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ECOSYSTEM INTERLABORATORY QA PROGRAM
STUDY FP76 - TRACE ELEMENTS IN SURFACE WATERS
(MARCH & APRIL 2000)

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NLET-TN00-005

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NLET-TN00-005

Ecosystem Interlaboratory Quality Assurance Program Study FP 76 - Final Report

March and April, 2000

An Interlaboratory Quality Assurance Study for Trace Metals/Elements in Surface Waters *

by

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Management Perspective

Quality assured analytical results are critical when transforming environmental analytical data into useful scientific advice. In the area of water analysis, the NLET branch of NWRI provides a variety of QA products and services geared to assisting EC labs provide quality assured analytical results. One of the most valuable QA services provided is the interlaboratory performance evaluation (PE) studies. The PE studies conducted by NLET fill a parameter and concentration gap not covered by any other PE or proficiency testing (PT) program. Participant labs find the NLET PE studies very useful to improve the quality of their analytical processes, while project leaders use the results of these studies to enable them to better compare data generated from different laboratories, in both the private and public sector. These studies are provided to EC laboratories, affiliate institutions in Canada and the US, and other public and private laboratories for a cost recovery fee.

The PE studies are created using many water types of natural waters and their associated parameter groups as the raw material. The availability of so many different water types in Canada is ideally suited to the preparation of test samples spanning the complete range of available water matrices. Waters range from very soft natural rainwaters, to soft waters found in Ontario, Quebec and British Columbia and to hard surface waters found in the Prairies and Canadian groundwaters. The chemical composition of the natural waters are diverse, and include 50 different parameters for nutrients, minerals and trace elements. Special studies are provided for Total Phosphorus and ambient Mercury.

Evaluations of laboratory performance are timely and complete. Laboratories receive a preliminary report which discloses systematic bias and precision. The final reports, which are also scheduled, provide a complete listing of current and historical performance. Individual performance appraisals indicate areas and parameters where remedial action is required to improve performance. In this way, the PE studies are effective for improved performance of laboratories.

Methodologies and approaches in analytical laboratories change as research and monitoring programs evolve. The PE studies, while large in terms of the number of laboratories being assessed, are flexible enough to respond to these changing requirements. Feedback from laboratories is solicited and assessed on a regular basis, and changes to the studies are implemented to meet these new needs. One recent example of this change is the development of a customised PE study to assess trace elements in natural sediments for the Metals in the Environment (MITE) Program being conducted by Canadian universities. This study is being added to the PE program in the 2000-01 fiscal year.

Perspective de gestion

Il est crucial de disposer de résultats d'analyse ayant subi une assurance de la qualité (AQ) lorsqu'on transforme des données analytiques environnementales en conseils scientifiques utiles. Dans le domaine de l'analyse de l'eau, le LNEE de l'INRE offre une gamme de produits et de services AQ visant à aider les laboratoires d'EC à produire des données d'analyse dont la qualité est assurée. Parmi les services AQ les plus valables figurent les études d'évaluation de la performance (EP) interlaboratoires. Les études EP réalisées par le LNEE comblent une lacune. Aucun autre programme EP ou de vérification de la compétence (VC) n'avait permis de recueillir des données sur les paramètres et les concentrations. Les laboratoires participants estiment que les études EP du LNEE sont très utiles pour améliorer la qualité de leurs processus d'analyse. Les chefs de projet utilisent les résultats de ces études pour les aider à comparer des données provenant de laboratoires différents, privés ou publics. Ces études sont en effet réalisées pour des laboratoires d'EC, des institutions affiliées du Canada et des États-Unis et d'autres laboratoires publics et privés selon la formule de recouvrement des coûts.

Pour les études EP, on utilise comme échantillons bruts de nombreux types d'eau naturelle et leurs paramètres associés. Le grand nombre de types d'eau qui existent au Canada permet de préparer suffisamment d'échantillons d'essai pour couvrir l'éventail complet des matrices d'eau disponibles, allant des eaux de pluie naturelles très douces que l'on trouve en Ontario, au Québec et en Colombie-Britannique aux eaux superficielles dures des Prairies et aux eaux souterraines. La composition chimique des eaux naturelles varie et comporte 50 paramètres différents sur les nutriments, les minéraux et les éléments traces. Des études spéciales portent sur le phosphore total et le mercure ambiant.

Les évaluations de la performance des laboratoires sont exécutées au moment opportun et de façon exhaustive. Les laboratoires reçoivent un rapport provisoire indiquant le biais systématique et le niveau de précision. Les rapports finaux, dont la date de livraison est également fixée, contiennent toutes les données sur la performance tant actuelle qu'antérieure. Les évaluations individuelles de la performance indiquent les secteurs et les paramètres envers lesquels il faut prendre des mesures correctives pour améliorer la performance. Les études EP s'avèrent ainsi efficaces pour améliorer la performance des laboratoires.

À mesure que les programmes de recherche et de suivi évoluent, les méthodologies et les approches utilisées par les laboratoires d'analyse se transforment. Les études EP, bien que vastes, compte tenu du nombre de laboratoires évalués, sont suffisamment souples pour tenir compte des changements. Pour ce faire, on invite régulièrement les laboratoires à communiquer leurs commentaires et on s'en sert pour modifier les études. À titre d'exemple de changement, mentionnons la conception sur mesure d'une étude EP pour évaluer les éléments traces dans les sédiments naturels aux fins du programme Métaux dans l'environnement mis en oeuvre par des universités canadiennes. Cette étude s'ajoute au programme EP au cours de l'année financière 2000-2001.

Abstract

Interlaboratory performance evaluation studies are an important part of assuring the accuracy and integrity of analytic results. NLET provides these PE studies as part of its mandate. The branch provides this service to all EC laboratories and to many affiliated institutions in Canada and the US. Such a wide range of institutions and laboratories, in turn, provides a diversity of data which gives greater credibility to data analysis and laboratory performance statements.

Evaluation of the analytic results is the most visible aspect of PE studies. All results are evaluated for the two important aspects of data - systematic bias and precision. The former is extremely important for comparability of data sets from different origins and the latter, precision, is a measure of the reliability of the data. For the NLET PE studies, systematic bias is tested with the non-parametric method of Youden, and precision is tested against precision functions developed by the quality assurance staff. Both evaluations are totalled to give a performance rating for each laboratory.

Performance ratings for laboratories are given in relative terms. Laboratories are ranked from the best performance to the lowest (the least flagged results to the most flagged). In real terms, good laboratories have few flagged results and the laboratories with poor performance may have half their results flagged. These results are summarised in individual laboratory appraisals which are sent to the lab managers in a timely, expedient manner. This objective, third party performance rating is valued by the laboratory managers and data users alike.

Evaluations include historical listings of performance. With these historical listings laboratories may track their previous performance and see the effectiveness of their remedial action. This unique and highly developed tool helps many laboratories generate more reliable and accurate data.

Résumé

Les études d'évaluation de la performance (EP) interlaboratoires constituent un volet important de l'assurance de l'exactitude et de l'intégrité des résultats d'analyse. Dans le cadre de son mandat, le LNEE offre ce service à tous les laboratoires d'EC et à ses nombreuses institutions affiliées du Canada et des États-Unis. En raison de leur grand nombre, ces institutions et laboratoires fournissent en contrepartie des données diversifiées qui ajoutent à la crédibilité des analyses et des énoncés sur la performance des laboratoires.

L'évaluation des données d'analyse est l'aspect le plus visible des études EP. Elle porte sur deux aspects importants – le biais systématique et la précision. Le premier aspect est essentiel à la comparaison d'ensembles de données de sources différentes; le second aspect permet de mesurer le degré de fiabilité des données. Aux fins des études EP du LNEE, on teste le biais systématique par la méthode non paramétrique de Youden, et la précision, au moyen de fonctions sur la précision mises au point par le personnel chargé de l'assurance de la qualité. Les deux évaluations sont combinées pour coter la performance de chaque laboratoire.

La performance des laboratoires est cotée en termes relatifs. Les laboratoires sont classés du plus performant au moins performant. En termes réels, les laboratoires performants ont un faible nombre de résultats marqués tandis que les laboratoires peu performants peuvent avoir la moitié de leurs résultats marqués. Les évaluations remises dans un délai raisonnable aux gestionnaires de laboratoire contiennent un résumé des données. Cette évaluation objective par une tierce partie est utile tant pour les gestionnaires que pour les utilisateurs des données.

Comme les évaluations contiennent des données sur les performances antérieures, les laboratoires peuvent comparer leur performance avant et après la prise de mesures correctives. Cet outil exceptionnel et perfectionné aide nombre de laboratoires à produire des données plus fiables et plus exactes.

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NWRI Interlaboratory Quality Assurance Studies

NWRI's interlaboratory quality assurance (QA) studies support a core group of government labs and various environmental programs. The QA program also addresses health issues such as, toxic metal (lead, manganese and mercury) contamination of drinking water. US government agencies as well as the Canadian Metals in the Environment (MITE) program participate in the semi-annual studies along with many global participants. More than 200 labs are invited to participate, with approximately 60 labs completing analyses of the various study matrices.

The primary feature of these studies is the quality of data produced by the participating labs. Lab performance is ranked in terms of the number of biased parameters (systematic bias) and flagged results (precision measurement). The reports produced from the client data provide a powerful tool for the diagnosis of problem areas within labs, as well participation quantifies lab performance and data quality.

These NWRI studies are an independent client driven QA service. The QA staff appreciates receiving questions and consults on all aspects of the program. In this study there were several inquiries regarding the flagging process and its validity. Over the years, the Institute has developed elaborate and comprehensive criteria which evaluates data for systemic bias and precision. These indicators are, we feel, superior to others currently in use (i.e. Z-scores), and these criteria take advantage of our diverse natural samples used in each study. For more information on flagging, see Appendix A.

NWRI studies run on a voluntary and cost recovery basis, which leads to ongoing interest in study design and sample requirements by lab and program managers. Proposals for contract specialised studies are welcomed.

Table 1 List of participating[†] laboratories in trace elements in surface waters study FP 76 (March & April, 2000).

ALS Chemex
Analytical Service Laboratories
Battelle Marine Sciences Lab
Carleton University - Department of Chemistry
City of Calgary
Environment Canada - ECS, Atlantic
Environment Canada - EPL, Prairie and Northern
Environment Canada - NWRI, NLET
Environment Canada - PESC
Enviro-Test Laboratories
EPCOR Water Services
Frontier Geosciences Inc.
Laboratoire de Santé Publique du Québec
Laurentian University - Elliot Lake Research Field Station
Maxxam Analytics Inc.
McGill University - Natural Resource Sciences
McMaster University - Department of Biology
Ministère de l'Environnement et de la Faune du Québec - Laval
Ministère de l'Environnement et de la Faune du Québec - Sainte-Foy
Natural Resources Canada - CFS, Atlantic
Natural Resources Canada - CFS, Ontario
Natural Resources Canada - GSC
New Brunswick Department of the Environment
Ontario Ministry of the Environment - Etobicoke
Ontario Ministry of Northern Development and Mines - Geosciences Lab
Ontario Power Technologies
Petroleo Brasileiro S.A.
Philip Analytical Services
Saskatchewan Research Council
TAIGA Environmental Lab
US GS - NWQL
Université du Québec - INRS - Eau
University of Maine - WRI
University of Maryland - Centre for Environmental Science
University of Waterloo - Department of Biology

[†] Lab select their routine parameters for this study.

Table 2 Laboratory Performance Scores Study 76 Trace Elements

	SYSTEMATIC BIAS			FLAGGED RESULTS			
LAB CODE	# ANALYZED PARAMETERS	#BIASES	% BIASED PARAMETERS	# RESULTS RANKED	# FLAGS ASSIGNED	% RESULTS FLAGGED	AVE. BIAS & FLAGS (%)
F163	7	0	0.00	69	0	0.00	0.00
F038	23	0	0.00	211	2	0.95	0.47
F065	21	0	0.00	205	6	2.93	1.46
F032b	15	0	0.00	150	6	4.00	2.00
F003	21	1	4.76	206	1	0.49	2.62
F010	20	0	0.00	184	14	7.61	3.80
F131	8	0	0.00	77	6	7.79	3.90
F011	23	1	4.35	208	12	5.77	5.06
F167	3	0	0.00	30	4	13.33	6.67
F169	5	0	0.00	45	6	13.33	6.67
F069	21	2	9.52	168	7	4.17	6.85
F002	18	0	0.00	172	25	14.53	7.27
F048	22	2	9.09	179	13	7.26	8.18
F014	16	2	12.50	132	8	6.06	9.28
F025	22	1	4.55	187	30	16.04	10.29
F133	23	2	8.70	212	30	14.15	11.42
F139	10	0	0.00	68	16	23.53	11.76
F009	19	3	15.79	183	15	8.20	11.99
F031	12	1	8.33	110	19	17.27	12.80
F096	23	5	21.74	197	15	7.61	14.68
F032a	19	4	21.05	165	14	8.48	14.77
F015	19	4	21.05	181	17	9.39	15.22
F024	18	2	11.11	143	33	23.08	17.09
F037	13	2	15.38	129	25	19.38	17.38
F168	2	0	0.00	19	7	36.84	18.42
F094	23	6	26.09	210	27	12.86	19.47
F026	8	1	12.50	70	19	27.14	19.82
F019	16	3	18.75	121	26	21.49	20.12
F012	22	1	4.55	168	65	38.69	21.62
F042	15	4	26.67	123	21	17.07	21.87
F022	20	3	15.00	155	53	34.19	24.60
F162	5	2	40.00	41	7	17.07	28.54
F138	21	9	42.86	210	42	20.00	31.43
F159	21	6	28.57	172	63	36.63	32.60
F064	23	16	69.57	222	90	40.54	55.05

Laboratory parameters are selected from:

Al	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	As	Sr	Mo	Ag	Cd
Sb	Ba	Pb	Be	Se	U	Li	Tl	Bi					

Table 3

Summary of Study-to-Study Performance
Trace Elements

% BIASED PARAMETERS & FLAGGED RESULTS ON STUDIES

LAB	0067	0068	0069	0070	0071	0072	0073	0074	0075	0076	MEDIAN	COMMENTS
F002	5.7	0.0	1.4	0.6	0.0	0.6	0.0	1.2	16.4	7.3	0.9	GOOD
F003	6.1	7.8	0.7	1.2	3.1	5.4	3.1	19.5	1.9	2.6	3.1	GOOD
F009	24.7	30.9	10.8	22.2	26.4	16.2	49.4	31.9	6.6	12.0	23.5	MODERATE
F010	25.0	12.5	-	20.2	9.6	19.7	10.3	12.1	9.0	3.8	12.1	SATISFACTORY
F011	7.3	3.7	22.7	14.0	10.0	15.8	5.0	4.5	33.2	5.1	8.7	SATISFACTORY
F012	-	20.6	26.2	28.0	25.1	20.5	53.9	43.0	54.3	21.6	26.2	MODERATE
F013	2.6	3.1	4.8	13.1	9.1	-	-	-	-	-	4.8	GOOD
F014	27.3	26.9	30.9	9.6	19.0	15.1	14.0	2.1	1.4	9.3	14.6	MODERATE
F015	9.9	1.9	5.9	7.0	11.0	6.4	11.7	7.4	13.5	15.2	8.6	SATISFACTORY
F019	20.7	26.6	13.3	14.2	6.8	7.7	10.6	10.4	24.1	20.1	13.8	MODERATE
F022	-	28.2	-	-	34.3	12.6	-	21.7	10.2	24.6	23.1	MODERATE
F024	9.6	10.5	14.4	8.1	16.2	18.1	9.7	9.5	26.5	17.1	12.5	SATISFACTORY
F025	-	-	-	59.0	24.0	51.9	27.1	30.9	80.9	10.3	30.9	POOR
F026	35.5	14.7	28.5	22.2	13.6	8.1	27.2	23.4	52.6	19.8	22.8	MODERATE
F031	29.0	28.3	32.3	32.8	48.6	32.5	40.2	29.8	18.5	12.8	31.1	POOR
F032	1.4	9.4	13.0	3.1	21.8	5.5	1.7	52.9	22.1	-	9.4	SATISFACTORY
F032a	-	-	-	-	-	-	-	-	-	14.8	-	
F032b	-	5.7	-	-	10.6	7.2	5.2	16.7	23.0	2.0	7.2	SATISFACTORY
F037	20.5	17.0	41.7	25.9	18.7	26.2	36.4	22.9	13.9	17.4	21.7	MODERATE
F038	9.7	4.0	5.4	5.3	4.2	4.2	1.9	3.2	3.7	0.5	4.1	GOOD
F042	0.0	-	-	-	-	-	-	18.1	6.9	21.9	12.5	SATISFACTORY
F048	2.8	5.2	31.2	11.0	1.9	13.0	22.8	21.8	22.1	8.2	12.0	SATISFACTORY
F064	-	21.5	-	-	-	42.6	-	-	-	55.1	42.6	POOR
F065	-	-	6.4	-	-	-	-	-	-	1.5	3.9	GOOD
F069	17.1	11.4	1.0	3.7	-	2.8	-	-	5.0	6.8	5.0	SATISFACTORY
F094	45.8	37.3	4.8	6.5	9.8	14.0	11.6	16.6	9.9	19.5	12.8	MODERATE
F096	-	32.2	-	7.4	10.5	17.3	4.6	9.7	13.0	14.7	11.7	SATISFACTORY
F131	-	-	-	-	25.7	-	46.0	-	-	3.9	25.7	MODERATE
F133	-	-	-	54.2	17.0	10.1	15.4	35.2	23.8	11.4	17.0	MODERATE
F138	-	-	-	20.0	3.6	-	20.5	5.0	30.2	31.4	20.2	MODERATE
F139	-	-	-	-	-	43.1	40.2	29.0	22.3	11.8	29.0	MODERATE
F159	-	-	-	-	-	-	-	-	30.6	32.6	31.6	POOR
F162	-	-	-	-	-	-	-	-	3.3	28.5	15.9	MODERATE
F163	-	-	-	-	-	-	-	-	23.4	0.0	11.7	SATISFACTORY
F166	-	-	-	-	-	-	-	-	3.6	-	-	
F167	-	-	-	-	-	-	-	-	13.3	6.7	10.0	SATISFACTORY
F168	-	-	-	-	-	-	-	-	53.9	18.4	36.2	POOR
F169	-	-	-	-	-	-	-	-	6.9	6.7	6.8	SATISFACTORY

INTERLAB	0067	0068	0069	0070	0071	0072	0073	0074	0075	0076
MEDIAN	9.9	12.5	13.3	14.2	13.6	15.5	15.4	18.1	16.4	12.0

STUDY DATES: 0067(05-JUL-1995), 0068(01-MAR-1996), 0069(01-SEP-1996), 0070(03-MAR-1997), 0071(02-SEP-1997), 0072(02-MAR-1998), 0073(01-SEP-1998), 0074(01-MAR-1999), 0075(01-SEP-1999), 0076(01-MAR-2000).

Table 4 Sample design for the trace elements in water FP 76

Sample Number	Sample Name	Expected Copper concentration (µg/L)
FP76 TM-1	TMRain-95	6.2
FP76 TM-2	TM-24	7.5
FP76 TM-3	TM-27	36.3
FP76 TM-4	TM-LnglkeB	36.8
FP76 TM-5	TM-15	18.4
FP76 TM-6	TM-25.2	27.7
FP76 TM-7	TM-DWS	179
FP76 TM-8	TMDA-62	105
FP76 TM-9	TMDA-51	65.2
FP76 TM-10	TMDA-65	386

Table 5 **Summary of Interlaboratory Median Values for Trace Elements - Study 76**

PARAMETER		TMRAIN-95 Sample 1	TM-24 Sample 2	TM-27 Sample 3	TM-LNGLKEB Sample 4	TM-15 Sample 5
Aluminum	µg/L	1.8540	21.150	66.460	14.208	22.000
Antimony	µg/L	0.3650	14.800	3.1300	0.1090	15.900
Arsenic	µg/L	1.1000	2.8000	2.2700	0.7000	14.700
Barium	µg/L	0.7250	9.0000	8.3905	21.000	13.300
Beryllium	µg/L	0.2500	1.5600	1.0300	-	15.200
Bismuth	µg/L	0.7000	2.8155	2.2800	-	16.350
Cadmium	µg/L	0.4800	12.660	0.9000	0.1200	13.050
Chromium	µg/L	0.9000	5.5000	2.6335	0.3000	17.300
Cobalt	µg/L	0.2110	19.000	3.9492	0.0889	15.220
Copper	µg/L	6.2000	7.5050	36.000	36.900	18.100
Iron	µg/L	23.600	6.0000	53.600	117.00	25.490
Lead	µg/L	0.2600	7.3000	4.7700	4.0400	11.790
Lithium	µg/L	0.3695	4.1400	4.0000	0.6180	14.240
Manganese	µg/L	6.0750	2.8825	2.6200	15.430	18.200
Molybdenum	µg/L	0.2000	3.6300	2.2900	0.1830	13.500
Nickel	µg/L	0.7675	3.2000	2.6000	107.00	18.300
Selenium	µg/L	0.7000	3.4000	4.0600	0.8000	14.633
Silver	µg/L	0.2600	0.3200	0.8380	0.1000	12.000
Strontium	µg/L	1.6500	108.10	49.000	58.400	71.300
Thallium	µg/L	0.3290	0.0210	0.0260	-	17.400
Uranium	µg/L	0.2550	0.0900	2.9800	0.1350	14.700
Vanadium	µg/L	0.6692	6.7288	0.6000	0.2985	12.536
Zinc	µg/L	12.000	14.200	22.315	7.8500	22.650

		TM-25.2 Sample 6	TM-DWS Sample 7	TMDA-62 Sample 8	TMDA-51 Sample 9	TMDA-65 Sample 10
Aluminum	µg/L	25.000	158.00	92.240	85.500	361.50
Antimony	µg/L	24.250	16.900	58.250	14.020	195.00
Arsenic	µg/L	28.320	72.000	51.300	15.000	194.00
Barium	µg/L	26.800	149.00	115.00	78.700	399.00
Beryllium	µg/L	25.200	11.795	54.000	25.000	184.003
Bismuth	µg/L	24.845	14.900	52.515	6.2540	170.428
Cadmium	µg/L	23.595	14.000	88.795	34.900	302.00
Chromium	µg/L	24.200	94.000	92.100	60.000	398.00
Cobalt	µg/L	28.100	65.300	99.150	73.850	384.80
Copper	µg/L	27.600	178.00	104.789	65.615	389.00
Iron	µg/L	29.500	339.216	120.00	149.40	406.09
Lead	µg/L	27.400	34.100	97.650	65.506	417.25
Lithium	µg/L	25.200	20.000	57.800	15.270	181.96
Manganese	µg/L	25.200	87.005	102.941	35.000	403.30
Molybdenum	µg/L	29.000	69.150	98.005	95.000	387.24
Nickel	µg/L	15.455	79.400	97.000	82.700	390.00
Selenium	µg/L	28.000	30.600	48.470	9.6000	190.50
Silver	µg/L	22.300	14.450	11.300	17.200	24.000
Strontium	µg/L	69.400	327.00	118.00	121.967	390.00
Thallium	µg/L	29.750	8.3950	50.200	0.0840	199.11
Uranium	µg/L	27.510	136.00	52.000	31.300	207.38
Vanadium	µg/L	26.000	45.000	107.50	81.150	369.30
Zinc	µg/L	35.050	373.00	108.10	92.720	378.00

Appendix A

GLOSSARY OF TERMS

Used for the Evaluation of Interlaboratory Results

Acceptable Deviation: The absolute value of the maximum difference between a result and the target value that will not be flagged.

