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**SIM.8.10P
Trace Elements in Drinking Water**

Part I and Part II

Technical Report

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Canada

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Introduction

Safe drinking water is fundamental to every-day life. The goal of SIM.8.10P is to determine state of the practice in SIM countries for the determination of trace elements in water. This report summarizes the results of two intercomparison exercises, SIM 8.10P, Part I and Part II, organized in 2003 and 2004. These were co-ordinated by the

Chemical Metrology Group of the Institute for National Measurement Standards (INMS) of the National Research Council Canada (NRCC). SIM 8.10P is a follow-up to SIM.8.P2, conducted between October 1999 and September 2000 and co-ordinated by the National Institute of Standards and Technology (NIST), USA.

Participation in SIM.8.10P

Table 1 presents the timetable for SIM 8.10P, Part I and Part II. A call for participation was sent out to each country within the SIM Region. Laboratories were asked to respond directly to NRCC with their intention to participate. In addition to NMIs within SIM or their official designees, several additional laboratories were included in the exercise. The samples were distributed by courier from NRCC. The deadline for the submission of results for each exercise is listed in Table I.

Laboratories were permitted to use their analytical method of choice to determine the primary elements for this study: Cr, Fe, Ni, Cu, Zn, As, Cd, Ba, and Pb. A full uncertainty budget in accordance with the GUM [1] was also requested from the participants. Table 2 lists the participants in SIM.8.10P. Seventeen laboratories participated in both Part I and Part II, four and six laboratories participated in only Part I and Part II, respectively.

Table 1. Schedule for SIM.8.10P.

Timeline	Part I	Part II
Call for participation	8-Mar-03	1-Apr-04
Sample distribution	8-May-03	30-Apr-04
Deadline for reporting results	5-Sep-03	20-Sep-04
Results presented at SIM	26-Nov-03	3-Nov-04
Follow up workshop	5-Feb-04	-

Table 2. Participants in SIM.8.10P.

Institute	Country	Contact
Laboratories that participated in Part I and Part II		
Instituto de Tecnología Minera - SEGEMAR	Argentina	Ricardo Crubellati
INTI-CEQUIPE	Argentina	Celia Puglisi
Laboratorio de Calidad Ambiental (LCA)	Bolivia	Hugo Guerrero
Fundação Centro Tecnológico de Minas Gerais - CETEC	Brazil	Olguita Geralda Ferreira Rocha
INMETRO	Brazil	Thiago de Oliveira Araujo
Instituto de Pesquisas Tecnológicas, IPT	Brazil	Vera Ponçano
SENAI/ CETIND	Brazil	Sérgio Motta
National Research Council of Canada (NRCC)	Canada	Ralph Sturgeon
CENMA	Chile	Pablo Richter-Duk, Ruben Verdugo
INN	Chile	Nury Gras-Rebolledo
Fundación Chile	Chile	Gabriela Massiff
LACOMET	Costa Rica	Carlos Paniagua
University of the West Indies	Jamaica	Robin Rattray
West Indies Alumina Company, WINDALCO	Jamaica	Desmond Lawson
Envirolab	Peru	Luis Bueno Carbajal
Laboratorio Tecnológico del Uruguay, LATU	Uruguay	Nury Prat
ICLAM SENCAMER	Venezuela	Haygas Kalustían
Laboratories that participated in Part I		
Institute of Chemical Technology	Czech Republic	Miloslav Suchanek
Physikalisch-Technische Bundesanstalt, (PTB)	Germany	Detlef Schiel
Multipurpose Laboratory	St. Kitts	Milton Whittaker
Caribbean Environmental Health Institute	St. Lucia	Andrew Lewis
Laboratories that participated in Part II		
Comisión Nacional de Energía Atómica	Argentina	Silvia Farías
Laboratorio Químico Lambda S.A.	Costa Rica	Rafael Amon
Bureau of Standards, Jamaica	Jamaica	James Kerr
CENAM	México	Yoshito Mitani
Centro para la Investigación de Recursos Acuáticos de Nicaragua	Nicaragua	Jorge Pitty
INDICASAT / SENACYT	Panamá	Félix Rodríguez

Sample Preparation

Samples were prepared in-house at NRCC. Two 25 liter LDPE carboys were cleaned with 10 % (v/v) high purity nitric acid for 72 hours. Each carboy was emptied, rinsed with high purity water and refilled with 18 liters of bottled natural spring water (Labrador Laurentienne Inc., Quebec, Canada). This water was packaged in 18 liter plastic containers and distributed for use with water dispensers. The samples were acidified by addition of 100 ml of NRC sub-boiled high purity nitric acid. Samples were fortified with Cr, Fe, Ni, Cu, Zn, As, Cd, Ba, and Pb by adding appropriate amounts of 1000 µg/ml stock solutions (ICP Grade, SCP Science, Montreal, Quebec) prepared from high purity materials and traceable to NIST. Samples A and B were distributed as in Part I and Samples C and D in Part II. The fortified

concentrations for Sample A and Sample C were chosen to approach the maximum acceptable limits of the USEPA and Canadian government guidelines for drinking water [2,3]. The fortified concentrations for Sample B and Sample D were approximately 10- fold greater. The resulting solutions were thoroughly mixed and sampled into precleaned 250 mL HDPE bottles.

A homogeneity test for all elements was performed on six randomly selected samples. In all cases, the coefficient of variation was less than 1.2% with the exception of As (3%). The latter measurement represented variation inherent to the analytical technique used (ETAAS) rather than reflecting between bottle differences. The material was deemed stable for at least one year at room temperature based on NRCC experience with similar samples.

Results

The majority of results for Part I and Part II were received by the respective deadlines. The submitted results were compiled in a database and a copy was returned by email to the participants for verification that no transcription errors had occurred. A few minor changes were made.

In Part I, Laboratories 2, 20 and 21 submitted two independent results based on alternative detection methodologies. In such cases, the independent results are listed separately and are delineated as the laboratory number accompanied by an alphabetical suffix.

Graphical representation of the results are presented on pages 8 to 43. The mean is shown as a square, and vertical error bars represent the reported expanded uncertainty. The assigned value is displayed as a solid horizontal line. Divergent data that would

distort the graph are indicated with an arrow head near the graph's upper border.

A table below the graph for each samples lists: the recommended values, uncertainties and instrumental techniques reported by the participants. As well, the source of the assigned value and, for comparative purposes, a summary of submitted results, is also provided for each sample. In some cases, obvious outliers were subjectively rejected from the overall summary.

Appendix A lists the submitted data: the mean, uncertainty and maximum of six values for each laboratory. For Samples C and D a "U" following the uncertainty indicates that the laboratory reported an uncertainty value, otherwise, the uncertainty in the data is represented as a standard deviation of the replicate results.

Assigned Values

Part I

The assigned values for Part I of this exercise were determined from results submitted by laboratories having successful BIPM/CIPM experience. Thus, SIM.8.10P could provide international comparability for trace element analysis in drinking water by linking intercomparison results for SIM nations with BIPM/CIPM key comparison participants. However, this restriction limited only data submitted by NRCC and PTB for calculation of the SIM.8.P10 Part I assigned values. In some cases, NRCC and PTB were able to employ the method of isotope dilution sector field inductively coupled plasma mass spectrometry (ID-SF-ICP-MS). The use of isotope dilution as a calibration method is considered a primary method when properly employed. Unfortunately, for monoisotopic elements or elements suffering severe interferences, other techniques must be used.

The assigned values for Cr, Cu and Ni were calculated based on NRCC results using alternative methods of detection, such as inductively coupled atomic emission (ICP-AES) and electrothermal atomization atomic absorption (ETAAS). For As and Fe, the assigned value was based on only one NRCC method.

Part II

The assigned values in the follow up exercise were based on gravimetric calculations where possible. The exception was Ba in both Sample C and D and Ni in Sample C where analysis of the unspiked spring water found levels of analyte naturally present that could not be considered negligible. In these cases the NRCC values was used for comparative purposes.

Uncertainties

The majority of laboratories reported results with an uncertainty value calculated according to the principles outlined in the GUM [1]. Only a few participants included in their report details of the uncertainty budget calculation.

Some laboratories did not state whether the uncertainty reported was an expanded uncertainty i.e., multiplied by the coverage factor, k .

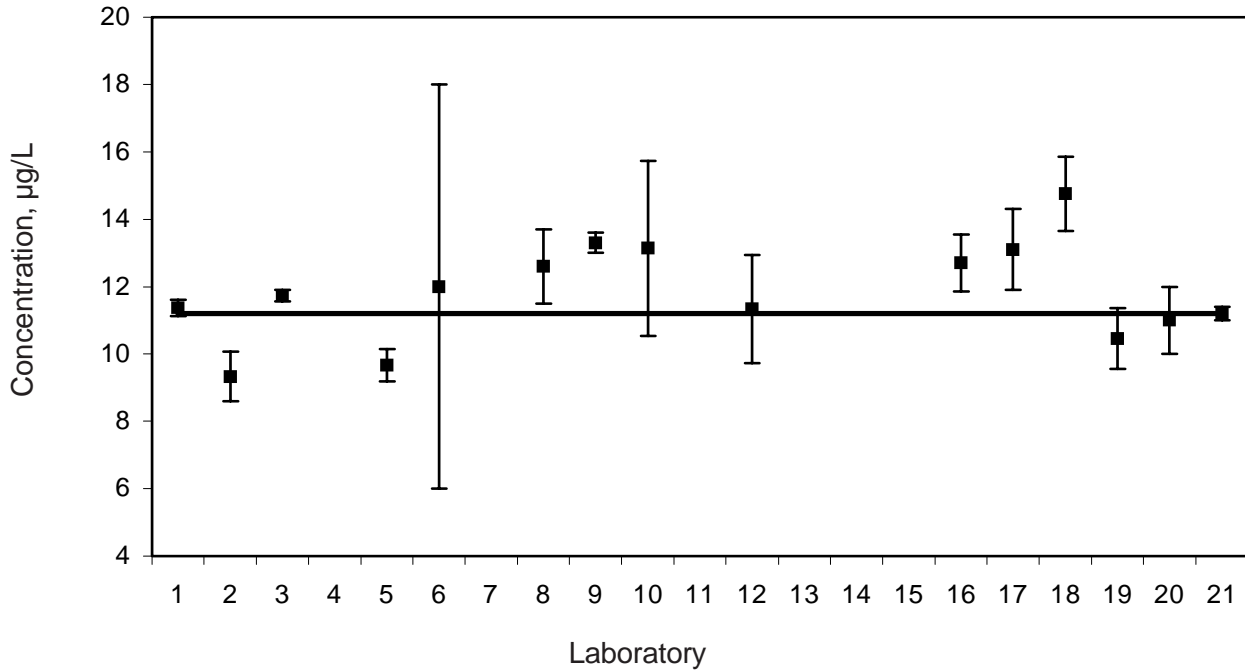
Major sources contributing to overall uncertainty identified by several participants were calibration and dilution factors.

Workshop

Following each of these two exercises the results were discussed by the participants at workshops in Caracas (November 2003), Costa Rica (February 2004) and Margarita Is. Venezuela (November 2004).

Participants were encouraged to attend and make a brief presentation outlining their measurement method and model for calculating measurement uncertainty.

Part I Sample A



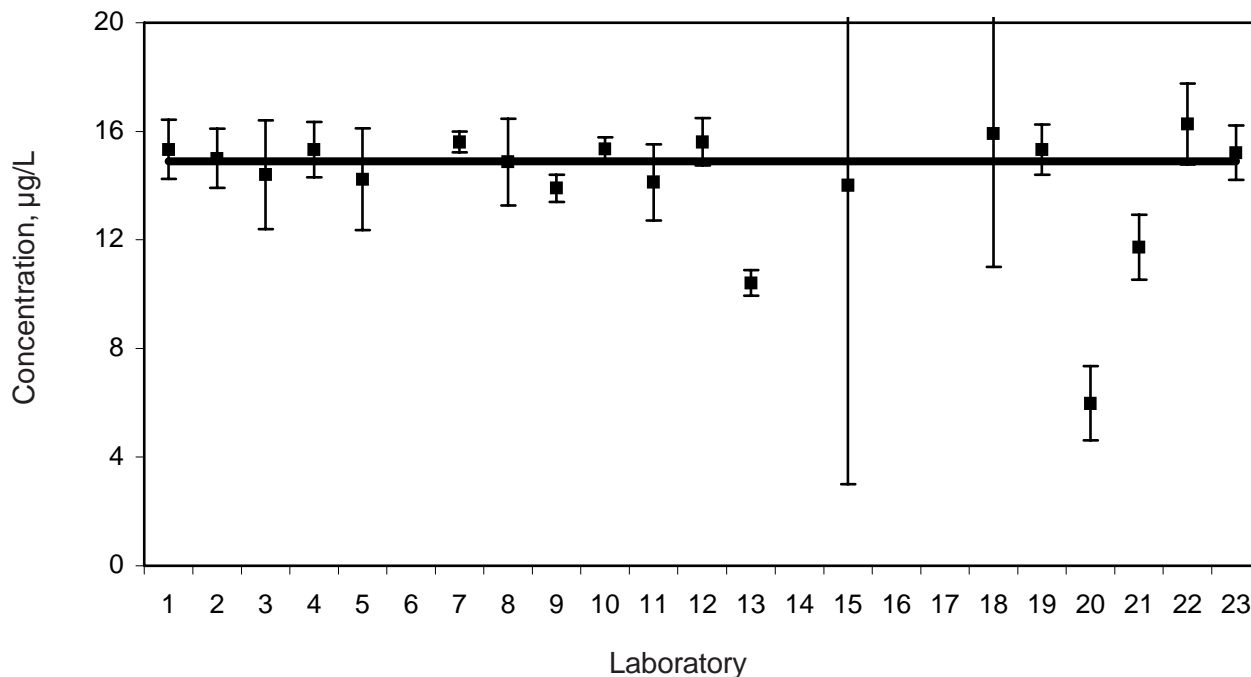
Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	11.37	0.24	ETAAS
2	9.33	0.74	ETAAS
3	11.73	0.17	ETAAS
4	<2		ICP-AES
5	9.67	0.48	ETAAS
6	12	6	ICP-AES
7			
8	12.6	1.1	ETAAS
9	13.3	0.3	ETAAS
10	13.1	2.6	ETAAS
11			
12	11.3	1.5	ICP-AES
13			
14			
15			
16	12.7	0.848	ETAAS
17	13.1	1.2	ETAAS
18	14.8	1.1	ICP-AES
19	10.5	0.9	ICP-MS
20	11.0	1.0	ICP-AES
21	11.2	0.2	ETAAS

Assigned Value

A value of 11.2 µg/L was assigned to Cr in Sample A based on the ETAAS results from NRCC.

Overall Summary	
No. of results	15
Overall mean	11.8
Median	11.7
Sample S.D.	1.45
95% C.I.	0.95
gravimetric	11.0

Part II Sample C



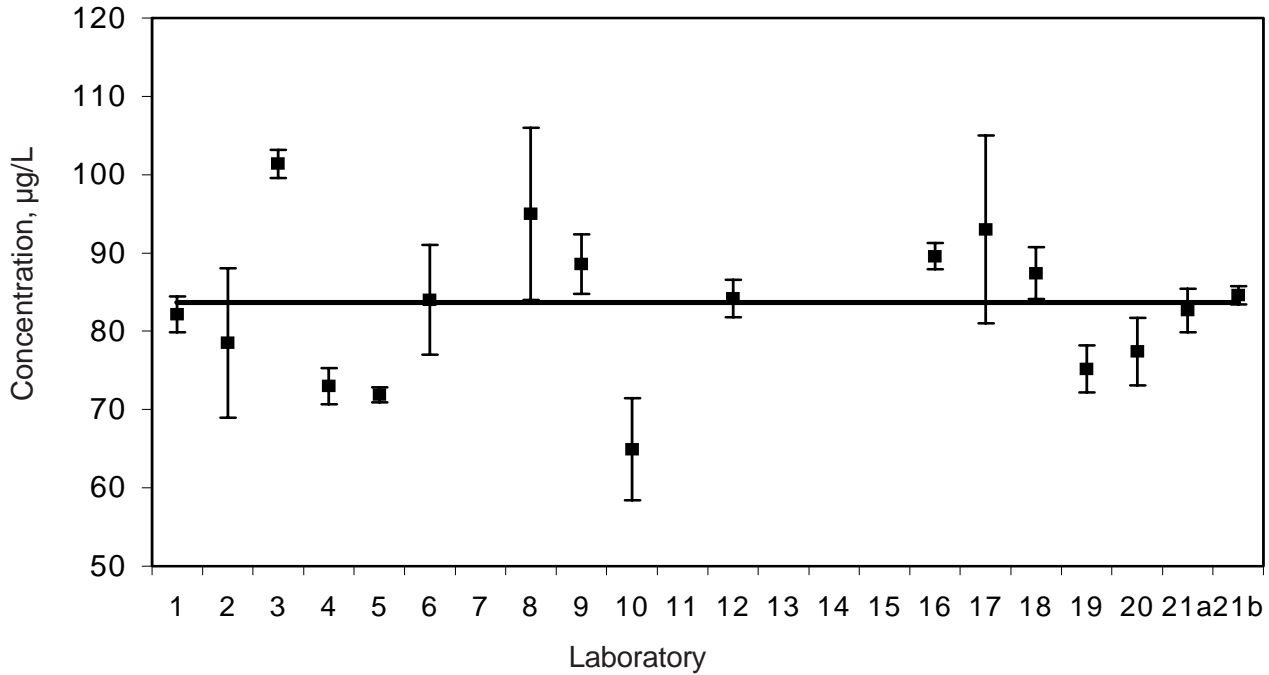
Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	15.3	1.1	ICP-AES
2	15.0	1.1	ICP-AES
3	14.4	2	ETAAS
4	15.33	1.02	ICP-AES
5	14.2	1.9	ICP-AES
6			
7	15.603	0.384	ETAAS
8	14.9	1.6	ETAAS
9	13.9	0.5	ICP-AES
10	15.35	0.42	ETAAS
11	14.1	1.4	ICP-AES
12	15.61	0.87	ETAAS
13	10.41	0.47	ETAAS
14			
15	14	11	ETAAS
16	<30		FAAS
17			
18	15.9	4.9	ICP-AES
19	15.32	0.92	ETAAS
20	5.98	1.37	ICP-MS
21	11.7	1.2	ICP-AES
22	16.3	1.5	ETAAS
23	15.2	4.0	ICP-AES

Assigned Value

A value of 14.9 µg/L was assigned to Cr in Sample C based on the gravimetric calculation.

Overall Summary	
No. of results	19
Overall mean	14.1
Median	15.0
Sample S.D.	2.4
95% C.I.	1.4
gravimetric	14.9

Part I Sample B



Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	82.18	2.28	ETAAS
2	78.52	9.57	ICP-AES
3	101.4	1.78	ETAAS
4	73.0	2.3	ICP-AES
5	71.8	4.7	ETAAS
6	84	7	ICP-AES
7			
8	95	11	ETAAS
9	88.6	3.8	ETAAS
10	64.9	6.5	FAAS
11			
12	84.2	1.2	ICP-AES
13			
14			
15			
16	89.6	1.65	ETAAS
17	93	12	ETAAS
18	87.5	3.3	ICP-AES
19	75.2	3.0	ICP-MS
20	77.4	4.3	ICP-AES
21a	75.2	2.6	ETAAS
21b	84.6	1.2	ICP-AES

Assigned Value

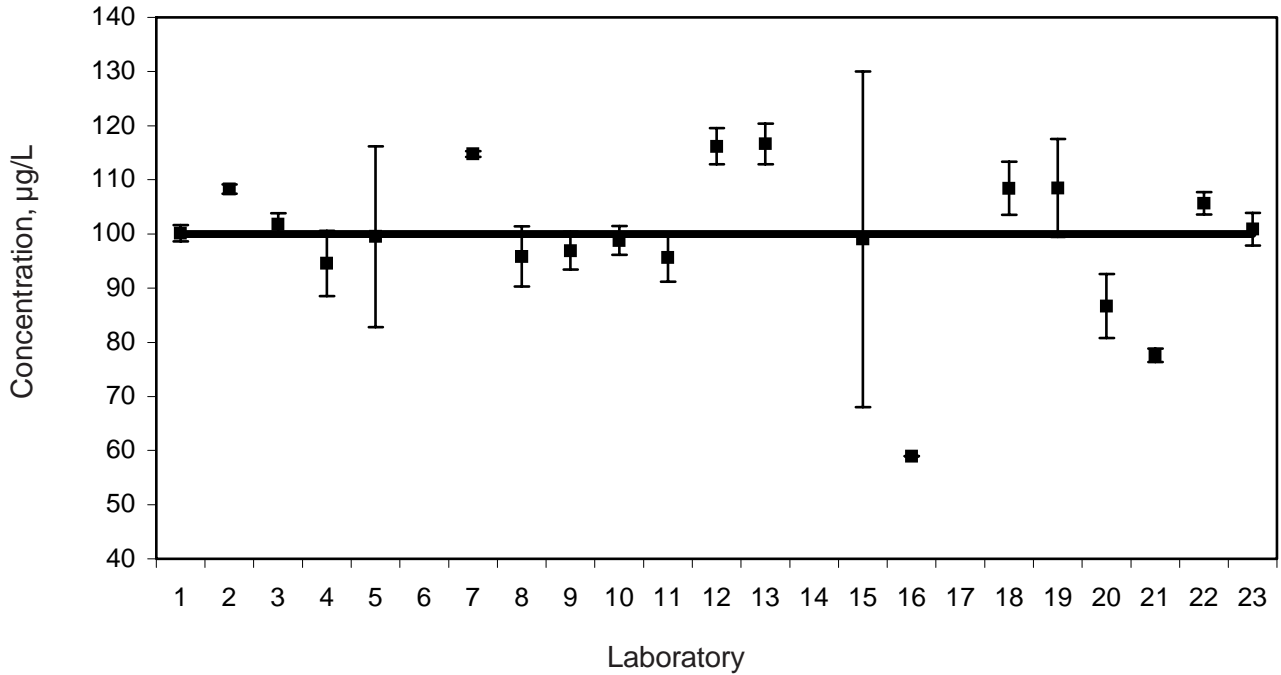
A value of 83.7 µg/L was assigned to Cr in Sample B based on the ETAAS and ICP-AES results from NRCC.

