA	NA	NA	NA	NA	NA
13							
14	ICP-MS	Rh	ORS	He	1	1	65
15	ICP-MS	Sc	CRI	He	1	1	63
16							
17	ICP-MS	Sc	ORS	He	1	1	63
18	ICP-MS	72 Ge	ORS	He	NA	NA	65
19	ICP-MS	Rh/Ir	ORS	He	1.25	1.25	
20	ICP-MS	72 Ge	ORS	He	NA	NA	65
21	ICP-MS	Ir, Rh	KED				
22	ICP-MS	89 Y	KED	He	1	1	NA
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-MS		CRI	He			63

Table 75 Instrument Conditions Fe

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	89 Y	KED	He	1	1	NA
2							
3	ICP-MS			He			
4	ICP-OES-AV-buffer	Y			1	1	239.562nm
5	ICP-MS	74 Ge	ORS	H2	NA	NA	56
6	ORC ICPMS	Ir, Rh & Sc	ORS	He	1	1	56 (m/z)
7	ICP-MS	Sc	ORS	He			56
8	ICP-MS	Rh, Sc, Ir	ORS	HEHe	NA	NA	56
9	ICP-MS	Sc	UC	He	1	20	56
10	ICP-MS	Sc	KED	He	1	1	56
11	ICP-OES-AV	NA	NA	NA	NA	neat	238.204
12	NA	NA	NA	NA	NA	NA	NA
13							
14	ICP-MS	Sc	ORS	HEHe	1	1	56
15	ICP-MS	Sc	CRI	He	1	1	56
16							
17	ICP-MS	Sc	ORS	He	1	1	56
18	ICP-MS	72 Ge	ORS	He	NA	NA	56
19	ICP-OES-AV	Y	NA	NA	1.25	1.25	
20	ICP-MS	72 Ge	ORS	He	NA	NA	56
21	ICP-MS	Ir, Rh	KED				
22	ICP-MS	89 Y	KED	He	1	1	NA
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-MS		CRI	He			56

Table 76 Instrument Conditions Hg

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	175 Lu	KED	He	1	1	NA
2	ICP-MS	Y	KED				
3	ICP-MS			He			
4	CVAAS				1	1	
5	CVAAS				NA	NA	253.7
6	CETAC	NA	NA	NA	1	1	253nm
7	CVAAS						153
8	GFAAS	-	NA	NA	NA	NA	253.7
9	ICP-MS	Tb	UC	He	1	20	201
10	ICP-MS	Ir	NA	NA	1	1	201
11	FIMS	NA	NA	NA	NA	4	253.7
12	NA	NA	NA	NA	NA	NA	NA
13							
14	CVAAS				1	1	253.7
15	ICP-MS	Lu	CRI	He	1	1	201
16							
17	ICP-MS	Lu	ORS	He	1	1	202
18	CVAAS				NA	NA	253.7
19	ICP-MS	Rh/Ir	ORS	He	1.25	1.25	
20	CVAAS				NA	NA	253.7
21	ICP-MS	Ir, Rh					
22	ICP-MS	175 Lu	KED	He	1	1	NA
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-MS		CRI	He			202

Table 77 Instrument Conditions La

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1							
2						NA	
3						NA	
4						NA	
5	ICP-MS	115 In	ORS	standard mode	NA	NA	139
6	ICP-MS	Ir, Rh & Sc	NA	He	1	NA	139 (m/z)
7	ICP-MS	Rh	ORS	He		NA	139
8	ICP-MS	Rh, Sc, Ir	ORS	He	NA	NA	139
9	ICP-MS	Tb	UC	He	1	NA	139
10						NA	
11	NA	NA	NA	NA	NA	NA	NA
12	NA	NA	NA	NA	NA	NA	NA
13						NA	
14	ICP-MS	Rh	ORS	standard mode	1	1	139
15						NA	
16						NA	
17	NA	NA	NA	NA	NA	NA	NA
18	ICP-MS	175 Lu	ORS	standard mode	NA	NA	139
19	ICP-MS	Rh/Ir	ORS	He	1.25	NA	
20	ICP-MS	175 Lu	ORS	standard mode	NA	NA	139
21	NA	NA				NA	
22	NA	NA	NA	NA	NA	NA	NA
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-MS		CRI	He		NA	139