Bias: Results for a parameter are assessed to be biased by the procedure of Youden when they are consistently ranked to be either higher or lower than the median result. In these interlaboratory studies, for most parameters, a bias of greater than 5% is considered to be excessive. Biases of less than 5% are noted for caution and investigation.

Bias Blank: In the graph for bias % slope, the y-intercept for the laboratory results indicates a systematic blank of analysis. This is the second component of bias.

Bias % Slope: When laboratory results for a parameter are plotted against the target values, the slope as compared to the ideal results (no bias) is considered to be the major component of the degree of bias. For an explanation of Bias % Slope see the following explanation in "Quantifying Bias in NWRI QA Studies".

Erratic: Results for a parameter are evaluated as erratic when both high and low flags are assigned.

Flagged Result: A result is flagged when its value is beyond that of the median (target value) plus or minus the acceptable difference.

Isolated Outlier: A parameter analysis that performs satisfactorily but produces an extreme result. (formerly, 'out of control')

Satisfactory: Fully acceptable, 'good results'.

'W' or 'T' Code: A 'W' or 'T' code may be used with a reported result as described in ASTM. However, in the NWRI QA studies, these codes may result in flagging discrepancies. "Less than" values or negative results are also legitimate when reporting the results. Laboratories should use their usual data reporting protocols insofar as they are compatible with the other laboratories.

The following three terms define the acceptable differences from the median of results (**target value**) that is allowed without a result being flagged either low or high:

- **LLBAE:** Lower Limit for Use of Basic Acceptable Error,
- **BAE:** Basic Acceptable Error, and
- **CEI:** Concentration Error Increment.

In general, the values chosen for the **basic acceptable error** and the **concentration error increment** are selected so that good precision may be inferred. Historically, for the Federal-Provincial QA Program, for moderate ranges, this has been achieved with the 10% Deviation Rule. These values are open to change with the effort to improve data assessment and in return; the quality of data submitted.

For a sample whose **target value** is at or below the **lower limit for use of basic acceptable error**, the **basic acceptable error** is used to determine the range of acceptable deviations.

> For example: If the **lower limit for use of the basic acceptable error** has been set as 10 mg/L, the **basic acceptable error** is 1.0 mg/L and the **target** (median) **value** for a sample is 5 mg/L, then any **reported result** within the range 5 ± 1.0 or 4.0 to 6.0 mg/L would be considered acceptable. The **BAE** would define the acceptable result within the 0-10 mg/L range.

For results above the **lower limit for use of basic acceptable error**, an allowance is made for the increased variability due to concentration. This allowance is added to the **basic acceptable error** and is calculated by multiplying the **concentration error increment** (as a percentage) by the difference between the **target value** and the **lower limit for use of basic acceptable error**.

> For example: The **target value** is 21 mg/L, the **BAE** is 1.0, the **LLBAE** is 10 mg/L and the **CEI** 0.1. The acceptable difference is calculated by the equation: (**Target** - **LLBAE**) x **CEI** + **BAE**. Therefore, (21 - 10) x 0.10 + 1.0 = 2.1. Thus the range 18.9 to 23.1 mg/L would be considered acceptable and would not be flagged.

The calculated acceptable difference is termed **1 criteria** or **crit**. This value and the value of three standard deviations (**3SD**) are both used to determine flags. When the **reported value** is subtracted from the **target value**, the difference is then divided by the **1 criteria** value. This produces the number of **1 crit** deviations. The assigned flag is dependent upon the range of this number.

1 Criteria Deviations	Assigned Flag
1 - 1.5	L or H
1.5 - 3SD	VL or VH
> 3SD	EL or EH

In cases where the **3SD** value is lower than that of **1 crit**, only extreme flags (EL or EH) are assigned. A minimum of 6 results is required for the calculation of **3SD**, otherwise, 2 criteria deviations are used.

References:

1. ASTM, 1983, Volume 11.01, Water 1, Section II, pp. D4210-83.
2. Ranking Laboratories by Round-Robin Tests, W.J. Youden, Precision Measurement and Calibration, H.H. Ku, Editor, NBS Special Publication 300-Volume 1, U.S. Government Printing Office, Washington, D.C., 1969.

June 2000

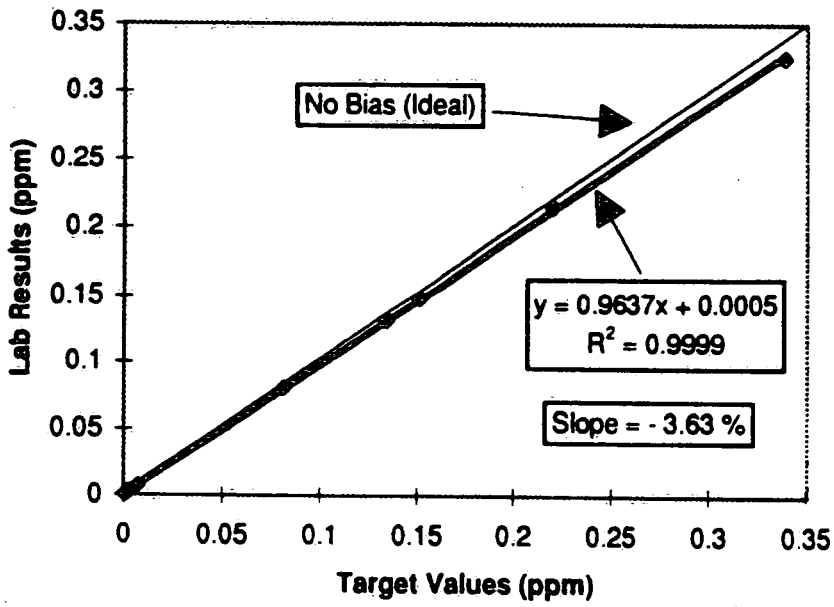
Quantifying Bias in NWRI QA Studies

Systematic bias is a major element in quantifying QA data quality. It is important in qualifying the accuracy of data when the entire set of analysis data may be affected by factors such as calibration, instrument setup, chemical reagent efficiency and purity of blank solutions. The absence of bias is not only very important when assessing data accuracy, but also when merging data sets from different times or locations.

Degree of Bias

In the NWRI QA studies with 10 sample series, systematic bias[1] is assessed non-parametrically by the procedure of Youden. The degree of bias may be parametrically quantified by two parameters taken from the parameter performance chart, as in figure 1. When bias is indicated by the procedure of Youden, the slope and intercept, give the degree of bias. High precision methodologies and instrumentation like ICPMS yield a very high precision of analysis which may lead to an assessment of very low bias, e.g. 2 or 3%.

Figure 1 **Parameter Performance**



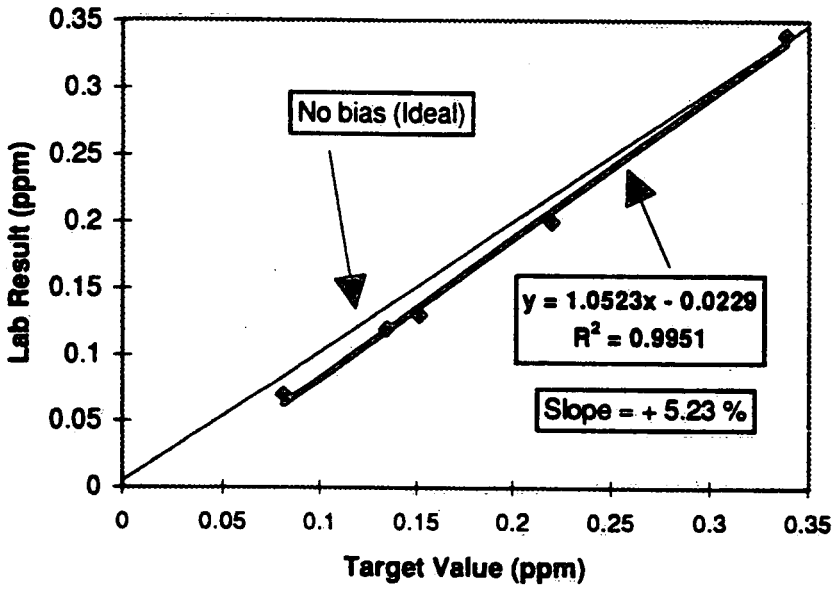
[1] Systematic bias is often identified with the comparison of data to a certified standard.

Parameter Performance Graph and Bias

The parameter performance graph, Figure 1, charts the lab results against the target values for a parameter. Ideal results, showing no bias and no deviating data, would fall on the 45° line labeled 'no bias (ideal)'. In this figure, the lab results have a very high degree of precision as indicated by the correlation coefficient (R^2) of 0.9999. The slope of the regression line, as indicated by the equation was 0.9637 and as a percentage calculates to be -3.63%. The slope is one factor in evaluating the degree of bias.

The second contribution of bias, as indicated by the parameter performance graph, is the analysis blank. This blank value is given by the y-intercept, and in this case is indicated to be 0.0005 ppm. Thus, slope and blank are considered to be the two important considerations in quantifying bias. Preliminary investigation indicates that the slope value is the most important factor and needs to be followed most closely. However, the blank may be contaminated (alternatively the standards) and become the larger factor of the two. The example in Figure 2 is a case in point.

Figure 2 **Parameter Performance**



In this parameter performance graph, we have a worst case situation. The Youden bias for this parameter is indicated as 'biased low'. However, the graph for this parameter and lab indicates a positive slope of 5.23%. Upon examining the graph, the regression line indicates a considerably large negative intercept or blank value. In this case it is the blank value that needs to be investigated.

NWRI Ecosystem Interlaboratory QA Program

Bias Critical Values
Trace Metals

Parameter	%
Aluminum	5
Antimony	5
Arsenic	10
Barium	5
Beryllium	10
Bismuth	25
Cadmium	5
Chromium	5
Cobalt	5
Copper	5
Iron	5
Lead	5
Lithium	5
Manganese	5
Molybdenum	5
Nickel	5
Selenium	5
Silver	5
Strontium	5
Thallium	10
Uranium	5
Vanadium	5
Zinc	5

June 2000

Appendix B

Data & Evaluation Summary

FPTM STUDY 0076 DATA SUMMARY 2000-05-31 PAGE 1

PARAMETER: 13095 Aluminum ug/L

NATIONAL WATER RESEARCH INSTITUTE
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BURLINGTON ONTARIO

NWRI Interlab QA for Trace Elements

LOWER LIMIT FOR USE OF BASIC ACCEPTABLE ERROR= 5.0000 BASIC ACCEPTABLE ERROR= 5.0000 CONCENTRATION ERROR INCREMENT= 0.1000

SAMPLE	1= TMRAIN-95	2= TM-24	3= TM-27	4= TM-LNGLKEB	5= TM-15	6= TM-25.2	7= TM-DWS	8= TMDA-62	9= TMDA-51	10= TMDA-65
LAB NO	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE
F002	2.3	18.8	64.7	12.9	21.3	21.6	158.	90.8	84.8	378.
F003	1.83	21.3	69.8	14.8	22.6	25.6	168.	99.3	88.6	368.
F009	1.6	21.	66.	14.	22.	24.	16. EL	92.	86.	341.
F010	5.	24.	67.	20.	26.	30.	161.	99.	90.	364.
F011	<30.	<30.	60.4	<30.	<30.	<30.	212. VH	83.	79.	355.
F012		7. VL			8. VL	12. VL	173.	88.	85.	467. EH
F014	1.7	22.0	69.4	14.3	22.5	25.5	165.	95.2	90.4	368.
F015	1.6	20.0	62.0	13.1	20.5	22.9	150.	90.2	83.1	332.
F019	<30.	<30.	70.	<30.	<30.	<30.	150.	80.	80.	340.
F022	<10.	50. EH	<10. EL	10.	60. EH	10. EL	140.	80.	70. L	350.
F024	<5.	9. VL	58.	<5. EL	<5. VL	11. VL	134. L	75. L	76.	331.
F025	<10.	18.7	65.0	12.7	19.7	22.7	156.	86.3	80.	378.
F026	<5.00	26.8	70.7	19.4	28.4	30.2	162.2	97.5	90.3	368.3
F031	<20.	20.	70.	<20.	20.	20.	160.	100.	88.	370.
F032a	<3.0	21.59	65.88	15.57	23.02	25.56	156.5	94.6	88.22	359.3
F032b	1.878	22.6174	70.2071	15.2386	23.0015	25.7	162.9773	98.4891	89.9132	363.1002
F037	1.768	20.34	66.02	12.93	21.54	25.74	144.0	92.48	82.6	338.0
F038	2.	21.	64.	14.	22.	25.	151.	92.	82.	344.
F042	<10.	25.4	68.4	19.6	26.3	30.0	165.	98.6	87.5	366.
F048	<1.0	20.33	65.94	13.77	21.13	25.15	153.06	91.47	84.18	352.76
F064	16.6 EH	101.1 EH	110.7 EH	119.4 EH	106.9 EH	112.1 EH	237.4 EH	172.0 EH	141.1 EH	427.2 EH
F065	1.97	21.5	66.9	15.0	22.3	24.7	153.	90.9	83.2	355.
F069	<15.	25.880	68.740	<15.	22.555	25.097	161.367	98.433	91.697	368.267
F094	<10.	20.	70.	20.	20.	20.	160.	100.	90.	360.
F096	1.79	21.958	68.42	14.117	22.296	25.38	161.833	96.781	90.339	369.398
F133	3.	22.	66.	16.	22.	25.	158.	94.	87.	363.
F138	1.65	19.6	60.3	13.1	19.5	21.6	135. L	81.9	73.9	309. L
F159	<5.	10.7 VL	58.6	12.3	19.1	21.6	87.1 EL	81.2	75.5	300. VL
MEDIAN	1.8540	21.1500	66.4600	14.2085	22.0000	25.0000	158.0000	92.2400	85.5000	361.5000
1CRIT	5.0000	6.6150	11.1460	5.9208	6.7000	7.0000	20.3000	13.7240	13.0500	40.6500
N	11	24	24	20	23	24	26	26	26	26
MEAN	2.2624	21.8548	66.4336	15.1413	23.8149	23.5845	155.3091	92.0059	84.8942	358.3971
3STDEV	2.8154	21.0496	10.0907	7.4946	24.0529	13.5770	59.1889	19.2813	15.0092	63.2339

LAB NO.	TOTAL RANK	AVERAGE RANK	NO.SAMPLES RANKED	SUMMARY OF FLAGGING	BIAS STATEMENT	BIAS % SLOPE	BIAS BLANK	METHOD CODING
F002	106.00	10.600	10					ICP MS
F003	181.50	18.150	10					ICP MS
F009	94.50	9.450	10	EL				ICP MS
F010	195.50	19.550	10					ICP OES
F011	53.50	10.700	5	VH				ICP MS
F012	81.00	11.571	7	VL VLVL EH				ICP MS
F014	174.50	17.450	10					ICP MS
F015	68.50	6.850	10					
F019	44.50	8.900	5					ICP
F022	68.50	8.562	8	EHEL EHEL L				ICP
F024	16.00	2.286	7	VL ELVLVLL L	BIASED LOW	-5.99	-9.6212	ICP AES
F025	79.00	8.778	9					ICP
F026	202.00	22.444	9		BIASED HIGH*	0.28	5.0409	ICP
F031	125.00	15.625	8					ICP
F032a	142.00	15.778	9					ICP AES
F032b	188.00	18.800	10					ICP MS
F037	101.00	10.100	10					ICP MS
F038	102.00	10.200	10					ICPMS
F042	184.00	20.444	9					ICP OES
F048	97.00	10.778	9					ICP MS
F064	250.00	25.000	10	EHEHEHEHEHEHEHEHEH	BIASED HIGH*	-0.43	70.0272	ICP AES(USN)
F065	122.50	12.250	10					EPA 200.8
F069	161.00	20.125	8					ICP
F094	140.00	15.556	9					ICP/MS
F096	169.00	16.900	10					ICP MS
F133	146.00	14.600	10					ICP MS
F138	41.50	4.150	10	L L	BIASED LOW	-14.78	1.2957	ICP MS
F159	26.00	2.889	9	VL EL VL	BIASED LOW	-19.68	-1.4923	ASTM D 5673

* NOTE: INDICATED BIAS STATEMENT IS FOR CAUTION ONLY AND NOT COUNTED IN STUDY STATISTICS
PERCENT SLOPE USED FOR CAUTION COMPARISON= 5.00

OVERALL AVERAGE
RANK IS 13.386

PARAMETER: 51095 Antimony ug/L

NATIONAL WATER RESEARCH INSTITUTE
ENVIRONMENT CANADA
BURLINGTON ONTARIO

NWRI Interlab QA for Trace Elements

LOWER LIMIT FOR USE OF BASIC ACCEPTABLE ERROR= 0.5000 BASIC ACCEPTABLE ERROR= 0.5000 CONCENTRATION ERROR INCREMENT= 0.0800

SAMPLE LAB NO	1= TMRAIN-95 REPORTED VALUE	2= TM-24 REPORTED VALUE	3= TM-27 REPORTED VALUE	4= TM-LNGLKEB REPORTED VALUE	5= TM-15 REPORTED VALUE	6= TM-25.2 REPORTED VALUE	7= TM-DWS REPORTED VALUE	8= TMDA-62 REPORTED VALUE	9= TMDA-51 REPORTED VALUE	10= TMDA-65 REPORTED VALUE
F002	0.45	13.5	3.06	0.21	15.5	21.6 L	17.4	62.1	14.5	203.
F003	0.2	14.4	3.0	<0.2	15.9	24.4	16.8	58.6	13.5	207.
F009	0.5	17. H	3.6	0.1	17.	26.	19. H	57.	17. EH	194.
F011	0.4	15.2	3.2	0.1	15.7	24.1	17.0	58.6	14.0	196.
F012		10. EL			17.	27. H	18.	63.	13.	193.
F014	1.3 EH	16.7 H	3.9 H	<1.0	16.8	25.4	18.6	60.0	15.4	203.
F015	<0.005 EL	14.4	2.44	<0.005 EL	15.0	23.2	15.8	57.7	13.1	190.
F022	<5.	20. EH	6. EH	<5.	20. EH	29. VH	18.	50. VL	16. H	180.
F025	<0.4	14.8	3.5	<0.4	15.0	24.5	16.8	48.8 VL	14.0	107. EL
F031	<3.	14.	<3.	<3.	16.	25.	16.	57.	14.	194.
F032a	0.1	13.3	2.8	<0.05	14.4	21.8 L	16.2	58.0	13.1	173.1 L
F038	0.33	14.4	2.92	0.11	15.0	22.7	16.6	54.2	14.0	183.
F048	<1.0	15.87	3.26	<1.0	16.33	25.00	17.53	61.55	14.04	205.26
F064	0.42	17.32 VH	3.00	0.70 EH	18.15 H	28.41 VH	19.72 VH	65.36 H	15.24	219.44 VH
F065	0.301	15.0	3.15	0.108	15.6	24.0	16.7	59.7	13.6	196.
F069	<1.	15.867	4.000 H	<1.	16.100	23.767	17.567	60.900	14.367	213.667 H
F094	<0.8	14.8	3.1	<0.8	15.2	23.5	16.5	57.2	14.	192.
F096	<1.	14.621	3.005	<1.	15.168	22.393	16.296	54.081	14.529	178.458 L
F131	0.16	15.57	3.11	<0.04	16.85	25.19	17.97	0.40 EL	14.53	206.45
F133	0.45	16.20	3.30	0.15	15.90	24.0	17.50	58.5	14.30	202.
F138	0.31	14.1	2.96	0.10	14.4	21.7 L	15.2	51.6 L	12.2 L	174. L
F159	<1.	8.7 EL	3.4	<1.	16.8	25.5	10.9 EL	58.9	14.9	202.
MEDIAN	0.3650	14.8000	3.1300	0.1090	15.9000	24.2500	16.9000	58.2500	14.0200	195.0000
1CRIT	0.5000	1.6440	0.7104	0.5000	1.7320	2.4000	1.8120	5.1200	1.5816	16.0600
N	10	20	18	7	19	20	20	20	20	20
MEAN	0.3521	14.8524	3.2369	0.1254	16.0525	24.3780	17.0732	57.3716	14.2053	194.2968
3STDEV	0.3187	4.6671	0.9652	0.1147	2.5329	4.8828	2.8303	11.3390	2.2779	33.8763