Overall Summary

No. of results	17
Overall mean	83.2
Median	84.0
Sample S.D.	9.1
95% C.I.	5.5
gravimetric	82.7

Part II Sample D

Chromium



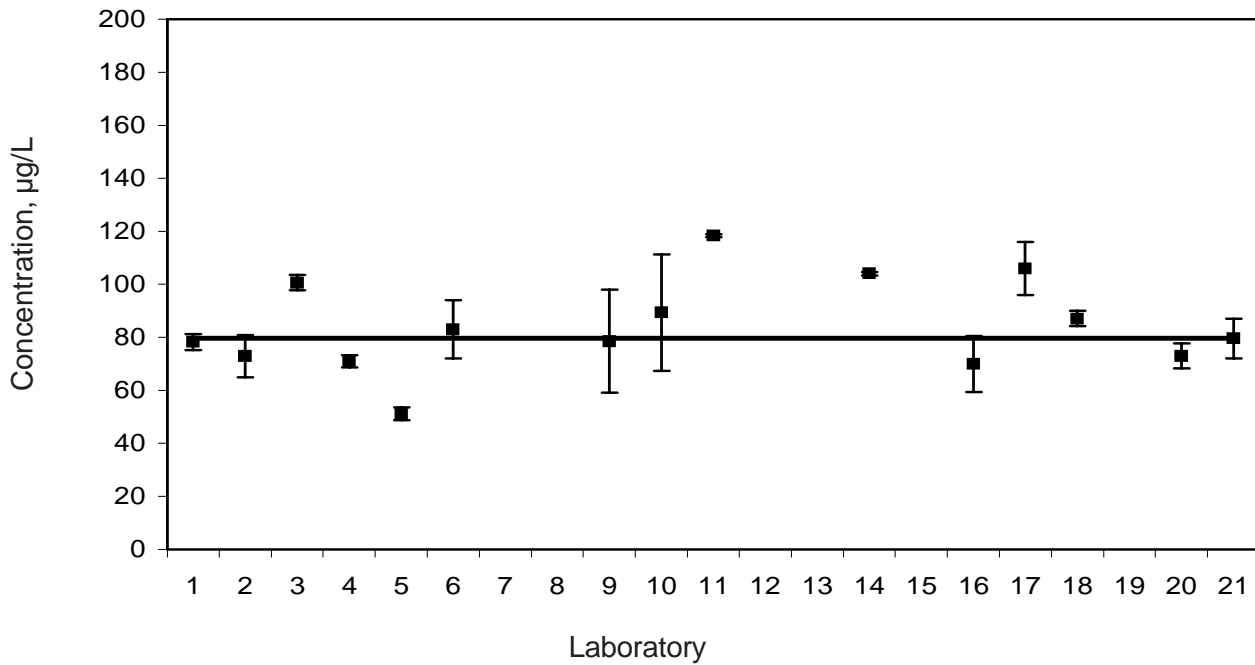
Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	100.1	1.5	ICP-AES
2	108.3	0.9	ICP-AES
3	101.80	2	ETAAS
4	94.57	6.01	ICP-AES
5	99.5	16.7	ICP-AES
6			
7	114.767	0.564	ETAAS
8	95.8	5.5	ETAAS
9	96.9	3.5	ICP-AES
10	98.8	2.7	ETAAS
11	95.7	4.5	ICP-AES
12	116.2	3.4	ETAAS
13	116.62	3.76	ICP-AES
14			
15	99	31	ETAAS
16	59	0	FAAS
17			
18	108.4	4.9	ICP-AES
19	108.5	9.0	ETAAS
20	86.70	5.90	ICP-MS
21	77.6	1.2	ICP-AES
22	106	2	FAAS
23	101	3	ICP-AES

Assigned Value

A value of 100 µg/L was assigned to Cr in Sample D based on the gravimetric calculation.

Overall Summary	
No. of results	20
Overall mean	99.2
Median	99.8
Sample S.D.	13.4
95% C.I.	7.3
gravimetric	100

Part I Sample A



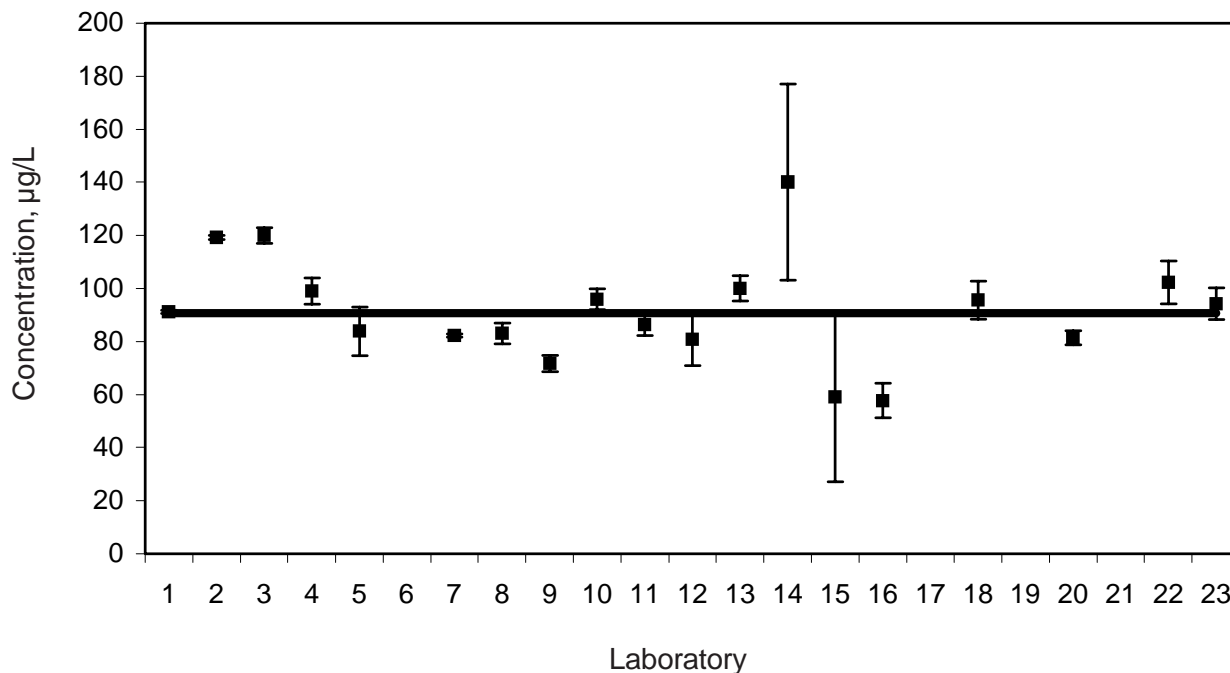
Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	78.24	3.08	ETAAS
2	73	7.98	ICP-AES
3	100.6	2.91	ETAAS
4	71.0	2.3	ICP-AES
5	51.2	2.4	ETAAS
6	83	11	ICP-AES
7			
8			
9	78.5	19.4	ETAAS
10	89	22	FAAS
11	118.4	0.5	FAAS
12			
13			
14	103.99	0.734	ICP-AES
15			
16	70.0	10.6	FAAS
17	106	10	ETAAS
18	87.1	2.9	ICP-AES
19			
20	73.0	4.8	ICP-AES
21	79.5	7.6	ICP-AES

Assigned Value

A value of 79.5 µg/L was assigned to Fe in Sample A based on the ICP-AES results from NRCC.

Overall Summary	
No. of results	15
Overall mean	84.2
Median	79.5
Sample S.D.	17.2
95% C.I.	11.2
gravimetric	81.0

Part II Sample C



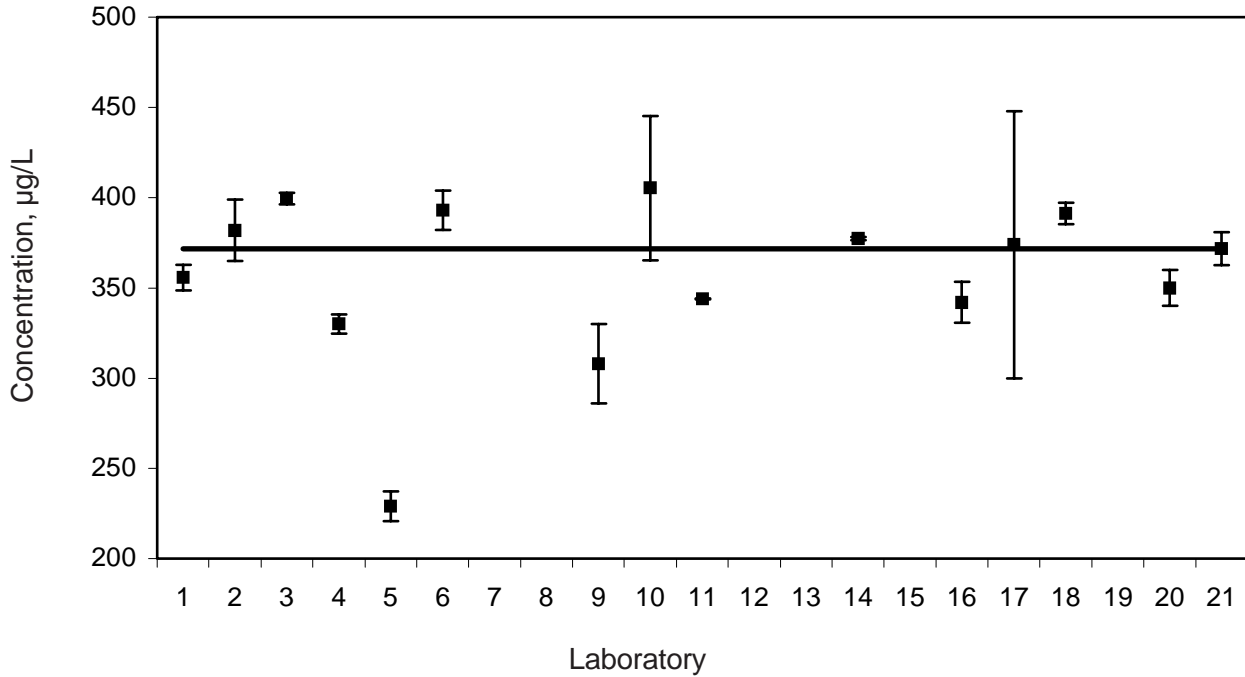
Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	91.2	0.6	ICP-AES
2	119.2	0.8	ICP-AES
3	120.00	3	FAAS
4	98.90	4.94	ICP-AES
5	83.8	9.2	ICP-AES
6			
7	82.216	0.546	FAAS
8	83.0	3.9	FAAS
9	71.7	3.1	ICP-AES
10	95.9	3.9	ETAAS
11	86.3	4.0	ICP-AES
12	80.8	10.0	FAAS
13	100.05	4.71	ICP-AES
14	140	37	FAAS
15	59	32	FAAS
16	58	7	FAAS
17			
18	95.6	7.2	ICP-AES
19			
20	81.33	2.70	ICP-MS
21			
22	102	8	ETAAS
23	94.1	6.0	ICP-AES

Assigned Value

A value of 90.8 µg/L was assigned to Fe in Sample C based on the gravimetric calculation.

Overall Summary	
No. of results	19
Overall mean	91.7
Median	91.2
Sample S.D.	20.1
95% C.I.	11.3
gravimetric	90.8

Part I Sample B



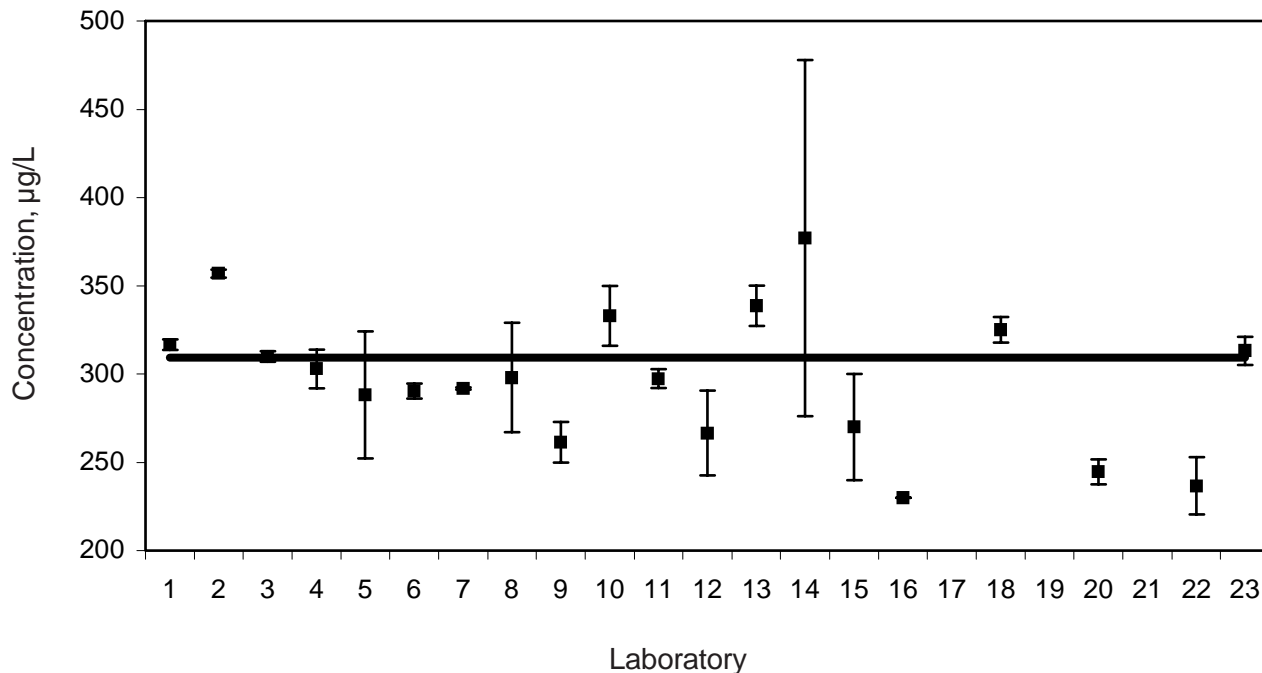
Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	355.8	7.2	FAAS
2	381.85	16.92	ICP-AES
3	399.60	3.28	FAAS
4	330.0	5.4	ICP-AES
5	228.3	8.2	ETAAS
6	393	11	ICP-AES
7			
8			
9	308	22	FAAS
10	405	40	FAAS
11	343.9	0.4	FAAS
12			
13			
14	377.3	0.938	ICP-AES
15			
16	342	11.3	FAAS
17	374	74	FAAS
18	391.3	5.8	ICP-AES
19			
20	350	10	ICP-AES
21	371.6	9.2	ICP-AES

Assigned Value

A value of 372 µg/L was assigned to Fe in Sample B based on the ICP-AES results from NRCC.

Overall Summary	
No. of results	15
Overall mean	357
Median	371
Sample S.D.	45
95% C.I.	29
gravimetric	387

Part II Sample D



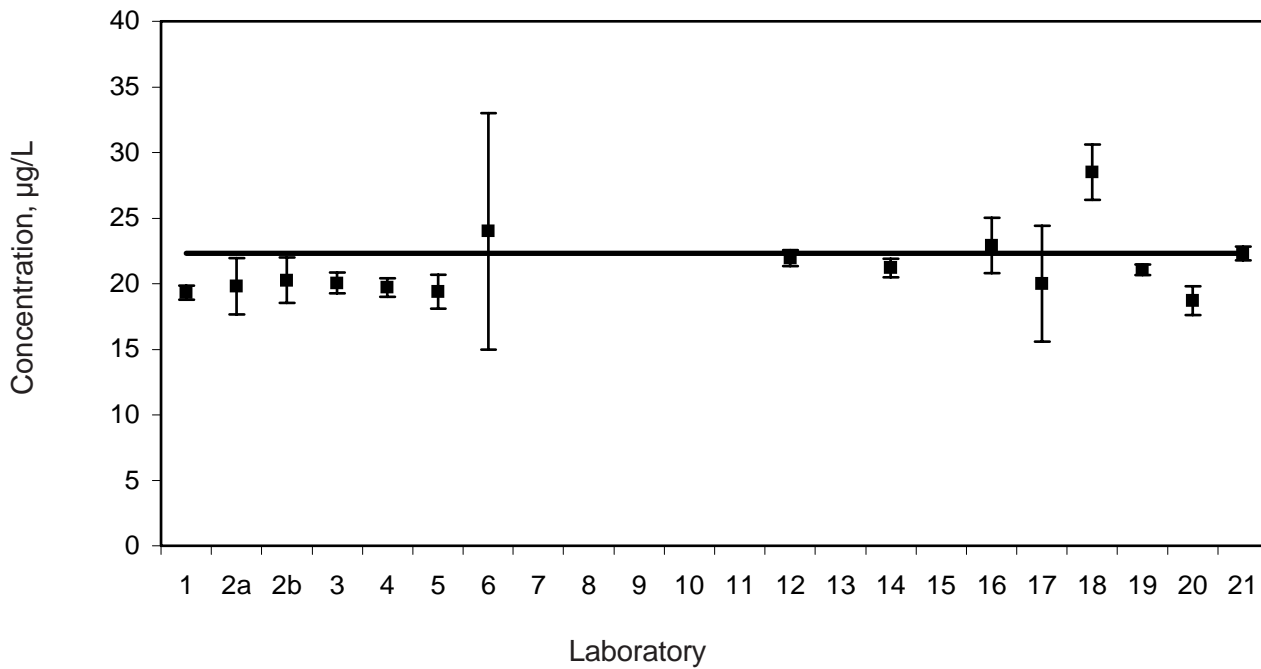
Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	316.7	3.1	ICP-AES
2	357.0	2.3	ICP-AES
3	310.00	3	FAAS
4	302.92	11.06	ICP-AES
5	288	36	ICP-AES
6	290.4	4.2	FAAS
7	291.76	0.546	FAAS
8	298	31	FAAS
9	261.3	11.4	ICP-AES
10	333	17	ETAAS
11	297.4	5.3	ICP-AES
12	266.6	24.0	FAAS
13	338.68	11.42	ICP-AES
14	377	101	FAAS
15	270	30	FAAS
16	230	0	FAAS
17			
18	325.0	7.3	ICP-AES
19			
20	244.6	7.04	ICP-MS
21			
22	237	16	FAAS
23	313	8	ICP-AES

Assigned Value

A value of 309 µg/L was assigned to Fe in Sample D based on the gravimetric calculation.

Overall Summary	
No. of results	20
Overall mean	297
Median	298
Sample S.D.	39
95% C.I.	21
gravimetric	309

Part I Sample A



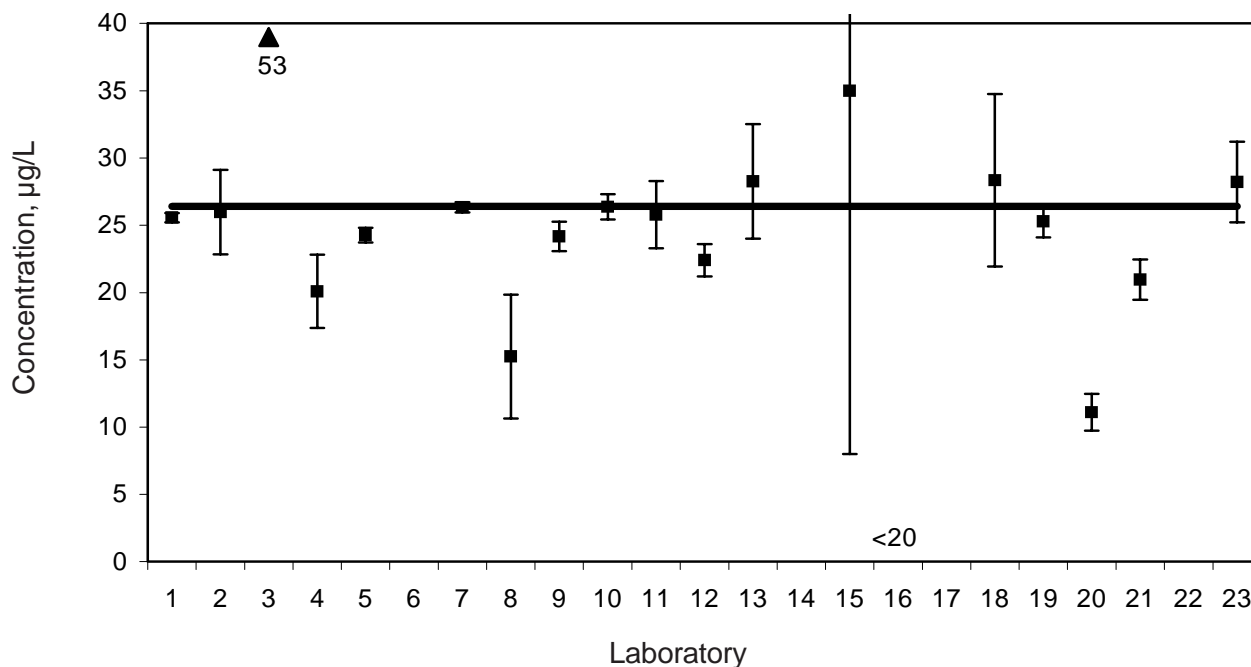
Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	19.31	0.52	ETAAS
2a	19.81	2.14	ETAAS
2b	20.25	1.72	ICP-AES
3	20.05	0.78	ETAAS
4	19.7	0.7	ICP-AES
5	19.4	1.3	ETAAS
6	24	9	ICP-AES
7			
8			
9			
10			
11			
12	21.9	0.6	ICP-AES
13			
14	21.21	0.707	ICP-AES
15			
16	22.9	2.11	ETAAS
17	20.0	4.4	ETAAS
18	28.5	2.1	ICP-AES
19	21.1	0.4	ICP-MS
20	18.7	1.1	ICP-AES
21	22.31	0.53	ID-SF-ICP-MS

Assigned Value

A value of 22.3 µg/L was assigned to Ni in Sample A based on the ID-SF-ICP-MS results from NRCC.