Table 78 Instrument Conditions Li

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1							
2	ICP-MS	Y	KED		NA		
3					NA		
4	ICP-MS				NA	1	7
5	ICP-MS	6 Li	ORS	standard mode	NA	NA	7
6	ORC ICPMS	Ir, Rh & Sc	ORS	He	NA	1	7 (m/z)
7	ICP-MS	Sc	ORS		NA		7
8	ICP-MS	Rh, Sc, Ir	ORS	NA	NA	NA	7
9	ICP-MS	Sc	UC	He	NA	20	7
10	ICP-MS	Sc	NA	NA	NA	1	7
11	NA	NA	NA	NA	NA	NA	NA
12	NA	NA	NA	NA	NA	NA	NA
13					NA		
14	ICP-MS	Sc	ORS	standard mode	1	1	7
15	ICP-MS	Sc	CRI	NA	NA	1	7
16					NA		
17	ICP-MS	Sc	ORS	NA	NA	1	7
18	ICP-MS	6 Li	ORS	standard mode	NA	NA	7
19	ICP-MS	Rh/Ir	ORS	He	NA	1.25	
20	ICP-MS	6 Li	ORS	standard mode	NA	NA	7
21	NA	NA			NA		
22	ICP-MS	45 Sc	NA	NA	NA	1	NA
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-MS		CRI	He	NA		7

Table 79 Instrument Conditions Mn

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	89 Y	KED	He	1	1	NA
2	ICP-MS	Y	KED				
3	ICP-MS			He			
4	ICP-MS		KED		1	1	55
5	ICP-MS	74 Ge	ORS	He	NA	NA	55
6	ORC ICPMS	Ir, Rh & Sc	ORS	He	1	1	55 (m/z)
7	ICP-MS	Sc	ORS	He			55
8	ICP-MS	Rh, Sc, Ir	ORS	He	NA	NA	55
9	ICP-MS	Sc	UC	He	1	20	55
10	ICP-MS	Sc	KED	He	1	1	55
11	ICP-OES-AV	NA	NA	NA	NA	neat	294.921
12	NA	NA	NA	NA	NA	NA	NA
13							
14	ICP-MS	Sc	ORS	He	1	1	59
15	ICP-MS	Sc	CRI	He	1	1	55
16							
17	ICP-MS	Sc	ORS	He	1	1	55
18	ICP-MS	72 Ge	ORS	He	NA	NA	55
19	ICP-MS	Rh/Ir	ORS	He	1.25	1.25	
20	ICP-MS	72 Ge	ORS	He	NA	NA	55
21	ICP-MS	Ir, Rh	KED				
22	ICP-MS	89 Y	KED	He	1	1	NA
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-MS		CRI	He			55

Table 80 Instrument Conditions Mo

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	89 Y	KED	He	NA	1	NA
2	ICP-MS	Y	KED		NA		
3	ICP-MS			He	NA		
4	ICP-MS				NA	1	95
5	ICP-MS	103 Rh	ORS	He	NA	NA	95
6	ORC ICPMS	Ir, Rh & Sc	ORS	He	NA	1	95 (m/z)
7	ICP-MS	Rh	ORS	He	NA		95
8	ICP-MS	Rh, Sc, Ir	ORS	He	NA	NA	95
9	ICP-MS	Rh	UC	He	NA	20	98
10	ICP-MS	Rh	NA	NA	NA	1	95
11	ICP-OES-AV	NA	NA	NA	NA	neat	202.032
12	NA	NA	NA	NA	NA	NA	NA
13					NA		
14	ICP-MS	Rh	ORS	He	1	1	95
15	ICP-MS	Rh	CRI	He	NA	1	95
16					NA		
17	ICP-MS	Rh	ORS	He	NA	1	95
18	ICP-MS	103 Rh	ORS	He	NA	NA	95
19	ICP-MS	Rh/Ir	ORS	He	NA	1.25	
20	ICP-MS	103 Rh	ORS	He	NA	NA	95
21	ICP-MS	Ir, Rh			NA		
22	ICP-MS	89 Y	KED	He	NA	1	NA
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-MS		CRI	He	NA		95