LAB NO.	TOTAL RANK	AVERAGE RANK	NO.SAMPLES RANKED	SUMMARY OF FLAGGING	BIAS STATEMENT	BIAS % SLOPE	BIAS BLANK	METHOD CODING
F002	102.00	10.200	10	L				ICP MS
F003	89.00	9.889	9					Hydride, ICP OES
F009	149.50	14.950	10	H H EH				ICP MS
F011	103.00	10.300	10					ICP MS
F012	92.00	13.143	7	EL H				ICP MS
F014	156.00	17.333	9	EHH H	BIASED HIGH*	3.61	0.6809	ICP MS
F015	42.50	5.312	8	EL EL				ICPMS
F022	133.50	16.688	8	EHEH EHVH VLH				ICP
F025	67.00	8.375	8	VL EL				HAA
F031	63.50	9.071	7					ICP
F032a	32.00	3.556	9	L L	BIASED LOW	-10.96	0.8612	HYD FAAS
F038	60.00	6.000	10					ICPMS
F048	123.50	15.438	8					ICP MS
F064	169.50	16.950	10	VH EHH VHVHH VH	BIASED HIGH	12.41	0.2505	ICP AES(USN)
F065	94.00	9.400	10					EPA 200.8
F069	126.00	15.750	8	H H				GFAA
F094	67.50	8.438	8					ICP/MS
F096	58.00	7.250	8	L				ICP MS
F131	115.00	12.778	9	EL				ICP MS
F133	122.00	12.200	10					ICP MS
F138	30.50	3.050	10	L L L L	BIASED LOW	-10.87	0.1101	ICP MS
F159	99.00	12.375	8	EL EL				ASTM D 5673

* NOTE: INDICATED BIAS STATEMENT IS FOR CAUTION ONLY AND NOT COUNTED IN STUDY STATISTICS
PERCENT SLOPE USED FOR CAUTION COMPARISON= 5.00

OVERALL AVERAGE
RANK IS 10.799

PARAMETER: 33095 Arsenic ug/L

NATIONAL WATER RESEARCH INSTITUTE
ENVIRONMENT CANADA
BURLINGTON ONTARIO

NWRI Interlab QA for Trace Elements

LOWER LIMIT FOR USE OF BASIC ACCEPTABLE ERROR= 0.5000 BASIC ACCEPTABLE ERROR= 0.5000 CONCENTRATION ERROR INCREMENT= 0.0800

SAMPLE LAB NO	1= TMRAIN-95 REPORTED VALUE	2= TM-24 REPORTED VALUE	3= TM-27 REPORTED VALUE	4= TM-LNGLKEB REPORTED VALUE	5= TM-15 REPORTED VALUE	6= TM-25.2 REPORTED VALUE	7= TM-DWS REPORTED VALUE	8= TMDA-62 REPORTED VALUE	9= TMDA-51 REPORTED VALUE	10= TMDA-65 REPORTED VALUE
F002	1.2	2.7	2.2	0.8	13.9	24.1 VL	65.3 L	52.	14.9	199.
F003	1.0	2.8	2.2	0.5	14.7	27.4	74.3	50.5	15.1	209.
F009	1.0	2.6	2.1	0.8	14.	25. L	66.	47.	14.	182.
F010	1.0	2.5	2.1	0.5	14.	26.	70.	48.	14.5	189.
F011	1.1	2.4	2.4	0.4	14.7	31.0	74.2	51.0	18.4 VH	138. VL
F012	8. EH		13. EH		23. EH	33. VH	71.	52.	12. VL	213. H
F014	1.3	2.9	2.2	<1.0	15.1	28.9	73.9	52.4	15.1	201.
F015	0.9	2.6	2.2	0.6	13.6	26.0	65.8	47.9	13.5	190.
F019	<1.	<1. EL	<1. VL	<1.	13. L	23. VL	67.	50.	13. L	175. L
F022	5. EH	<5.	5. EH	7. EH	16.	37. EH	78.	60. VH	100. EH	190.
F024	<2.	3.	<2.	<2.	14.5	25.5 L	71.	51.	15.	193.
F025	1.0	3.3	2.6	0.4	13.1	32.2 H	83.6 VH	54.2	20.6 EH	120. EL
F031	<2.	2. L	<2.	<2.	13. L	24. VL	63. L	46. L	13. L	179.
F032a	0.8	3.4	1.9	0.4	8.1 EL	13.4 EL	45.5 EL	35.0 EL	15.0	116.4 EL
F037	1.815 H	3.547 H	3.182 H	1.576 VH	16.19	28.32	72.1	51.3	14.22	191.0
F038	1.1	2.8	2.2	0.6	13.9	27.0	72.0	52.0	16.0	200.
F042	<2.	2.06 L	2.62	<2.	15.2	28.7	73.7	52.9	14.3	201.
F048	1.32	3.04	2.54	1.13	16.16	31.55 H	76.26	54.20	16.25	205.50
F064	1.14	2.16	2.34	1.04	17.18 VH	31.65 H	80.02 H	57.50 H	13.08 L	209.74
F065	1.15	2.93	2.43	1.21	15.4	28.8	74.1	53.1	15.0	209.
F069	<2.	3.433	2.833	<2.	15.767	29.000	73.800	53.367	15.567	207.000
F094	0.9	2.5	2.2	0.6	14.1	26.5	69.2	50.2	14.1	192.
F096	<1.	2.628	2.119	<1.	14.554	27.164	70.233	49.853	14.055	190.842
F131	1.21	3.14	2.55	1.19	16.03	29.26	78.85 H	0.39 EL	15.86	207.59
F133	1.	3.	2.	<1.	16.	29.	77.	56. H	15.	215. H
F138	1.1	2.9	2.2	0.6	13.4	26.3	69.5	45.1 L	16.6	194.
F159	<1.	1.6 VL	2.5	1.1	15.	29.	46.8 EL	51.8	15.1	198.
MEDIAN	1.1000	2.8000	2.2700	0.7000	14.7000	28.3200	72.0000	51.3000	15.0000	194.0000
1CRIT	0.5480	0.6840	0.6416	0.5160	1.6360	2.7256	6.2200	4.5640	1.6600	15.9800
N	18	22	22	17	25	25	25	25	25	25
MEAN	1.3464	2.7632	2.4870	0.7909	14.7392	27.9338	70.9225	50.5728	15.0893	191.3469
3STDEV	2.7270	1.1668	1.8356	1.0283	3.3761	7.8402	19.6196	12.8143	4.9087	62.8329

LAB NO.	TOTAL RANK	AVERAGE RANK	NO.SAMPLES RANKED	SUMMARY OF FLAGGING	BIAS STATEMENT	BIAS % SLOPE	BIAS BLANK	METHOD CODING
F002	105.00	10.500	10	VLL				ICP MS
F003	133.00	13.300	10					Hydride, ICP OES
F009	66.00	6.600	10	L	BIASED LOW	-6.36	-0.3372	ICP MS
F010	72.50	7.250	10					Hydride AA
F011	128.00	12.800	10	VHVL				Hydride. AA
F012	153.50	19.188	8	EH EH EHVH VLH				ICP MS
F014	147.00	16.333	9					ICP MS
F015	65.50	6.550	10		BIASED LOW*	-2.41	-0.9892	ICPMS
F019	27.00	4.500	6	ELVL L VL L L	BIASED LOW	-9.35	0.1306	AA Hydride
F022	195.00	21.667	9	EH EHEH EH VHEH	BIASED HIGH	-10.89	17.7676	ICP
F024	88.00	12.571	7	L				ICP AES
F025	155.50	15.550	10	H VH EHEL				HAA
F031	22.00	3.143	7	L L VLL L L	BIASED LOW	-7.42	-1.4366	ICP
F032a	46.50	4.650	10	ELELELEL EL	BIASED LOW	-40.12	1.1046	HYD FAAS
F037	169.00	16.900	10	H H H VH				ICP MS
F038	127.50	12.750	10					ICPMS
F042	120.50	15.062	8	L				ICP OES
F048	202.50	20.250	10	H	BIASED HIGH	5.72	0.3908	ICP MS
F064	172.00	17.200	10	VHH H H L				ICP AES(USN)
F065	173.00	17.300	10					EPA 200.8
F069	163.00	20.375	8					GFAA
F094	84.50	8.450	10					ICP/MS
F096	76.00	9.500	8					ICP MS
F131	181.00	18.100	10	H EL				ICP MS
F133	155.50	17.278	9	H H				ICP MS
F138	105.00	10.500	10	L				HG AFS
F159	115.00	12.778	9	VL EL				ASTM D 5673

* NOTE: INDICATED BIAS STATEMENT IS FOR CAUTION ONLY AND NOT COUNTED IN STUDY STATISTICS
PERCENT SLOPE USED FOR CAUTION COMPARISON= 5.00

OVERALL AVERAGE
RANK IS 13.101

PARAMETER: 56095 Barium ug/L

NATIONAL WATER RESEARCH INSTITUTE
ENVIRONMENT CANADA
BURLINGTON ONTARIO

NWRI Interlab QA for Trace Elements

LOWER LIMIT FOR USE OF BASIC ACCEPTABLE ERROR= 1.5000 BASIC ACCEPTABLE ERROR= 1.5000 CONCENTRATION ERROR INCREMENT= 0.0600

SAMPLE LAB NO	1= TMRAIN-95 REPORTED VALUE	2= TM-24 REPORTED VALUE	3= TM-27 REPORTED VALUE	4= TM-LNGLKEB REPORTED VALUE	5= TM-15 REPORTED VALUE	6= TM-25.2 REPORTED VALUE	7= TM-DWS REPORTED VALUE	8= TMDA-62 REPORTED VALUE	9= TMDA-51 REPORTED VALUE	10= TMDA-65 REPORTED VALUE
F002	0.72	7.8	7.88	18.3 L	12.7	23.5 L	141.	117.	78.2	400.
F003	0.762	9.42	8.72	21.7	13.8	27.7	156.	119.	80.3	419.
F009	0.7	9.1	8.5	21.	14.	27.	151.	116.	78.	399.
F010	0.7	9.0	8.3	20.0	13.3	26.1	145.	111.	76.	383.
F011	0.7	9.1	8.4	20.8	13.0	26.5	149.	113.	76.6	396.
F012		8.	9.	21.	13.	29.	166. VH	123.	81.	408.
F014	<10.	<10.	<10.	22.1	13.9	28.1	153.	119.	82.5	413.
F015	0.71	8.58	7.97	20.2	12.8	25.6	143.	108.	75.7	373. L
F019	2. EH	11. EH	11. EH	21.	14.	27.	151.	116.	81.	404.
F022	<5.	10.	10.	22.	15. EH	32. EH	158.	122.	83.	440. VH
F024	<1.	8.	8.	22.	14.	28.	159.	120.	82.	418.
F025	0.7	9.0	8.0	21.2	13.0	25.7	150.	120.	80.	410.
F031	1.	9.	8.	20.	13.	26.	149.	114.	79.	396.
F032a	<1.0	8.823	8.381	20.48	13.19	26.33	146.	111.7	78.35	385.1
F032b	0.7878	9.0001	8.4123	21.4643	13.4647	26.8908	149.893	112.6269	76.2557	390.877
F037	0.8588	9.288	8.492	20.36	12.53	27.16	139.0	111.0	71.63 L	376.0
F038	0.78	9.04	7.92	20.0	13.3	26.2	149.	117.	82.2	405.
F048	<1.0	9.30	8.52	22.08	13.88	28.23	155.27	117.57	79.74	408.65
F064	0.94	8.51	7.83	19.11	12.58	24.85	138.44 L	103.02 L	68.56 VL	359.18 VL
F065	0.725	9.31	8.69	21.7	13.5	27.2	152.	117.	79.0	410.
F069	<1.	9.290	8.500	21.197	13.490	27.170	152.267	116.633	79.487	404.167
F094	0.8	8.5	8.	19.8	12.4	25.4	137. L	107.	72.6	354. VL
F096	<1.	8.4	7.8	19.8	12.6	25.6	143.7	108.8	73.9	375.1
F133	0.70	9.10	8.15	21.5	13.15	26.3	149.6	115.0	76.1	406.
F138	0.61	7.77	7.10	17.6 EL	11.2 EL	22.2 EL	133. VL	93.6 EL	62.1 EL	342. VL
F139	<8.0	10.4	10.	22.1	14.4	28.3	145.1	112.6	79.3	387.1
F159	<1.	5.1 EL	8.6	21.5	13.4	26.8	95.9 EL	111.	78.7	372. L
MEDIAN	0.7250	9.0000	8.3905	21.0000	13.3000	26.8000	149.0000	115.0000	78.7000	399.0000
1CRIT	1.5000	1.9500	1.9134	2.6700	2.2080	3.0180	10.3500	8.3100	6.1320	25.3500
N	15	24	24	24	25	25	25	25	25	25
MEAN	0.7722	8.9055	8.4194	20.7580	13.2954	26.6652	147.8108	114.2380	77.8449	394.0869
3STDEV	0.2723	1.8693	1.7128	2.8485	1.6048	3.5966	19.5306	13.5497	10.1063	52.6444

LAB NO.	TOTAL RANK	AVERAGE RANK	NO.SAMPLES RANKED	SUMMARY OF FLAGGING	BIAS STATEMENT	BIAS % SLOPE	BIAS BLANK	METHOD CODING
F002	77.00	7.700	10	L L				ICP MS
F003	211.00	21.100	10		BIASED HIGH	5.00	-0.5571	ICP MS
F009	152.00	15.200	10					ICP MS
F010	89.50	8.950	10					ICP OES
F011	117.00	11.700	10					ICP MS
F012	173.50	19.278	9	VH				ICP MS
F014	166.00	23.714	7		BIASED HIGH*	3.36	0.2555	ICP MS
F015	65.50	6.550	10	L	BIASED LOW	-6.41	0.7268	ICPMS
F019	196.00	19.600	10	EHEHEH				ICP
F022	231.00	25.667	9	EHEH VH	BIASED HIGH	9.80	-0.9547	ICP
F024	182.00	20.222	9					ICP AES
F025	142.00	14.200	10					ICP
F031	115.00	11.500	10					ICP
F032a	101.00	11.222	9					ICP AES
F032b	138.00	13.800	10					ICP MS
F037	102.00	10.200	10	L				ICP MS
F038	137.50	13.750	10					ICPMS
F048	194.00	21.556	9		BIASED HIGH*	2.46	0.3221	ICP MS
F064	47.00	4.700	10	L L VLVL	BIASED LOW	-9.90	0.3353	ICP AES(USN)
F065	189.50	18.950	10					EPA 200.8
F069	163.50	18.167	9					ICP
F094	51.00	5.100	10	L VL	BIASED LOW	-11.14	1.6062	ICP/MS
F096	47.00	5.222	9		BIASED LOW	-5.83	0.3712	ICP AES
F133	130.50	13.050	10					ICP MS
F138	12.00	1.200	10	ELELELVLELELVL	BIASED LOW	-14.07	-0.8243	ICP MS
F139	174.00	19.333	9					ICP OES
F159	96.50	10.722	9	EL EL L				ASTM D 5673

* NOTE: INDICATED BIAS STATEMENT IS FOR CAUTION ONLY AND NOT COUNTED IN STUDY STATISTICS
PERCENT SLOPE USED FOR CAUTION COMPARISON= 5.00

OVERALL AVERAGE
RANK IS 13.570

PARAMETER: 94095 Beryllium ug/L

NATIONAL WATER RESEARCH INSTITUTE
ENVIRONMENT CANADA
BURLINGTON ONTARIO

NWRI Interlab QA for Trace Elements

LOWER LIMIT FOR USE OF BASIC ACCEPTABLE ERROR= 0.5000 BASIC ACCEPTABLE ERROR= 0.5000 CONCENTRATION ERROR INCREMENT= 0.0600

SAMPLE LAB NO	1= TMRAIN-95 REPORTED VALUE	2= TM-24 REPORTED VALUE	3= TM-27 REPORTED VALUE	4= TM-LNGLKEB REPORTED VALUE	5= TM-15 REPORTED VALUE	6= TM-25.2 REPORTED VALUE	7= TM-DWS REPORTED VALUE	8= TMDA-62 REPORTED VALUE	9= TMDA-51 REPORTED VALUE	10= TMDA-65 REPORTED VALUE
F002	0.2	1.5	0.9	<0.1	14.7	23.8	11.4	56.9	27.5 H	191.
F003	0.271	1.67	1.10	<0.002	15.9	25.9	11.9	54.7	25.9	190.
F009	0.3	1.5	1.1	<0.1	15.	2.6 EL	12.	54.	25.	178.
F010	<0.2	1.4	0.8 EL	<0.2	14.7	25.2	10.9	52.4	24.6	178.
F011	0.3	1.7	1.2	<0.2	15.0	25.0	11.4	52.5	25.2	180.
F012		12. EH	14. EH		13. VL	23. L		54.	25.	192.
F015	0.242	1.60	1.10	<0.002	15.2	25.6	12.1	54.2	26.5	186.
F019	<1.	2.	1.	<1.	14.	25.	11.	50. L	24.	176.
F025	<0.4	1.3	0.8 EL	<0.4	13.4 L	22.9 L	10.8	54.7	24.7	186.
F032a	0.2377	1.509	1.011	<0.1	15.23	24.86	11.56	51.48	24.79	173.6
F032b	0.2372	1.5801	0.9933	0.0395	16.1453	27.08	12.4265	54.1	26.4026	189.
F038	<0.5	1.5	1.0	<0.5	15.4	26.1	11.9	55.1	26.5	180.
F042	0.26	1.52	1.03	<0.02	14.5	24.8	11.2	50.6	24.4	170. L
F048	<1.0	1.37	<1.0	<1.0	16.31	27.85 H	12.46	56.97	27.98 VH	189.26
F064	0.25	1.56	1.03	<0.04	15.31	25.43	11.79	51.81	24.07	177.69
F065	0.229	1.68	1.10		16.4	27.7 H	13.1 H	57.5	27.4 H	189.
F069	<1.	1.609	1.078	<1.	15.600	26.189	11.879	53.051	24.608	184.003
F094	<0.5	1.9	1.2	<0.5	18.3 EH	30.5 EH	14.3 EH	63.8 EH	30.2 EH	220. EH
F096	<1.	1.45	0.93	<1.	14.47	24.34	11.28	49.89 L	23.69	168.51 L
F133	<0.5	1.5	1.0	<0.5	16.5	28.0 H	12.5	59.0 H	28. VH	204. VH
F138	0.311	1.74	1.11	0.007	16.4	25.3	11.8	50.8	24.8	181.
F139	<9.0	<9.0	<9.0	<9.0	14.	24.1	9.9 VL	52.9	24.2	184.2
F159	<1.	<1. EL	<1.	<1.	14.1	24.6	7.1 EL	46.8 VL	24.	166. VL
MEDIAN	0.2500	1.5600	1.0300		15.2000	25.2000	11.7950	54.0000	25.0000	184.0030
1CRIT	0.5000	0.5636	0.5318	0.5000	1.3820	1.9820	1.1777	3.7100	1.9700	11.5102
N	9	19	17	2	21	21	20	21	21	21
MEAN	0.2585	1.5941	1.0519	0.0233	15.1555	25.3690	11.6648	53.6477	25.5024	183.2030
3STDEV	0.0755	0.4680	0.2405	-	2.6423	4.2071	2.1071	7.3741	3.9418	24.3389

LAB NO.	TOTAL RANK	AVERAGE RANK	NO.SAMPLES RANKED	SUMMARY OF FLAGGING	BIAS STATEMENT	BIAS % SLOPE	BIAS BLANK	METHOD CODING
F002	90.50	10.056	9	H				ICP MS
F003	135.50	15.056	9					ICP MS
F009	90.50	10.056	9	EL				ICP MS
F010	51.50	6.438	8	EL				ICP OES
F011	107.00	11.889	9					ICP MS
F012	91.00	13.000	7	EHEH VLL				ICP MS
F015	123.50	13.722	9					ICPMS
F019	56.50	7.062	8	L				ICP
F025	49.50	6.188	8	EL L L				ICP
F032a	74.00	8.222	9					ICP AES
F032b	123.50	12.350	10					ICP MS
F038	105.00	13.125	8					ICPMS
F042	61.50	6.833	9	L				ICP OES
F048	120.00	17.143	7	H VH				ICP MS
F064	83.50	9.278	9					ICP AES(USN)
F065	150.50	16.722	9	H H H				EPA 200.8
F069	104.00	13.000	8					ICP MS
F094	174.50	21.812	8	EHEHEHEHEHEH	BIASED HIGH	19.45	0.0758	ICP/MS
F096	32.00	4.000	8	L L	BIASED LOW	-8.62	0.5197	ICP AES
F133	143.50	17.938	8	H H VHVH	BIASED HIGH	10.95	-0.2612	ICP MS
F138	119.50	11.950	10					ICP MS
F139	38.50	6.417	6	VL				ICP OES
F159	17.50	2.917	6	EL ELVL VL	BIASED LOW	-9.62	-0.3801	ASTM D 5673

OVERALL AVERAGE
RANK IS 11.220

PARAMETER: 83095 Bismuth ug/L

NATIONAL WATER RESEARCH INSTITUTE
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BURLINGTON ONTARIO

NWRI Interlab QA for Trace Elements

LOWER LIMIT FOR USE OF BASIC ACCEPTABLE ERROR= 0.5000 BASIC ACCEPTABLE ERROR= 0.5000 CONCENTRATION ERROR INCREMENT= 0.0800