Overall Summary	
No. of results	15
Overall mean	21.3
Median	20.3
Sample S.D.	2.5
95% C.I.	1.6
gravimetric	21.6

Part II Sample C



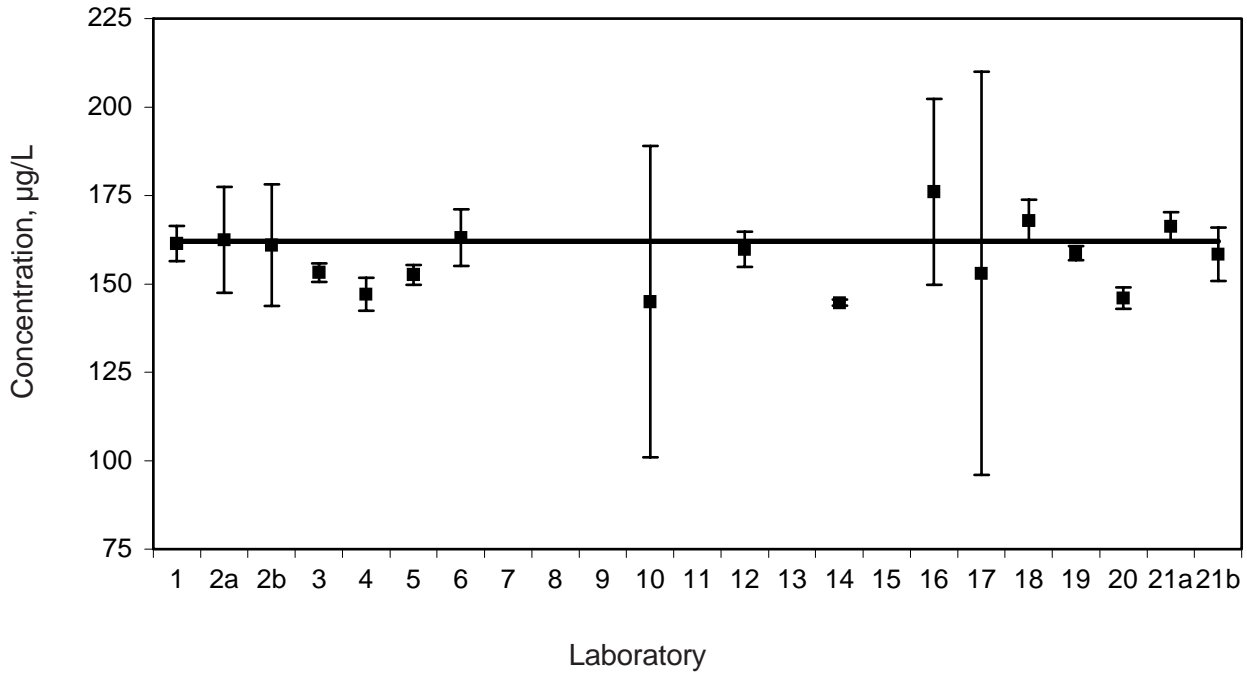
Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	25.6	0.4	ICP-AES
2	26.0	3.1	ICP-AES
3	53.00	4	ETAAS
4	20.09	2.71	ICP-AES
5	24.3	0.6	ICP-AES
6			
7	26.33	0.377	ETAAS
8	15.3	4.6	FAAS
9	24.2	1.1	ICP-AES
10	26.37	0.94	ETAAS
11	25.8	2.5	ICP-AES
12	22.4	1.2	ETAAS
13	28.27	4.26	ICP-AES
14			
15	35	27	FAAS
16	<20		FAAS
17			
18	28.3	6.4	ICP-AES
19	25.3	1.2	ETAAS
20	11.10	1.36	ICP-MS
21	21.0	1.5	ICP-AES
22			
23	28.22	3	ICP-MS

Assigned Value

A value of 26.4 µg/L was assigned to Ni in Sample C based on the gravimetric calculation.

Overall Summary	
No. of results	18
Overall mean	25.9
Median	25.7
Sample S.D.	8.6
95% C.I.	5.0
gravimetric	26.4

Part I Sample B



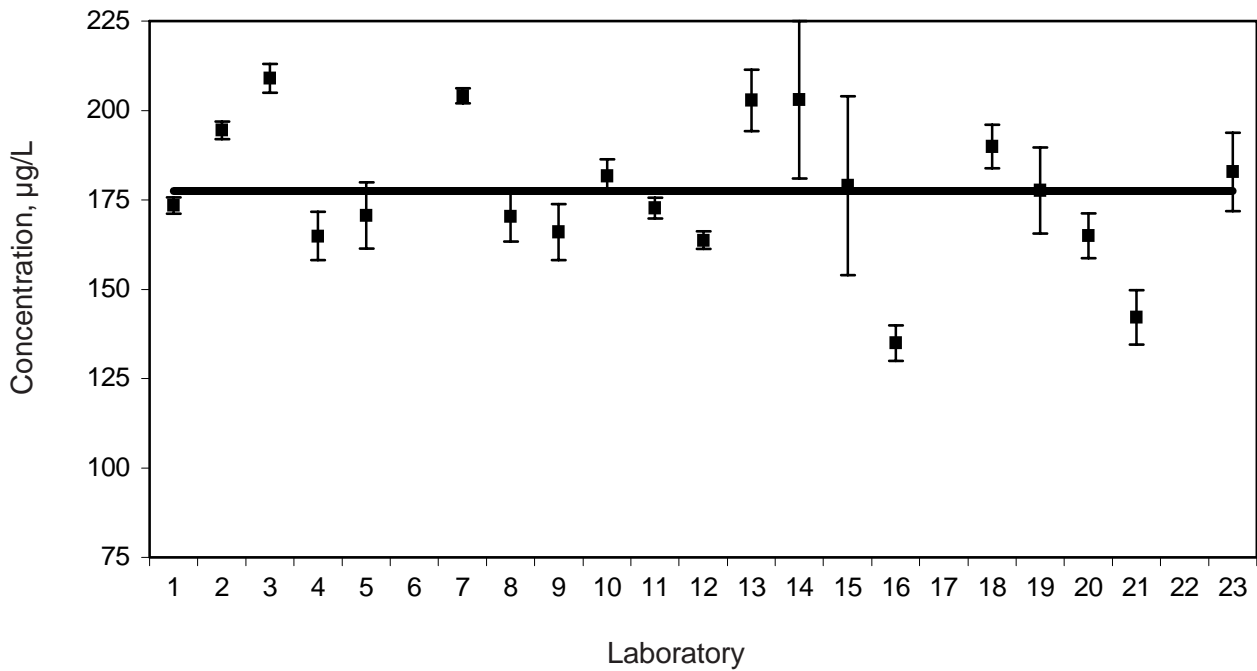
Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	161.4	5.0	ETAAS
2a	162.43	14.99	ETAAS
2b	160.89	17.23	ICP-AES
3	153.2	2.62	ETAAS
4	147.0	4.7	ICP-AES
5	152.6	2.8	ETAAS
6	163	8	ICP-AES
7			
8			
9			
10	145	44	FAAS
11			
12	159.7	5.0	ICP-AES
13			
14	144.71	0.823	ICP-AES
15			
16	176	26.3	FAAS
17	153	57	FAAS
18	167.9	5.9	ICP-AES
19	159	2	ICP-MS
20	146	3	ICP-AES
21a	166.2	4.1	ID-SF-ICP-MS
21b	158.4	7.5	ICP-AES

Assigned Value

A value of 162 µg/L was assigned to Ni in Sample B based on the ID-SF-ICP-MS and ICP-AES results from NRCC.

Overall Summary	
No. of results	17
Overall mean	157
Median	159
Sample S.D.	8.8
95% C.I.	5.3
gravimetric	162

Part II Sample D



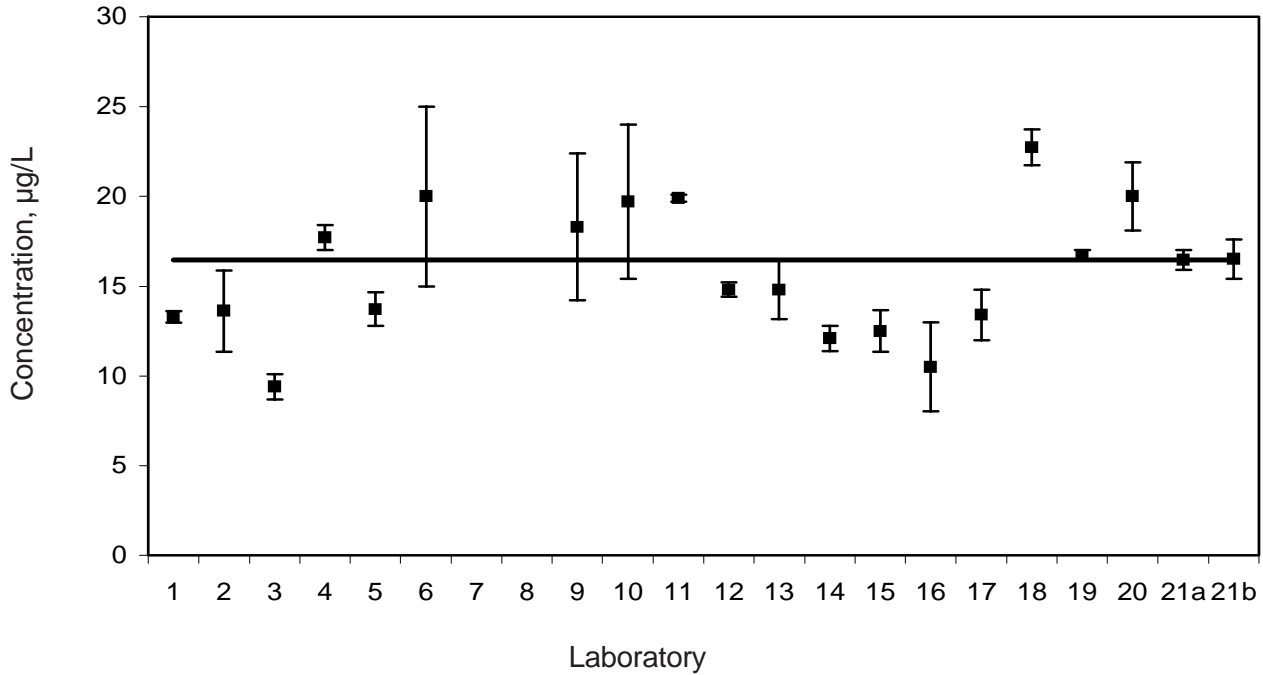
Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	173.5	2.3	ICP-AES
2	194.5	2.5	ICP-AES
3	209.00	4	ETAAS
4	164.87	6.80	ICP-AES
5	171	9	ICP-AES
6			
7	204.1	2.03	ETAAS
8	170.3	6.9	FAAS
9	166	7.8	ICP-AES
10	181.7	4.6	ETAAS
11	172.7	2.9	ICP-AES
12	163.7	2.5	ETAAS
13	202.844	8.540	ICP-AES
14	203	22	FAAS
15	179	25	FAAS
16	135	5	FAAS
17			
18	189.9	6.1	ICP-AES
19	178	12	ETAAS
20	165.0	6.30	ICP-MS
21	142.2	7.6	ICP-AES
22			
23	183	11	ICP-MS

Assigned Value

A value of 178 µg/L was assigned to Ni in Sample D based on the the gravimetric calculation.

Overall Summary	
No. of results	20
Overall mean	177
Median	176
Sample S.D.	19.6
95% C.I.	10.7
gravimetric	178

Part I Sample A



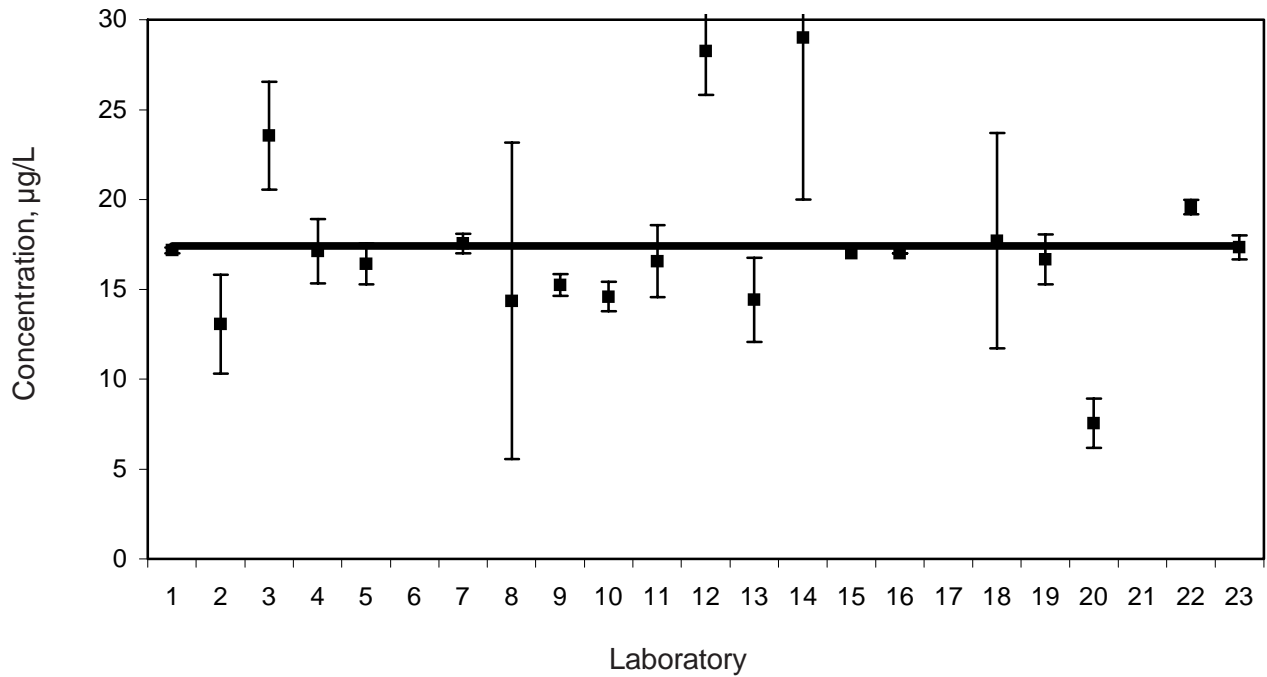
Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	13.29	0.32	ETAAS
2	13.62	2.26	ICP-AES
3	9.40	0.71	ETAAS
4	17.7	0.7	ICP-AES
5	13.72	0.92	ETAAS
6	20	5	ICP-AES
7			
8			
9	18.3	4.1	ETAAS
10	19.7	4.3	ETAAS
11	19.9	0.2	FAAS
12	14.8	0.4	ICP-AES
13	14.8	1.64	AAS
14	12.09	0.707	ICP-AES
15	13	2	FAAS
16	10.5	2.49	ETAAS
17	13.4	1.4	ETAAS
18	22.7	1.0	ICP-AES
19	16.7	0.3	ICP-MS
20	20.0	1.9	ICP-AES
21a	16.45	0.56	ID-ICP-MS
21b	16.5	1.1	ICP-AES

Assigned Value

A value of 16.5 µg/L was assigned to Cu in Sample A based on the ID-SF-ICP-MS and ICP-AES results from NRCC.

Overall Summary	
No. of results	20
Overall mean	15.8
Median	15.6
Sample S.D.	3.6
95% C.I.	2.0
gravimetric	16.5

Part II Sample C



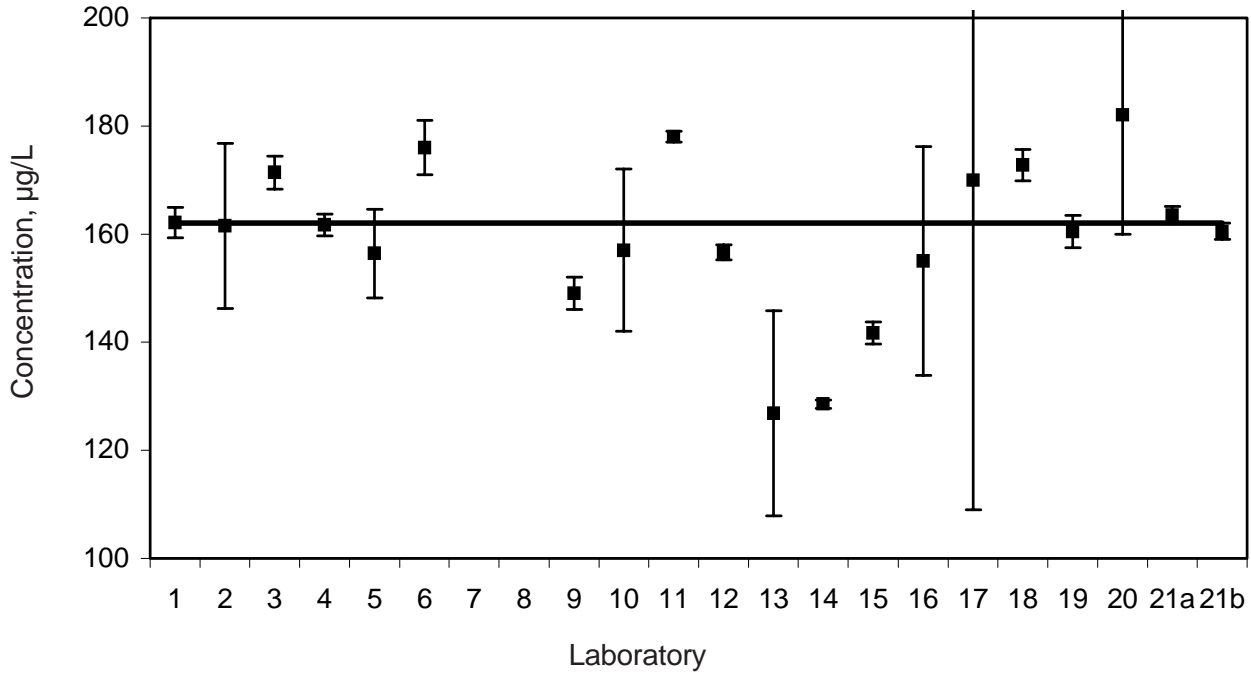
Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	17.2	0.2	ICP-AES
2	13.1	2.8	ICP-AES
3	23.55	3	ETAAS
4	17.13	1.79	ICP-AES
5	16.4	1.1	ICP-AES
6			
7	17.55	0.545	FAAS
8	14.4	8.8	FAAS
9	15.2	0.6	ICP-AES
10	14.60	0.82	ETAAS
11	16.6	2.0	ICP-AES
12	28.3	2.46	ETAAS
13	14.41	2.34	ICP-AES
14	29	9	FAAS
15	17	0.2	FAAS
16	17	0	FAAS
17			
18	17.7	6.0	ICP-AES
19	16.7	1.4	ETAAS
20	7.55	1.36	ICP-MS
21			
22	19.6	0.4	ETAAS
23	17.34	0.67	ICP-MS

Assigned Value

A value of 17.4 µg/L was assigned to Cu in Sample C based on the gravimetric calculation.

Overall Summary	
No. of results	20
Overall mean	17.5
Median	17.0
Sample S.D.	4.8
95% C.I.	2.6
gravimetric	17.4

Part I Sample B



Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	162.1	2.8	FAAS
2	161.52	15.25	ICP-AES
3	171.38	3.061	ETAAS
4	161.7	2.0	ICP-AES
5	155.5	8.2	ETAAS
6	176	5	ICP-AES
7			
8			
9	149	3	FAAS
10	157	15	FAAS
11	178	1	FAAS
12	156.6	1.4	ICP-AES
13	126.8	19	AAS
14	128.55	0.800	ICP-AES
15	141	5	FAAS
16	155	21.2	FAAS
17	170	61	FAAS
18	172.8	2.9	ICP-AES
19	161	3	ICP-MS
20	182	22	ICP-AES
21a	163.5	1.6	ID-ICP-MS
21b	160.5	1.5	ICP-AES

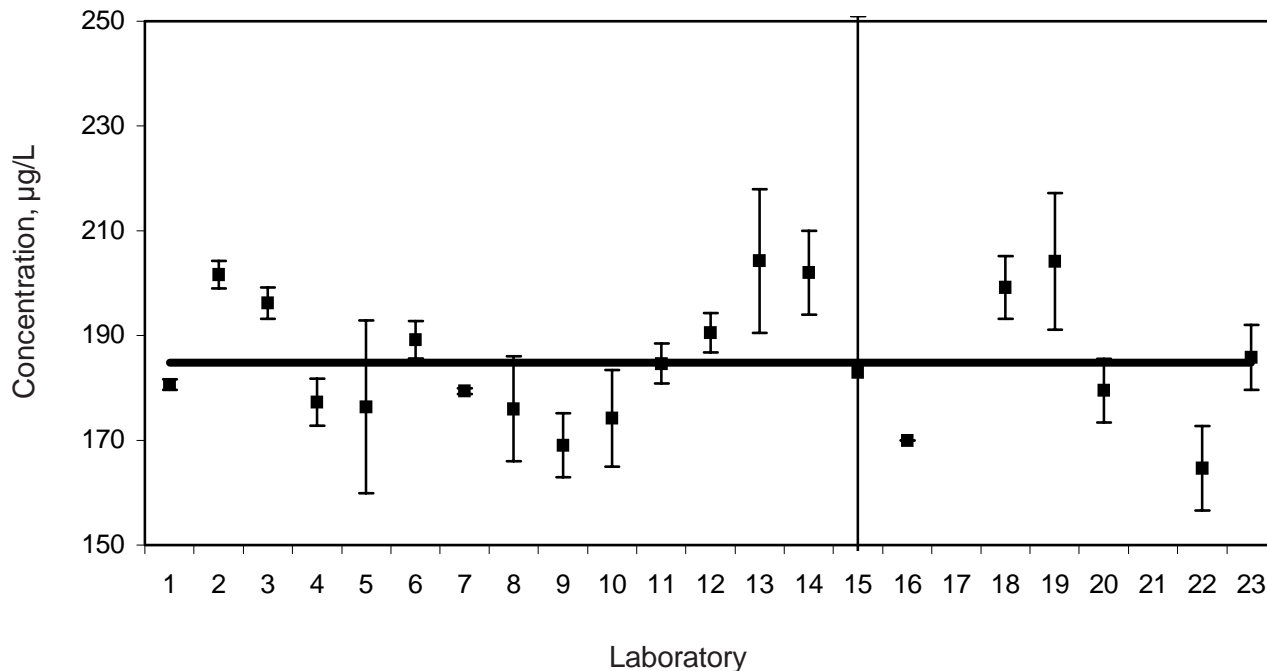
Assigned Value

A value of 162 µg/L was assigned to Cu in Sample B based on the ID-SF-ICP-MS and ICP-AES results from NRCC.

Overall Summary	
No. of results	20
Mean*	163
Median*	161
Sample S.D.*	10
95% C.I.*	6
gravimetric	162

* Two results not included.

Part II Sample D



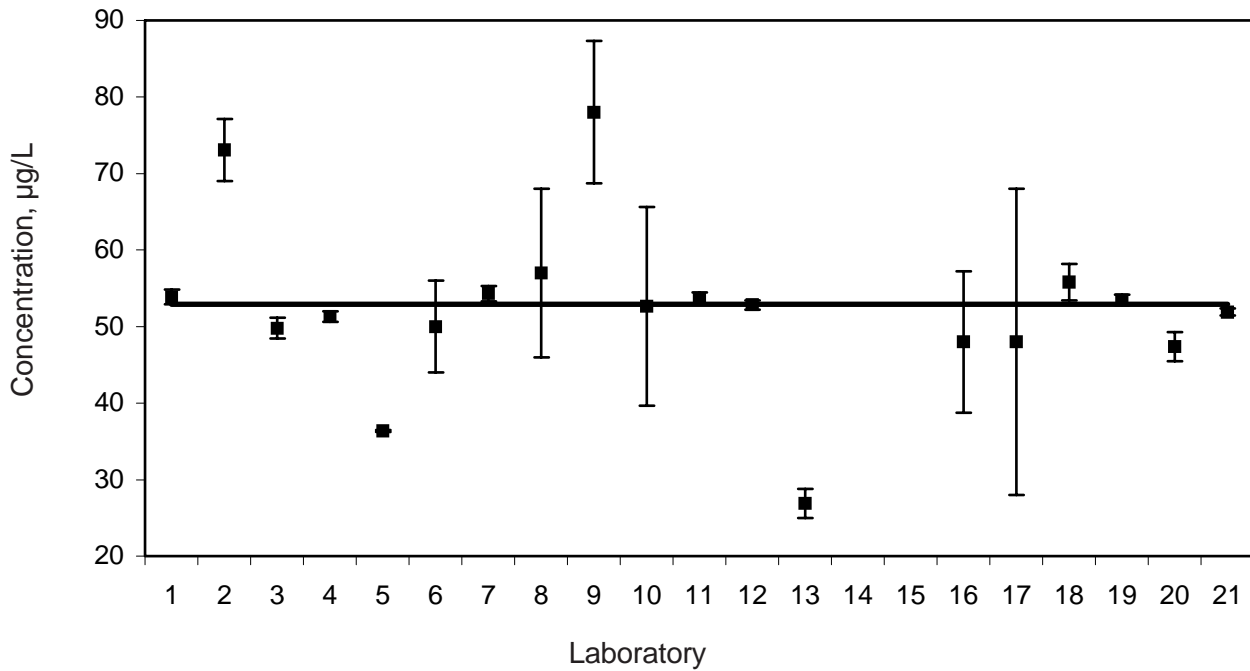
Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	180.6	1.0	ICP-AES
2	201.6	2.6	ICP-AES
3	196.20	3	ETAAS
4	177.29	4.51	ICP-AES
5	176	17	ICP-AES
6	189.2	3.6	FAAS
7	179.41	0.545	FAAS
8	176	10	FAAS
9	169.0	6.1	ICP-AES
10	174.2	9.2	ETAAS
11	184.7	3.8	ICP-AES
12	190.5	3.75	ETAAS
13	204.25	13.72	ICP-AES
14	202	8	FAAS
15	183	68	FAAS
16	170	0	FAAS
17			
18	199.2	6.0	ICP-AES
19	204	13	ETAAS
20	179.5	6.08	ICP-MS
21			
22	165	8	FAAS
23	185.8	6.2	ICP-MS

Assigned Value

A value of 185 µg/L was assigned to Cu in Sample D based on the gravimetric calculation.