Table 81 Instrument Conditions Ni

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	89 Y	KED	He	1	1	NA
2							
3	ICP-MS			He			
4	ICP-MS		KED		1	1	60
5	ICP-MS	74 Ge	ORS	He	NA	NA	60
6	ORC ICPMS	Ir, Rh & Sc	ORS	He	1	1	60 (m/z)
7	ICP-MS	Sc	ORS	He			60
8	ICP-MS	Rh, Sc, Ir	ORS	He	NA	NA	60
9	ICP-MS	Ga	UC	He	1	20	60
10	ICP-MS	Ge	KED	He	1	1	60
11	ICP-OES-AV	NA	NA	NA	NA	neat	231.604
12	NA	NA	NA	NA	NA	NA	NA
13							
14	ICP-MS	Rh	ORS	He	1	1	60
15	ICP-MS	Sc	CRI	He	1	1	60
16							
17	ICP-MS	Sc	ORS	He	1	1	60
18	ICP-MS	72 Ge	ORS	He	NA	NA	60
19	ICP-MS	Rh/Ir	ORS	He	1.25	1.25	
20	ICP-MS	72 Ge	ORS	He	NA	NA	60
21	ICP-MS	Ir, Rh	KED				
22	ICP-MS	89 Y	KED	He	1	1	NA
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-MS		CRI	He			60

Table 82 Instrument Conditions P

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1							
2						NA	
3	ICP-MS			He		NA	
4	ICP-OES-AV-buffer	Y			1	NA	
5	ICP-OES-RV	Lu	NA		NA	NA	213.618
6	ICP-OES	Eu & Cs	NA	NA	1	NA	185.827 (nm)
7	ICP-OES-AV	Eu				NA	186
8							
9	ICP-MS	Sc	UC	He	1	NA	31
10	ICP-MS	Sc	KED	He	1	NA	31
11	NA	NA	NA	NA	NA	NA	NA
12	NA	NA	NA	NA	NA	NA	NA
13						NA	
14	ICP-OES-AV	Eu			1	1	185.827
15						NA	
16						NA	
17	ICP-MS	Sc	ORS	He	1	NA	31
18	ICP-OES-AV	Lu/Cs	NA		NA	NA	178.222
19	ICP-OES-AV	Y	NA	NA	1.25	NA	
20	ICP-OES-RV	Lu	NA		NA	NA	178.222
21	NA	NA				NA	
22	ICP-OES-AV	175 Lu	NA	NA	1	NA	178.226
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-OES-RV					NA	177.4

Table 83 Instrument Conditions Pb

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	175 Lu	KED	He	1	1	NA
2							
3	ICP-MS			He			
4	ICP-MS				1	1	208
5	ICP-MS	175 Lu	ORS	standard mode	NA	NA	208
6	ORC ICPMS	Ir, Rh & Sc	ORS	He	1	1	208 (m/z)
7	ICP-MS	Ir	ORS	He			208
8	ICP-MS	Rh, Sc, Ir	ORS	He	NA	NA	208
9	ICP-MS	Tb	UC	He	1	20	206, 207, 208
10	ICP-MS	Ir	NA	NA	1	1	206+207+208
11	ICP-OES-AV	NA	NA	NA	NA	neat	220.353
12	NA	NA	NA	NA	NA	NA	NA
13							
14	ICP-MS	Ir	ORS	He	1	1	208
15	ICP-MS	Lu	CRI	He	1	1	208
16							
17	ICP-MS	Lu	ORS	He	1	1	208
18	ICP-MS	175 Lu	ORS	standard mode	NA	NA	208
19	ICP-MS	Rh/Ir	ORS	He	1.25	1.25	
20	ICP-MS	175 Lu	ORS	standard mode	NA	NA	208
21	ICP-MS	Ir, Rh					
22	ICP-MS	175 Lu	KED	He	1	1	NA
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-MS		CRI	He			sum of isotopes