SAMPLE LAB NO	1= TMRAIN-95 REPORTED VALUE	2= TM-24 REPORTED VALUE	3= TM-27 REPORTED VALUE	4= TM-LNGLKEB REPORTED VALUE	5= TM-15 REPORTED VALUE	6= TM-25.2 REPORTED VALUE	7= TM-DWS REPORTED VALUE	8= TMDA-62 REPORTED VALUE	9= TMDA-51 REPORTED VALUE	10= TMDA-65 REPORTED VALUE
F011	0.8	3.7 H	2.8	<0.1	21.8 EH	33.7 EH	19.6 EH	52.4	7.6 H	175.
F012	9. EH	6. EH			17.	28. H	16.	49.	8. VH	158.
F015	0.53	2.75	2.20	0.03	17.0	25.2	14.9	52.7	5.89	176.
F038	0.7	2.6	2.2	<0.5	15.7	22.9	14.1	53.6	6.6	178.
F064	0.69	3.02	2.58	<0.2	15.10	24.49	<0.2 EL	52.63	6.21	171.74
F094	0.7	2.6	2.28	0.15	15.	22.8	13.8	49.7	6.13	167.
F096	0.754	2.881	2.596	<0.1	17.396	25.847	15.213	53.849	6.298	169.117
F133	0.35 EL	2.05 L	1.20 VL	<0.05	10.75 EL	16.40 EL	9.80 EL	40.0 EL	3.30 EL	156.0 L
MEDIAN	0.7000	2.8155	2.2800		16.3500	24.8450	14.9000	52.5150	6.2540	170.4285
1CRIT	0.5160	0.6852	0.6424	0.5000	1.7680	2.4476	1.6520	4.6612	0.9603	14.0943
N	6	6	5	2	6	6	5	6	6	6
MEAN	0.6957	2.9252	2.3712	0.0900	16.1993	24.8728	14.8026	51.6717	6.4547	169.4762
3STDEV	0.2504	1.1315	-	-	2.9010	5.3624	-	5.0863	1.6620	18.0068

LAB NO.	TOTAL RANK	AVERAGE RANK	NO.SAMPLES RANKED	SUMMARY OF FLAGGING	BIAS STATEMENT	BIAS % SLOPE	BIAS BLANK	METHOD CODING
F011	61.00	6.778	9	H EHEHEH H				ICP MS
F012	46.50	5.812	8	EHEH H VH				ICP MS
F015	39.00	3.900	10					
F038	40.50	4.500	9					ICPMS
F064	35.00	4.375	8	EL				ICP AES(USN)
F094	28.00	2.800	10					ICP/MS
F096	52.00	5.778	9					ICP MS
F133	9.00	1.000	9	ELL VL ELELELELELL				ICP MS

NOTE: BIAS WAS NOT ASSESSED BECAUSE STATISTICS FOR FEWER THAN 10 LABS WERE AVAILABLE

OVERALL AVERAGE
RANK IS 4.319

PARAMETER: 48095 Cadmium ug/L

NATIONAL WATER RESEARCH INSTITUTE
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BURLINGTON ONTARIO

NWRI Interlab QA for Trace Elements

LOWER LIMIT FOR USE OF BASIC ACCEPTABLE ERROR= 1.0000 BASIC ACCEPTABLE ERROR= 1.0000 CONCENTRATION ERROR INCREMENT= 0.0600

SAMPLE LAB NO	1= TMRAIN-95 REPORTED VALUE	2= TM-24 REPORTED VALUE	3= TM-27 REPORTED VALUE	4= TM-LNGLKEB REPORTED VALUE	5= TM-15 REPORTED VALUE	6= TM-25.2 REPORTED VALUE	7= TM-DWS REPORTED VALUE	8= TMDA-62 REPORTED VALUE	9= TMDA-51 REPORTED VALUE	10= TMDA-65 REPORTED VALUE
F002	0.5	11.6	0.88	0.12	12.9	21.6	13.5	95.7 H	36.9	314.
F003	0.477	13.1	0.926	0.156	13.6	24.3	14.6	92.2	35.7	309.
F009	0.5	12.	0.9	0.1	12.	23.	14.	85.	34.	29. EL
F010	0.6	12.8	1.0	0.3 EH	13.0	23.7	14.0	88.	34.8	292.
F011	0.4	12.6	0.9	0.1	13.1	24.0	14.5	88.2	35.4	300.
F012		15. EH	10. EH		7. EL	21. L	10. EL	92.	34.	313.
F014	0.5	13.2	0.9	0.1	13.3	25.0	14.7	94.8	36.4	312.
F015	0.41	12.3	0.81	0.12	12.7	23.3	13.9	85.4	33.4	285.
F019	<4.	15. EH	<4.	<4.	14.	25.	15.	95.	36.	327. H
F022	<2.	13.	<2.	<2.	13.	25.	14.	90.	34.	304.
F024	<1.	12.	<1.	<1.	14.	24.	14.	94.	37.	314.
F025	0.4	12.6	1.0	<0.4	13.1	23.5	14.3	92.3	34.	315.
F026	<2.00	12.9	<2.00	<2.00	13.7	23.6	15.2	84.3	35.5	298.4
F031	1. EH	13.	2. EH	1. EH	12.	23.	14.	87.	35.	280. L
F032a	<1.0	11.82	1.016	<1.0	12.94	23.59	13.68	89.25	34.51	297.6
F032b	0.4823	13.2732	0.9315	0.1347	13.4243	24.7079	14.8357	90.6	36.3	309.4659
F037	0.4879	11.56	0.9056	0.1569	13.21	22.92	13.35	82.76	30.85 L	276.0 L
F038	0.48	12.9	0.84	0.12	13.0	24.1	14.6	91.0	35.5	309.
F042	<0.5	12.2	0.88	<0.5	12.2	22.9	13.7	85.2	34.2	279. L
F048	<1.0	13.77	1.20	<1.0	14.22	25.62	15.31	95.46 H	36.75	311.94
F064	0.41	11.64	0.84	0.11	12.37	22.61	13.13	82.87	31.62 L	277.76 L
F065	0.437	12.7	0.814	0.123	13.2	24.1	14.3	90.5	35.3	302.
F069	<8.	11.843	<8.	<8.	11.977	21.717	12.910	89.190	33.680	300.000
F094	0.4	12.3	0.9	0.1	12.9	23.2	14.1	87.1	34.1	292.
F096	0.437	12.3	0.833	0.125	12.572	22.684	13.87	83.678	32.605	274.717 L
F131	0.32	12.62	0.76	<0.01	13.41	24.14	14.51	90.11	36.13	303.85
F133	0.4	13.4	0.9	0.1	13.1	23.6	14.1	89.8	35.0	308.
F138	0.48	12.8	0.94	0.12	12.9	22.8	13.8	84.2	32.6	281. L
F139	<10.	13.2	<10.	<10.	14.7	24.8	13.3	85.6	32.5	303.5
F159	<1.	7.3 EL	1.1	<1.	13.7	26.2 H	9.9 EL	92.	36.5	311.4
F162	0.5	12.2	0.8	<0.3	12.7	21. L	13.	84.1	33.4	296.1
F163	0.49	12.4	0.87	0.14	12.6	23.0	13.5	87.9	35.0	292.
F167	0.3	13.2	0.7	0.04	13.2	24.1	14.1	88.4	35.	308.2
F169	0.504	13.2	0.91	0.16	13.5	23.	14.5	86.	34.6	
MEDIAN	0.4800	12.6600	0.9000	0.1200	13.0500	23.5950	14.0000	88.7950	34.9000	302.0000
1CRIT	1.0000	1.6996	1.0000	1.0000	1.7230	2.3557	1.7800	6.2677	3.0340	19.0600
N	21	31	26	18	32	31	32	32	32	31
MEAN	0.4579	12.5944	0.9522	0.1325	13.0476	23.6319	13.9058	88.7862	34.6998	299.0301
3STDEV	0.1746	1.7272	0.6873	0.1352	1.6969	2.8059	2.6860	10.5493	3.9372	37.9279

LAB NO.	TOTAL RANK	AVERAGE RANK	NO.SAMPLES RANKED	SUMMARY OF FLAGGING	BIAS STATEMENT	BIAS % SLOPE	BIAS BLANK	METHOD CODING
F002	162.50	16.250	10	H				ICP MS
F003	232.00	23.200	10					ICP MS
F009	94.50	9.450	10	EL				ICP MS
F010	178.00	17.800	10	EH				ICP OES
F011	158.50	15.850	10					ICP MS
F012	132.00	16.500	8	EHEH ELL EL				ICP MS
F014	238.00	23.800	10					ICP MS
F015	95.00	9.500	10					ICPMS
F019	220.00	31.429	7	EH H	BIASED HIGH	8.29	-0.3632	ICP
F022	139.00	19.857	7					ICP
F024	172.00	24.571	7					ICP AES
F025	172.50	19.167	9					ICP
F026	147.00	21.000	7					ICP
F031	163.00	16.300	10	EH EHEH L				ICP
F032a	117.00	14.625	8					ICP AES
F032b	241.00	24.100	10					ICP MS
F037	95.00	9.500	10	L L				ICP MS
F038	192.50	19.250	10					ICPMS
F042	71.00	8.875	8	L				ICP OES
F048	250.00	31.250	8	H	BIASED HIGH*	3.17	1.1063	ICP MS
F064	50.00	5.000	10	L L	BIASED LOW	-8.01	0.2164	ICP AES(USN)
F065	175.50	17.550	10					EPA 200.8
F069	56.50	8.071	7					ICP
F094	117.50	11.750	10					ICP/MS
F096	76.50	7.650	10	L	BIASED LOW	-9.06	0.7778	ICP MS
F131	168.00	18.667	9					ICP MS
F133	172.50	17.250	10					ICP MS
F138	109.50	10.950	10	L				ICP MS
F139	127.50	18.214	7					ICP OES
F159	174.00	21.750	8	EL H EL				ASTM D 5673
F162	68.50	7.611	9	L	BIASED LOW*	-1.92	-0.7963	GFAAS
F163	125.50	12.550	10					ICP AES
F167	155.50	15.550	10					AAS, GFAAS
F169	175.50	19.500	9					AAS GF

* NOTE: INDICATED BIAS STATEMENT IS FOR CAUTION ONLY AND NOT COUNTED IN STUDY STATISTICS
PERCENT SLOPE USED FOR CAUTION COMPARISON= 5.00

OVERALL AVERAGE
RANK IS 16.308

PARAMETER: 24095 Chromium ug/L

NATIONAL WATER RESEARCH INSTITUTE
ENVIRONMENT CANADA
BURLINGTON ONTARIO

NWRI Interlab QA for Trace Elements

LOWER LIMIT FOR USE OF BASIC ACCEPTABLE ERROR= 1.5000 BASIC ACCEPTABLE ERROR= 1.5000 CONCENTRATION ERROR INCREMENT= 0.0600

SAMPLE	1= TMRAIN-95	2= TM-24	3= TM-27	4= TM-LNGLKEB	5= TM-15	6= TM-25.2	7= TM-DWS	8= TMDA-62	9= TMDA-51	10= TMDA-65
LAB NO	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE
F002	<0.1 EL	4.4	1.4 EL	0.8	16.	20.9 L	80.1 VL	95.4	62.2	423.
F003	1.06	6.07	2.94	<0.2	18.4	25.3	99.3	97.5	62.7	414.
F009	1.0	5.6	2.7	0.3	18.	25.	95.	93.	60.	380.
F010	0.8	5.4	2.3	7.2 EH	17.1	24.2	93.	92.	59.	393.
F011	0.8	5.5	2.5	<0.3	17.2	24.7	95.6	89.6	58.3	398.
F012		5.			20. H	26.	98.	95.	59.	413.
F014	1.1	6.1	2.7	<0.5	19.7	26.4	96.3	92.8	62.7	410.
F015	0.9	5.5	2.7	0.2	16.6	23.5	91.6	87.7	58.1	376.
F019	<6.	6.	<6.	<6.	18.	24.	94.	93.	59.	413.
F022	<10.	3. EL	<1. EL	<1.	14. L	21. L	98.	98.	63.	410.
F024	<1.	5.	2.	<1.	18.	25.	98.	97.	62.	419.
F025	<2.	5.3	2.7	<2.	17.3	24.7	93.7	94.0	60.3	415.
F031	1.	6.	3.	<1.	16.	24.	91.	91.	59.	389.
F032a	<2.5	4.972	<2.5	<2.5	16.61	23.1	92.01	89.49	58.16	384.9
F032b	1.3923EH	5.6657	2.8301	0.9484	17.9478	25.2	95.9263	91.72	59.7304	389.674
F037	1.018	5.531	2.667	0.2866	16.74	23.84	84.88 L	84.4 L	52.58 EL	375.0
F038	0.9	5.5	2.6	<0.5	17.1	23.9	94.0	92.1	61.7	405.
F042	<2.	5.82	3.14	<2.	17.0	24.4	90.3	89.7	58.4	374.
F048	<1.0	5.23	2.26	<1.0	17.54	24.85	96.29	94.55	60.68	408.35
F064	0.70	4.66	2.30	0.23	15.53	21.93	85.31 L	82.29 L	53.01 EL	373.88
F065	0.804	5.85	2.75	0.385	18.3	25.6	96.2	95.6	61.7	411.
F069	<14.	<14.	<14.	<14.	17.583	23.883	93.663	94.090	60.040	396.533
F094	<0.4	3.6 L	1. EL	<0.4	15.4	22.8	92.3	90.1	58.5	390.
F096	<2.	6.4	<2.	<2.	17.6	25.5	99.3	97.5	62.3	411.6
F131	0.34 EL	5.34	2.34	<0.21	17.38	24.12	95.88	91.66	60.45	389.90
F133	0.5	5.5	2.5	<0.5	17.5	24.5	96.	94.	60.	406.
F138	0.72	5.17	2.51	0.11	16.1	23.0	84.9 L	79.3 EL	55.8	360. VL
F139	<10.	<10.	<10.	<10.	13.4 EL	21.6	93.6	91.4	57.9	408.5
F159	<1.	3.6 L	2.9	<1.	18.7	26.5	61.4 EL	92.1	61.8	391.
MEDIAN	0.9000	5.5000	2.6335	0.3000	17.3000	24.2000	94.0000	92.1000	60.0000	398.0000
1CRIT	1.5000	1.7400	1.5680	1.5000	2.4480	2.8620	7.0500	6.9360	5.0100	25.2900
N	13	25	20	7	27	27	26	27	27	27
MEAN	0.8694	5.2923	2.5299	0.4500	17.1604	24.1490	92.9061	92.1741	59.7211	397.9754
3STDEV	0.4915	1.9481	1.0772	0.8295	3.4389	3.8237	13.3967	10.5322	6.4832	42.5472

LAB NO.	TOTAL RANK	AVERAGE RANK	NO.SAMPLES RANKED	SUMMARY OF FLAGGING	BIAS STATEMENT	BIAS % SLOPE	BIAS BLANK	METHOD CODING
F002	99.50	11.056	9	EL EL L VL				ICP MS
F003	217.50	24.167	9		BIASED HIGH*	3.99	0.5445	ICP MS
F009	149.50	14.950	10					ICP MS
F010	109.00	10.900	10	EH				ICP OES
F011	108.00	12.000	9					ICP MS
F012	148.50	21.214	7	H				ICP MS
F014	198.50	22.056	9		BIASED HIGH*	2.79	0.4231	ICP MS
F015	78.50	7.850	10					ICPMS
F019	128.00	18.286	7					ICP
F022	109.50	15.643	7	ELEL L L				ICP
F024	159.00	19.875	8					ICP AES
F025	137.50	17.188	8					ICP
F031	108.50	12.056	9					ICP
F032a	49.00	7.000	7					ICP AES
F032b	160.00	16.000	10	EH				ICP MS
F037	76.00	7.600	10	L L EL				ICP MS
F038	126.00	14.000	9					ICPMS
F042	94.00	11.750	8					ICP OES
F048	135.00	16.875	8					ICP MS
F064	35.50	3.550	10	L L EL	BIASED LOW	-6.06	-1.2950	ICP AES(USN)
F065	193.50	19.350	10					EPA 200.8
F069	94.00	15.667	6					ICP
F094	49.50	6.188	8	L EL	BIASED LOW*	-1.63	-1.0872	ICP/MS
F096	177.00	25.286	7		BIASED HIGH*	3.32	0.8826	ICP AES
F131	109.00	12.111	9	EL				ICP MS
F133	133.00	14.778	9					ICP MS
F138	46.00	4.600	10	L EL VL	BIASED LOW	-9.69	0.0004	ICP MS
F139	49.00	8.167	6	EL				ICP OES
F159	128.00	16.000	8	L EL				ASTM D 5673

* NOTE: INDICATED BIAS STATEMENT IS FOR CAUTION ONLY AND NOT COUNTED IN STUDY STATISTICS
PERCENT SLOPE USED FOR CAUTION COMPARISON= 5.00

OVERALL AVERAGE
RANK IS 13.789

PARAMETER: 27095 Cobalt ug/L

NATIONAL WATER RESEARCH INSTITUTE
ENVIRONMENT CANADA
BURLINGTON ONTARIO

NWRI Interlab QA for Trace Elements

LOWER LIMIT FOR USE OF BASIC ACCEPTABLE ERROR= 1.5000 BASIC ACCEPTABLE ERROR= 1.5000 CONCENTRATION ERROR INCREMENT= 0.0600

SAMPLE LAB NO	1= TMRAIN-95 REPORTED VALUE	2= TM-24 REPORTED VALUE	3= TM-27 REPORTED VALUE	4= TM-LNGLKEB REPORTED VALUE	5= TM-15 REPORTED VALUE	6= TM-25.2 REPORTED VALUE	7= TM-DWS REPORTED VALUE	8= TMDA-62 REPORTED VALUE	9= TMDA-51 REPORTED VALUE	10= TMDA-65 REPORTED VALUE
F002	0.31 EH	18.8	4.13	0.1	15.5	26.6	71.5 H	103.	76.	405.
F003	0.233	20.3	4.09	0.065	15.9	28.9	68.6	105.	77.1	399.
F009	0.2	19.	4.0	<0.1	15.	28.	63.	97.	72.	357. L
F010	<0.8	19.5	4.2	1.2 EH	15.6	28.4	65.	99.	74.	375.
F011	0.2	19.0	3.9	<0.1	14.6	27.4	65.1	95.6	71.2	374.
F012		19.			15.	29.	70.	104.	75.	384.
F015	0.164	19.4	3.74	0.031	14.7	27.3	62.9	93.9	72.5	372.
F019	<5.	19.	<5.	<5.	15.	28.	66.	99.	75.	392.
F022	<2.	19.	<2. EL	<2.	16.	29.	65.	100.	75.	393.
F024	<1.	19.	3. EL	<1.	16.	29.	66.	101.	75.	394.
F025	<3.	18.8	4.0	<3.	14.5	27.2	67.0	100.7	76.3	402.
F032a	<2.0	18.62	3.453	<2.0	15.46	27.27	64.33	97.84	73.15	373.6
F032b	0.2265	19.5717	3.9574	0.0889	15.601	30.4007	67.6593	99.9599	73.5822	388.
F038	0.2	19.3	3.9	<0.1	15.3	28.3	62.6	98.1	75.0	380.
F048	<1.0	19.25	3.71	<1.0	14.77	28.56	66.23	101.33	75.80	388.80
F064	0.23	16.75 EL	3.32	0.07	13.47	24.85 EL	57.75 L	86.76 VL	64.43 EL	337.02 EL
F065	0.222	20.2	4.20	0.111	16.1	29.4	66.3	102.	76.2	402.
F069	<1.	18.963	3.941	<1.	15.140	27.762	62.891	94.383	70.283	396.544
F094	0.2	18.2	3.8	<0.1	14.3	26.8	61.5	93.2	69.9	356. L
F096	<3.	18.	<3. EL	<3.	12.8 EL	29.8	69.6	99.3	73.	381.1
F133	0.24	20.1	4.00	0.40	15.36	28.2	65.5	101.2	73.7	387.
F138	0.18	18.9	3.83	0.05	14.3	25.6	59.2 L	85.9 EL	64.7 EL	354. L
F139	<20.	34.8 EH	22.2 EH	<20.	26.6 EH	52.3 EH	69.2	106.2	92.5 EH	385.6
F159	<1.	10.8 EL	4.	<1.	15.3	28.	41.3 EL	94.3	72.9	365.
MEDIAN	0.2110	19.0000	3.9492	0.0889	15.2200	28.1000	65.3000	99.1500	73.8500	384.8000
1CRIT	1.5000	2.5500	1.6470	1.5000	2.3232	3.0960	5.3280	7.3590	5.8410	24.4980
N	10	22	18	7	22	22	22	22	22	22
MEAN	0.2131	19.0298	3.8984	0.1264	15.1319	28.1315	65.0618	98.4806	73.5143	381.8020
3STDEV	0.0557	2.2295	0.6807	0.3401	1.9212	3.2761	9.2855	12.3002	8.1198	42.6710

LAB NO.	TOTAL RANK	AVERAGE RANK	NO.SAMPLES RANKED	SUMMARY OF FLAGGING	BIAS STATEMENT	BIAS % SLOPE	BIAS BLANK	METHOD CODING
F002	150.50	15.050	10	EH H				ICP MS
F003	176.00	17.600	10					ICP MS
F009	77.50	8.611	9	L				ICP MS
F010	123.50	13.722	9	EH				ICP OES
F011	71.50	7.944	9					ICP MS
F012	114.50	16.357	7					ICP MS
F015	63.00	6.300	10					ICPMS
F019	92.50	13.214	7					ICP
F022	112.50	16.071	7	EL				ICP
F024	120.50	15.062	8	EL				ICP AES
F025	108.50	13.562	8					ICP
F032a	65.00	8.125	8					ICP AES
F032b	145.00	14.500	10					ICP MS
F038	98.50	10.944	9					ICPMS
F048	114.00	14.250	8					ICP MS
F064	26.00	2.600	10	EL ELL VLELEL	BIASED LOW	-12.43	0.0741	ICP AES(USN)
F065	179.00	17.900	10		BIASED HIGH*	4.40	-0.3300	EPA 200.8
F069	76.00	9.500	8					ICP MS
F094	35.00	3.889	9	L	BIASED LOW	-7.56	0.7136	ICP/MS
F096	81.00	11.571	7	EL EL				ICP AES
F133	138.50	13.850	10					ICP MS
F138	32.50	3.250	10	L ELELL	BIASED LOW	-8.22	-0.6334	ICP MS
F139	174.00	21.750	8	EHEH EHEH EH	BIASED HIGH*	-4.34	16.2423	ICP OES
F159	58.00	7.250	8	EL EL				ASTM D 5673