Overall Summary	
No. of results	21
Mean	185
Median	183
Sample S.D.	12
95% C.I.	6
gravimetric	185

Part I Sample A



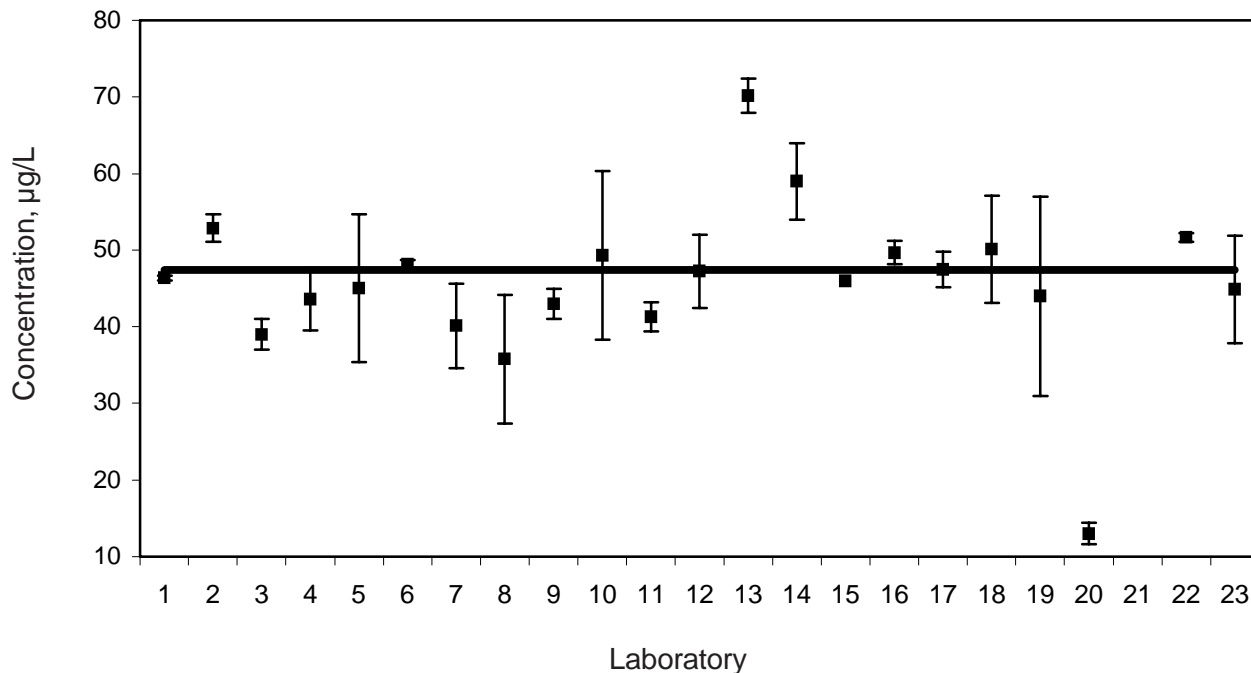
Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	53.87	0.92	FAAS
2	73.06	4.08	ICP-AES
3	49.80	1.38	FAAS
4	51.3	0.7	ICP-AES
5	36.4	4.1	ETAAS
6	50	6	ICP-AES
7	54.3	1.0	ID-SF-ICP-MS
8	57	11	FAAS
9	78	9.3	FAAS
10	53	13	FAAS
11	53.7	0.8	FAAS
12	52.8	0.6	ICP-AES
13	26.9	1.9	AAS
14			
15			
16	48.0	9.24	FAAS
17	48	20	FAAS
18	55.8	2.4	ICP-AES
19	53.5	0.7	ICP-MS
20	47.4	1.9	ICP-AES
21	51.9	0.47	ID-SF-ICP-MS

Assigned Value

A value of 52.9 µg/L was assigned to Zn in Sample A based on the ID-SF-ICP-MS results from NRCC and ID-SF-ICP-MS results from PTB.

Overall Summary	
No. of results	19
Overall mean	52.3
Median	52.7
Sample S.D.	10.5
95% C.I.	6.1

Part II Sample C



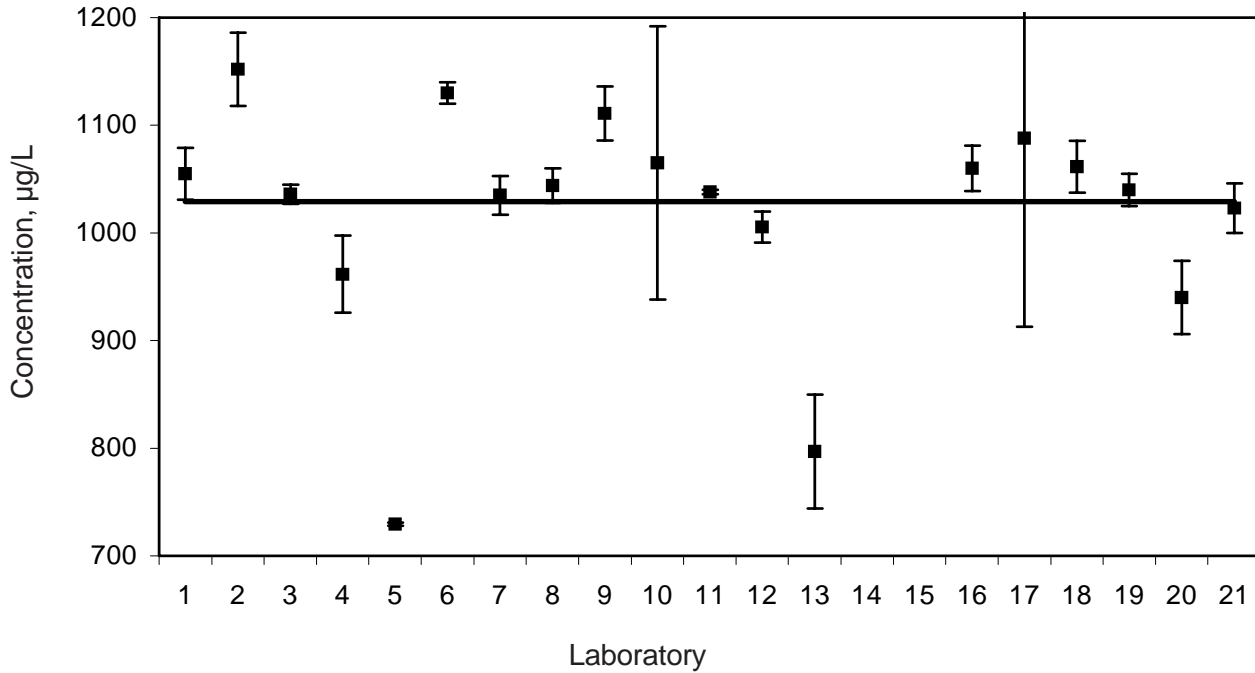
Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	46.4	0.3	ICP-AES
2	52.9	1.8	ICP-AES
3	39.00	2	ETAAS
4	43.61	4.09	ICP-AES
5	45.0	9.7	ICP-AES
6	48.15	0.52	FAAS
7	40.13	5.518	FAAS
8	35.8	8.4	FAAS
9	43	2	ICP-AES
10	49	11	FAAS
11	41.3	1.9	ICP-AES
12	47.3	4.79	FAAS
13	70.16	2.24	ICP-AES
14	59	5	FAAS
15	46	2	FAAS
16	50	2	FAAS
17	47.5	2.3	HR-ICP-MS
18	50.2	7.0	ICP-AES
19	44	13	FAAS
20	13.00	1.4	ICP-MS
21			
22	52	1	FAAS
23	44.9	7.0	ICP-AES

Assigned Value

A value of 47.4 µg/L was assigned to Zn in Sample C based on the gravimetric calculation.

Overall Summary	
No. of results	22
Overall mean	45.8
Median	46.2
Sample S.D.	10.2
95% C.I.	5.3
gravimetric	47.4

Part I Sample B



Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	1055	24	FAAS
2	1151.86	34.02	ICP-AES
3	1036	9.21	FAAS
4	961.7	35.8	ICP-AES
5	714.6	57.5	ETAAS
6	1130	10	ICP-AES
7	1035	18	ID-SF-ICP-MS
8	1044	16	FAAS
9	1111	25	FAAS
10	1065	127	FAAS
11	1038	2	FAAS
12	1006	14.6	ICP-AES
13	797	53	AAS
14			
15			
16	1060	21.2	FAAS
17	1088	175	FAAS
18	1061.3	24	ICP-AES
19	1040	15	ICP-MS
20	940	34	ICP-AES
21	1023	23	ID-SF-ICP-MS

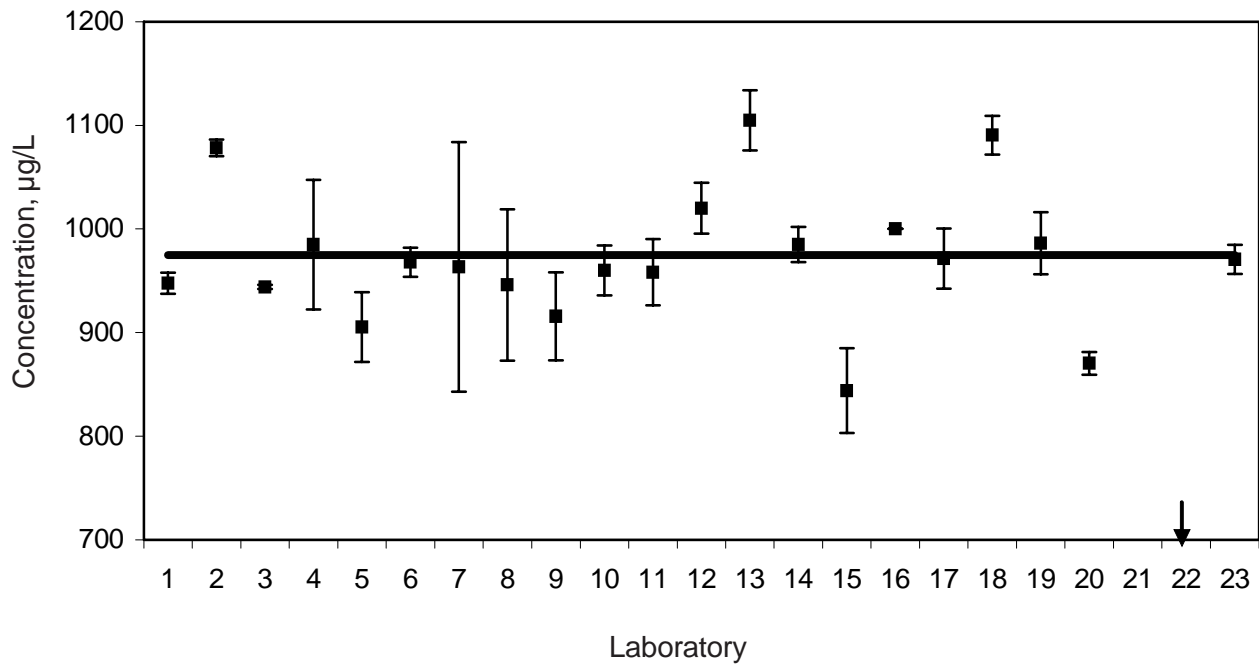
Assigned Value

A value of 1029 µg/L was assigned to Zn in Sample B based on the ID-SF-ICP-MS results from NRCC and ID-SF-ICP-MS results from PTB.

Overall Summary	
No. of results	17
Mean*	1050
Median*	1044
Sample S.D.*	52
95% C.I.*	30

* Two results not included.

Part II Sample D



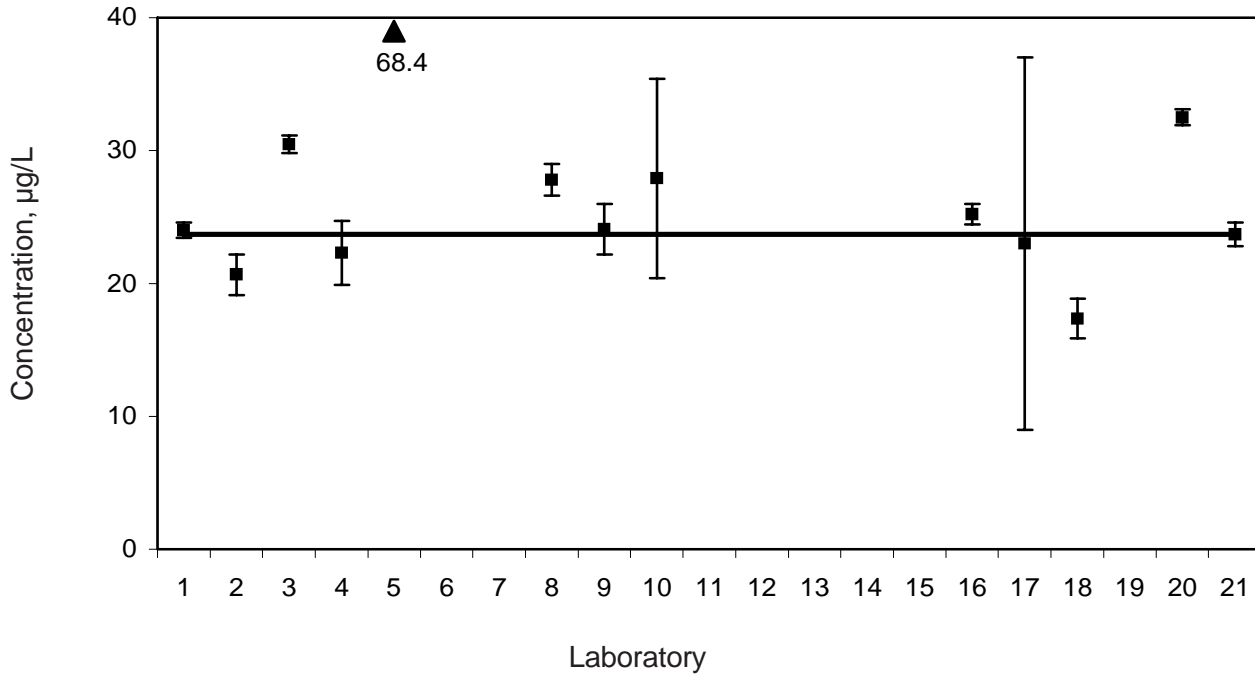
Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	947.6	10.2	ICP-AES
2	1078.2	8.0	ICP-AES
3	944.00	2	ETAAS
4	984.83	62.42	ICP-AES
5	905	34	ICP-AES
6	967.9	14.1	FAAS
7	963.39	120.429	FAAS
8	946	73	FAAS
9	915.6	42.5	ICP-AES
10	960	24	FAAS
11	958	32	ICP-AES
12	1020	24.7	FAAS
13	1104.78	28.89	ICP-AES
14	985	17	FAAS
15	844	41	FAAS
16	1000	0	FAAS
17	972	29	HR-ICP-MS
18	1090.6	18.6	ICP-AES
19	986	30	FAAS
20	870.27	10.92	ICP-MS
21			
22	98.9	1.4	FAAS
23	971	14	ICP-AES

Assigned Value

A value of 975 µg/L was assigned to Zn in Sample D based on the gravimetric calculation.

Overall Summary	
No. of results	22
Mean	932
Median	966
Sample S.D.	197
95% C.I.	975
gravimetric	975

Part I Sample A



Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	24.01	0.59	HGAAS
2	20.66	1.52	ETAAS
3	30.48	0.65	ETAAS
4	22.3	2.4	ICP-AES
5	68.4	3.9	ETAAS
6			
7			
8	27.8	1.2	ETAAS
9	24.1	1.9	HGAAS
10	27.9	7.5	ETAAS
11			
12			
13			
14			
15			
16	25.2	0.778	ETAAS
17	23	14	HGAAS
18	17.4	1.5	ICP-AES
19			
20	32.5	0.6	HGAAS
21	23.7	0.9	ETAAS

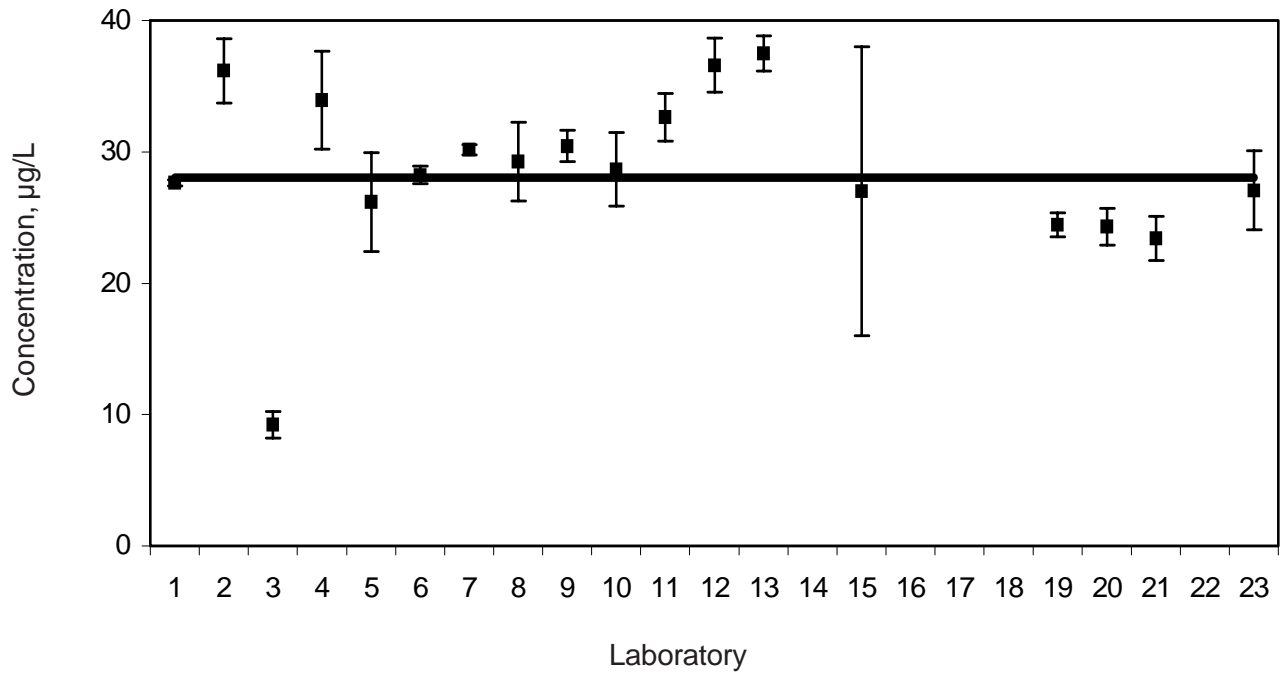
Assigned Value

A value of 23.7 µg/L was assigned to As in Sample A based on the ETAAS results from NRCC.

Overall Summary	
No. of results	13
Mean*	24.9
Median*	24.1
Sample S.D.*	4.2
95% C.I.*	3.1
gravimetric	23.0

* One result not included.

Part II Sample C



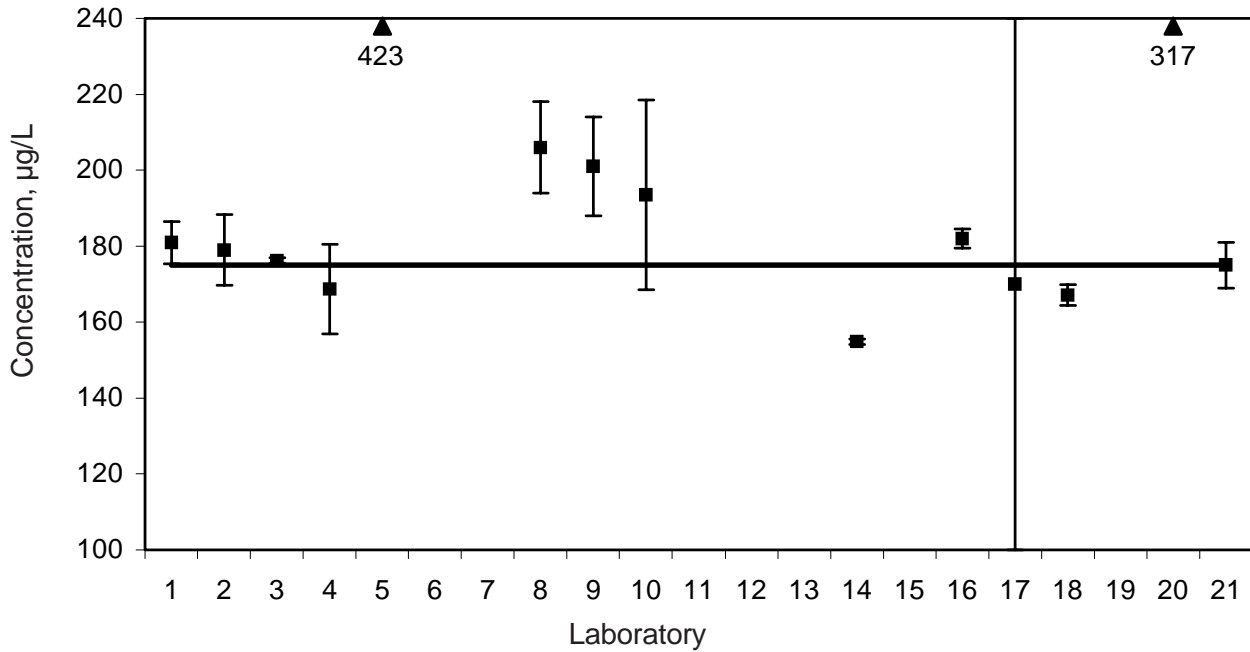
Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	27.6	0.3	ICP-AES
2	36.2	2.4	ICP-AES
3	9.21	1	VGAAS
4	33.93	3.74	ICP-AES
5	26.2	3.8	ICP-AES
6	28.23	0.68	HGAAS
7	30.177	0.384	ETAAS
8	29.3	3.0	ETAAS
9	30.4	1.2	ICP-AES
10	28.7	2.8	ETAAS
11	32.6	1.8	ICP-AES
12	36.59	2.05	ETAAS
13	37.50	1.35	ETAAS
14			
15	27	11	FAAS
16			
17			
18			
19	24.44	0.91	ETAAS
20	24.3	1.41	ICP-MS
21	23.4	1.7	ICP-AES
22			
23	27.1	3.0	ICP-AES

Assigned Value

A value of 28.1 µg/L was assigned to As in Sample C based on the gravimetric calculation.