Table 84 Instrument Conditions Sb

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	175 Lu	KED	He	1	1	NA
2							
3	ICP-MS			He			
4	ICP-MS				1	1	121
5	ICP-MS	175 Lu	ORS	He	NA	NA	121
6	ORC ICPMS	Ir, Rh & Sc	ORS	He	1	1	121 (m/z)
7	ICP-MS	Rh	ORS	He			121
8	ICP-MS	Rh, Sc, Ir	ORS	He	NA	NA	121
9	ICP-MS	Rh	UC	He	1	20	121
10	ICP-MS	Rh	NA	NA	1	1	121
11	ICP-OES-AV	NA	NA	NA	NA	neat	206.834
12	NA	NA	NA	NA	NA	NA	NA
13							
14	ICP-MS	Rh	ORS	He	1	1	121
15	ICP-MS	Rh	CRI	He	1	1	123
16							
17	ICP-MS	Rh	ORS	He	1	1	123
18	ICP-MS	175 Lu	ORS	He	NA	NA	121
19	ICP-MS	Rh/Ir	ORS	He	1.25	1.25	
20	ICP-MS	175 Lu	ORS	He	NA	NA	121
21	ICP-MS	Ir, Rh					
22	ICP-MS	175 Lu	KED	He	1	1	NA
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-MS		CRI	He			121

Table 85 Instrument Conditions Se

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	89 Y	ORS	HEHe	1	1	NA
2							
3	ICP-MS			He			
4	ICP-MS		KED		1	1	78
5	ICP-MS	74 Ge	ORS	H2	NA	NA	78
6	ORC ICPMS	Ir, Rh & Sc	ORS	He	1	1	78 (m/z)
7	ICP-MS	Sc	ORS	He			78
8	ICP-MS	Rh, Sc, Ir	ORS	HEHe	NA	NA	78
9	ICP-MS	Te	UC	He	1	20	82
10	ICP-MS	Rh	DRC	NH3	1	1	82
11	ICP-OES-AV	NA	NA	NA	NA	neat	196.026
12	NA	NA	NA	NA	NA	NA	NA
13							
14	ICP-MS	Rh	ORS	HEHe	1	1	78
15	ICP-MS	Sc	CRI	He	1	1	78
16							
17	ICP-MS	Rh	ORS	H2	1	1	78
18	ICP-MS	72 Ge	ORS	H2	NA	NA	78
19	ICP-MS	Rh/Ir	ORS	He	1.25	1.25	
20	ICP-MS	72 Ge	ORS	HEHe	NA	NA	78
21	ICP-MS	Ir, Rh	KED				
22	ICP-MS	89 Y	ORS	HEHe	1	1	NA
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-MS		CRI	HEHe			82