* NOTE: INDICATED BIAS STATEMENT IS FOR CAUTION ONLY AND NOT COUNTED IN STUDY STATISTICS
PERCENT SLOPE USED FOR CAUTION COMPARISON= 5.00

OVERALL AVERAGE
RANK IS 11.641

PARAMETER: 29095 Copper ug/L

NATIONAL WATER RESEARCH INSTITUTE
ENVIRONMENT CANADA
BURLINGTON ONTARIO

NWRI Interlab QA for Trace Elements

LOWER LIMIT FOR USE OF BASIC ACCEPTABLE ERROR= 1.5000 BASIC ACCEPTABLE ERROR= 1.5000 CONCENTRATION ERROR INCREMENT= 0.0600

SAMPLE LAB NO	1= TMRAIN-95 REPORTED VALUE	2= TM-24 REPORTED VALUE	3= TM-27 REPORTED VALUE	4= TM-LNGLKEB REPORTED VALUE	5= TM-15 REPORTED VALUE	6= TM-25.2 REPORTED VALUE	7= TM-DWS REPORTED VALUE	8= TMDA-62 REPORTED VALUE	9= TMDA-51 REPORTED VALUE	10= TMDA-65 REPORTED VALUE
F002	6.35	7.06	35.6	33.8	17.9	25.4	177.	111.	70.4	413.
F003	6.47	7.98	37.2	38.0	19.3	28.9	185.	111.	67.9	405.
F009	6.5	7.7	36.	37.	18.	27.	175.	103.	65.	361. L
F010	6.5	8.0	37.	38.	18.6	27.8	180.	107.	67.	386.
F011	6.2	7.6	35.2	34.0	17.4	26.5	185.	101.	63.3	378.
F012	5.	7.	36.	44. VH	18.	27.	200. VH	123. EH	93. EH	434. VH
F014	6.9	8.1	38.4	38.5	19.2	28.5	191. H	110.	69.2	404.
F015	6.06	7.45	34.2	34.7	17.7	27.0	174.	101.	63.4	368.
F019	8. EH	8.	40. H	34.	15. EL	25.	186.	107.	63.	401.
F022	6.	6.	39.	40.	25. EH	34. EH	190.	110.	70.	398.
F024	6.	7.	36.	38.	18.	28.	183.	110.	67.	400.
F025	6.2	7.1	33.8	33.3	16.6	27.7	189.	111.	68.3	407.
F026	6.5	9.6 EH	35.8	32.9 L	19.5	27.6	151.3 VL	91.0 VL	61.1	343.4 VL
F031	7.	9.	38.	39.	19.	28.	178.	99.	67.	363. L
F032a	5.459	7.395	34.92	37.24	17.33	26.79	176.7	99.37	64.94	363.1 L
F032b	6.3348	7.6256	34.48	37.9113	18.4978	28.07	179.1904	104.5777	64.6527	361.6027L
F037	6.348	7.813	36.46	41.09 H	19.47	27.87	172.0	101.0	60.19 L	389.0
F038	6.5	7.6	35.1	34.6	18.4	27.6	170.	103.	65.8	380.
F042	<10.	<10.	39.5	44.7 EH	21.0 H	32.9 EH	206. VH	121. VH	70.4	435. VH
F048	5.76	7.15	36.60	36.31	17.97	27.91	181.46	109.32	67.98	398.85
F064	5.69	7.51	34.54	35.82	17.63	26.58	176.55	93.31 L	58.87 L	358.94 L
F065	6.53	7.94	37.4	37.3	18.5	27.7	176.	105.	66.2	404.
F069	<10.	<10.	37.983	39.157	19.227	29.263	191.467 H	113.500 H	69.540	409.867
F094	5.8	7.1	33.	33.5	17.2	25.2	166.	99.2	60.8	355. L
F096	5.9	7.4	34.8	36.1	17.1	27.5	184.2	107.7	65.7	392.
F131	5.73	7.29	36.08	35.57	17.97	26.58	177.49	102.09	65.63	373.54
F133	6.3	8.1	35.1	37.8	18.4	26.8	180.0	107.5	64.7	393.
F138	6.44	7.64	37.1	34.0	18.2	26.3	166.	97.2	61.1	353. L
F159	4.5 EL	4.3 EL	36.3	35.9	17.9	27.1	112. EL	103.	64.	371.
F162	6.8	8.	38.7	39.2	20.4	31. H	183.	109.7	69.4	366.3
F163	6.0	7.3	35.9	34.5	17.8	26.8	178.	105.	65.6	380.
F167	6.1	7.5	36.7	36.8	19.7	30.	175.3	99.	53.3 EL	396.4
F168	5.9	7.3	34.2	34.1	17.5	26.1	171.	96. L	62.8	390.
F169	6.	6.9	34.1	37.2	18.5	34. EH	167.	98.	49. EL	
MEDIAN	6.2000	7.5050	36.0000	36.9000	18.1000	27.6000	178.0000	104.7888	65.6150	389.0000
1CRIT	1.7820	1.8603	3.5700	3.6240	2.4960	3.0660	12.0900	7.6973	5.3469	24.7500
N	30	30	32	32	32	31	32	32	32	31
MEAN	6.1757	7.5185	36.1926	36.7624	18.3717	27.6601	178.6143	104.8584	65.1313	385.6000
3STDEV	1.2654	1.5704	4.5082	7.2751	2.8804	4.5859	27.4103	17.6400	11.1881	59.7098

LAB NO.	TOTAL RANK	AVERAGE RANK	NO.SAMPLES RANKED	SUMMARY OF FLAGGING	BIAS STATEMENT	BIAS % SLOPE	BIAS BLANK	METHOD CODING
F002	167.00	16.700	10					ICP MS
F003	264.50	26.450	10					ICP MS
F009	157.50	15.750	10	L				ICP MS
F010	226.50	22.650	10					ICP OES
F011	125.50	12.550	10					ICP MS
F012	218.50	21.850	10	VH VHEHEHVH				ICP MS
F014	282.00	28.200	10	H	BIASED HIGH*	4.19	0.7688	ICP MS
F015	107.50	10.750	10					ICPMS
F019	183.50	18.350	10	EH H EL				ICP
F022	254.00	25.400	10	EHEH				ICP
F024	196.00	19.600	10					ICP AES
F025	164.50	16.450	10					ICP
F026	130.50	13.050	10	EH L VLVL VL				ICP
F031	222.50	22.250	10	L				ICP
F032a	105.00	10.500	10	L				ICP AES
F032b	170.00	17.000	10	L				ICP MS
F037	187.00	18.700	10	H L				ICP MS
F038	157.00	15.700	10					ICPMS
F042	264.50	33.062	8	EHH EHVHVH VH	BIASED HIGH	12.00	1.4732	ICP OES
F048	184.50	18.450	10					ICP MS
F064	78.50	7.850	10	L L L	BIASED LOW	-7.12	0.7675	ICP AES(USN)
F065	220.00	22.000	10					EPA 200.8
F069	237.00	29.625	8	H H	BIASED HIGH	5.55	0.8135	ICP
F094	44.00	4.400	10	L	BIASED LOW	-8.51	0.7113	ICP/MS
F096	150.50	15.050	10					ICP AES
F131	126.00	12.600	10					ICP MS
F133	186.50	18.650	10					ICP MS
F138	113.00	11.300	10	L				ICP MS
F159	101.50	10.150	10	ELEL EL				ASTM D 5673
F162	266.50	26.650	10	H	BIASED HIGH	-5.61	5.1574	GFAAS
F163	135.00	13.500	10					ICP AES
F167	172.50	17.250	10	EL				AAS, GFAAS
F168	79.50	7.950	10	L	BIASED LOW*	-0.02	-2.4611	GFAAS
F169	103.50	11.500	9	EH EL				AAS GF

* NOTE: INDICATED BIAS STATEMENT IS FOR CAUTION ONLY AND NOT COUNTED IN STUDY STATISTICS
PERCENT SLOPE USED FOR CAUTION COMPARISON= 5.00

OVERALL AVERAGE
RANK IS 17.260

PARAMETER: 26095 Iron ug/L

NATIONAL WATER RESEARCH INSTITUTE
ENVIRONMENT CANADA
BURLINGTON ONTARIO

NWRI Interlab QA for Trace Elements

LOWER LIMIT FOR USE OF BASIC ACCEPTABLE ERROR= 2.0000 BASIC ACCEPTABLE ERROR= 2.0000 CONCENTRATION ERROR INCREMENT= 0.0800

SAMPLE	1= TMRAIN-95	2= TM-24	3= TM-27	4= TM-LNGLKEB	5= TM-15	6= TM-25.2	7= TM-DWS	8= TMDA-62	9= TMDA-51	10= TMDA-65
LAB NO	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE
F002	<50.	<50.	<50.	100. VL	<50.	<50.	380. H	120.	150.	500. EH
F003	24.0	6.00	55.0	122.	27.0	30.0	355.	123.	154.	425.
F010	24.2	5.6	56.	116.	25.1	28.4	336.	118.	150.	408.
F011	<30.	<30.	50.	120.	<30.	<30.	340.	120.	140.	400.
F012	12. EL	6.	51.	135. VH	16. VL	29.	434. EH	135. H	136.	106. EL
F014	<50.	<50.	52.	114.	<50.	<50.	323.	112.	142.	396.
F015	22.	6.	53.	121.	23.	34. H	352.	126.	174. EH	454. H
F019	25.	6.	58.	120.	27.	30.	347.	119.	151.	425.
F022	22.	9. H	58.	118.	25.	30.	340.	124.	150.	406.
F024	25.	5.	57.	120.	27.	30.	350.	123.	157.	430.
F025	<10. EL	<10.	20. EL	90. VL	<10. EL	<10. EL	356.	90. EL	120. EL	400.
F026	23.7	5.8	53.6	91.8 VL	24.2	26.5	293.0 VL	104.5 L	139.4	376.0
F031	22.	4.	53.	113.	23.	26.	323.	113.	148.	400.
F032a	22.02	5.376	52.63	116.6	25.39	27.63	336.1	116.1	147.8	405.4
F032b	26.6672	8.136	52.05	124.7245	29.1435	34.122 H	339.2159	120.4	149.6025	409.2462
F037	21.44	16.45 VH	51.42	126.0	43.01 EH	45.89 EH	304.0 L	122.0	132.0 L	388.0
F038	<30.	<30.	60. H	110.	<30.	<30.	330.	120.	150.	420.
F042	24.5	5.73	55.5	113.	24.5	28.3	327.	113.	146.	393.
F048	<100.	<100.	<100.	<100. VL	<100.	<100.	322.12	<100. EL	121.76 VL	406.09
F064	22.84	6.59	50.17	105.12 L	25.59	28.17	309.22 L	107.77 L	133.48 L	361.46 L
F069	27.577 H	<10.	55.353	117.767	25.287	28.853	340.933	119.967	149.533	414.467
F094	20.	20. EH	60. H	80. EL	<10. EL	<10. EL	304. L	90. EL	150.	400.
F096	20.5	<3. L	51.6	117.	22.	25.8	350.8	120.	149.4	417.7
F133	30. EH	10. VH	50.	120.	30. H	30.	340.	120.	150.	430.
F138	23.6	6.42	55.6	117.	26.0	30.1	356.	121.	148.	419.
F159	18.6 L	16.5 VH	63.2 EH	171.6 EH	64. EH	71.5 EH	243. EL	160. EH	165. H	436.
F163	24.0	5.0	53.9	110.	26.4	26.8	326.	115.	149.	396.
MEDIAN	23.6000	6.0000	53.6000	117.0000	25.4900	29.5000	339.2159	120.0000	149.4000	406.0900
1CRIT	3.7280	2.3200	6.1280	11.2000	3.8792	4.2000	28.9773	11.4400	13.7920	34.3272
N	19	17	23	24	18	18	25	23	25	25
MEAN	23.1392	7.6236	54.1227	114.9171	26.5900	30.2092	335.2155	118.8147	146.3590	408.6545
3STDEV	6.5147	10.4782	8.9395	29.8336	13.3129	13.0370	57.9196	18.3963	25.8550	57.5842

LAB NO.	TOTAL RANK	AVERAGE RANK	NO.SAMPLES RANKED	SUMMARY OF FLAGGING	BIAS STATEMENT	BIAS % SLOPE	BIAS BLANK	METHOD CODING
F002	91.50	18.300	5	VL H EH				ICP MS
F003	178.00	17.800	10					ICP OES
F010	122.50	12.250	10					ICP OES
F011	68.50	11.417	6					Flame AA
F012	109.50	10.950	10	EL VHVL EHH EL				ICP MS
F014	45.00	7.500	6					ICP MS
F015	168.50	16.850	10	H EHH				ICP
F019	169.50	16.950	10					ICP
F022	151.00	15.100	10	H				ICP
F024	176.50	17.650	10					ICP AES
F025	39.50	6.583	6	EL ELVLELEL ELEL				ICP
F026	57.00	5.700	10	VL VLL	BIASED LOW	-10.13	-0.2785	ICP
F031	68.50	6.850	10					ICP
F032a	94.00	9.400	10					ICP AES
F032b	164.00	16.400	10	H				ICP MS
F037	120.50	12.050	10	VH EHEHL L				ICP MS
F038	95.50	15.917	6	H				ICPOES
F042	91.00	9.100	10					ICP OES
F048	22.00	7.333	3	VL ELVL	INSUFFICIENT DATA			ICP MS
F064	64.00	6.400	10	L L L L L	BIASED LOW	-10.68	1.6151	ICP AES(USN)
F069	131.00	14.556	9	H				ICP
F094	80.50	10.062	8	EHH ELELELL EL				ICP/MS
F096	95.50	10.611	9	L				ICP AES
F133	163.00	16.300	10	EHVH H				ICP MS
F138	156.50	15.650	10					Colorimetric
F159	189.00	18.900	10	L VHEHEHEHEHELEHH				ASTM D 5673
F163	90.00	9.000	10					ICP AES

OVERALL AVERAGE
RANK IS 12.613

PARAMETER: 82095 Lead ug/L

NATIONAL WATER RESEARCH INSTITUTE
ENVIRONMENT CANADA
BURLINGTON ONTARIO

NWRI Interlab QA for Trace Elements

LOWER LIMIT FOR USE OF BASIC ACCEPTABLE ERROR= 1.5000 BASIC ACCEPTABLE ERROR= 1.5000 CONCENTRATION ERROR INCREMENT= 0.0600

SAMPLE LAB NO	1= TMRAIN-95 REPORTED VALUE	2= TM-24 REPORTED VALUE	3= TM-27 REPORTED VALUE	4= TM-LNGLKEB REPORTED VALUE	5= TM-15 REPORTED VALUE	6= TM-25.2 REPORTED VALUE	7= TM-DWS REPORTED VALUE	8= TMDA-62 REPORTED VALUE	9= TMDA-51 REPORTED VALUE	10= TMDA-65 REPORTED VALUE
F002	0.32	6.98	4.88	3.92	12.1	26.7	35.8	105. H	68.5	440.
F003	0.275	7.35	4.82	4.30	12.0	28.3	34.5	100.	68.0	425.
F009	0.2	7.2	4.8	4.1	12.	28.	35.	100.	66.	422.
F010	<0.3	7.	4.5	4.9	10.2	27.3	33.	98.	65.	417.
F011	0.2	6.9	4.4	4.0	11.3	27.1	32.4	93.7	64.1	408.
F012					13.	27.	36.	92.	68.	396.
F014	<1.0	7.8	4.9	4.3	12.3	29.0	34.8	99.3	67.9	428.
F015	0.26	7.44	4.91	4.15	12.1	28.5	34.4	95.7	66.0	415.
F019	<30.	<30.	<30.	<30.	<30.	30.	50. EH	100.	60. L	430.
F022	<5.	<5. EL	<5.	<5.	10. EL	24. L	30. L	100.	50. EL	420.
F024	<2.	8.	4. EL	5. EH	12.	29.	35.	101.	68.	435.
F025	<0.6	6.8	4.6	3.9	11.4	26.2	32.3	90.1 L	61.6	443.
F026	<20.00	<20.00	<20.00	<20.00	<20.00	30.3	35.6	101.2	70.9 H	436.5
F031	<1.	8.	5.	4.	12.	28.	36.	96.	59. L	390. L
F032a	<11.0	<11.0	<11.0	<11.0	14.09 EH	27.7	36.59	106.4 H	63.86	441.1
F032b	0.2472	7.5445	4.8791	4.3031	11.5	23.8844L	32.4435	91.9	65.5125	377. VL
F037	0.3783	6.602	4.406	3.538	10.43	26.11	30.24 L	87.27 L	57.22 VL	382.0 L
F038	0.26	7.12	4.52	3.89	11.7	26.9	34.9	101.	68.1	410.
F042	<2.	7.17	4.78	3.80	11.7	28.0	33.8	97.9	66.1	415.
F048	<1.0	7.12	4.52	4.09	11.91	27.95	34.52	99.22	65.95	426.10
F064	0.26	6.48	4.26	3.41	11.17	25.80	31.50	88.53 L	56.64 VL	377.90 L
F065	0.245	7.43	4.90	4.04	11.9	27.8	34.1	97.4	65.6	432.
F069	<1.	7.450	4.822	4.199	12.024	27.810	33.960	94.168	64.737	428.172
F094	0.3	7.3	4.7	4.2	11.8	27.5	33.8	96.4	64.7	407.
F096	<1.	7.304	4.808	4.128	12.019	28.194	34.127	97.228	64.857	401.231
F131	0.57 EH	7.46	5.02	4.24	11.78	26.70	34.10	107.14 H	65.50	418.05
F133	<2.	6. EL	4. EL	4.	10. EL	26.	34.	96.	66.	418.
F138	0.253	7.32	4.77	4.03	11.8	27.3	32.8	93.8	61.9	399.
F159	<1.	3.9 EL	4.6	3.9	11.	26.3	20.3 EL	86.8 L	60.7	370. VL
F162	<0.5	7.5	4.7	3.6	11.7	29.	35.	103.5	71.7 H	417.5
F163	0.28	7.2	5.0	4.5	11.3	26.3	33.0	93.5	64.1	411.
F169	<2.	7.3	4.3	3.4	11.6	26.5	33.3	102.	66.	400.
MEDIAN	0.2600	7.3000	4.7700	4.0400	11.7900	27.4000	34.1000	97.6500	65.5062	417.2500
1CRIT	1.5000	1.8480	1.6962	1.6524	2.1174	3.0540	3.4560	7.2690	5.3404	26.4450
N	11	24	24	25	27	30	30	30	30	30
MEAN	0.2799	7.1571	4.6990	4.0575	11.6938	27.3655	33.8993	97.2739	64.6825	414.1184
3STDEV	0.1141	1.1458	0.6380	0.8992	1.6472	3.5826	4.7003	13.7007	9.9532	52.1007

LAB NO.	TOTAL RANK	AVERAGE RANK	NO.SAMPLES RANKED	SUMMARY OF FLAGGING	BIAS STATEMENT	BIAS % SLOPE	BIAS BLANK	METHOD CODING
F002	204.00	20.400	10	H				ICP MS
F003	206.50	20.650	10					ICP MS
F009	180.50	18.050	10					ICP MS
F010	118.00	13.111	9					GFAA ICO OES
F011	80.50	8.050	10					ICP MS
F012	110.50	18.417	6					ICP MS
F014	218.00	24.222	9		BIASED HIGH*	2.50	0.1940	ICP MS
F015	188.50	18.850	10					ICPMS
F019	116.50	23.300	5	EH L				ICP
F022	49.00	8.167	6	EL ELL L EL				ICP
F024	211.00	23.444	9	ELEH				ICP AES
F025	86.00	9.556	9	L				ICP
F026	146.00	29.200	5	H	BIASED HIGH*	4.35	0.9281	ICP
F031	158.50	17.611	9	L L				GFAAS
F032a	150.00	25.000	6	EH H	BIASED HIGH	5.80	-0.3149	ICP AES
F032b	114.00	11.400	10	L VL				ICP MS
F037	47.00	4.700	10	L L VLL	BIASED LOW	-8.48	-0.5050	ICP MS
F038	145.50	14.550	10					ICPMS
F042	135.00	15.000	9					ICP OES
F048	155.00	17.222	9					ICP MS
F064	36.00	3.600	10	L VLL	BIASED LOW	-9.47	-0.0674	ICP AES(USN)
F065	173.00	17.300	10					EPA 200.8
F069	166.00	18.444	9					ICP MS
F094	140.00	14.000	10					ICP/MS
F096	155.00	17.222	9					ICP MS
F131	193.00	19.300	10	EH H				ICP MS
F133	87.00	9.667	9	ELEL EL				ICP MS
F138	113.00	11.300	10					ICP MS
F159	40.50	4.500	9	EL ELL VL	BIASED LOW	-11.05	-0.9183	ASTM D 5673
F162	184.50	20.500	9	H				GFAAS
F163	128.00	12.800	10					SAA FG ICP AES
F169	108.00	12.000	9					AAS GF

* NOTE: INDICATED BIAS STATEMENT IS FOR CAUTION ONLY AND NOT COUNTED IN STUDY STATISTICS
PERCENT SLOPE USED FOR CAUTION COMPARISON= 5.00

OVERALL AVERAGE
RANK IS 15.242

PARAMETER: 93095 Lithium ug/L

NATIONAL WATER RESEARCH INSTITUTE
ENVIRONMENT CANADA
BURLINGTON ONTARIO

NWRI Interlab QA for Trace Elements

LOWER LIMIT FOR USE OF BASIC ACCEPTABLE ERROR= 0.5000 BASIC ACCEPTABLE ERROR= 0.5000 CONCENTRATION ERROR INCREMENT= 0.0600