Overall Summary	
No. of results	18
Mean	28.5
Median	28.4
Sample S.D.	6.4
95% C.I.	3.7
gravimetric	28.1

Part I Sample B



Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	180.9	5.6	HGAAS
2	179.02	9.24	ETAAS
3	176.2	0.71	ETAAS
4	168.7	11.8	ICP-AES
5	423.4	23	ETAAS
6			
7			
8	206	12	ETAAS
9	201	13	HGAAS
10	194	25	ETAAS
11			
12			
13			
14	154.88	0.722	ICP-AES
15			
16	182	2.53	ETAAS
17	170	70	HGAAS
18	167.1	2.8	ICP-AES
19			
20	317	14	HGAAS
21	175	6	ETAAS

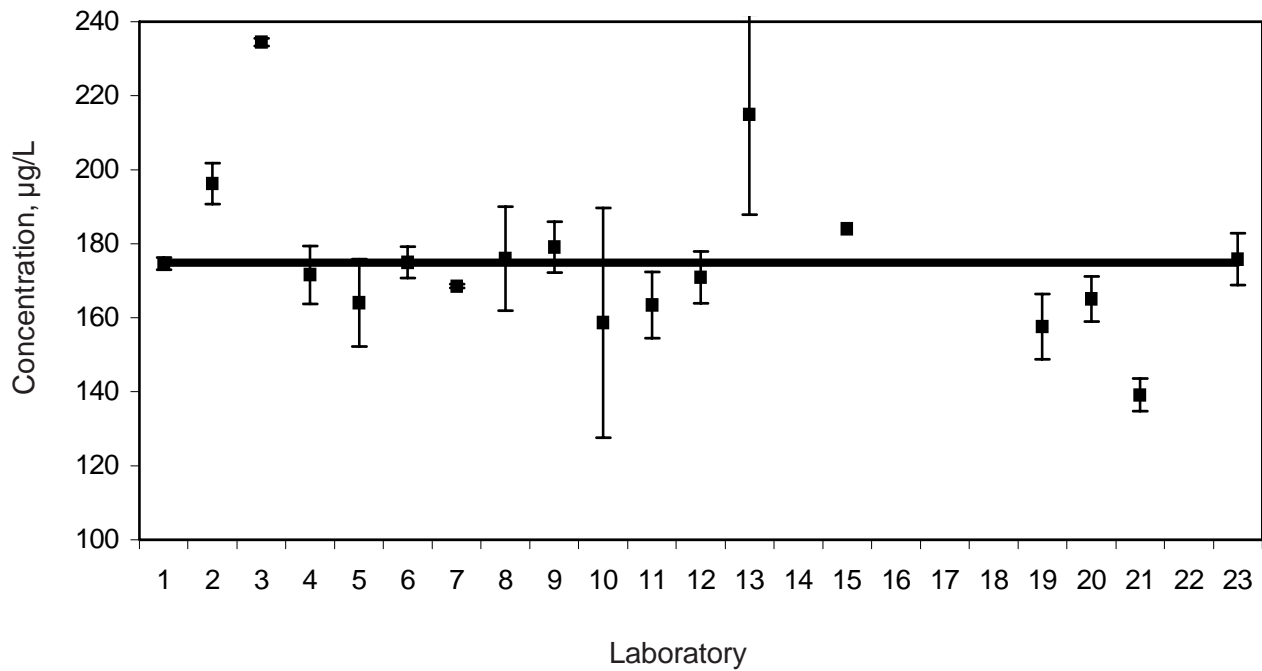
Assigned Value

A value of 175 µg/L was assigned to As in Sample B based on the ETAAS results from NRCC.

Overall Summary	
No. of results	14
Mean*	179
Median*	178
Sample S.D.*	15
95% C.I.*	11
gravimetric	173

* Two results not included.

Part II Sample D



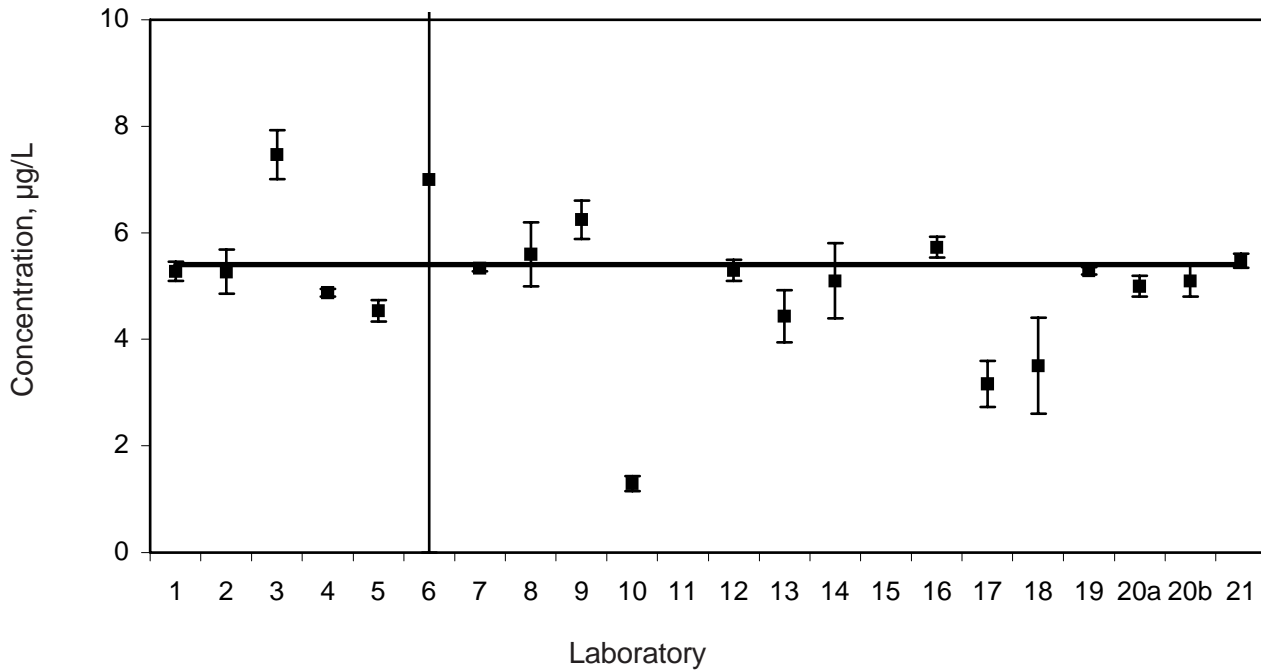
Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	174.6	1.6	ICP-AES
2	196.2	5.5	ICP-AES
3	234.50	1	VGAAS
4	171.63	7.84	ICP-AES
5	164	12	ICP-AES
6	175.0	4.3	HGAAS
7	168.567	0.539	ETAAS
8	176	14	ETAAS
9	179.1	6.8	ICP-AES
10	159	31	ETAAS
11	163.5	9.0	ICP-AES
12	170.9	7.1	ETAAS
13	214.93	26.95	ICP-AES
14			
15	184	13	FAAS
16			
17			
18			
19	157.6	8.8	ETAAS
20	165.03	6.11	ICP-MS
21	139.2	4.4	ICP-AES
22			
23	175.9	7.0	ICP-AES

Assigned Value

A value of 175 µg/L was assigned to As in Sample B based on the gravimetric calculation.

Overall Summary	
No. of results	18
Mean	176
Median	173
Sample S.D.	22
95% C.I.	13
gravimetric	175

Part I Sample A



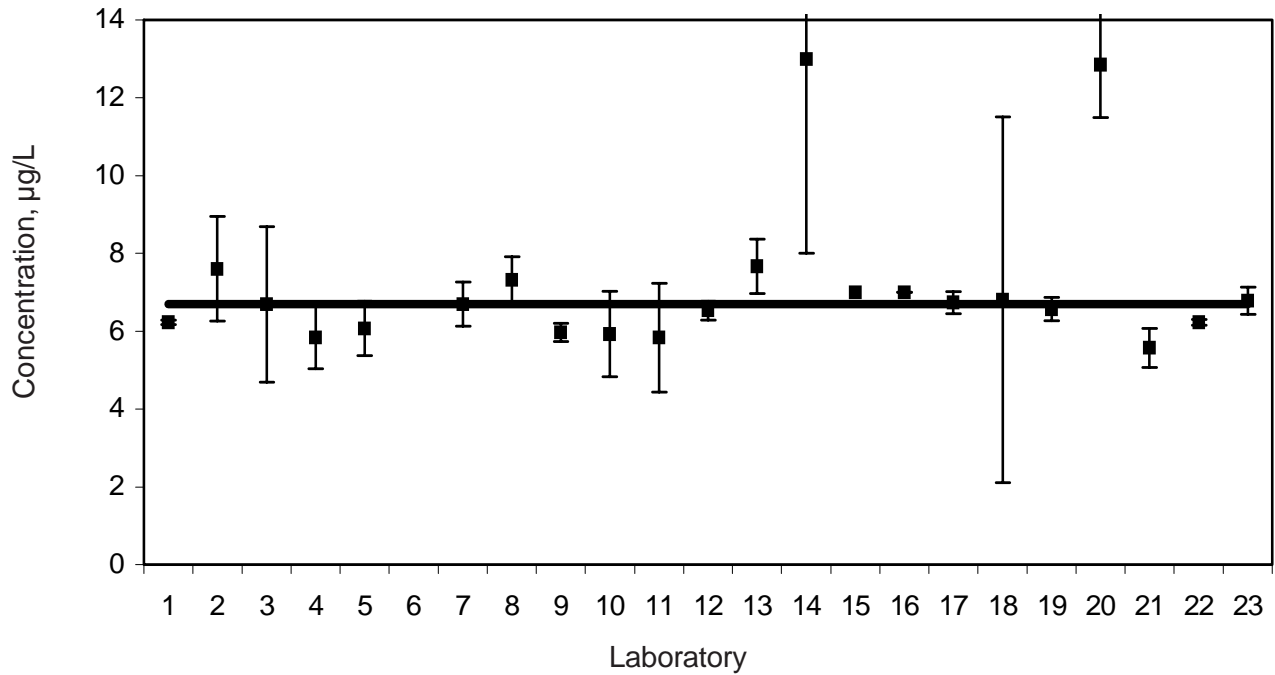
Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	5.28	0.18	ETAAS
2	5.27	0.42	ETAAS
3	7.47	0.46	ETAAS
4	4.87	0.07	ICP-AES
5	4.53	0.20	ETAAS
6	7	7	ICP-AES
7	5.34	0.06	ID-SF-ICP-MS
8	5.6	0.6	ETAAS
9	6.25	0.36	ETAAS
10	1.30	0.14	ETAAS
11			
12	5.3	0.2	ICP-AES
13	4.43	0.49	AAS
14	5.10	0.707	ICP-AES
15			
16	5.73	0.196	ETAAS
17	3.16	0.43	ETAAS
18	3.5	0.9	ICP-AES
19	5.29	0.07	ICP-MS
20a	5.0	0.2	ICP-AES
20b	5.1	0.3	ASV
21	5.48	0.13	ID-SF-ICP-MS

Assigned Value

A value of 5.41 µg/L was assigned to Cd in Sample A based on the ID-SF-ICP-MS results from NRCC and ID-SF-ICP-MS results from PTB.

Overall Summary	
No. of results	20
Overall mean*	5.25
Median*	5.28
Sample S.D.*	1
95% C.I.*	0.56
gravimetric	5.40

Part II Sample C



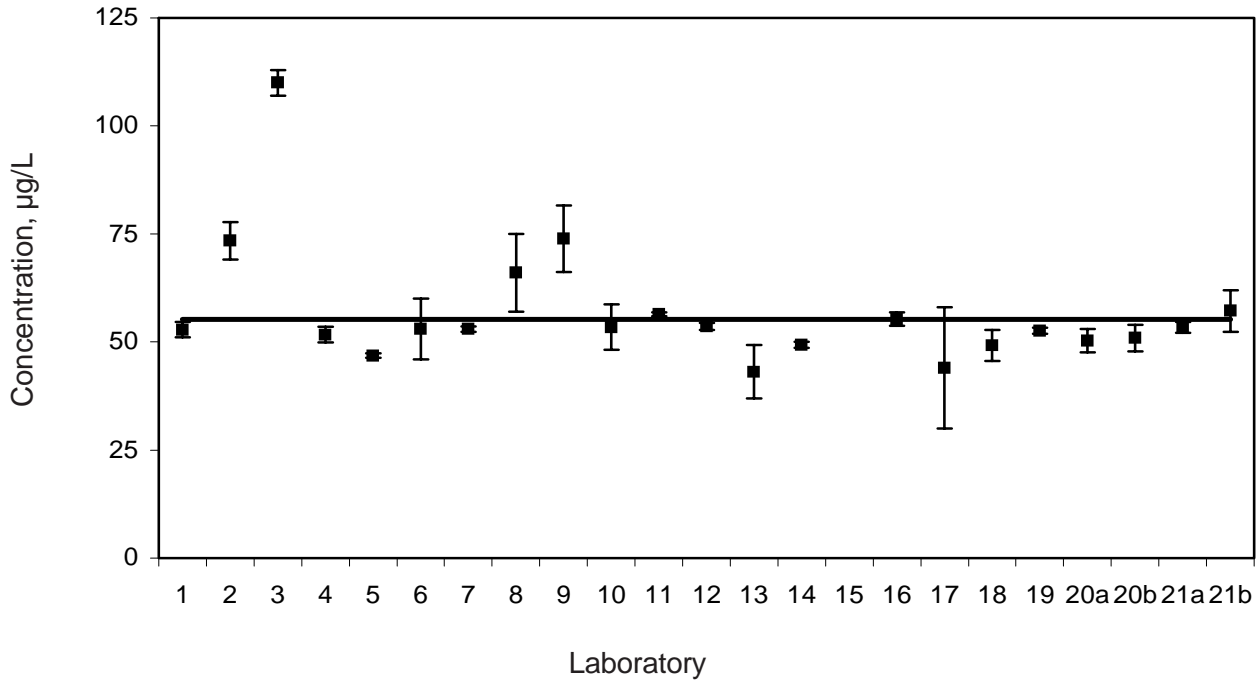
Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	6.2	0.1	ICP-AES
2	7.6	1.3	ICP-AES
3	6.69	2	ETAAS
4	5.84	0.80	ICP-AES
5	6.1	0.7	ICP-AES
6			
7	6.69	0.569	ETAAS
8	7.31	0.61	ETAAS
9	6.0	0.2	ICP-AES
10	5.93	1.1	ETAAS
11	5.8	1.4	ICP-AES
12	6.528	0.243	ETAAS
13	7.67	0.7	ICP-AES
14	13	5	FAAS
15	7	0.2	ETAAS
16	7	0	FAAS
17	6.73	0.29	HR-ICP-MS
18	6.8	4.7	ICP-AES
19	6.57	0.30	ETAAS
20	12.85	1.36	ICP-MS
21	5.6	0.5	ICP-AES
22	6.23	0.07	ETAAS
23	6.79	0.35	ICP-MS

Assigned Value

A value of 6.7 µg/L was assigned to Cd in Sample C based on the gravimetric calculation.

Overall Summary	
No. of results	22
Overall mean	7.1
Median	6.7
Sample S.D.	2.0
95% C.I.	1.0
gravimetric	6.7

Part I Sample B



Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	52.86	1.84	ETAAS
2	73.44	4.33	ETAAS
3	110.0	2.94	ETAAS
4	51.7	1.8	ICP-AES
5	46.86	0.50	ETAAS
6	53	7	ICP-AES
7	53.0	0.6	ID-SF-ICP-MS
8	66	9	ETAAS
9	73.9	7.7	FAAS
10	53.4	5.3	FAAS
11	56.4	0.5	FAAS
12	53.7	0.8	ICP-AES
13	43.1	6.2	AAS
14	49.36	0.709	ICP-AES
15			
16	55.3	1.52	ETAAS
17	44	14	ETAAS
18	49.2	3.6	ICP-AES
19	52.6	0.7	ICP-MS
20a	50.3	2.7	ICP-AES
20b	50.9	3.1	ASV
21a	53.4	1.3	ID-SF-ICP-MS
21b	57.2	4.8	ICP-AES

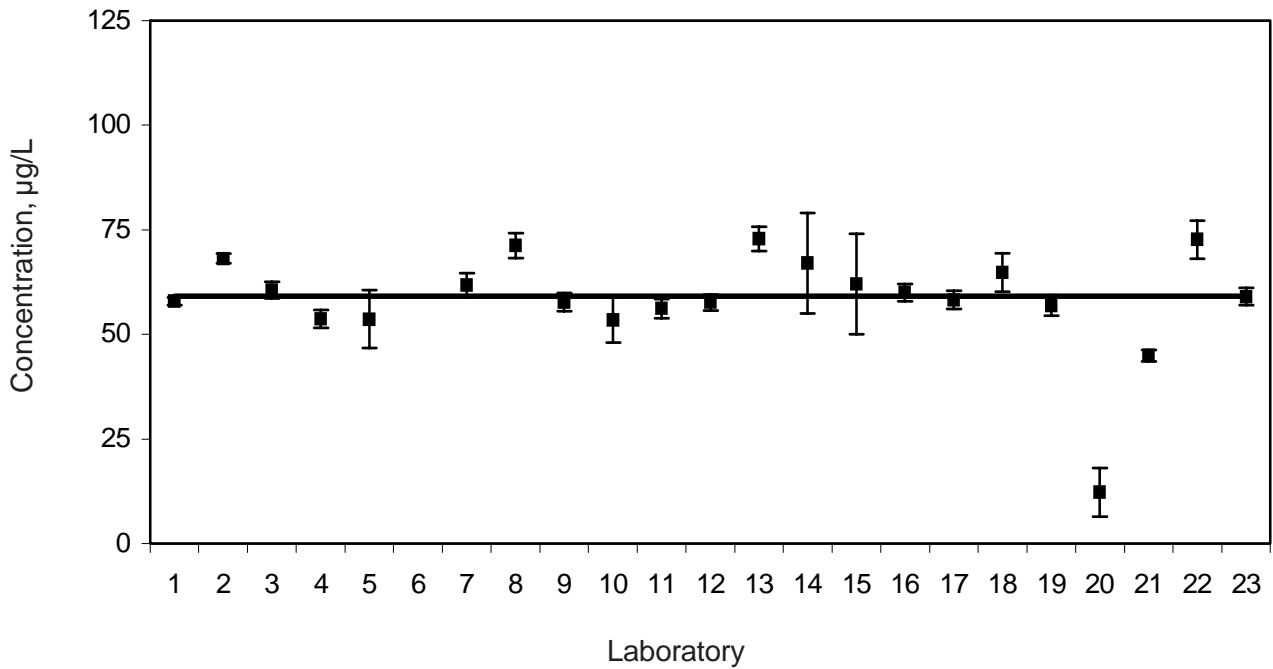
Assigned Value

A value of 55.3 µg/L was assigned to Cd in Sample B based on the ID-SF-ICP-MS and ICP-AES results from NRCC and ID-SF-ICP-MS results from PTB.

Overall Summary	
No. of results	22
Overall mean	54.3
Median	53.0
Sample S.D.	8.0
95% C.I.	4.2
gravimetric	54.0

* One result not included.

Part II Sample D



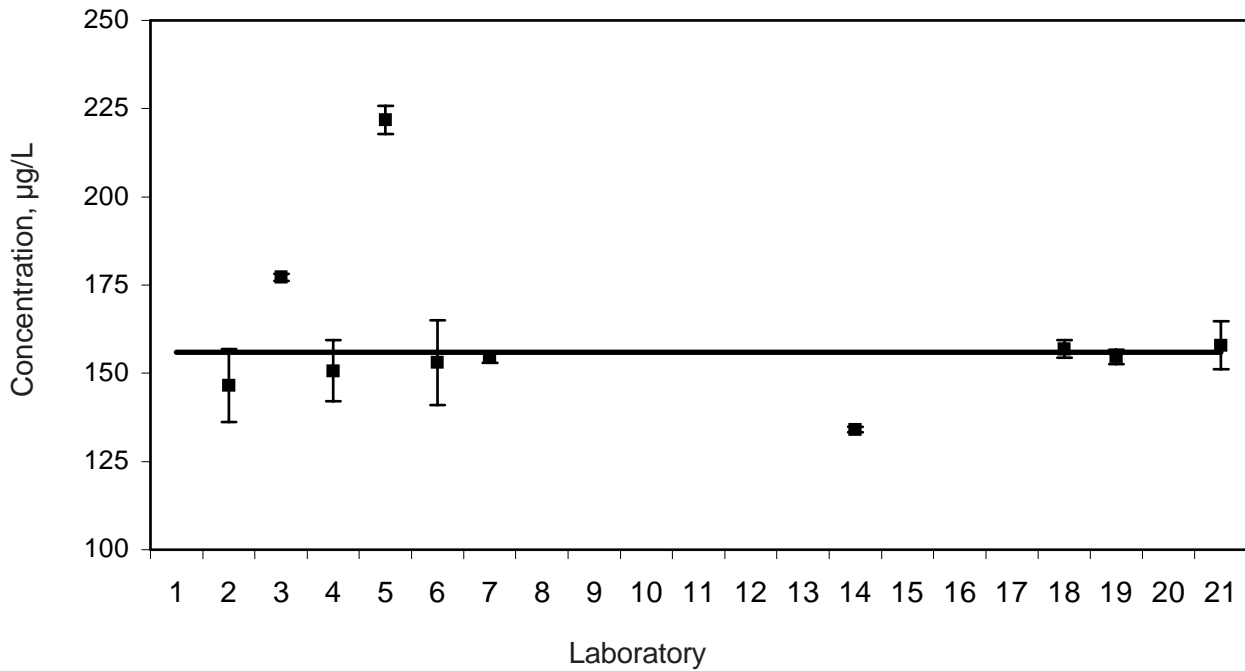
Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	58.0	0.9	ICP-AES
2	68.2	1.1	ICP-AES
3	60.60	2	ETAAS
4	53.76	2.10	ICP-AES
5	53.6	6.9	ICP-AES
6			
7	61.76	2.868	FAAS
8	71.2	3.0	ETAAS
9	57.7	2.2	ICP-AES
10	53.5	5.4	ETAAS
11	56.2	2.3	ICP-AES
12	57.64	1.92	ETAAS
13	72.87	2.90	ICP-AES
14	67	12	FAAS
15	62	12	ETAAS
16	60	2	FAAS
17	58.3	2.2	HR-ICP-MS
18	64.8	4.6	ICP-AES
19	56.9	2.4	ETAAS
20	12.26	5.85	ICP-MS
21	45.0	1.4	ICP-AES
22	73	4.6	FAAS
23	59.05	2.00	ICP-MS

Assigned Value

A value of 59.2 µg/L was assigned to Cd in Sample D based on the the gravimetric calculation.