Table 86 Instrument Conditions Sn

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	175 Lu	KED	He	NA	1	NA
2	ICP-MS	Y	KED		NA		
3	ICP-MS			He	NA		
4	ICP-MS				NA	1	118
5	ICP-MS	115 In	ORS	He	NA	NA	118
6	ORC ICPMS	Ir, Rh & Sc	ORS	He	NA	1	188 (m/z)
7	ICP-MS	Th	ORS	He	NA		118
8	ICP-MS	Rh, Sc, Ir	ORS	He	NA	NA	189
9	ICP-MS	Rh	UC	He	NA	20	120
10					NA		
11	ICP-OES-AV	NA	NA	NA	NA	neat	189.925
12	NA	NA	NA	NA	NA	NA	NA
13					NA		
14	ICP-MS	Rh	ORS	He	1	1	118
15	ICP-MS	Rh	CRI	He	NA	1	118
16					NA		
17	ICP-MS	Rh	ORS	He	NA	1	118
18	ICP-MS	115 In	ORS	He	NA	NA	118
19	ICP-MS	Rh/Ir	ORS	He	NA	1.25	
20	ICP-MS	115 In	ORS	He	NA	NA	118
21	NA	NA			NA		
22	ICP-MS	175 Lu	KED	He	NA	1	NA
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-MS		CRI	He	NA		118

Table 87 Instrument Conditions Sr

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	89 Y	KED	He	NA	1	NA
2	ICP-MS	Y	KED		NA		
3	ICP-MS			He	NA		
4	ICP-OES-AV-buffer	Y			NA	1	407.771nm
5	ICP-MS	74 Ge	ORS	He	NA	NA	88
6	ORC ICPMS	Ir, Rh & Sc	ORS	He	NA	1	88 (m/z)
7	ICP-MS	Sc	ORS	He	NA		88
8	ICP-MS	Rh, Sc, Ir	ORS	He	NA	NA	925
9	ICP-MS	Rh	UC	He	NA	20	88
10	ICP-MS	Rh	NA	NA	NA	1	88
11	ICP-OES-AV	NA	NA	NA	NA	neat	407.771
12	NA	NA	NA	NA	NA	NA	NA
13					NA		
14	ICP-MS	Rh	ORS	He	1	1	88
15	ICP-MS	Rh	CRI	He	NA	1	88
16					NA		
17	ICP-MS	Rh	ORS	He	NA	1	88
18	ICP-MS	72 Ge	ORS	He	NA	NA	88
19	ICP-MS	Rh/Ir	ORS	He	NA	1.25	
20	ICP-MS	72 Ge	ORS	He	NA	NA	88
21	NA	NA			NA		
22	ICP-MS	89 Y	KED	He	NA	1	NA
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-MS		CRI	He	NA		88

Table 88 Instrument Conditions Tl

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	175 Lu	KED	He	1	NA	NA
2	ICP-MS	Y	KED			NA	
3	ICP-MS			He		NA	
4	ICP-MS				1	NA	203
5	ICP-MS	175 Lu	ORS	standard mode	NA	NA	205
6	ORC ICPMS	Ir, Rh & Sc	ORS	He	1	NA	205 (m/z)
7	ICP-MS	Ir	ORS	He		NA	205
8	ICP-MS	Rh, Sc, Ir	ORS	He	NA	NA	205
9	ICP-MS	Tb	UC	He	1	NA	205
10	ICP-MS	Ir	NA	NA	1	NA	205
11	NA	NA	NA	NA	NA	NA	NA
12	NA	NA	NA	NA	NA	NA	NA
13						NA	
14	ICP-MS	Ir	ORS	He	1	1	205
15	ICP-MS	Lu	CRI	He	1	NA	205
16						NA	
17	ICP-MS	Lu	ORS	He	1	NA	205
18	ICP-MS	175 Lu	ORS	standard mode	NA	NA	205
19	ICP-MS	Rh/Ir	ORS	He	1.25	NA	
20	ICP-MS	175 Lu	ORS	standard mode	NA	NA	205
21	ICP-MS	Ir, Rh				NA	
22	ICP-MS	175 Lu	KED	He	1	NA	NA
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-MS		CRI	He		NA	205