SAMPLE LAB NO	1= TMRAIN-95 REPORTED VALUE	2= TM-24 REPORTED VALUE	3= TM-27 REPORTED VALUE	4= TM-LNGLKEB REPORTED VALUE	5= TM-15 REPORTED VALUE	6= TM-25.2 REPORTED VALUE	7= TM-DWS REPORTED VALUE	8= TMDA-62 REPORTED VALUE	9= TMDA-51 REPORTED VALUE	10= TMDA-65 REPORTED VALUE
F003	0.388	4.84	4.33	0.676	15.7 H	26.6	21.0	60.8	16.2	186.
F010	<1.	4.	4.	<1.	14.	24.	20.	55.	15.	173.
F011	0.4	4.7	4.4	0.6	15.5	25.0	19.5	54.8	15.3	178.
F012					15.	27.	23. EH	58.	17. H	198. EH
F015	0.35	4.58	4.17	0.60	14.3	25.2	20.6	57.8	16.2	183.
F022	<10.	3. VL	2. EL	<1.	13.	23. L	19.	50. VL	12. VL	180.
F025	<2.	3.7	3.0 L	<2.	13.7	24.7	19.3	56.3	14.3	177.
F038	<1.	4.	4.	<1.	14.	26.	20.	60.	16.	186.
F048	<1.0	4.28	3.82	<1.0	14.24	26.15	20.41	58.57	15.27	181.96
F064	0.29	3.57	3.47	0.12	12.93	23.31	18.22 L	52.08 L	12.63 VL	167.20 L
F065	0.434	4.69	4.44	0.731	15.8 H	27.1	21.4	60.7	16.7 H	188.
F069	0.351	4.682	4.194	0.636	15.250	26.808	20.707	56.430	14.999	174.936
F094	<3.	5. H	4.	<3.	15.	26.	21.	58.	16.	182.
F096	<1.	3.633	3.154 L	<1.	11.866 VL	20.638 EL	16.422 EL	46.371 EL	11.961 VL	151.653 EL
F133	<1.	4.	4.	<1.	14.	25.	20.	58.	15.	183.
MEDIAN	0.3695	4.1400	4.0000	0.6180	14.2400	25.2000	20.0000	57.8000	15.2700	181.9600
1CRIT	0.5000	0.7184	0.7100	0.5071	1.3244	1.9820	1.6700	3.9380	1.3862	11.3876
N	4	12	12	4	13	13	13	13	13	13
MEAN	0.3722	4.2229	3.8782	0.6280	14.3554	25.2898	20.0875	56.5908	15.0461	180.0074
3STDEV	-	1.3318	1.2805	-	2.5568	3.7252	2.6042	8.7060	3.9914	16.9156

LAB NO.	TOTAL RANK	AVERAGE RANK	NO.SAMPLES RANKED	SUMMARY OF FLAGGING	BIAS STATEMENT	BIAS % SLOPE	BIAS BLANK	METHOD CODING
F003	112.50	11.250	10	H	BIASED HIGH*	2.13	0.6055	ICP MS
F010	45.00	5.625	8					FLAA
F011	76.00	7.600	10					ICP MS
F012	79.50	13.250	6	EH H EH	BIASED HIGH	8.58	-0.5754	ICP MS
F015	81.50	8.150	10					ICPMS
F022	21.00	2.625	8	VLEL L VLVL	BIASED LOW*	-0.53	-2.3627	ICP
F025	34.00	4.250	8	L				ICPAES
F038	72.00	9.000	8					ICPMS
F048	69.00	8.625	8					ICP MS
F064	23.00	2.300	10	L L VLL	BIASED LOW	-8.00	-0.3877	ICP AES(USN)
F065	123.00	12.300	10	H H	BIASED HIGH*	3.13	0.6270	EPA 200.8
F069	80.00	8.000	10					ICP MS
F094	83.50	10.438	8	H				ICP/MS
F096	12.00	1.500	8	L VLELELELVLEL	BIASED LOW	-16.66	-0.3944	ICP MS
F133	60.00	7.500	8					ICP MS

* NOTE: INDICATED BIAS STATEMENT IS FOR CAUTION ONLY AND NOT COUNTED IN STUDY STATISTICS
PERCENT SLOPE USED FOR CAUTION COMPARISON= 5.00

OVERALL AVERAGE
RANK IS 7.477

PARAMETER: 25095 Manganese ug/L

NATIONAL WATER RESEARCH INSTITUTE
ENVIRONMENT CANADA
BURLINGTON ONTARIO

NWRI Interlab QA for Trace Elements

LOWER LIMIT FOR USE OF BASIC ACCEPTABLE ERROR= 1.5000 BASIC ACCEPTABLE ERROR= 1.5000 CONCENTRATION ERROR INCREMENT= 0.0600

SAMPLE	1= TMRAIN-95	2= TM-24	3= TM-27	4= TM-LNGLKEB	5= TM-15	6= TM-25.2	7= TM-DWS	8= TMDA-62	9= TMDA-51	10= TMDA-65
LAB NO	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE
F002	6.21	2.88	2.79	15.1	18.8	23.6	93.6	105.	35.	435. H
F003	6.19	3.08	2.77	16.7	19.3	26.3	90.1	106.	36.2	417.
F009	6.1	2.8	2.6	15.	18.	25.	84.	100.	34.	377. L
F010	5.7	2.4	2.2	14.9	17.8	24.8	86.	103.	35.	403.
F011	6.2	3.0	2.7	15.4	18.2	25.5	94.0 H	100.	34.9	404.
F012	6.			16.	18.	27.	93.	106.	34.	402.
F014	6.6	<5.	<5.	17.3	20.2	26.8	92.1	105.	38.1	406.
F015	5.99	2.84	2.55	15.4	17.6	24.4	82.5	95.6	34.2	375. L
F019	7. EH	3.	3.	16.	20.	26.	87.	100.	36.	409.
F022	7. EH	4. EH	4. EH	14.	18.	24.	90.	108.	35.	410.
F024	6.	2.	2. EL	16.	20.	27.	92.	110.	37.	432. H
F025	6.3	2.6	2.4	15.9	18.6	25.7	90.7	107.7	36.0	428.
F026	6.20	3.3	3.0	14.6	18.0	24.4	76.8 VL	91.9 L	33.5	373.9 L
F031	6.	3.	3.	15.	18.	24.	83.	100.	35.	393.
F032a	5.741	2.885	2.679	16.1	18.86	25.58	87.98	103.2	35.66	403.6
F032b	6.2422	3.0396	2.7538	17.2711	19.0811	26.7	87.0106	102.8825	35.5668	396.
F037	6.323	2.806	2.554	13.58	17.18	24.07	77.19 L	93.0 L	31.62	383.0
F038	5.97	2.75	2.54	15.1	19.0	26.0	86.6	105.	36.3	410.
F042	<10.	<10.	<10.	14.2	16.8	24.1	83.2	100.	34.1	394.
F048	5.47	2.08	2.26	15.87	18.59	25.82	89.16	104.44	35.79	418.15
F064	5.51	2.64	2.44	14.07	16.90	22.99	78.80 L	90.00 EL	30.76 EL	356.55 VL
F065	6.30	3.09	2.80	16.9	19.6	26.7	88.1	105.	36.2	416.
F069	5.434	2.442	<2.2	15.430	17.743	24.767	85.573	101.233	34.103	395.300
F094	6.1	3.	2.7	15.9	18.3	25.2	85.6	101.	34.9	392.
F096	6.	3.2	2.5	16.3	19.	26.3	89.7	104.8	35.9	412.
F133	6.05	3.00	2.60	16.60	18.65	25.4	87.9	105.0	35.5	410.
F138	6.05	2.91	2.61	15.1	17.7	24.5	81.2	97.8	32.8	381.
F139	<20.	<20.	<20.	<20.	<20.	24.8	90.1	105.8	35.8	424.8
F159	4.4 EL	1.7 EL	2.7	15.8	17.8	25.2	52.9 EL	102.	35.	374. L
F163	6.15	2.84	2.62	14.6	17.6	24.2	82.6	99.0	35.1	391.
MEDIAN	6.0750	2.8825	2.6200	15.4300	18.2000	25.2000	87.0053	102.9413	35.0000	403.3000
1CRIT	1.7745	1.5829	1.5672	2.3358	2.5020	2.9220	6.6303	7.5865	3.5100	25.6080
N	25	24	23	27	27	27	28	28	28	28
MEAN	6.0332	2.8159	2.6420	15.5274	18.3816	25.1791	86.4826	102.0841	35.0050	401.0982
3STDEV	0.8232	0.9422	0.6142	2.5162	2.3497	2.7628	13.4795	12.0128	3.4232	48.4287

LAB NO.	TOTAL RANK	AVERAGE RANK	NO.SAMPLES RANKED	SUMMARY OF FLAGGING			BIAS STATEMENT	BIAS % SLOPE	BIAS BLANK	METHOD CODING
F002	182.00	18.200	10			H				ICP MS
F003	236.00	23.600	10				BIASED HIGH*	3.33	0.1740	ICP MS
F009	99.00	9.900	10			L				ICP MS
F010	97.00	9.700	10							ICP OES
F011	166.50	16.650	10		H					ICP MS
F012	147.00	18.375	8							ICP MS
F014	209.00	26.125	8				BIASED HIGH*	0.26	2.1438	ICP MS
F015	77.00	7.700	10			L				ICPMS
F019	207.00	20.700	10	EH						ICP
F022	182.00	18.200	10	EHEHEH						ICP
F024	205.50	20.550	10	EL		H				ICP AES
F025	195.50	19.550	10							ICP
F026	103.50	10.350	10		VLL	L				ICP
F031	116.50	11.650	10							ICP
F032a	168.00	16.800	10							ICP AES
F032b	202.50	20.250	10							ICP MS
F037	68.00	6.800	10		L L		BIASED LOW	-5.17	-1.1225	ICP MS
F038	163.00	16.300	10							ICPMS
F042	47.00	6.714	7							ICP OES
F048	149.00	14.900	10							ICP MS
F064	29.00	2.900	10		L ELELVL		BIASED LOW	-11.68	0.3591	ICP AES(USN)
F065	238.50	23.850	10				BIASED HIGH*	2.99	0.1153	EPA 200.8
F069	84.00	9.333	9							ICP
F094	143.00	14.300	10							ICP/MS
F096	197.50	19.750	10							ICP AES
F133	181.00	18.100	10							ICP MS
F138	86.50	8.650	10							ICP MS
F139	110.00	22.000	5							ICP OES
F159	90.00	9.000	10	ELEL	EL	L				ASTM D 5673
F163	96.50	9.650	10							ICP AES

* NOTE: INDICATED BIAS STATEMENT IS FOR CAUTION ONLY AND NOT COUNTED IN STUDY STATISTICS
PERCENT SLOPE USED FOR CAUTION COMPARISON= 5.00

OVERALL AVERAGE
RANK IS 14.902

PARAMETER: 42095 Molybdenum ug/L

NATIONAL WATER RESEARCH INSTITUTE
ENVIRONMENT CANADA
BURLINGTON ONTARIO

NWRI Interlab QA for Trace Elements

LOWER LIMIT FOR USE OF BASIC ACCEPTABLE ERROR= 1.5000 BASIC ACCEPTABLE ERROR= 1.5000 CONCENTRATION ERROR INCREMENT= 0.0600

SAMPLE LAB NO	1= TMRAIN-95 REPORTED VALUE	2= TM-24 REPORTED VALUE	3= TM-27 REPORTED VALUE	4= TM-LNGLKEB REPORTED VALUE	5= TM-15 REPORTED VALUE	6= TM-25.2 REPORTED VALUE	7= TM-DWS REPORTED VALUE	8= TMDA-62 REPORTED VALUE	9= TMDA-51 REPORTED VALUE	10= TMDA-65 REPORTED VALUE
F002	0.27	3.25	2.23	0.37	12.6	25.5 L	71.2	99.9	95.7	411.
F003	0.107	3.63	2.28	0.13	13.9	29.9	72.1	101.	97.0	403.
F009	<0.1	3.7	2.3	0.1	14.	30.	73.	100.	98.	404.
F010	<2.	4.	2.	<2.	14.	29.	70.	98.	95.	387.
F011	0.2	3.8	2.4	0.2	13.5	29.2	67.0	94.6	91.1	382.
F012			6. EH		12.	29.	65.	97.	95.	424. H
F015	<0.05 EL	3.17	1.87	0.18	12.6	27.3	66.3	91.2	88.1	361. L
F019	<5.	<5.	<5.	<5.	14.	27.	65.	97.	91.	394.
F022	<2.	<2. EL	<2.	<2.	8. EL	22. EL	60. VL	100.	90.	387.
F024	<1.	1. EL	<1. EL	<1.	14.	28.	71.	98.	95.	392.
F025	<3.	3.7	2.5	<3.	13.3	29.3	69.3	100.	93.3	390.
F032a	<1.5	2.789	1.616 EL	<1.5	12.79	27.91	68.77	96.53	94.29	383.
F032b	0.2428	4.0132	2.5099	0.229	13.9002	29.882	71.1	100.221	96.8	392.
F038	0.17	3.57	2.22	0.19	13.4	27.9	69.6	99.1	95.0	390.
F048	<1.0	3.88	2.57	<1.0	13.70	29.41	69.99	98.01	95.08	387.48
F064	0.29	3.50	2.18	0.04	12.66	26.75	63.44 L	87.32 EL	82.86 VL	342.59 VL
F065	0.175	3.76	2.37	0.183	14.1	29.8	71.9	101.	96.2	378.
F069	<1.	3.433	2.400	<1.	13.333	29.000	69.400	99.067	95.733	394.500
F094	0.2	3.7	2.4	0.2	13.6	29.4	69.	97.1	93.	378.
F096	<1.	3.714	2.279	<1.	13.514	28.531	68.583	94.443	89.365	368.957
F133	<0.1	3.4	2.0	0.1	12.4	27.0	65.9	93.3	87.8 L	370.
F138	0.158	3.57	2.25	0.166	12.9	27.0	62.5 L	87.9 L	82.3 VL	346. VL
F139	<15.	15.8 EH	<15.	20.9 EH	<15.	32.7 H	83.8 EH	115.6 EH	104.4 H	385.2
F159	<1.	2.2 EL	2.5	<1.	14.9	31.9	46.8 EL	102.	101.	399.
MEDIAN	0.2000	3.6300	2.2900	0.1830	13.5000	29.0000	69.1500	98.0050	95.0000	387.2400
1CRIT	1.5000	1.6278	1.5474	1.5000	2.2200	3.1500	5.5590	7.2903	7.1100	24.6444
N	7	19	18	11	21	22	22	22	22	22
MEAN	0.2023	3.5147	2.2922	0.1862	13.3427	28.5765	68.1856	97.5169	93.4695	385.5971
3STDEV	0.1133	1.2663	0.5589	0.2111	1.8445	4.2412	9.9616	10.1384	11.8867	43.2520

LAB NO.	TOTAL RANK	AVERAGE RANK	NO.SAMPLES RANKED	SUMMARY OF FLAGGING	BIAS STATEMENT	BIAS % SLOPE	BIAS BLANK	METHOD CODING
F002	114.50	11.450	10	L				ICP MS
F003	148.50	14.850	10					ICP MS
F009	153.00	17.000	9					ICP MS
F010	108.50	13.562	8					ICP OES
F011	104.00	10.400	10					ICP MS
F012	86.50	12.357	7	EH H				ICP MS
F015	41.50	4.611	9	EL L	BIASED LOW	-6.78	0.1169	ICPMS
F019	63.50	10.583	6					ICP
F022	39.50	6.583	6	EL ELELVL				ICP
F024	90.00	12.857	7	ELEL				ICP AES
F025	110.00	13.750	8					ICP
F032a	58.00	7.250	8	EL				ICP AES
F032b	168.50	16.850	10					ICP MS
F038	103.50	10.350	10					ICPMS
F048	128.00	16.000	8					ICP MS
F064	40.00	4.000	10	L ELVLVL	BIASED LOW	-11.63	0.4647	ICP AES(USN)
F065	148.00	14.800	10					EPA 200.8
F069	109.00	13.625	8					GFAA
F094	110.50	11.050	10					ICP/MS
F096	72.00	9.000	8					ICP MS
F133	39.00	4.333	9	L	BIASED LOW*	-4.42	-0.5800	ICP MS
F138	45.50	4.550	10	L L VLVL	BIASED LOW	-10.79	0.1913	ICP MS
F139	140.00	20.000	7	EH EH H EHEHH	BIASED HIGH*	-4.11	14.8919	ICP OES
F159	131.50	16.438	8	EL EL				ASTM D 5673

* NOTE: INDICATED BIAS STATEMENT IS FOR CAUTION ONLY AND NOT COUNTED IN STUDY STATISTICS
PERCENT SLOPE USED FOR CAUTION COMPARISON= 5.00

OVERALL AVERAGE
RANK IS 11.422

PARAMETER: 28095 Nickel ug/L

NATIONAL WATER RESEARCH INSTITUTE
ENVIRONMENT CANADA
BURLINGTON ONTARIO

NWRI Interlab QA for Trace Elements

LOWER LIMIT FOR USE OF BASIC ACCEPTABLE ERROR= 1.5000 BASIC ACCEPTABLE ERROR= 1.5000 CONCENTRATION ERROR INCREMENT= 0.0600

SAMPLE LAB NO	1= TMRAIN-95 REPORTED VALUE	2= TM-24 REPORTED VALUE	3= TM-27 REPORTED VALUE	4= TM-LNGLKEB REPORTED VALUE	5= TM-15 REPORTED VALUE	6= TM-25.2 REPORTED VALUE	7= TM-DWS REPORTED VALUE	8= TMDA-62 REPORTED VALUE	9= TMDA-51 REPORTED VALUE	10= TMDA-65 REPORTED VALUE
F002	0.8	3.	2.8	101.	18.1	15.2	82.6	103.	84.3	420. H
F003	0.789	3.35	2.68	114.	18.9	16.3	81.8	103.	86.5	405.
F009	0.8	3.2	2.7	103.	17.	15.	77.	94.	80.	369.
F010	<0.8	2.7	22. EH	106.	17.5	14.9	78.	96.	82.	385.
F011	0.8	3.2	2.6	108.	17.6	15.1	79.4	94.5	80.0	389.
F012		5. EH	5. EH	127. EH	19.	15.	82.	99.	78.	415. H
F014	<5.	<5.	<5.	115. H	19.0	16.2	85.8 H	101.	87.4	414.
F015	0.76	3.42	2.55	104.	17.6	15.3	76.0	93.0	81.0	369.
F019	<10.	<10.	<10.	100.	20.	10. EL	80.	90.	80.	410.
F022	<2.	<2.	<2.	110.	18.	16.	80.	97.	83.	410.
F024	<1.	3.	2.	112.	19.	16.	83.	100.	86.	410.
F025	<1.	2.0	1.3	110.	19.3	13.0 L	82.7	104.	84.7	413.
F026	<2.00	5.3 EH	3.6	90.9 VL	20.6	17.9 H	70.0 VL	89.7 L	82.7	361.8 L
F032a	<2.0	3.186	2.349	109.4	18.98	15.5	80.39	97.76	82.96	393.6
F032b	0.7554	3.043	2.64	111.1	17.5271	15.9	79.2279	97.6144	81.0646	394.
F037	0.9246EH	3.202	2.699	107.0	19.18	16.09	77.14	94.26	76.04 L	368.0
F038	0.8	3.2	2.5	107.	18.2	16.0	78.5	99.0	85.3	390.
F042	<2.	2.89	2.32	101.	16.9	14.9	75.5	94.5	81.5	374.
F048	<1.0	3.71	2.61	104.61	17.98	16.18	80.64	99.87	84.14	399.35
F064	0.75	2.80	2.27	95.03 VL	16.21	13.99	71.43 L	86.56 L	72.98 VL	354.53 L
F065	0.775	3.59	2.92	113.	18.9	16.3	79.7	98.6	83.4	409.
F069	<1.	3.211	2.886	109.253	18.627	15.924	82.264	98.946	83.893	400.774
F094	0.7	2.9	2.4	100.	17.	14.2	73.8	90.4	76.1 L	361. L
F096	<8.	<8.	<8.	108.6	20.2	17.6	83.5	100.9	85.9	402.8
F131	0.66	3.15	2.66	107.45	18.44	15.41	80.89	97.35	84.45	388.49
F133	0.6 EL	3.2	2.4	113.0	18.0	15.2	79.4	98.4	81.8	397.
F138	0.74	2.83	2.46	98.4 L	16.9	14.0	71.0 L	88.3 L	74.0 L	355. L
F139	<40.	<40.	<40.	100.4	<40.	<40.	82.6	95.2	88.	385.5
F159	<1.	2.	2.7	107.	18.4	15.7	51. EL	93.7	85.	377.
F162	<2.4	2.8	2.6	96.71 L	17.4	15.2	74.5	90.4	75. L	342.7 VL
F163	<2.	3.2	2.6	103.	18.2	15.0	78.5	96.7	84.1	388.
F168	<0.5 EL	3.4	2.6	93.1 VL	20.6	16.4	68.1 VL	81. EL	72.4 VL	324. EL
F169	<1.	3.5	2.4	110.	18.8	16.7	87. H	105. H	75. L	411.
MEDIAN	0.7675	3.2000	2.6000	107.0000	18.3000	15.4550	79.4000	97.0000	82.7000	390.0000
1CRIT	1.5000	1.6020	1.5660	7.8300	2.5080	2.3373	6.1740	7.2300	6.3720	24.8100
N	12	25	26	31	29	30	31	31	31	31
MEAN	0.7608	3.2273	2.6902	105.7436	18.2977	15.4731	78.5607	96.2149	81.5557	388.4692
3STDEV	0.1272	1.3193	1.6195	17.0138	2.6120	2.7258	12.6738	13.2204	11.7291	60.3132