Overall Summary	
No. of results	22
Overall mean	58.3
Median	58.7
Sample S.D.	12.4
95% C.I.	6.4
gravimetric	59.2

Part I Sample A



Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1			
2	146.53	10.34	ICP-AES
3	177.2	0.93	ETAAS
4	150.7	8.7	ICP-AES
5	221.6	19.1	ETAAS
6	153	12	ICP-AES
7	154.4	1.5	ID-SF-ICP-MS
8			
9			
10			
11			
12			
13			
14	134.04	0.708	ICP-AES
15			
16			
17			
18	156.9	2.5	ICP-AES
19	155	2	ICP-MS
20			
21	157.9	6.8	ICP-AES

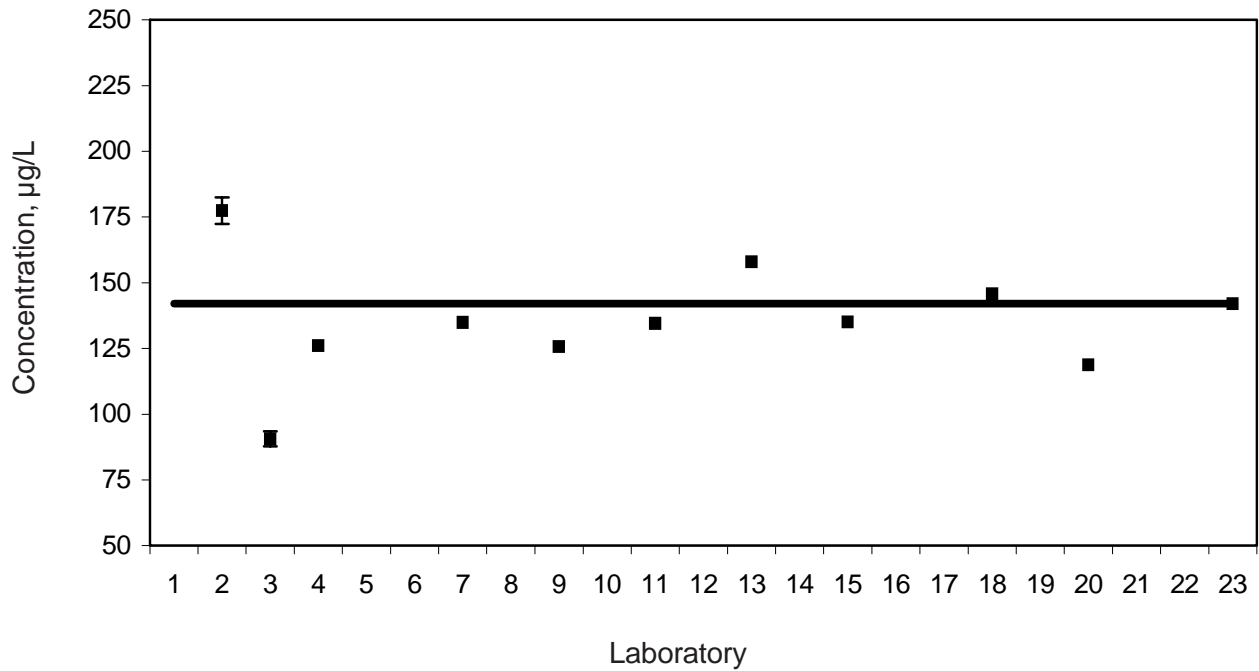
Assigned Value

A value of 156 µg/L was assigned to Ba in Sample A based on the ICP-AES results from NRCC and ID-SF-ICP-MS results from PTB.

Overall Summary	
No. of results	9
Mean*	154
Median*	154
Sample S.D.*	11
95% C.I.*	10

* One result not included.

Part II Sample C



Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1			
2	177.4	1.9	ICP-AES
3	90.63	5	ETAAS
4	126.10	2.90	ICP-AES
5			
6			
7	134.863	5.525	ETAAS
8			
9	125.7	4.7	ICP-AES
10			
11	134.5	4.1	ICP-AES
12			
13	157.9	5.9	ICP-AES
14			
15	135	1	FAAS
16			
17			
18	145.7	14.6	ICP-AES
19			
20	118.73	3.06	ICP-MS
21			
22			
23	146	2	ICP-AES

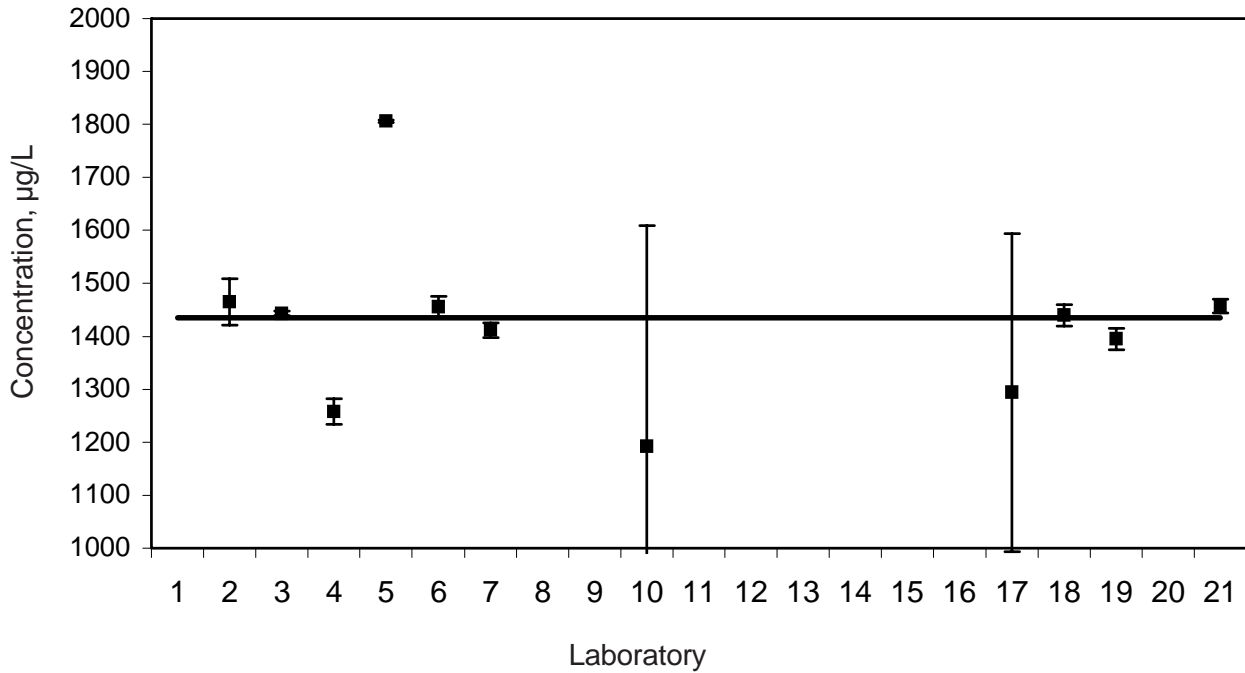
Assigned Value

A value of 146 µg/L was assigned to Ba in Sample C based on the ICP-AES results from NRCC.

Overall Summary	
No. of results	11
Mean	135
Median	135
Sample S.D.	22
95% C.I.	18

Part I Sample B

Barium



Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1			
2	1465.12	43.22	ICP-AES
3	1443	4.17	ETAAS
4	1258.0	23.5	ICP-AES
5	1811.4	101.2	ETAAS
6	1456	20	ICP-AES
7	1412	14	ID-SF-ICP-MS
8			
9			
10	1192	417	FAAS
11			
12			
13			
14			
15			
16			
17	1294	300	FAAS
18	1439.8	20	ICP-AES
19	1395	20	ICP-MS
20			
21	1458	13	ICP-AES

Assigned Value

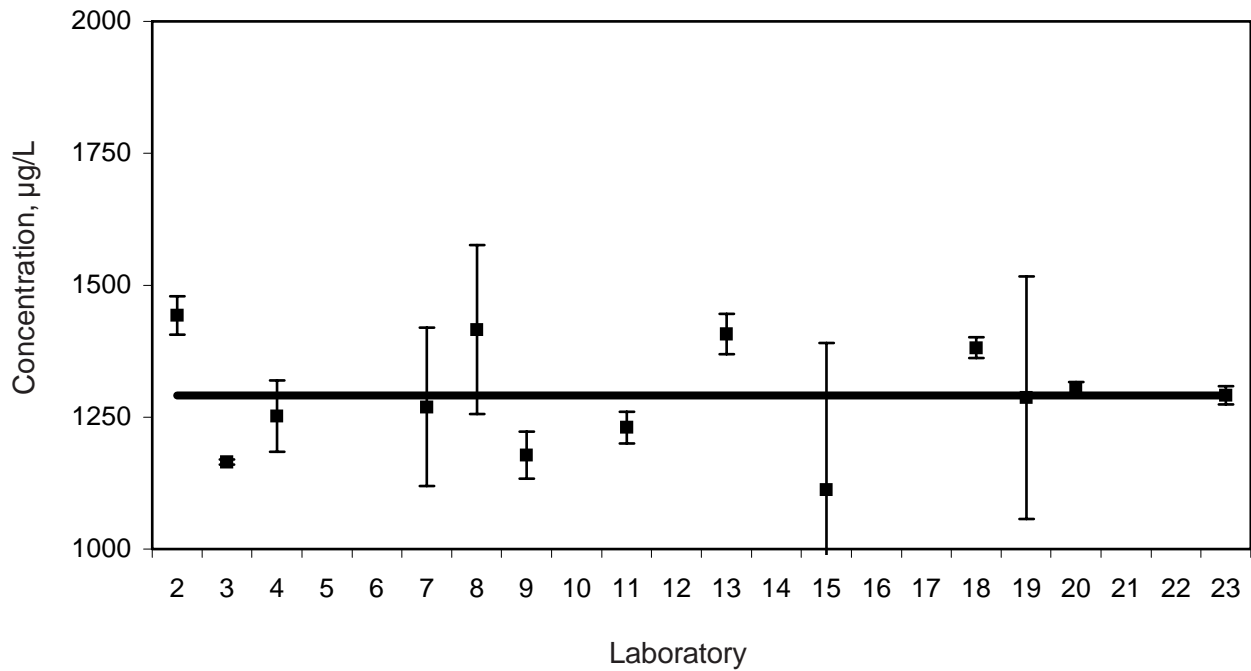
A value of 1435 µg/L was assigned to Ba in Sample B based on the ICP-AES results from NRCC and ID-SF-ICP-MS results from PTB.

Overall Summary

No. of results	11
Overall mean	1420
Median	1440
Sample S.D.	158
95% C.I.	126

* Four results not included.

Part II Sample D



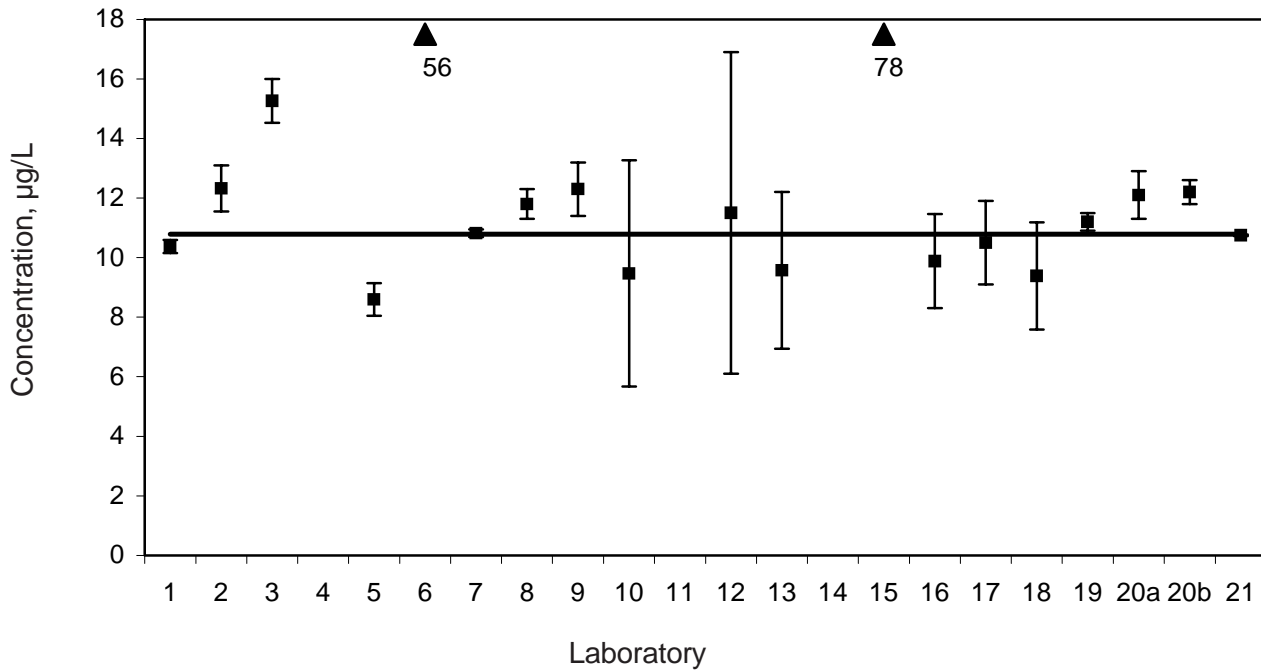
Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1			
2	1442.9	36.9	ICP-AES
3	1164.60	5	ETAAS
4	1251.7	67.66	ICP-AES
5			
6			
7	1269.167	150.1139	ETAAS
8	1416	160	FAAS
9	1178	44	ICP-AES
10			
11	1230	30	ICP-AES
12			
13	1407.54	38.07	ICP-AES
14			
15	1112	278	FAAS
16			
17			
18	1381.4	19.9	ICP-AES
19	1287	230	FAAS
20	1306	11	ICP-MS
21			
22			
23	1291	17	ICP-AES

Assigned Value

A value of 1291 µg/L was assigned to Ba in Sample D based on the ICP-AES results from NRCC.

Overall Summary	
No. of results	13
Overall mean	1287
Median	1287
Sample S.D.	103
95% C.I.	73.1

Part I Sample A



Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	10.37	0.22	ETAAS
2	12.32	0.77	ETAAS
3	15.26	0.74	ETAAS
4	<15		ICP-AES
5	8.59	0.55	ETAAS
6	56	10	ICP-AES
7	10.82	0.13	ID-SF-ICP-MS
8	11.8	0.5	ETAAS
9	12.3	0.9	ETAAS
10	9.5	3.8	ETAAS
11			
12	11.5	5.4	ICP-AES
13	9.57	2.63	AAS
14			
15	78	34	FAAS
16	9.88	1.58	ETAAS
17	10.5	1.4	ETAAS
18	9.4	1.8	ICP-AES
19	11.2	0.3	ICP-MS
20a	12.1	0.8	ICP-AES
20b	12.2	0.4	ASV
21	10.75	0.028	ID-ICP-MS

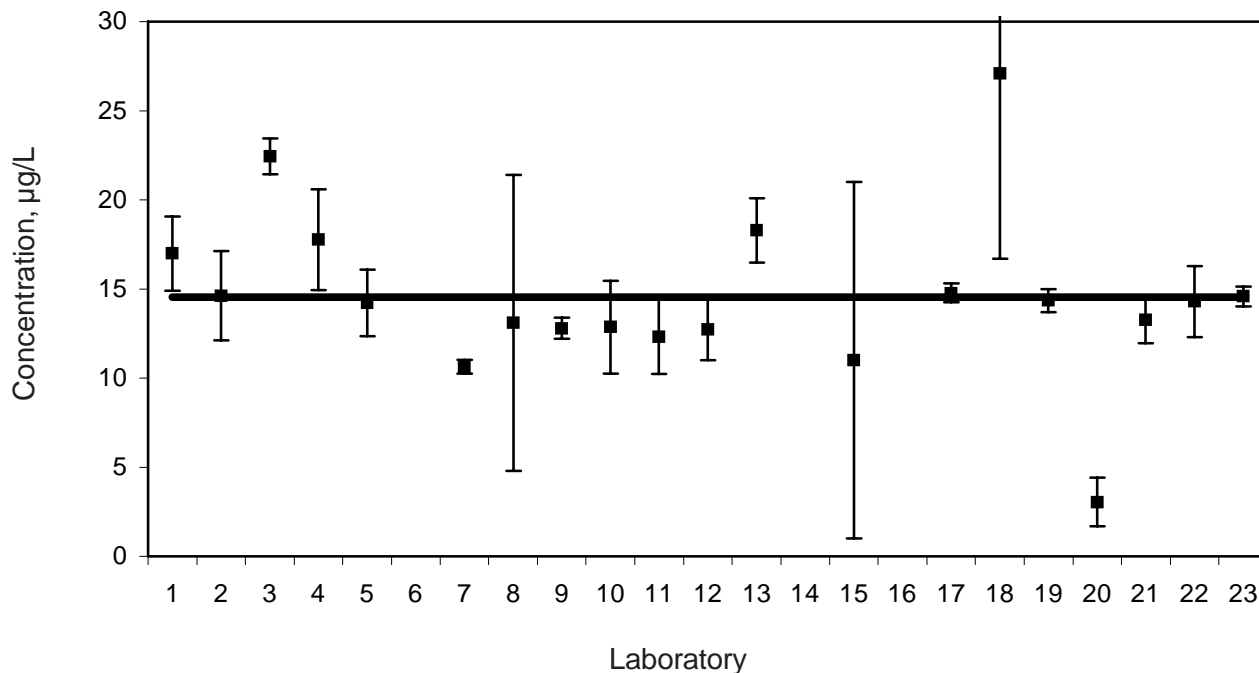
Assigned Value

A value of 10.8 µg/L was assigned to Pb in Sample A based on the ID-SF-ICP-MS results from NRCC and ID-SF-ICP-MS results from PTB.

Overall Summary	
No. of results	19
Mean*	11.1
Median*	10.8
Sample S.D.*	1.6
95% C.I.*	1.0
gravimetric	10.8

* Two results not included.

Part II Sample C



Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	17.0	2.1	ICP-AES
2	14.6	2.5	ICP-AES
3	22.44	1	ETAAS
4	17.78	2.83	ICP-AES
5	14.2	1.9	ICP-AES
6			
7	10.643	0.378	ETAAS
8	13.1	8.3	ETAAS
9	12.8	0.6	ICP-AES
10	12.9	2.6	ETAAS
11	12.3	2.1	ICP-AES
12	12.73	1.71	ETAAS
13	18.30	1.8	ETAAS
14			
15	11	10	ETAAS
16	<20		FAAS
17	14.78	0.53	HR-ICP-MS
18	27.1	10.4	ICP-AES
19	14.36	0.65	ETAAS
20	3.05	1.36	ICP-MS
21	13.3	1.3	ICP-AES
22	14.3	2.0	ETAAS
23	14.59	0.56	ICP-MS

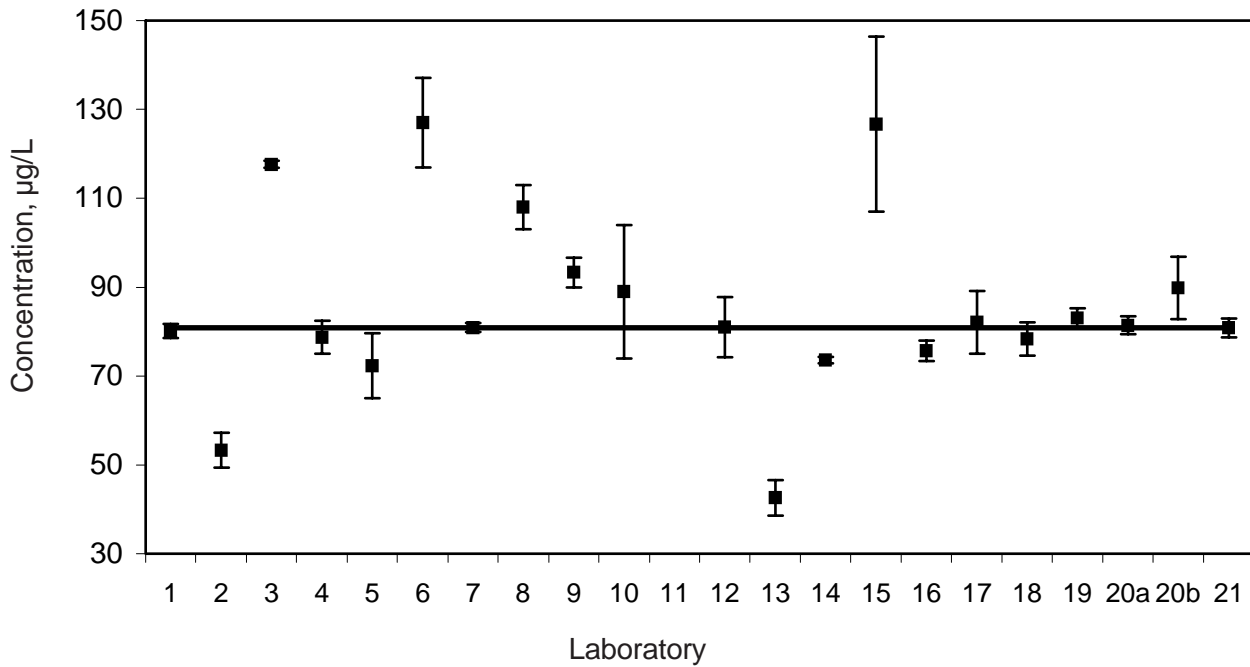
Assigned Value

A value of 14.6 µg/L was assigned to Pb in Sample C based on the gravimetric calculation.