Table 89 Instrument Conditions U

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	175 Lu	KED	He	1	NA	NA
2	ICP-MS	Y	KED			NA	
3	ICP-MS			He		NA	
4	ICP-MS				1	NA	238
5	ICP-MS	175 Lu	ORS	standard mode	NA	NA	238
6	ORC ICPMS	Ir, Rh & Sc	ORS	He	1	NA	238 (m/z)
7	ICP-MS	Ir	ORS	He		NA	232
8	ICP-MS	Rh, Sc, Ir	ORS	He	NA	NA	238
9	ICP-MS	Tb	UC	He	1	NA	238
10	ICP-MS	Ir	NA	NA	1	NA	238
11	NA	NA	NA	NA	NA	NA	NA
12	NA	NA	NA	NA	NA	NA	NA
13						NA	
14	ICP-MS	Ir	ORS	He	1	1	238
15	ICP-MS	Lu	CRI	He	1	NA	238
16						NA	
17	ICP-MS	Lu	ORS	He	1	NA	238
18	ICP-MS	175 Lu	ORS	standard mode	NA	NA	238
19	ICP-MS	Rh/Ir	ORS	He	1.25	NA	
20	ICP-MS	175 Lu	ORS	standard mode	NA	NA	238
21	ICP-MS	Ir, Rh				NA	
22	ICP-MS	175 Lu	KED	He	1	NA	NA
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-MS		CRI	He		NA	238

Table 90 Instrument Conditions V

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	45 Sc	KED	He	1	1	NA
2							
3	ICP-MS			He			
4	ICP-MS		KED		1	1	51
5	ICP-MS	72 Ge	ORS	He	NA	NA	51
6	ORC ICPMS	Ir, Rh & Sc	ORS	He	1	1	51 (m/z)
7	ICP-MS	Sc	ORS	He			51
8	ICP-MS	Rh, Sc, Ir	ORS	He	NA	NA	51
9	ICP-MS	Sc	UC	He	1	20	51
10	ICP-MS	Sc	KED	He	1	1	51
11	ICP-OES-AV	NA	NA	NA	NA	neat	292.401
12	NA	NA	NA	NA	NA	NA	NA
13							
14	ICP-MS	Sc	ORS	He	1	1	51
15	ICP-MS	Sc	CRI	He	1	1	51
16							
17	ICP-MS	Sc	ORS	He	1	1	51
18	ICP-MS	72 Ge	ORS	He	NA	NA	51
19	ICP-MS	Rh/Ir	ORS	He	1.25	1.25	
20	ICP-MS	72 Ge	ORS	He	NA	NA	51
21	ICP-MS	Ir, Rh					
22	ICP-MS	45 Sc	KED	He	1	1	NA
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-MS		CRI	He			51

Table 91 Instrument Conditions Zn

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	89 Y	KED	He	1	1	NA
2							
3	ICP-MS			He			
4	S1: ICP-MS/S2: ICP-OES-AV-buffer		DRC		1	1	66/206.200nm
5	ICP-MS	72 Ge	ORS	He	NA	NA	66
6	ORC ICPMS	Ir, Rh & Sc	ORS	He	1	1	64 (m/z)
7	ICP-MS	Sc	ORS	He			65
8	ICP-MS	Rh, Sc, Ir	ORS	He	NA	NA	68
9	ICP-MS	Te	UC	He	1	20	66
10	ICP-MS	Ge	KED	He	1	1	66
11	ICP-OES-AV	NA	NA	NA	NA	neat	206.2
12	NA	NA	NA	NA	NA	NA	NA
13							
14	ICP-MS	Rh	ORS	He	1	1	66
15	ICP-MS	Sc	CRI	He	1	1	66
16							
17	ICP-MS	Sc	ORS	He	1	1	66
18	ICP-MS	72 Ge	ORS	He	NA	NA	66
19	ICP-MS	Rh/Ir	ORS	He	1.25	1.25	
20	ICP-MS	72 Ge	ORS	He	NA	NA	66
21	ICP-MS	Ir, Rh					
22	ICP-MS	89 Y	KED	He	1	1	NA
23	NA	NA	NA	NA	NA	NA	NA
24	ICP-MS		CRI	He			66

END OF REPORT