LAB NO.	TOTAL RANK	AVERAGE RANK	NO.SAMPLES RANKED	SUMMARY OF FLAGGING	BIAS STATEMENT	BIAS % SLOPE	BIAS BLANK	METHOD CODING
F002	195.50	19.550	10	H				ICP MS
F003	238.50	23.850	10					ICP MS
F009	112.50	11.250	10					ICP MS
F010	114.50	12.722	9	EH				ICP OES
F011	136.50	13.650	10					ICP MS
F012	210.50	23.389	9	EHEHEH H				ICP MS
F014	207.00	29.571	7	H H	BIASED HIGH	6.20	-0.0601	ICP MS
F015	116.00	11.600	10					ICPMS
F019	98.00	14.000	7	EL				ICP
F022	142.00	20.286	7					ICP
F024	200.50	22.278	9					ICP AES
F025	174.50	19.389	9	L				ICP
F026	148.50	16.500	9	EH VL H VLL L				ICP
F032a	158.00	17.556	9					ICP AES
F032b	154.00	15.400	10					ICP MS
F037	156.00	15.600	10	EH L				ICP MS
F038	175.00	17.500	10					ICPMS
F042	74.00	8.222	9					ICP OES
F048	184.00	20.444	9					ICP MS
F064	31.50	3.150	10	VL L L VLL	BIASED LOW	-9.14	-0.7086	ICP AES(USN)
F065	221.50	22.150	10					EPA 200.8
F069	197.00	21.889	9					ICP MS
F094	58.50	5.850	10	L L	BIASED LOW	-7.40	0.1011	ICP/MS
F096	193.00	27.571	7		BIASED HIGH*	2.93	0.9332	ICP AES
F131	166.00	16.600	10					ICP MS
F133	151.50	15.150	10	EL				ICP MS
F138	44.50	4.450	10	L L L L L	BIASED LOW	-8.97	-0.1379	ICP MS
F139	95.50	19.100	5					ICP OES
F159	123.00	13.667	9	EL				ASTM D 5673
F162	61.00	6.778	9	L L VL	BIASED LOW	-12.30	2.1677	GFAAS
F163	131.00	14.556	9					ICP AES
F168	103.00	11.444	9	EL VL VLELVLEL				GFAAS
F169	205.50	22.833	9	H H L				AAS GF

* NOTE: INDICATED BIAS STATEMENT IS FOR CAUTION ONLY AND NOT COUNTED IN STUDY STATISTICS
PERCENT SLOPE USED FOR CAUTION COMPARISON= 5.00

OVERALL AVERAGE
RANK IS 15.980

PARAMETER: 34095 Selenium ug/L

NATIONAL WATER RESEARCH INSTITUTE
ENVIRONMENT CANADA
BURLINGTON ONTARIO

NWRI Interlab QA for Trace Elements

LOWER LIMIT FOR USE OF BASIC ACCEPTABLE ERROR= 0.5000 BASIC ACCEPTABLE ERROR= 0.5000 CONCENTRATION ERROR INCREMENT= 0.0800

SAMPLE LAB NO	1= TMRAIN-95 REPORTED VALUE	2= TM-24 REPORTED VALUE	3= TM-27 REPORTED VALUE	4= TM-LNGLKEB REPORTED VALUE	5= TM-15 REPORTED VALUE	6= TM-25.2 REPORTED VALUE	7= TM-DWS REPORTED VALUE	8= TMDA-62 REPORTED VALUE	9= TMDA-51 REPORTED VALUE	10= TMDA-65 REPORTED VALUE
F003	0.7	3.7	4.1	0.7	14.1	27.1	30.7	47.1	10.4	201.
F009	0.7	3.1	3.7	0.8	14.	26.	28.	44. L	9.3	176.
F010	0.7	2.5 L	4.0	<0.2 L	14.8	29.	32.	52.	10.4	200.
F011	<1.	4.	4.1	<1.	16.	30.	33.	51.9	9.6	191.
F014	<1.5	3.4	4.1	<1.5	15.4	29.9	31.1	51.0	9.9	200.
F015	0.3	3.3	3.8	0.4	14.1	27.4	29.7	48.5	10.0	194.
F019	<2.	<2. VL	<2. EL	<2.	11. EL	25. L	23. VL	48.	6. EL	144. EL
F022	<5.	<5.	<5.	<5.	8. EL	25. L	23. VL	48.	7. VL	180.
F024	<5.	<5.	<5.	<5.	<5. EL	<5. EL	<5. EL	12. EL	<5. EL	160. VL
F025	2.1 VH	2.8	4.7	0.2 L	14.9	28.2	32.6	46.9	9.2	110. EL
F031	5. EH	8. EH	10. EH	8. EH	18. EH	28.	31.	52.	17. EH	191.
F032a	0.4	2.2 VL	3.7	0.1 L	14.1	26.0	30.2	46.9	9.4	180.3
F037	0.5922	3.57	4.222	0.881	15.31	28.0	31.19	48.44	9.095	184.0
F038	0.8	3.4	3.6	0.8	13.0 L	28.0	29.0	50.0	9.2	190.
F042	1.02	6.10 EH	5.60 VH	4.61 VH	16.3 H	29.2	32.0	50.9	11.9 VH	190.
F048	2.81 VH	4.70 VH	4.73	2.84 VH	15.42	29.70	33.06	51.88	10.64	197.45
F064	0.72	2.93	4.12	0.83	14.87	25.54	31.04	46.63	9.22	187.42
F065	0.593	3.57	4.03	0.816	14.2	27.4	29.1	48.2	9.48	194.
F069	<2.4	4.233 H	4.867 H	<2.4	14.633	27.967	30.567	49.433	10.500	200.333
F094	<0.4	2.7	3.6	<0.4	13.5	26.3	28.9	48.6	9.3	189.
F096	<1.	3.331	3.648	<1.	14.271	27.29	28.639	46.447	9.096	181.615
F133	<1.	3.	4.	<1.	15.	30.	34. H	58. EH	10.	207. H
F138	0.68	3.66	4.06	0.76	15.7	29.9	30.6	52.8	10.7	204.
F159	<1.	1.9 VL	4.	<1.	14.6	28.1	19.1 EL	45.8	10.2	197.
MEDIAN	0.7000	3.4000	4.0600	0.8000	14.6330	28.0000	30.6000	48.4700	9.6000	190.5000
1CRIT	0.5160	0.7320	0.7848	0.5240	1.6306	2.7000	2.9080	4.3376	1.2280	15.7000
N	12	19	18	11	21	19	21	22	21	22
MEAN	0.9846	3.4839	4.1932	1.2397	14.5335	27.8420	29.9236	48.8832	9.7396	187.8235
3STDEV	2.0615	2.5476	1.4327	3.7394	3.3545	3.8380	7.9071	7.0302	2.7775	41.3428

LAB NO.	TOTAL RANK	AVERAGE RANK	NO.SAMPLES RANKED	SUMMARY OF FLAGGING	BIAS STATEMENT	BIAS % SLOPE	BIAS BLANK	METHOD CODING
F003	114.50	11.450	10					Hydride, ICP OES
F009	54.00	5.400	10	L	BIASED LOW	-7.72	0.0369	ICP MS
F010	125.00	13.889	9	L L				Hydride AA
F011	140.00	17.500	8					ICP MS
F014	129.50	16.188	8					ICP MS
F015	87.50	8.750	10					ICPMS
F019	18.50	3.083	6	VLEL ELL VL ELEL	BIASED LOW	-24.82	2.5117	AA Hydride
F022	21.50	3.583	6	ELL VL VL	BIASED LOW*	-3.46	-3.2789	ICP
F024	4.00	2.000	2	ELELELELELVL	INSUFFICIENT DATA			ICP AES
F025	100.00	10.000	10	VH L EL				HAA
F031	177.00	17.700	10	EHEHEHEHEH EH	BIASED HIGH*	-2.64	4.5955	ICP
F032a	53.50	5.350	10	VL L	BIASED LOW	-5.13	-0.0501	HYD FAAS
F037	112.50	11.250	10					ICP MS
F038	85.50	8.550	10	L				HVAAS
F042	172.00	17.200	10	EHVHVHH VH				ICP OES
F048	178.00	17.800	10	VHVH VH	BIASED HIGH*	3.03	1.2454	ICP MS
F064	92.00	9.200	10					ICP AES(USN)
F065	99.50	9.950	10					EPA 200.8
F069	126.00	15.750	8	H H				GFAA
F094	54.00	6.750	8					ICP/MS
F096	51.00	6.375	8					ICP MS
F133	139.00	17.375	8	H EH H				ICP MS
F138	155.50	15.550	10					HG AFS
F159	72.00	9.000	8	VL EL				ASTM D 5673

* NOTE: INDICATED BIAS STATEMENT IS FOR CAUTION ONLY AND NOT COUNTED IN STUDY STATISTICS
PERCENT SLOPE USED FOR CAUTION COMPARISON= 5.00

OVERALL AVERAGE
RANK IS 11.301

PARAMETER: 47095 Silver ug/L

NATIONAL WATER RESEARCH INSTITUTE
ENVIRONMENT CANADA
BURLINGTON ONTARIO

NWRI Interlab QA for Trace Elements

LOWER LIMIT FOR USE OF BASIC ACCEPTABLE ERROR= 0.5000 BASIC ACCEPTABLE ERROR= 0.5000 CONCENTRATION ERROR INCREMENT= 0.0800

SAMPLE	1= TMRAIN-95	2= TM-24	3= TM-27	4= TM-LNGLKEB	5= TM-15	6= TM-25.2	7= TM-DWS	8= TMDA-62	9= TMDA-51	10= TMDA-65
LAB NO	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE
F002	0.28	0.48	0.79	<0.1	12.3	20.3	15.	12.9 H	18.3	27.6
F003	0.294	0.117	0.836	<0.005	12.3	22.3	14.8	12.0	17.3	26.8
F009	0.1	<0.1	0.8	<0.1	12.	22.	14.	11.	17.	21.
F010	0.2	0.2	0.9	0.1	12.4	22.9	14.6	11.3	17.2	14.2
F011	0.2	0.4	0.9	<0.1	12.0	22.3	14.4	11.6	17.1	25.8
F012					10. L	27. EH		9. VL	17.	7.
F015	<0.02 EL	<0.02	<0.02 EL	<0.02	8.47 EL	19.6 L	11.1 VL	7.92 VL	13.6 EL	21.8
F022	<2.	<2.	<2.	<2.	11.	22.	13.	8. VL	14. EL	3.
F024	<1.	<1.	<1.	<1.	10. L	21.	13.	10.	18.	28.
F025	<0.6	<0.6	0.9	<0.6	11.9	22.9	14.5	11.9	17.3	27.0
F032a	<0.6	<0.6	<0.6 EL	<0.6	11.5	21.41	13.34	10.68	16.39	24.6
F037	0.2664	0.384	0.8433	<0.2	12.06	20.93	13.58	10.98	15.9	9.67
F038	0.25	0.38	0.84	<0.01	12.2	23.5	15.2	12.4	18.9	13.8
F042	<2.	<2.	<2.	<2.	12.6	23.7	15.2	12.4	17.5	26.0
F048	<1.0	<1.0	<1.0	<1.0	12.42	23.39	14.85	11.73	17.68	9.60
F064	0.26	0.34	0.76	0.11	13.86 H	24.86 H	15.72	12.79 H	17.37	22.60
F065	0.278	0.108	0.740		11.6	21.6	13.8	11.0	16.6	24.0
F069	<1.	<1.	<1.	<1.	12.617	23.500	14.997	11.937	18.150	27.407
F094	0.4	0.3	0.7	<0.1	7.3 EL	16.4 EL	10. EL	9.2 VL	16.7	10.
F096	0.332	0.426	0.878	<0.1	11.69	21.373	13.759	10.892	16.388	24.179
F133	0.15	0.10	0.95	<0.05	12.65	23.3	15.20	12.40	17.95	14.65
F138	0.17	0.05	0.80	0.002	11.8	21.5	13.6	10.9	15.6	24.1
F159	<1.	<1.	<1.	<1.	12.1	24.	17. VH	12.5	18.9	28.
MEDIAN	0.2600	0.3200	0.8380	0.1000	12.0000	22.3000	14.4500	11.3000	17.2000	24.0000
1CRIT	0.5000	0.5000	0.5270	0.5000	1.4200	2.2440	1.6160	1.3640	1.8360	2.3800
N	11	10	12	1	21	21	20	21	20	20
MEAN	0.2437	0.2755	0.8323	0.1000	11.6956	22.3030	14.1823	11.1719	16.9714	20.0903
3STDEV	0.1610	0.3738	0.1589	-	3.0569	3.8736	3.1479	3.6888	2.9351	20.6144

LAB NO.	TOTAL RANK	AVERAGE RANK	NO.SAMPLES RANKED	SUMMARY OF FLAGGING	BIAS STATEMENT	BIAS % SLOPE	BIAS BLANK	METHOD CODING
F002	127.50	14.167	9	H				ICP MS
F003	113.50	12.611	9					ICP MS
F009	67.50	8.438	8					ICP MS
F010	100.00	10.000	10					ICP OES
F011	101.50	11.278	9					ICP MS
F012	41.00	8.200	5	L EH VL				ICP MS
F015	18.00	3.000	6	EL EL ELL VLVLEL	BIASED LOW	8.99	-4.6443	ICPMS
F022	24.00	4.000	6	VLEL	BIASED LOW	-88.99	9.9757	ICP
F024	58.50	9.750	6	L				ICP AES
F025	96.00	13.714	7					ICP
F032a	45.00	7.500	6	EL				ICP AES
F037	66.00	7.333	9					ICP MS
F038	122.00	13.556	9					ICPMS
F042	111.00	18.500	6		BIASED HIGH	7.85	-0.2991	ICP OES
F048	85.00	14.167	6					ICP MS
F064	134.00	13.400	10	H H H				ICP AES(USN)
F065	68.50	7.611	9					EPA 200.8
F069	111.50	18.583	6		BIASED HIGH	16.46	-1.5507	GFAA
F094	40.00	4.444	9	ELELELVL	BIASED LOW	-38.19	0.8380	ICP/MS
F096	81.00	9.000	9					ICP MS
F133	120.00	13.333	9					ICP MS
F138	58.50	5.850	10					ICP MS
F159	123.00	20.500	6	VH	BIASED HIGH	17.67	-1.1061	ASTM D 5673

OVERALL AVERAGE
RANK IS 10.687

PARAMETER: 38095 Strontium ug/L

NATIONAL WATER RESEARCH INSTITUTE
ENVIRONMENT CANADA
BURLINGTON ONTARIO

NWRI Interlab QA for Trace Elements

LOWER LIMIT FOR USE OF BASIC ACCEPTABLE ERROR= 2.5000 BASIC ACCEPTABLE ERROR= 2.5000 CONCENTRATION ERROR INCREMENT= 0.0600

SAMPLE LAB NO	1= TMRAIN-95 REPORTED VALUE	2= TM-24 REPORTED VALUE	3= TM-27 REPORTED VALUE	4= TM-LNGLKEB REPORTED VALUE	5= TM-15 REPORTED VALUE	6= TM-25.2 REPORTED VALUE	7= TM-DWS REPORTED VALUE	8= TMDA-62 REPORTED VALUE	9= TMDA-51 REPORTED VALUE	10= TMDA-65 REPORTED VALUE
F002	2.06	97.6 L	50.3	58.4	72.2	65.3	343.	123.	123.	415.
F003	1.67	114.	50.5	62.4	74.0	72.6	339.	121.	124.	400.
F009	1.6	103.	47.	51. L	62. L	68.	317.	112.	114.	371.
F010	1.7	111.	506. EH	59.5	71.9	70.3	327.	118.	122.	390.
F011	1.7	109.	49.4	59.2	69.7	69.4	329.	118.	122.	386.
F012		98. L		59.	67.	65.	317.	123.	125.	427. H
F015	1.65	103.	47.0	56.9	67.5	68.0	316.	111.	114.	381.
F022	<5.	114.	50.	60.	75.	70.	339.	120.	129.	396.
F024	1.	121. H	55. H	66. H	80. H	79. H	368. VH	130. H	137. VH	436. VH
F025	<2.	107.	49.3	58.7	69.3	72.3	342.	122.	126.	405.
F032a	1.506	106.1	48.32	57.8	69.98	68.26	314.2	113.2	119.3	370.4
F032b	1.7751	116.0382	51.6	57.3642	72.1	73.6534	336.5918	122.4682	126.1545	405.
F038	1.7	110.	48.0	58.0	72.0	68.5	320.	115.	120.	385.
F048	1.22	111.1	49.75	60.53	72.05	71.98	331.80	119.78	123.31	391.80
F064	1.61	93.22 VL	41.66 L	49.33 VL	62.18 L	61.55 L	284.56 VL	100.69 EL	101.72 EL	339.35 VL
F065	1.74	114.	51.2	63.1	73.7	72.1	330.	118.	121.	402.
F069	1.650	110.367	49.533	59.680	71.497	71.033	331.700	118.833	121.967	391.600
F094	3.3 EH	107.	48.5	57.9	70.3	69.1	315.	116.	119.	374.
F096	1.5	102.	46.1	55.2	67.1	66.5	311.9	110.8	113.7	363.4 L
F133	1.65	113.0	48.7	62.0	71.3	70.1	325.	119.2	119.5	390.
F138	1.53	106.	45.2	54.0	61.7 L	62.2 L	298. L	104. L	99.3 EL	351. VL
F139	<5.0	108.1	41.2 L	52.2 L	66.5	64.9	340.9	113.	119.1	410.1
F159	1.1	62.6 EL	46.5	57.5	73.1	76. H	211. EL	119.	126.	361. L
MEDIAN	1.6500	108.1000	49.0000	58.4000	71.3000	69.4000	327.0000	118.0000	121.9670	390.0000
1CRIT	2.5000	8.8360	5.2900	5.8540	6.6280	6.5140	21.9700	9.4300	9.6680	25.7500
N	17	21	20	21	21	21	21	21	21	21
MEAN	1.6095	107.3107	48.6782	58.1131	70.0194	69.2965	324.2215	117.0134	120.4644	388.8714
3STDEV	0.6178	17.7982	8.0592	8.9776	10.3724	9.7349	43.9247	14.3232	17.4264	55.9329

LAB NO.	TOTAL RANK	AVERAGE RANK	NO.SAMPLES RANKED	SUMMARY OF FLAGGING	BIAS STATEMENT	BIAS % SLOPE	BIAS BLANK	METHOD CODING
F002	152.50	15.250	10	L				ICP MS
F003	181.50	18.150	10		BIASED HIGH*	2.78	0.7834	ICP MS
F009	55.50	5.550	10	L L	BIASED LOW*	-3.68	-1.9891	ICP MS
F010	145.00	14.500	10	EH				ICP OES
F011	123.50	12.350	10					ICP MS
F012	97.00	12.125	8	L H				ICP MS
F015	67.00	6.700	10					ICPMS
F022	161.50	17.944	9					ICP
F024	206.00	20.600	10	H H H H H VHH VHVH	BIASED HIGH	12.09	-0.0829	ICP AES
F025	140.50	15.611	9					ICP
F032a	76.00	7.600	10					ICP AES
F032b	180.50	18.050	10		BIASED HIGH*	3.51	0.1745	ICP MS
F038	109.00	10.900	10					ICPMS
F048	149.00	14.900	10					ICP MS
F064	23.00	2.300	10	VLL VLL L VLELELVL	BIASED LOW	-12.86	-0.9849	ICP AES(USN)
F065	168.00	16.800	10					EPA 200.8
F069	138.00	13.800	10					ICP
F094	99.50	9.950	10	EH				ICP/MS
F096	44.00	4.400	10	L	BIASED LOW	-6.03	0.2678	ICP AES
F133	131.50	13.150	10					ICP MS
F138	32.00	3.200	10	L L L L ELVL	BIASED LOW	-9.57	-0.6058	ICP MS
F139	76.00	8.444	9	L L				ICP OES
F159	94.50	9.450	10	EL H EL L				ASTM D 5673

* NOTE: INDICATED BIAS STATEMENT IS FOR CAUTION ONLY AND NOT COUNTED IN STUDY STATISTICS
PERCENT SLOPE USED FOR CAUTION COMPARISON= 5.00

OVERALL AVERAGE
RANK IS 11.782

PARAMETER: 81095 Thallium ug/L

NATIONAL WATER RESEARCH INSTITUTE
ENVIRONMENT CANADA
BURLINGTON ONTARIO

NWRI Interlab QA for Trace Elements

LOWER LIMIT FOR USE OF BASIC ACCEPTABLE ERROR= 0.7500 BASIC ACCEPTABLE ERROR= 0.7500 CONCENTRATION ERROR INCREMENT= 0.0800