Overall Summary	
No. of results	20
Mean	14.6
Median	14.3
Sample S.D.	4.7
95% C.I.	2.6
gravimetric	14.6

Lead

Part I Sample B



Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	80.10	1.60	ETAAS
2	53.28	3.91	ETAAS
3	117.6	0.74	ETAAS
4	78.7	3.7	ICP-AES
5	72.3	7.3	ETAAS
6	127	10	ICP-AES
7	80.9	1.0	ID-SF-ICP-MS
8	108	5	ETAAS
9	93.3	3.3	ETAAS
10	89	15	FAAS
11			
12	81.0	6.8	ICP-AES
13	42.6	4	AAS
14	73.59	0.712	ICP-AES
15	127	40	FAAS
16	75.6	2.30	ETAAS
17	82.1	7.0	ETAAS
18	78.3	3.8	ICP-AES
19	83.1	2.1	ICP-MS
20a	81.4	2.0	ICP-AES
20b	89.8	7.0	ASV
21	80.8	2.1	ID-ICP-MS

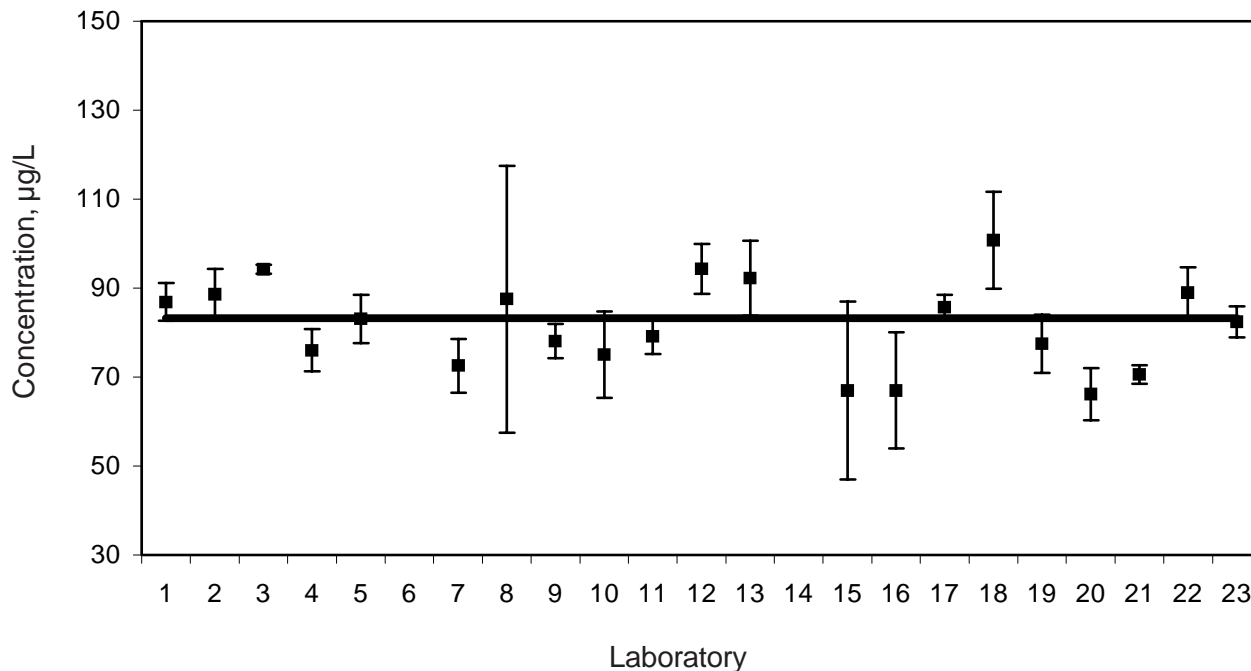
Assigned Value

A value of 80.9 µg/L was assigned to Cr in Sample A based on the ID-SF-ICP-MS results from NRCC and ID-SF-ICP-MS results from PTB.

Overall Summary

No. of results	21
Mean	85.5
Median	81.0
Sample S.D.	20.7
95% C.I.	10.9
gravimetric	80.9

Part II Sample D



Lab	Reported Value, µg/L	Uncertainty, µg/L	Technique
1	86.9	4.3	ICP-AES
2	88.6	5.8	ICP-AES
3	94.25	1	ETAAS
4	76.01	4.74	ICP-AES
5	83.1	5.4	ICP-AES
6			
7	72.533	6.002	ETAAS
8	88	30	ETAAS
9	78.1	3.9	ICP-AES
10	75.0	9.7	ETAAS
11	79.2	4.0	ICP-AES
12	94.3	5.62	ETAAS
13	92.24	8.40	ICP-AES
14			
15	67	20	ETAAS
16	67	13	FAAS
17	85.7	2.8	HR-ICP-MS
18	100.7	10.9	ICP-AES
19	77.5	6.5	ETAAS
20	66.16	5.83	ICP-MS
21	70.6	2.1	ICP-AES
22	89.0	5.7	ETAAS
23	82.34	3.50	ICP-MS

Assigned Value

A value of 83.2 µg/L was assigned to Cr in Sample D based on the gravimetric calculation.

Overall Summary	
No. of results	21
Mean	81.6
Median	82.4
Sample S.D.	9.9
95% C.I.	5.2
gravimetric	83.2

Conclusions

It is clear from Part I of this study that for a few laboratories accuracy is difficult to achieve for the analysis of trace elements in drinking water at these concentration levels. Results were generally closer to the assigned values for Part II. Only a few laboratories were able to use multiple analytical techniques; thus one might question the use of ICP-AES for some low level metal analysis or the application of ETAAS for the higher concentrations. The concept of “fit for purpose” should be given more consideration.

In a few cases, unrealistic uncertainty budgets were submitted for Part I, but many laboratories made commendable attempts to submit data based on the concept of the GUM for Part II.

References

- [1] Guide to the Expression of Uncertainty in Measurement, ISO, Geneva, 1995.
- [2] Summary of Guidelines for Canadian Drinking Water Quality (04/02), Health Canada, April 2002.
- [3] U.S. Environmental Protection Agency (EPA) National Primary Drinking Water Regulations. URL: <http://www.epa.gov/safewater.consumer/2ndstandards.html>

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CHROMIUM

Sample A

µg/L

Lab	value	U	Repeats						
1	11.37	0.24	11.31	11.28	11.51				
2	9.33	0.74	9.27	9.32	9.27	9.42	9.37	9.42	
3	11.73	0.17							
4	<2								
5	9.67	0.48	9.76	9.58					
6	12	6	11.94	11.01	12.19				
7									
8	12.6	1.1	12.2	12.4	12.5	12.8	12.9	12.9	
9	13.3	0.3	13.5	13.3	13.2				
10	13.1	2.6	14.1	12.4	12.9				
11									
12	11.3	1.5	10.9	12.2	10.9				
13									
14									
15									
16	12.7	0.848	12.79	12.50					
17	13.1	1.2	13.5	12.4	13.4				
18	14.8	1.1	14.9	14.6	15.3	13.9	15.7	14.1	
19	10.5	0.9	10.8	11.2	9.4	11.0	10.6	9.7	
20	11.0	1.0							
21	11.2	0.2	11.1	11.1	11.1	11.4	11.1	11.2	

Sample B

µg/L

Lab	value	U	Repeats						
1	82.18	2.28	82.94	81.88	81.73				
2	78.52	9.57	78.05	78.33	78.46	80.32	77.46	-	
3	101.4	1.78							
4	73.0	2.3	75	73	71				
5	71.9	0.94	74.49	69.25					
6	84	7	82.90	85.70	84.36				
7									
8	95	11	90	89	88	100	102	101	
9	88.6	3.8	87.5	90.2	88.2				
10	64.9	6.5	64.8	64.8	65.2				
11									
12	84.2	2.4	82.9	85.2	84.5				
13									
14									
15									
16	89.6	1.65	87.85	91.29					
17	93	12	86	94	98				
18	87.5	3.3	87.7	88.1	88.7	87.0	86.6	86.6	
19	75.2	3.0	71.9	79.4	74.3	71.9	79.4	74.3	
20	77.4	4.3							
21a	82.7	2.8	82.30	81.30	83.20	82.90	82.30	84.10	
21b	84.6	1.2	85.7	83.1	84.0	86.1	85.0	83.7	

CHROMIUM

Sample C

µg/L

Lab	value	U		Repeats					
1	15.3	1.1		14.1	15.7	16.2			
2	15.0	1.1		15.2	15.3	15.0	12.9	16.1	15.5
3	14.4	2							
4	15.33	1.02	U						
5	14.2	1.9		12.1	15.6	15.0			
6									
7	15.603	0.384	U						
8	14.9	1.6	U	14.8	14.7	15.1			
9	13.9	0.5	U	14.1	14.0	13.6			
10	15.35	0.42	U	15.34	15.02	15.69			
11	14.1	1.4	U	14.1	14.2	14.3	14.4	13.9	13.8
12	15.61	0.87	U	15.94	15.15	15.67	15.67		
13	10.41	0.47	U	10.19	10.76	10.01	10.58	9.96	10.95
14									
15	14	11	U	15.6	15	12.5	13.5	14.9	14.4
16	<30			<30	<30	<30			
17									
18	15.9	4.9	U	15.4	15.3	15.7	16.6	16.2	16.4
19	15.32	0.92	U	14.94	15.33	15.88	14.46	15.09	16.24
20	5.98	1.37	U	6.108	6.03	5.798			
21	11.7	1.2	U	11.8	11.7	11.7			
22	16.3	1.5		16.5	15.4	16.9			
23	15.2	4.0	U	14.5	14.7	15.4	16.0	15.6	15.1

Sample D

µg/L

Lab	value	U		Repeats					
1	100.1	1.5		98.4	100.78	101.2			
2	108.3	0.9		109.9	107.4	108.5	108.1	108.4	107.5
3	101.80	2							
4	94.57	6.01	U						
5	99.5	16.7		82.6	116	99.9			
6									
7	114.767	0.564	U						
8	95.8	5.5	U	99.0	92.3	96.2			
9	96.9	3.5	U	96.9	96.7	97.2			
10	98.8	2.7	U	98.4	100.2	97.8			
11	95.7	4.5	U	94.5	94.9	96.3	96.2	95.5	96.5
12	116.2	3.4	U	115.8	116.3	118.8	113.9		
13	116.62	3.76	U	115.32	118.82	118.19	113.95	116.76	116.69
14									
15	99	31	U	89.1	95.9	104.1	102.5	109.6	94.9
16	59	0		59	59	59			
17									
18	108.4	4.9	U	108.1	108.9	108.4	108.1	109.2	107.9
19	108.5	9.0	U	108.0	107.0	110.6	110.9	104.7	109.7
20	86.70	5.90	U	86.70	87.46	85.93			
21	77.6	1.2	U	77.5	77.6	77.7			
22	106	2		106	105	106			
23	101	3	U	100	102	101	101	101	101

IRON
Sample A
µg/L

Lab	value	U	Repeats					
1	78.24	3.08	79.68	75.78	79.26			
2	73.60	7.98	74.72	74.19	75.49	73.22	72.52	71.47
3	100.6	2.91						
4	71.0	2.3	69	71	73			
5	51.2	2.4	51.7	50.7				
6	83	11	83.13	81.6	84.39			
7								
8								
9	78.5	19.4	77.7	78.5	79.5			
10	89	22	89	89	90			
11	118.4	0.5						
12								
13								
14	103.99	0.734	110.0	97.9	106.0	105.0	105.0	
15								
16	70.0	10.6	70.0	70.0				
17	106	10	112	96	109			
18	87.1	2.9	87.2	87.5	89.3	84.1	89.4	85.0
19	nd							
20	73.0	4.8						
21	79.5	7.6	80.4	78.4	79.7	79.7	79.3	79.5

Sample B
µg/L

Lab	value	U	Repeats					
1	355.8	7.2	355.4	352.6	359.5			
2	381.85	16.92	385.21	387.12	379.13	381.05	376.75	
3	399.60	3.28						
4	330.0	5.4	335	328	327			
5	229.0	8.2	227.3	229.2				
6	393	11	392.57	392.47	396.63			
7								
8								
9	308	22	315	311	298			
10	405	40	405	405	406			
11	343.9	0.4						
12								
13								
14	377.3	0.938	398.0	399.0	369.0	367.0	385.0	
15								
16	342	11.3	342	341				
17	374	74	369	379	374			
18	391.3	5.8	388.4	394.9	392.9	383.3	400.7	387.4
19								
20	350	10						
21	371.6	9.2	374.2	369.9	372.0	372.9	369.0	371.8

IRON
Sample C
µg/L

Lab	value	U	Repeats						
1	91.2	0.6	90.7	91.0	91.8				
2	119.2	0.8	118.9	119.3	118.8	118.6	118.6	120.8	
3	120.00	3							
4	98.90	4.94	U						
5	83.8	9.2		73.4	87.3	90.8			
6									
7	82.216	0.546	U						
8	83.0	3.9	U	80.5	82.9	85.7			
9	71.7	3.1	U	70.7	71.3	73			
10	95.9	3.9	U	98.0	95.3	94.3			
11	86.3	4.0	U	85.6	86.5	88.3	85.2	85.6	86.6
12	80.8	10.0	U	74.5	76.6	87.0	85.1		
13	100.05	4.71	U	100.62	102.65	100.73	99.05	98.79	98.49
14	140	37							
15	59	32	U	59.1	55.3	57.4	60.6	61	59.6
16	58	7		51	64	58			
17									
18	95.6	7.2	U	95.5	94.8	95.8	96.0	95.6	95.9
19									
20	81.33	2.70	U	81.28	83.36	79.35			
21									
22	102	8		97.7	103	106			
23	94.1	6.0	U	93.6	93.3	94.6	94.3	93.9	95.0

Sample D
µg/L

Lab	value	U	Repeats						
1	316.7	3.1		319.7	313.5	316.8			
2	357.0	2.3		358.7	356.7	358.3	357.0	352.5	358.5
3	310.00	3							
4	302.92	11.06	U						
5	288	36		247	312	306			
6	290.4	4.2	U	293.7	289.7	287.4	285.5	294.2	291.7
7	291.76	0.546	U						
8	298	31	U	297	294	303			
9	261.3	11.4	U	261.3	259.5	263.1			
10	333	17	U	330	327	342			
11	297.4	5.3	U	295.3	297.7	298.4	296.6	297.7	298.8
12	266.6	24.0	U	255.5	256.3	275.6	278.8		
13	338.68	11.42	U	341.39	340.40	337.02	336.58	338.53	338.15
14	377	101							
15	270	30	U	271	269	271	269	268	273
16	230	0		230	230	230			
17									
18	325.0	7.3	U	323.6	322.2	321.6	330.4	324.8	327.2
19									
20	244.6	7.04	U	245.4	247.5	241.0			
21									
22	237	16		230	255	225			
23	313	8	U	312.8	314.5	314.4	312.4	312.7	312.2

NICKEL
Sample A
µg/L

Lab	value	U	Repeats					
1	19.31	0.52	19.43	19.11	19.38			
2a	19.81	2.14	19.96	19.96	19.96	20.41	19.51	19.05
2b	20.25	1.72	20.57	19.99	16.77	23.94	19.99	19.62
3	20.05	0.78						
4	19.7	0.7	19	20	20			
5	19.4	1.3	19.5	19.3				
6	24	9	24.44	24.39	24.17			
7								
8								
9								
10								
11								
12	21.9	0.6	21.8	22.3	21.7			
13								
14	21.21	0.707	22.1	21.1	21.3	21.3	20.9	
15								
16	22.9	2.11	22.88	22.82				
17	20.0	4.4	19.6	20.3	20.0			
18	28.5	2.1	27.0	30.9	28.5	27.9	29.1	27.7
19	21.1	0.4	20.7	21.2	20.6	21.3	20.8	21.7
20	18.7	1.1						
21a	22.31	0.53	22.77	22.09	22.22	22.37	22.26	22.15
21b	22.5	6.7	24.0	23.9	20.3	23.4	21.1	22.5

Sample B
µg/L

Lab	value	U	Repeats					
1	161.4	5.0	161.5	167.2	155.4			
2a	162.43	14.99	163.59	160.60	162.60	167.58	158.61	161.60
2b	160.89	17.23	162.51	159.48	162.31	159.83	160.33	
3	153.2	2.62						
4	147.0	4.7	151	147	143			
5	152.6	2.8	152.1	153.1				
6	163	8	162.44	163.06	163.39			
7								
8								
9								
10	145	44	140	153	142			
11								
12	159.7	5.0	157.3	159.6	162.2			
13								
14	144.71	0.823	136.0	138.0	148.0	152.0	144.0	
15								
16	176	26.3	177	175				
17	153	57	153	156	153			
18	167.9	5.9	168.7	167.9	171.9	164.7	168.7	165.6
19	159	2	161	160	161	158	155	157
20	146	3						
21a	166.2	4.1	164.9	164.5	167.8	168.2	166.7	165.1
21b	158.4	7.5	158	156.5	161.7	158.6	154.5	161.2

NICKEL
Sample C
µg/L

Lab	value	U		Repeats					
1	25.6	0.4		25.6	25.2	25.9			
2	26.0	3.1		23.2	28.7	24.3	22.1	28.4	29.2
3	53.00	4							
4	20.09	2.71	U						
5	24.3	0.6		24.0	23.9	24.9			
6									
7	26.33	0.377	U						
8	15.3	4.6		16.2	14.3				
9	24.2	1.1	U	23.8	24.5	24.2			
10	26.37	0.94	U	26.84	26.58	25.7			
11	25.8	2.5	U	26.0	23.7	25.8	24.7	26.5	28.0
12	22.4	1.2	U	22.01	22.25	22.49	22.61		
13	28.27	4.26	U	24.32	31.75	28.54	27.19	27.46	30.35
14									
15	35	27	U	31.9	28.8	37	37.4	37.3	34.9
16	<20			<20	<20	<20			
17									
18	28.3	6.4	U	28.9	27.5	28.1	28.0	28.5	29.1
19	25.3	1.2	U	25.1	26.4	26.3	23.8	24.9	25.3
20	11.10	1.36	U	11.14	11.17	11.0			
21	21.0	1.5	U	21.1	20.9	20.9			
22									
23	28.22	3	U	28.21	28.14	28.42	28.38	27.99	28.16

Sample D
µg/L

Lab	value	U		Repeats					
1	173.5	2.3		171.6	172.7	176.1			
2	194.5	2.5		198.7	193.1	194.0	192.7	196.2	192.3
3	209.00	4							
4	164.87	6.80	U						
5	171	9		160	177	175			
6									
7	204.1	2.03	U						
8	170.3	6.9		172.3	167.2	171.4			
9	166	7.8	U	165.5	164.6	167.9			
10	181.7	4.6	U	181.5	183.6	180.1			
11	172.7	2.9	U	172.8	174.1	174.4	175.0	168.6	171.4
12	163.7	2.5	U	157.8	162.2	168.9	165.9		
13	202.844	8.540	U	200.830	204.597	200.938	201.386	207.336	201.979
14	203	22							
15	179	25	U	176.8	176	182	180	182	175
16	135	5		140	130	135			
17									
18	189.9	6.1	U	191.1	188.1	190.8	190.1	192.4	187.2
19	178	12	U	178	172	174	184	177	181
20	165.0	6.30	U	164.8	167.1	163.1			
21	142.2	7.6	U	142	142	142.5			
22									
23	183	11	U	184	188	182	179	183	181

COPPER

Sample A
µg/L

Lab	value	U	Repeats						
1	13.29	0.32	13.59	13.06	13.21				
2	13.62	2.26	13.75	13.76	13.53	14.20	12.84	13.48	
3	9.40	0.71							
4	17.7	0.7	18	17	18				
5	13.72	0.92	13.27	14.17					
6	20	5	18.99	20.59	19.4				
7									
8									
9	18.3	4.1	17.4	16.5	20.9				
10	19.7	4.3	19.2	20.2					
11	19.9	0.2							
12	14.8	0.4	15.0	14.7	14.7				
13	14.8	1.64	15.06	14.41	14.86				
14	12.09	0.707	12.9	12.0	12.8	12.2	11.7		
15	13	2	14	12	12	14	12	11	
16	10.5	2.49	10.8	10.3					
17	13.4	1.4	14.1	13.4	12.5				
18	22.7	1.0	23.2	23.1	23.5	22.2	22.2	22.1	
19	16.7	0.3	16.8	16.7	17.0	16.6	16.3	16.9	
20	20.0	1.9							
21a	16.45	0.56	16.33	16.20	16.37	16.44	16.66	16.67	
21b	16.5	1.1	16.3	16.9	17.2	16.1	16.8	16.0	

Sample B
µg/L

Lab	value	U	Repeats						
1	162.1	2.8	161.6	159.8	164.8				
2	161.52	15.25	161.43	163.36	158.49	161.00	163.33	-	
3	171.38	3.061							
4	161.7	2.0	163	162	160				
5	156.4	8.2	161.7	151.2					
6	176	5	176.09	175.00	176.23				
7									
8									
9	149	3	150	149	149				
10	157	15	156	157	160	156	156		
11	178	1							
12	156.6	1.4	155.8	156.8	157.1				
13	126.8	19	118.85	122.60	138.85				
14	128.55	0.800	130.0	131.0	123.3	125.0	129.0		
15	141	5	144	140	141	144	142	137	
16	155	21.2	155	155					
17	170	61	168	171	170				
18	172.8	2.9	173.3	174.1	174.2	170.7	172.7	171.7	
19	161	3	161	160	161	161	160	160	
20	182	22							
21a	163.5	1.6	165.5	163.6	163.8	164.3	163.4	160.6	
21b	160.5	1.5	160.7	160.2	160.8	160.4	160.3	160.6	

COPPER

Sample C
µg/L

Lab	value	U		Repeats						
1	17.2	0.2		17.2	17.0	17.3				
2	13.1	2.8		15.4	12.0	14.8	15.0	13.1	8.1	
3	23.55	3								
4	17.13	1.79	U							
5	16.4	1.1		15.1	16.9	17.2				
6										
7	17.55	0.545	U							
8	14.4	8.8	U	16.4	12.3					
9	15.2	0.6	U	15.3	15.0	15.4				
10	14.60	0.82	U	14.71	14.50	14.59				
11	16.6	2.0	U	15.7	16.2	16.1	16.4	17.2	17.8	
12	28.3	2.46	U	27.21	29.56	28.03				
13	14.41	2.34	U	15.35	14.40	14.43	14.09	14.01	14.20	
14	29	9								
15	17	0.2		16.35	16.8	16.4	16.4	16.3	16.8	
16	17	0		17	17	17				
17										
18	17.7	6.0	U	17.4	18.7	18.8	18.4	17.1	15.9	
19	16.7	1.4	U	16.3	16.4	17.4	16.9	17.2	15.8	
20	7.55	1.36	U	7.616	7.586	7.445				
21										
22	19.6	0.4		19.8	19.1	19.8				
23	17.34	0.67	U	17.14	17.48	17.35	17.46	17.25	17.34	