SAMPLE	1= TMRAIN-95	2= TM-24	3= TM-27	4= TM-LNGLKEB	5= TM-15	6= TM-25.2	7= TM-DWS	8= TMDA-62	9= TMDA-51	10= TMDA-65
LAB NO	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE
F003	0.337	0.021	0.026	0.221	17.9	30.5	8.64	52.2	0.021	207.
F011	0.3	<0.1	<0.1	<0.1	16.4	28.6	7.9	48.4	<0.1	194.
F012					17.	27.	36. EH	49.	68. VH	193.
F014	<1.0	<1.0	<1.0	<1.0	18.1	30.7	8.6	51.3	<1.0	204.
F015	0.320	0.065	0.079	0.054	17.9	30.7	8.83	51.1	0.108	206.
F025	0.4 EH	<0.4	<0.4	<0.4	16.5	28.5	8.1	46.5 EL	0.8	180. L
F038	0.34	<0.05	<0.05	<0.05	17.4	29.4	8.76	50.1	<0.05	202.
F042	<10.	<10.	<10.	<10.	22.8 EH	34.4 EH	10.3 EH	56.2 EH	<10.	175. L
F048	<1.0	<1.0	<1.0	<1.0	16.88	29.49	7.74	49.80	<1.0	199.22
F064	<0.1 EL	<0.1	<0.1	<0.1	11.54 EL	27.26	3.43 EL	49.42	<0.1	176.59 L
F065	0.319				17.4	29.8	8.31	50.3	65.6 VH	205.
F069	<0.9	<0.9	<0.9	<0.9	17.849	30.209	8.533	50.300	<0.9	207.724
F094	0.37	<0.05	<0.05	<0.05	17.5	30.	8.48	50.8	0.06	199.
F096	0.328	<0.1	<0.1	<0.1	17.33	29.88	8.304	49.566	<0.1	191.555
F133	0.25 EL	<0.05	<0.05	<0.05	17.10	29.7	8.30	51.2	0.05	205.
F138	0.33	0.001	0.001	0.003	17.4	29.7	8.13	49.6	0.002	194.
MEDIAN	0.3290	0.0210	0.0260		17.4000	29.7500	8.3950	50.2000	0.0840	199.1100
1CRIT	0.7500	0.7500	0.7500	0.7500	2.0820	3.0700	1.3616	4.7060	0.7500	16.6188
N	8	1	1	1	14	14	14	14	6	14
MEAN	0.3305	0.0210	0.0260	0.0540	17.3328	29.6028	8.4948	50.2204	11.1065	196.8832
3STDEV	0.0568	-	-	-	1.4944	2.7351	1.7559	2.9583	73.1152	27.3191

LAB NO.	TOTAL RANK	AVERAGE RANK	NO.SAMPLES RANKED	SUMMARY OF FLAGGING	BIAS STATEMENT	BIAS % SLOPE	BIAS BLANK	METHOD CODING
F003	84.50	8.450	10					
F011	19.50	3.250	6		BIASED LOW*	-2.42	-0.3647	ICP MS
F012	38.00	6.333	6	EH VH				ICP MS
F014	65.50	13.100	5		BIASED HIGH*	2.39	0.1139	ICP MS
F015	85.00	8.500	10					
F025	30.00	4.286	7	EH EL L				ICPMS
F038	53.00	8.833	6					ICPMS
F042	64.00	12.800	5	EHEHEHEH L	BIASED HIGH	-15.61	8.2839	ICP OES
F048	28.00	5.600	5					ICP MS
F064	10.00	2.000	5	EL EL EL L	BIASED LOW	-10.10	-1.1650	ICP AES(USN)
F065	58.00	8.286	7	VH				EPA 200.8
F069	59.50	11.900	5		BIASED HIGH*	4.62	-0.8656	
F094	63.00	9.000	7					ICP/MS
F096	38.00	6.333	6					ICP MS
F133	49.00	7.000	7	EL				ICP MS
F138	44.00	4.400	10					ICP MS

* NOTE: INDICATED BIAS STATEMENT IS FOR CAUTION ONLY AND NOT COUNTED IN STUDY STATISTICS
PERCENT SLOPE USED FOR CAUTION COMPARISON= 10.00

OVERALL AVERAGE
RANK IS 7.374

PARAMETER: 92095 Uranium ug/L

NATIONAL WATER RESEARCH INSTITUTE
ENVIRONMENT CANADA
BURLINGTON ONTARIO

NWRI Interlab QA for Trace Elements

LOWER LIMIT FOR USE OF BASIC ACCEPTABLE ERROR= 0.5000 BASIC ACCEPTABLE ERROR= 0.5000 CONCENTRATION ERROR INCREMENT= 0.0600

SAMPLE	1= TMRAIN-95	2= TM-24	3= TM-27	4= TM-LNGLKEB	5= TM-15	6= TM-25.2	7= TM-DWS	8= TMDA-62	9= TMDA-51	10= TMDA-65
LAB NO	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE	REPORTED VALUE
F003	0.26	0.088	3.03	0.137	14.8	27.6	139.	53.5	32.6	212.
F009	0.3	<0.1	2.9	0.1	14.	27.	137.	52.	31.	209.
F010	<5.	<5.	<5.	<5.	14.	21. EL	134.	52.	30.	198.
F011	0.2 EL	0.1	2.7	0.1	13.4	25.6	131.	48.7	28.7 L	188. VL
F012					13. L	24. VL	138.	51.	30.	20. EL
F014	<0.5	<0.5	3.0	<0.5	15.3	28.5	149. VH	53.0	32.8	225. H
F015	0.255	0.085	3.04	0.136	15.0	27.8	135.	50.8	32.3	210.
F022	<50.	<50.	<50.	<50.	<50.	50. EH	137.	<50.	<50.	208.
F024	<0.5	<0.5	2.9	<0.5	15.	28.	123. VL	44. EL	32.	197.
F025	<0.8	<0.8	2.6	<0.8	13.1 L	24.8 L	122. VL	48.5	28.9 L	180. VL
F038	0.30	0.09	3.10	0.13	14.9	27.1	139.	54.8	32.9	214.
F048	<1.0	<1.0	2.53	<1.0	14.68	27.42	135.24	52.33	31.30	207.76
F064	0.41 EH	0.55 EH	3.46 EH	1.19 EH	16.11 H	28.40	138.28	53.61	32.76	211.74
F065	0.254	0.0914	3.10	0.139	15.2	28.1	138.	53.3	32.4	215.
F069	<1.	<1.	2.968	<1.	14.624	26.724	137.635	50.935	30.270	211.079
F094	0.3	<0.1	3.	0.1	14.9	27.7	136.	53.1	32.1	204.
F096	0.252	0.093	3.06	0.145	15.168	28.224	128.647	52.704	31.516	203.625
F133	0.25	0.05 EL	2.90	0.10	14.70	27.6	136.0	53.1	31.3	207.
F138	0.246	0.085	2.98	0.135	14.7	27.0	133.	49.6	30.0	197.
F159	<1.	<1.	2.7	<1.	12.8 L	23.6 VL	78.4 EL	47.1 L	26.8 EL	171. VL
MEDIAN	0.2550	0.0900	2.9800	0.1350	14.7000	27.5100	136.0000	52.0000	31.3000	207.3800
1CRIT	0.5000	0.5000	0.6488	0.5000	1.3520	2.1206	8.6300	3.5900	2.3480	12.9128
N	9	7	15	10	17	18	18	17	17	18
MEAN	0.2686	0.0903	2.9319	0.1222	14.4984	26.9538	134.3223	51.4870	31.1733	202.4558
3STDEV	0.0675	0.0145	0.4436	0.0554	2.1256	4.3216	14.8977	5.7557	3.8450	35.4072

LAB NO.	TOTAL RANK	AVERAGE RANK	NO.SAMPLES RANKED	SUMMARY OF FLAGGING	BIAS STATEMENT	BIAS % SLOPE	BIAS BLANK	METHOD CODING
F003	122.00	12.200	10					ICP MS
F009	73.50	8.167	9					ICP MS
F010	35.00	5.833	6	EL				ICP AES
F011	39.00	3.900	10	EL L VL	BIASED LOW	-7.81	0.3045	ICP MS
F012	34.50	5.750	6	L VL EL				ICP MS
F014	118.50	16.929	7	VH H	BIASED HIGH	9.36	-1.3480	ICP MS
F015	99.00	9.900	10					
F022	44.50	14.833	3	EH	INSUFFICIENT DATA			ICP
F024	57.00	8.143	7	VLEL				Phosphorimetry
F025	20.00	2.857	7	L L VL L VL	BIASED LOW	-12.91	1.2770	ICPMS
F038	130.50	13.050	10					ICPMS
F048	59.50	8.500	7					ICP MS
F064	153.00	15.300	10	EHEHEHEHH	BIASED HIGH*	1.65	0.6387	Fluoro ICP AES
F065	134.00	13.400	10					EPA 200.8
F069	64.00	9.143	7					ICP MS
F094	94.50	10.500	9					ICP/MS
F096	103.00	10.300	10					ICP MS
F133	78.00	7.800	10	EL				ICP MS
F138	58.00	5.800	10					ICP MS
F159	12.50	1.786	7	L VLELL ELVL	BIASED LOW	-24.83	1.0980	ASTM D 5673

* NOTE: INDICATED BIAS STATEMENT IS FOR CAUTION ONLY AND NOT COUNTED IN STUDY STATISTICS
PERCENT SLOPE USED FOR CAUTION COMPARISON= 5.00

OVERALL AVERAGE
RANK IS 9.273

PARAMETER: 23095 Vanadium ug/L

NATIONAL WATER RESEARCH INSTITUTE
ENVIRONMENT CANADA
BURLINGTON ONTARIO

NWRI Interlab QA for Trace Elements

LOWER LIMIT FOR USE OF BASIC ACCEPTABLE ERROR= 1.5000 BASIC ACCEPTABLE ERROR= 1.5000 CONCENTRATION ERROR INCREMENT= 0.0600

SAMPLE LAB NO	1= TMRAIN-95 REPORTED VALUE	2= TM-24 REPORTED VALUE	3= TM-27 REPORTED VALUE	4= TM-LNGLKEB REPORTED VALUE	5= TM-15 REPORTED VALUE	6= TM-25.2 REPORTED VALUE	7= TM-DWS REPORTED VALUE	8= TMDA-62 REPORTED VALUE	9= TMDA-51 REPORTED VALUE	10= TMDA-65 REPORTED VALUE
F002	1.02	6.6	0.7	0.8	12.8	24.7	49.4 H	109.	81.3	396. H
F003	0.624	7.20	0.664	0.099	13.0	26.8	48.9	113.	83.3	379.
F009	0.7	6.8	0.6	<0.1	12.	26.	45.	106.	79.	351.
F010	5.5 EH	6.6	0.4	<0.3	11.9	25.	44.	107.	80.	363.
F011	0.6	6.7	0.6	<0.1	12.3	26.4	45.1	105.	79.8	370.
F012	7. EH	7.		6. EH	15. EH	23. L	54. EH	121. EH	82.	416. EH
F014	1.5	7.2	<1.0	<1.0	13.3	27.2	47.4	110.	83.1	371.
F015	0.64	6.49	0.52	<0.05	11.7	24.4	42.4	102.	77.6	346.
F019	<5.	8.	<5.	<5.	13.	28.	45.	105.	81.	367.
F022	2.	5.	1.	<1.	11.	24.	44.	110.	70. VL	370.
F024	<1.	4. EL	<1.	<1.	13.	26.	46.	110.	82.	381.
F025	<2.	7.0	<2.	<2.	12.7	26.0	45.0	109.7	81.7	375.
F032a	<1.0	6.735	<1.0	<1.0	12.5	25.79	45.3	106.8	81.47	366.9
F032b	0.6692	6.7225	0.597	0.127	12.5716	27.5654	47.0309	105.6695	78.8	324.8623VL
F038	<1.	7.	<1.	<1.	13.	25.	45.	107.	80.	370.
F042	<5.	6.75	<5.	<5.	12.3	26.3	44.5	107.	79.3	361.
F048	<1.0	6.25	<1.0	<1.0	12.19	26.62	46.75	110.58	82.36	376.34
F064	0.58	5.93	0.55	0.03	11.32	23.81	41.47	95.86 EL	69.79 VL	334.71 L
F065	0.571	7.03	0.646	0.0121	13.3	27.7	47.1	112.	83.1	378.
F069	<10.	<10.	<10.	<10.	12.053	25.077	44.710	105.500	77.255	359.933
F094	0.6	6.6	0.6	<0.1	12.1	26.4	44.2	108.	79.9	358.
F096	<3.	7.30	<3.	<3.	13.40	28.	46.40	108.50	81.90	368.6
F133	<1.	7.	<1.	<1.	12.	26.	45.	110.	82.	376.
F138	0.64	6.37	0.57	0.47	11.7	24.4	41.6	98.0 L	70.3 VL	329. VL
F139	<10.	<10.	<10.	<10.	13.8	30.6 EH	43.4	105.6	83.6	366.4
F159	1.7	4.9 L	1.3 EH	1.1	13.7	28.3	30.9 EL	109.3	86.	379.8
MEDIAN	0.6692	6.7288	0.6000	0.2985	12.5358	26.0000	45.0000	107.5000	81.1500	369.3000
1CRIT	1.5000	1.8137	1.5000	1.5000	2.1621	2.9700	4.1100	7.8600	6.2790	23.5680
N	13	22	11	6	24	24	24	24	24	24
MEAN	1.2902	6.5990	0.6406	0.4377	12.5681	26.0609	45.1942	107.5271	80.0327	366.4034
3STDEV	3.9019	1.8345	0.3706	1.1927	1.9665	3.8690	5.8224	9.5662	10.2895	43.7418

LAB NO.	TOTAL RANK	AVERAGE RANK	NO.SAMPLES RANKED	SUMMARY OF FLAGGING	BIAS STATEMENT	BIAS % SLOPE	BIAS BLANK	METHOD CODING
F002	138.00	13.800	10	H H				ICP MS
F003	172.00	17.200	10					ICP MS
F009	84.00	9.333	9					ICP MS
F010	75.50	8.389	9	EH				ICP OES
F011	94.00	10.444	9					ICP MS
F012	164.50	18.278	9	EH EHEHL EHEH EH				ICP MS
F014	157.00	19.625	8		BIASED HIGH*	0.24	1.2844	ICP MS
F015	39.50	4.389	9		BIASED LOW	-6.27	0.3319	ICPMS
F019	108.50	15.500	7					ICP
F022	76.00	8.444	9	VL				ICP
F024	113.50	16.214	7	EL				ICP AES
F025	110.00	15.714	7					ICP
F032a	89.00	12.714	7					ICP AES
F032b	100.00	10.000	10	VL				ICP MS
F038	95.00	13.571	7					ICPMS
F042	77.50	11.071	7					ICP OES
F048	117.00	16.714	7					ICP MS
F064	22.00	2.200	10	ELVLL	BIASED LOW	-9.47	-0.4183	ICP AES(USN)
F065	164.00	16.400	10					EPA 200.8
F069	44.00	7.333	6					ICP
F094	83.00	9.222	9					ICP/MS
F096	133.50	19.071	7					ICP AES
F133	108.00	15.429	7					ICP MS
F138	39.50	3.950	10	L VLVL	BIASED LOW	-10.99	0.4649	ICP MS
F139	98.00	16.333	6	EH				ICP OES
F159	150.00	15.000	10	L EH EL				ASTM D 5673

* NOTE: INDICATED BIAS STATEMENT IS FOR CAUTION ONLY AND NOT COUNTED IN STUDY STATISTICS
PERCENT SLOPE USED FOR CAUTION COMPARISON= 5.00

OVERALL AVERAGE
RANK IS 12.282

PARAMETER: 30095 Zinc ug/L

NATIONAL WATER RESEARCH INSTITUTE
ENVIRONMENT CANADA
BURLINGTON ONTARIO

NWRI Interlab QA for Trace Elements

LOWER LIMIT FOR USE OF BASIC ACCEPTABLE ERROR= 2.0000 BASIC ACCEPTABLE ERROR= 2.0000 CONCENTRATION ERROR INCREMENT= 0.0800

SAMPLE LAB NO	1= TMRAIN-95 REPORTED VALUE	2= TM-24 REPORTED VALUE	3= TM-27 REPORTED VALUE	4= TM-LNGLKEB REPORTED VALUE	5= TM-15 REPORTED VALUE	6= TM-25.2 REPORTED VALUE	7= TM-DWS REPORTED VALUE	8= TMDA-62 REPORTED VALUE	9= TMDA-51 REPORTED VALUE	10= TMDA-65 REPORTED VALUE
F002	13.	14.2	23.9	7.34	25.4	35.4	373.	120. H	101.	401.
F003	13.6	15.3	23.5	9.46	24.2	38.7	384.	115.	95.4	398.
F009	12.	14.	22.	6.6	21.	33.	320. VL	98.	86.	321. EL
F010	12.	12.	19.	<5. L	18. L	25. EL	380.	108.	78. VL	385.
F011	11.	13.	21.	<10.	23.	34.	368.	104.	89.	368.
F012	12.	13.	20.	9.	20.	30. L	402.	114.	92.	396.
F014	11.7	14.9	20.9	8.7	22.7	36.7	363.	113.	97.8	394.
F015	11.2	13.9	19.8	7.2	21.7	35.1	334. L	108.	91.5	379.
F019	12.	16.	23.	9.	23.	36.	389.	115.	96.	406.
F022	12.	15.	22.	8.	24.	35.	399.	115.	98.	407.
F024	12.	15.	23.	8.	24.	37.	392.	116.	98.	402.
F025	10.7	12.7	19.6	6.3	19.4	35.7	394.	116.	96.	404.
F026	12.8	14.0	23.9	9.0	21.6	33.4	327.7 L	100.1	92.2	353.1
F031	11.	13.	21.	6.	20.	32.	373.	107.	96.	363.
F032a	10.56	13.93	22.35	7.264	22.6	34.7	370.6	108.1	92.72	373.9
F032b	12.6804	15.2838	23.9984	8.4706	24.3036	37.297	378.9097	108.1	93.6	374.
F037	11.65	12.64	21.81	5.636	21.86	34.5	383.0	106.0	87.56	370.0
F038	13.	15.	23.	7.	23.	37.	379.	110.	94.	373.
F042	11.3	13.3	20.8	7.14	20.0	32.2	329. L	99.2	84.5	334. L
F048	13.54	16.6	25.71	8.62	25.03	40.87 H	391.70	119.27 H	110.11 EH	405.16
F064	11.01	13.41	20.90	7.11	21.62	33.55	351.15	101.97	84.29	353.37
F065	12.0	14.7	22.8	7.92	23.4	36.3	368.	111.	92.3	395.
F069	<20.	<20.	23.243	<20.	25.427	35.803	390.833	114.200	93.977	393.833
F094	11.	17.	20.	6.	21.	33.	351.	107.	87.	360.
F096	11.433	13.668	21.72	6.955	21.458	33.917	344.68	103.217	86.621	358.503
F131	11.35	13.99	22.28	7.87	22.17	34.34	376.05	105.7	91.59	378.64
F133	13.0	16.0	24.0	9.5	27.5 H	38.5	394.	117.0	99.0	412. H
F138	13.0	15.7	24.1	7.55	23.2	34.4	363.	95.0 L	84.5	353.
F159	8.4 EL	7.9 EL	21.4	6.6	21.1	32.9	235. EL	98.6	88.4	354.6
F162	<94.	<94.	<94.	<94.	<94.	<94.	358.9	115.3	102.3 H	375.8
F163	12.8	14.6	23.0	7.85	22.4	35.1	369.	110.	94.7	378.
F167	9.9	16.	24.5	11.1 H	28.1 EH	39.1	376.1	123.1 H	99.9	385.8
F169	<10.	17.	23.	11. H	23.	36.	354.	104.	91.	372.
MEDIAN	12.0000	14.2000	22.3150	7.8500	22.6500	35.0500	373.0000	108.1000	92.7200	378.0000
1CRIT	2.8000	2.9760	3.6252	2.4680	3.6520	4.6440	31.6800	10.4880	9.2576	32.0800
N	28	28	30	27	30	30	31	31	31	31
MEAN	11.8437	14.3151	22.2167	7.8315	22.6356	35.0202	368.5685	109.2825	92.8019	378.8615
3STDEV	2.6392	3.5138	4.2083	3.5123	5.4628	6.1515	62.6205	18.4821	14.9239	57.2241

LAB NO.	TOTAL RANK	AVERAGE RANK	NO.SAMPLES RANKED	SUMMARY OF FLAGGING	BIAS STATEMENT	BIAS % SLOPE	BIAS BLANK	METHOD CODING
F002	237.50	23.750	10	H				ICP MS
F003	259.00	25.900	10		BIASED HIGH*	3.88	0.9889	ICP MS
F009	75.50	7.550	10	VL EL	BIASED LOW	-15.19	2.9598	ICP MS
F010	81.50	9.056	9	L L EL VL				ICP OES
F011	94.00	10.444	9					ICP MS
F012	152.50	15.250	10	L				ICP MS
F014	186.00	18.600	10					ICP MS
F015	114.00	11.400	10	L				ICPMS
F019	238.00	23.800	10					ICP
F022	229.00	22.900	10					ICP
F024	242.50	24.250	10					ICP AES
F025	148.00	14.800	10					ICP
F026	133.50	13.350	10	L				ICP
F031	94.00	9.400	10					ICP
F032a	138.50	13.850	10					ICP AES
F032b	218.50	21.850	10					ICP MS
F037	111.00	11.100	10					ICP MS
F038	196.00	19.600	10					ICPMS
F042	55.50	5.550	10	L L	BIASED LOW	-11.91	1.2517	ICP OES
F048	293.00	29.300	10	H H EH	BIASED HIGH	5.64	3.0651	ICP MS
F064	74.50	7.450	10		BIASED LOW	-6.19	-0.1514	ICP AES(USN)
F065	191.50	19.150	10					EPA 200.8
F069	166.00	23.714	7					ICP
F094	91.00	9.100	10					ICP/MS
F096	86.00	8.600	10					ICP MS
F131	142.00	14.200	10					ICP MS
F133	292.00	29.200	10	H H	BIASED HIGH	7.07	0.9245	ICP MS
F138	149.50	14.950	10	L				ICP MS
F159	50.50	5.050	10	ELEL EL	BIASED LOW	-21.78	4.1117	ASTM D 5673
F162	85.00	21.250	4	H	INSUFFICIENT DATA			FAAS
F163	180.50	18.050	10					ICP AES
F167	256.00	25.600	10	H EH H	BIASED HIGH*	0.86	3.8545	AAS, GFAAS
F169	162.00	18.000	9	H				AAS Flame

* NOTE: INDICATED BIAS STATEMENT IS FOR CAUTION ONLY AND NOT COUNTED IN STUDY STATISTICS
PERCENT SLOPE USED FOR CAUTION COMPARISON= 5.00

OVERALL AVERAGE
RANK IS 16.428

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