Sample D
µg/L

Lab	value	U		Repeats						
1	180.6	1.0		181.3	181.1	179.5				
2	201.6	2.6		201.6	206.3	200.3	200.9	202.1	198.5	
3	196.20	3								
4	177.29	4.51	U							
5	176	17		158	190	181				
6	189.2	3.6		187.1	184.0	187.1	193.0	193.4	190.4	
7	179.41	0.545	U							
8	176	10	U	175	177					
9	169.0	6.1	U	169.0	169.0	169.1				
10	174.2	9.2	U	175.5	177.4	169.7				
11	184.7	3.8	U	185.9	185.2	183.8	183.9	186.1	183.0	
12	190.5	3.75	U	190.0	191.0	189.0	190.0	191.0	192.0	
13	204.25	13.72	U	201.74	205.21	205.54	204.21	204.34	204.47	
14	202	8								
15	183	68	U	183.2	184	182.8	182	183.1	184.5	
16	170	0		170	170	170				
17										
18	199.2	6.0	U	201.4	197.6	198.1	198.7	199.6	199.8	
19	204	13	U	189	208	187	206	225	210	
20	179.5	6.08	U	179.2	181.0	178.3				
21										
22	165	8		164	169	161				
23	185.8	6.2	U	185.6	186.4	185.3	185.8	185.8	186.2	

ZINC
Sample A
µg/L

Lab	value	U	Repeats					
1	53.87	0.92	53.47	54.02	54.13			
2	73.06	4.08	72.73	73.63	72.54	72.44	73.95	72.81
3	49.80	1.38						
4	51.3	0.7	52	51	51			
5	36.36	0.11	34.0	38.72				
6	50	6	50.81	49.99	49.30			
7	54.3	1.0						
8	57	11	55	57	56	56	58	57
9	78	9.3	80	76	77			
10	53	13	51	52	55			
11	53.7	0.8						
12	52.8	0.6	52.5	53.1	52.9			
13	26.9	1.9	26.6	26.4	27.7			
14								
15								
16	48.0	9.24	49.0	48.0				
17	48	20	49	49	47			
18	55.8	2.4	56.4	56.8	56.4	54.8	55.3	55.1
19	53.5	0.7	53.8	53.7	53.7	53.9	53.0	53.0
20	47.4	1.9						
21	51.9	0.47	51.7	51.2	52.3	52.4	52.3	51.8

Sample B
µg/L

Lab	value	U	Repeats					
1	1055	24	1052	1050	1062			
2	1151.86	34.02	1150.79	1159.22	1147.42	1155.33	1146.57	-
3	1036	9.21						
4	961.7	35.8	988	969	928			
5	729.39	1.57	687.34	771.43				
6	1130	10	1131.21	1133.72	1125.6			
7	1035	18						
8	1044	16	1036	1052	1044	1037	1050	1044
9	1111	25	1114	1113	1108			
10	1065	127	1060	1055	1080			
11	1038	2						
12	1006	14.6	997.7	1007	1012			
13	797	53	755	757	880			
14								
15								
16	1060	21.2	1050	1060				
17	1088	175	1101	1089	1075			
18	1061.3	24	1064.4	1069.4	1070.7	1050.3	1057.0	1056.0
19	1040	15	1020	1040	1050	1050	1040	1040
20	940	34						
21	1023	23	1013	1012	1024	1037	1026	1028

ZINC
Sample C
µg/L

Lab	value	U		Repeats					
1	46.4	0.3		46.1	46.3	46.7			
2	52.9	1.8		54.4	52.4	50.8	52.2	55.6	51.7
3	39.00	2							
4	43.61	4.09	U						
5	45.0	9.7		54.3	35.0	45.8			
6	48.15	0.52	U	48.82	47.87	48.07	48.38	47.98	47.80
7	40.13	5.518	U						
8	35.8	8.4	U	35.9	34.6	36.8			
9	43	2	U	42.7	43.1	43.2			
10	49	11	U	49	49	50			
11	41.3	1.9	U	40.9	41.2	42.1	41.0	41.1	41.6
12	47.3	4.79	U	48.0	48.0	47.0	46.0		
13	70.16	2.24	U	68.45	68.87	69.48	70.33	72.90	70.92
14	59	5							
15	46	2	U	47.6	46.3	43.4	46.9	46.8	43.4
16	50	2		51	48	50			
17	47.5	2.3	U	48.3	49.6	45.9	46.1	46.8	48.1
18	50.2	7.0	U	51.1	50.1	50.7	49.8	50.0	49.3
19	44	13	U	42	46	44	45	45	42
20	13.00	1.4	U	13.3	12.98	12.72			
21									
22	52	1		52	52	51			
23	44.9	7.0	U	45.2	44.5	45.1	44.8	45.1	44.4

Sample D
µg/L

Lab	value	U		Repeats					
1	947.6	10.2		938.8	945.1	958.8			
2	1078.2	8.0		1088.1	1087.2	1074.6	1067.8	1073.6	1077.9
3	944.00	2							
4	984.83	62.42	U						
5	905	34		940	903	873			
6	967.9	14.1	U	970.2	975.9	966.8	967.9	956.3	970.1
7	963.39	120.429	U						
8	946	73	U	959	932	947			
9	915.6	42.5	U	913.9	905.6	927.3			
10	960	24	U	963	954	963			
11	958	32	U	960	960	957	957	950	965
12	1020	24.7	U	1020	1010	1010	1030		
13	1104.78	28.89	U	1095.74	1106.28	1108.66	1101.80	1109.45	1106.73
14	985	17							
15	844	41	U	844	844	846	842	848	842
16	1000	0		1000	1000	1000			
17	972	29	U	977	963	977	968	976	968
18	1090.6	18.6	U	1079.2	1092.5	1098.5	1096.4	1095.5	1081.2
19	986	30	U	979	983	997	984	983	991
20	870.27	10.92	U	864.4	878.6	867.8			
21									
22	98.9	1.4		98.4	98.6	99.7			
23	971	14	U	971	978	973	968	966	969

ARSENIC

Sample A
µg/L

Lab	value	U	Repeats						
1	24.01	0.59	24.44	24.21	23.39				
2	20.66	1.52	20.62	20.42	21.22	21.22	19.82	20.62	
3	30.48	0.65							
4	22.3	2.4	24	23	20				
5	68.4	3.9	68.4	68.4					
6									
7									
8	27.8	1.2	27.6	28.0	27.8	27.9	27.7	27.8	
9	24.1	1.9	24.6	24.4	23.0				
10	27.9	7.5	29.9	25.9					
11									
12									
13									
14									
15									
16	25.2	0.778	24.56	25.81					
17	23	14	24	22	23				
18	17.4	1.5	17.8	18.0	18.6	16.6	16.7	16.5	
19									
20	32.5	0.6							
21	23.7	0.9	24.07	24.45	24.81	23.22	22.39	23.22	

Sample B
µg/L

Lab	value	U	Repeats						
1	180.9	5.6	185.37	181.37	175.81				
2	179.02	9.24	181.64	178.42	180.84	175.19			
3	176.2	0.71							
4	168.7	11.8	176	173	157				
5	425.7	23.0	427.4	423.91					
6									
7									
8	206	12	204	208	206	206	204	205	
9	201	13	203	194	206				
10	194	25	189	198					
11									
12									
13									
14	154.88	0.722	154.0	156.0	159.0	151.0	154.0		
15									
16	182	2.53	180	183.4					
17	170	70	178	163	170				
18	167.1	2.8	167.9	169.2	173.9	164.2	163.5	163.9	
19									
20	317	14							
21	175	6	170	182	184	171	171	171	

ARSENIC

Sample C
µg/L

Lab	value	U	Repeats						
1	27.6	0.3	27.6	27.9	27.4				
2	36.2	2.4	39.2	34.8	36.3	35.6	32.6	38.5	
3	9.21	1							
4	33.93	3.74	U						
5	26.2	3.8		28.3	28.4	21.8			
6	28.23	0.68	U	28.63	28.03	28.39	27.81	28.59	27.92
7	30.177	0.384	U						
8	29.3	3.0		28.0	30.5				
9	30.4	1.2	U	30.8	30.2	30.3			
10	28.7	2.8	U	28.3	29.6	28.1			
11	32.6	1.8	U	31.9	32.9	32.4	32.4	32.7	33.5
12	36.59	2.05	U	37.89	35.32	35.69	37.47		
13	37.50	1.35	U	37.02	39.25	36.39	38.42	37.51	36.40
14									
15	27	11	U	26.17	27.15	27.31	27.96	25.16	27.61
16									
17									
18									
19	24.44	0.91	U	24.14	24.24	24.30	24.87	24.53	24.53
20	24.3	1.41	U	24.28	24.63	23.99			
21	23.4	1.7	U	23.4	23.2	23.5			
22									
23	27.1	3.0	U	27.1	28.1	27.6	26.5	26.5	26.5

Sample D
µg/L

Lab	value	U	Repeats						
1	174.6	1.6	176.0	175.0	172.8				
2	196.2	5.5	196.8	200.7	190.6	191.6	204.5	193	
3	234.50	1							
4	171.63	7.84	U						
5	164	12		161	177	154			
6	175.0	4.3	U	177.9	174.7	175.2	173.4	174.7	173.8
7	168.567	0.539	U						
8	176	14		176	176				
9	179.1	6.8	U	185.1	177.6	174.6			
10	159	31	U	161	147	168			
11	163.5	9.0	U	162.2	163.8	163.8	162.8	162.9	165.2
12	170.9	7.1	U	178.8	170.5	171.6	162.8		
13	214.93	26.95	U	201.77	207.05	203.38	188.76	271.05	217.58
14									
15	184	13		209	181	181	177	180	175
16									
17									
18									
19	157.6	8.8	U	156.5	165.6	149.6	158.8	161.1	153.9
20	165.03	6.11	U	163.5	166.5	165.1			
21	139.2	4.4	U	139.0	139.5	139.0			
22									
23	175.9	7.0	U	176.9	179.8	176.2	176.5	168.1	177.6

CADMIUM

Sample A
µg/L

Lab	value	U	Repeats						
1	5.28	0.18	5.20	5.37	5.28				
2	5.27	0.42	5.13	5.28	5.30	5.36	5.34	5.21	
3	7.47	0.46							
4	4.87	0.07	4.8	4.9	4.9				
5	4.53	0.20	4.50	4.57					
6	7	7	7.09	7.14	7.15				
7	5.34	0.06							
8	5.6	0.6	5.6	5.7	5.6				
9	6.25	0.36	6.25	6.14	6.37				
10	1.30	0.14	1.27	1.32					
11									
12	5.3	0.2	5.4	5.3	5.2				
13	4.43	0.49	4.34	4.59	4.37				
14	5.10	0.707	5.2	5.2	5.1	5.2	5.4		
15									
16	5.73	0.196	5.762	5.706					
17	3.16	0.43	3.06	3.14	3.27				
18	3.5	0.9	3.6	3.5	3.4	3.6	3.6	3.3	
19	5.29	0.07	5.22	5.25	5.24	5.37	5.35	5.31	
20a	5.0	0.2							
20b	5.1	0.3							
21	5.48	0.13	5.38	5.46	5.46	5.49	5.58	5.51	

Sample B
µg/L

Lab	value	U	Repeats						
1	52.86	1.84	51.93	53.28	53.27				
2	73.44	4.33	73.68	71.75	72.18	71.75	77.73	74.32	
3	110.0	2.94							
4	51.7	1.8	53	52	50				
5	46.81	0.50	46.82	46.80					
6	53	7	52.93	52.53	53.13				
7	53.0	0.6							
8	66	9	68.4	71.0	70.0	60.9	64.2	62.5	
9	73.9	7.7	73	74	74				
10	53.4	5.3	51.2	53.5	55.6				
11	56.4	0.5							
12	53.7	0.8	53.3	53.6	54.1				
13	43.1	6.2	42.53	43.84	42.86				
14	49.36	0.709	46.9	47.2	47.7	47.8	50.6		
15									
16	55.3	1.52	55.59	55.00					
17	44	14	40	45	47				
18	49.2	3.6	49.3	49.4	49.5	49.0	49.0	48.9	
19	52.6	0.7	51.1	51.4	52.2	53.4	53.9	53.6	
20a	50.3	2.7							
20b	50.9	3.1							
21a	53.4	1.3	53.3	53.2	54.1	52.9	54.2	52.7	
21b	57.2	4.8	57.3	57.7	57.2	57.4	56.4	57.6	

CADMIUM

Sample C
µg/L

Lab	value	U	Repeats						
1	6.2	0.1	6.20	6.20	6.30				
2	7.6	1.3	7.3	7.6	8.8	7.8	8.9	5.2	
3	6.69	2							
4	5.84	0.80	U						
5	6.1	0.7		5.4	6.0	6.8			
6									
7	6.69	0.569	U						
8	7.31	0.61	U	7.27	7.89	6.78			
9	6.0	0.2	U	6.0	5.9	6.0			
10	5.93	1.1	U	5.93	5.88	5.98			
11	5.8	1.4	U	5.7	5.7	6.1	5.8	5.8	5.9
12	6.528	0.243	U	6.543	6.471	6.396	6.703		
13	7.67	0.7	U	7.65	6.31	8.40	7.15	8.07	8.42
14	13	5							
15	7	0.2		7.3	7.0	6.8	7.0	7.3	7.1
16	7	0		7	7	7			
17	6.73	0.29	U	6.69	6.81	6.67	6.73	6.82	6.67
18	6.8	4.7	U	7.0	6.6	7.0	6.5	7.3	6.5
19	6.57	0.30	U	6.38	6.51	6.46	6.62	6.74	6.71
20	12.85	1.36	U	12.86	12.98	12.72			
21	5.6	0.5	U	5.5	5.6	5.6			
22	6.23	0.07		6.23	6.26	6.19			
23	6.79	0.35	U	6.81	6.75	6.70	6.78	6.83	6.84

Sample D
µg/L

Lab	value	U	Repeats						
1	58.0	0.9	57.3	57.6	59.0				
2	68.2	1.1	69.4	69.4	66.9	68.3	68.2	66.8	
3	60.60	2							
4	53.76	2.10	U						
5	53.6	6.9		45.7	56.5	58.6			
6									
7	61.76	2.868	U						
8	71.2	3.0		68.3	75.2	70.2			
9	57.7	2.2	U	57.7	57.3	58.2			
10	53.5	5.4	U	52.2	54.1	54.2			
11	56.2	2.3	U	55.7	55.9	56.3	56.3	56.1	56.8
12	57.64	1.92	U	57.96	57.18	58.01	57.4		
13	72.87	2.90	U	72.45	72.85	74.54	71.88	72.33	73.18
14	67	12							
15	62	12	U	61.6	61.9	62.6	62.4	63.2	62.5
16	60	2		62	58	60			
17	58.3	2.2	U	59.9	56.9	57.6	58.5	58.3	58.3
18	64.8	4.6	U	64.6	64.9	64.8	65.1	64.3	64.8
19	56.9	2.4	U	56.3	56.9	56.5	57.5	57.5	56.9
20	12.26	5.85	U	11.94	12.76	12.07			
21	45.0	1.4	U	45.0	44.8	45.1			
22	73	4.6		74	70	74			
23	59.05	2.00	U	59.97	59.46	58.21	59.50	59.05	58.14

BARIUM

Sample A
µg/L

Lab	value	U	Repeats						
1									
2	146.53	10.34	145.83	149.53	145.11	146.74	145.46	146.55	
3	177.2	0.93							
4	150.7	8.7	155	155	142				
5	221.8	3.99	208.0	235.64					
6	153	12	153.47	153.76	153.16				
7	154.4	1.5							
8									
9									
10									
11									
12									
13									
14	134.04	0.708	142.0	138.0	133.0	133.0	133.1		
15									
16									
17									
18	156.9	2.5	157.4	157.5	158.0	155.3	157.5	155.7	
19	155	2	154	155	154	156	154	155	
20									
21	157.9	6.8	158.8	157.4	157.9	158.8	156.7	158.0	

Sample B
µg/L

Lab	value	U	Repeats						
1									
2	1465.12	43.22	1433.28	1503.32	1473.28	1470.59	1445.12		
3	1443	4.17							
4	1258.0	23.5	1277	1259	1238				
5	1806.2	2.81	1825.14	1781.25					
6	1456	20	1452.27	1463.6	1451.74				
7	1412	14							
8									
9									
10	1192	417	1148	1113	1315				
11									
12									
13									
14									
15									
16									
17	1294	300	1294	1229	1358				
18	1439.8	20	1442.6	1452.2	1450.0	1426.2	1434.3	1433.2	
19	1395	20	1390	1400	1390	1400	1400	1390	
20									
21	1458	13	1465	1452	1462	1458	1451	1459	

BARIUM

Sample C
µg/L

Lab	value	U		Repeats					
1									
2	177.4	1.9		178.6	175.9	176.3	175.0	179.0	179.6
3	90.63	5							
4	126.10	2.90	U						
5									
6									
7	134.863	5.525	U						
8									
9	125.7	4.7		123.0	127.1	127.1			
10									
11	134.5	4.1	U	133.4	134.6	137.2	133.8	133.3	134.7
12									
13	157.9	5.9	U	157.10	157.4	157.5	158.3	159.7	157.2
14									
15	135	1		136	135	133	134	135	136
16									
17									
18	145.7	14.6	U	147.4	144.8	144.2	148.2	144.8	144.8
19									
20	118.73	3.06	U	117	121.4	117.8			
21									
22									
23	146	2	U	145	145	148	147	147	147

Sample D
µg/L

Lab	value	U		Repeats					
1									
2	1442.9	36.9		1462.2	1390.7	1403.8	1458.1	1458.1	1484.2
3	1164.60	5							
4	1251.7	67.66	U						
5									
6									
7	1269.167	150.1139	U						
8	1416	160		1517	1315				
9	1178	44	U	1177	1169	1187			
10									
11	1230	30	U	1226	1230	1232	1232	1229	1232
12									
13	1407.54	38.07		1402.07	1398.84	1419.16	1399.64	1395.10	1430.43
14									
15	1112	278	U	1124	1119	1090	1121	1105	1115
16									
17									
18	1381.4	19.9	U	1378.2	1388.8	1377.1	1387.4	1373.6	1383.3
19	1287	230	U	1300	1240	1310	1320	1230	1320
20	1306	11	U	1303	1313	1301			
21									
22									
23	1291	17	U	1291	1302	1295	1288	1287	1285

**LEAD
Sample A
µg/L**

Lab	value	U	Repeats						
1	10.37	0.22	10.65	10.27	10.20				
2	12.32	0.77	11.39	12.98	12.98	13.78	10.60	12.19	
3	15.26	0.74							
4	<15								
5	8.59	0.55	8.68	8.50					
6	56	10	57.49	56.68	55.34				
7	10.82	0.13							
8	11.8	0.5	11.8	11.7	11.8	11.4	12.2	11.9	
9	12.3	0.9	12.7	12.2	11.8				
10	9.5	3.8	9.2	10.4	8.8				
11									
12	11.5	5.4	8.9	11.3	14.3				
13	9.57	2.63	8.65	9.52	10.54				
14									
15	78	17	100	60	90	70	90	60	
16	9.88	1.58	9.553	10.20					
17	10.5	1.4	10.6	10.5	10.5				
18	9.4	1.8	9.0	12.1	10.5	8.9	8.1	7.7	
19	11.2	0.3	11.1	11.2	11.7	11.0	11.0	11.2	
20a	12.1	0.8							
20b	12.2	0.4							
21	10.75	0.028	10.72	10.74	10.76	10.76	10.79	10.72	

**Sample B
µg/L**

Lab	value	U	Repeats						
1	80.10	1.60	79.98	81.45	78.85				
2	53.28	3.91	52.81	52.81	52.25	53.65	53.93	54.21	
3	117.6	0.74							
4	78.7	3.7	80	81	75				
5	72.3	7.3	75.8	69.8					
6	127	10	125.92	124.66	129.59				
7	80.9	1.0							
8	108	5	107	113	110	110	104	107	
9	93.3	3.3	94.21	92.80	92.93				
10	89	15	89	89	89				
11									
12	81.0	6.8	77.1	83.0	82.9				
13	42.6	4	41.04	43.82	42.96				
14	73.59	0.712	72.4	71.4	74.6	73.2	75.5		
15	127	20	100	160	120	130	130	120	
16	75.6	2.30	76.15	75.08					
17	82.1	7.0	81.2	80.9	84.3				
18	78.3	3.8	79.0	78.0	77.5	78.1	78.4	78.9	
19	83.1	2.1	81.4	86.0	82.9	82.3	82.3	83.5	
20a	81.4	2.0							
20b	89.8	7.0							
21	80.8	2.1	81.08	80.59	81.00	80.73	80.73	80.42	

LEAD
Sample C
µg/L

Lab	value	U		Repeats					
1	17.0	2.1		18.4	14.6	18.0			
2	14.6	2.5		12.6	16.0	16.1	10.5	15.9	16.7
3	22.44	1							
4	17.78	2.83	U						
5	14.2	1.9		12.1	15.6	15.0			
6									
7	10.643	0.378	U						
8	13.1	8.3		11.5	14.7				
9	12.8	0.6		13.2	12.6	12.6			
10	12.9	2.6		13.3	14.4	10.9			
11	12.3	2.1	U	12.8	12.3	12.7	12.0	12.2	12.0
12	12.73	1.71	U	12.23	13.22	12.73	12.73		
13	18.30	1.8	U	16.55	15.89	18.05	23.05	18.77	17.46
14									
15	11	10	U	11.4	11	10.6	10.4	10.6	10.1
16	<20			<20	<20	<20			
17	14.78	0.53	U	14.78	14.74	14.82	14.78	14.8	14.78
18	27.1	10.4	U	22.7	24.4	27.0	26.7	32.7	29.1
19	14.36	0.65	U	14.38	14.83	13.92	14.39	14.47	14.17
20	3.05	1.36	U	3.161	3.015	2.98			
21	13.3	1.3	U	13.1	13.4	13.3			
22	14.3	2.0		14.6	13	15.3			
23	14.59	0.56	U	14.61	14.58	14.69	14.48	14.64	14.55

Sample D
µg/L

Lab	value	U		Repeats					
1	86.9	4.3		83.0	86.2	91.5			
2	88.6	5.8		94.9	93.4	86.8	81.1	83.0	92.3
3	94.25	1							
4	76.01	4.74	U						
5	83.1	5.4		82.1	88.9	78.2			
6									
7	72.533	6.002	U						
8	88	30		90	85				
9	78.1	3.9		77.0	76.5	80.7			
10	75.0	9.7		76.5	73.9	74.7			
11	79.2	4.0	U	78.4	79.6	79.2	79.2	79.3	79.3
12	94.3	5.62	U	100.5	92.16	90.15	94.44		
13	92.24	8.40	U	83.90	100.94	94.63	96.04	85.58	92.32
14									
15	67	20	U	64.2	65.6	67.6	68.9	68.6	68.3
16	67	13		80	54	67			
17	85.7	2.8	U	84.9	86.4	85.4	86.0	85.4	85.9
18	100.7	10.9	U	99.0	98.7	103.3	101.0	103.6	98.8
19	77.5	6.5		76.8	78.2	71.4	79.7	81.7	77.1
20	66.16	5.83	U	66.26	66.03	66.2			
21	70.6	2.1	U	70.4	70.7	70.6			
22	89.0	5.7		88.6	86.3	92			
23	82.34	3.50	U	82.72	82.20	82.64	81.98	82.61	81.89

