LAW OFFICES
SHORT CRESSMAN & BURGESS PLLC

999 THIRD AVENUE, SUITE 3000
SEATTLE, WASHINGTON 98104-4088
FAX: (206) 340-8856
(206) 682-3333

[illegible]CIA BAUGHER
[illegible]D E. BRESKIN
KERRY S. BUCKLIN ★
JOHN O. BURGESS
SAMUEL S. CHUNG
BRYAN P. COLUCCIO
BRIAN L. COMSTOCK
STEPHEN P. CONNOR
JEFFREY A. COOP †††
PAUL R. CRESSMAN, JR.
PAUL R. CRESSMAN, SR. P.S.
DEREK D. CRICK
MICHAEL J. CRISERA
PAUL J. DAYTON
WILLIAM L. DIXON V
RICHARD A. DUBEY ◊◊
BRADLEY A. EVENS
CHRIS FARIAS
MICHAEL K. GARNER ◊
CHRISTINA A. GERRISH
DAVID A. HERRMAN
DANIELLE JOHNSON
CLAUDIA KILBREATH
DAVID R. KOOPMANS
ANDREW W. MARON • • •
CONNIE SUE MANOS MARTIN
ROBIN G. McPHERSON
SCOTT M. MISSALL
MAUREEN L. MITCHELL
KENNETH L. MYER
MARK S. NADLER
JAMES A. OLIVER
CHRISTOPHER R. OSBORN
ALEX J. ROSE
HEATHER M. ROY ‡‡
ANNE MARIE F. SARGENT
SCOTT A. SMITH
THANE D. SOMERVILLE
JOHN D. SULLIVAN
ELIZABETH A. C. THOMPSON †

SUSAN THORBROGGER
BRADLEY P. THORESON
PAUL R. WILLETT •
LISA A. WOLFARD
ZACHARY A. WRIGHT

BRUCE A. COHEN • •
DOUGLAS R. HARTWICH
ROBERT E. HEATON
JOHN J. HOULIHAN, JR. ‡
VINCENT T. LOMBARDI ★★
KENDALL H. MOORE
KENNETH P. SHORT
ROBERT A. STEWART
OF COUNSEL

ROBERT J. SHAW (1942-2000)

★ MEMBER OF PATENT BAR, USPTO
★★ ALSO ADMITTED IN ALASKA
‡ ALSO ADMITTED IN CALIFORNIA AND ILLINOIS
‡‡ ALSO ADMITTED IN OREGON
• ALSO ADMITTED IN FLORIDA AND IDAHO
• • ALSO ADMITTED IN VIRGINIA
• • • ALSO ADMITTED IN SOUTH CAROLINA
† ADMITTED IN HAWAII AND DISTRICT OF COLUMBIA ONLY
††† ALSO ADMITTED IN MONTANA
◊ ALSO ADMITTED IN HAWAII
◊◊ ALSO ADMITTED IN MASSACHUSETTS

June 10, 2002

HAND DELIVERED

Elizabeth McKenna
Assistant Legal Counsel
US EPA, Region 10
1200 - 6th Avenue
Seattle, WA 98101

Re: **Submission of Soil Metals Analysis Regarding Lake Roosevelt and the Upper Columbia River Basin (Canadian Section)**

Dear Elizabeth:

Thank you for taking the time on May 21, 2002 to write and inform me, on behalf of the Confederated Tribes of the Colville Indian Reservation (Tribes), that EPA may use the data obtained by the Tribes to establish site related "background" concentrations. We are again writing to you, in our capacity as Special Environmental Counsel to the Tribes and on behalf of the Tribes' Office of Environmental Trust, to provide EPA with the additional data requested by EPA which relates to the Tribes' sampling and analysis effort to date.

Accordingly, by this letter, the Tribes are formally providing EPA with the requested additional data, previously collected by the Tribes, which relates to the sampling data obtained by the Tribes in the Columbia River and Lower Arrow Lake in British Columbia, Canada.

The Tribes are submitting this additional data to EPA so that EPA will also have the use of valid background sampling data from the Columbia River north of the international border. As EPA was previously informed, this background data has enabled the Tribes to gain a better understanding of the river system and the nature of the wastes contributed to the Lake Roosevelt Environment by a variety of sources.

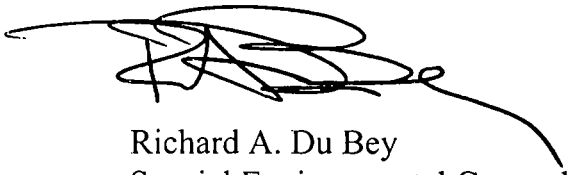
386837 1/8@HH01!/017053 00016

USEPA SF
1167615

As was the case with the Tribes' previous submittal of May 8, 2002, the Tribes are presenting this additional information to EPA in furtherance of their government-to-government relationship with EPA and as part of the Tribes' efforts to assist EPA in its work in and about the Lake Roosevelt Environment. If you have any questions, please call me at (206) 682-3333.

Sincerely yours,

SHORT CRESSMAN & BURGESS PLLC



Richard A. Du Bey
Special Environmental Counsel
Confederated Tribes of the Colville Reservation

RAD:vh
cc: Gary Passmore
Patti Stone
Monica Tonel (via facsimile)
Valerie Lee

Columbia River Watershed Sediment

Sampling Field Program

May 10, 2002

Prepared for:

Confederated Tribes of the Colville Reservation

P.O. Box 150

Nespelem, WA. 99155

COLUMBIA

ENVIRONMENTAL CONSULTING LTD

Columbia River Watershed Sediment

Sampling Field Program

Prepared for:

Confederated Tribes of the Colville Reservation

P.O. Box 150

Nespelem, WA. 99155

Prepared by:

Columbia Environmental Consulting Ltd.

RR 2 S55 C10 Green Mountain Road

Penticton, B.C. V2A 6J7

May 10, 2002

TABLE OF CONTENTS

EXECUTIVE SUMMARY ii

1. INTRODUCTION 1

2. OBJECTIVES 1

3. METHODS 1

3.1 Sampling Methods and Procedures 1

3.2. Field Equipment 4

3 3. Contamination prevention and Decontamination Procedures 5

3.4. Investigation-Derived Wastes 6

3.5. Sampling Logs 6

3.6. Sample Transportation and Chain of Custody Procedures 6

3.7. Laboratory Methods 7

3.8. Sample Target Analyte List 8

4. RESULTS AND QA/QC DOCUMENTATION 9

APPENDIX 1: FIELD SAMPLING LOG AND PHOTOGRAPHS 12

APPENDIX 2: LABORATORY ANALYSIS METHODS, MACHINE CALIBRATION AND SPIKE CALIBRATION DATA, RAW DATA, LABORATORY SAMPLING RESULTS, QUALITY CONTROL SAMPLE DATA, AND CHAIN OF CUSTODY FORMS 13

LIST OF FIGURES

Figure 1. Sample site locations within the Upper Columbia Watershed. 2

LIST OF TABLES

Table 1. Sample location information 3

Table 2. Target Analyte List for soil metals and their detection limits 8

Table 3. Summary of sediment sample laboratory analysis 10

EXECUTIVE SUMMARY

Columbia Environmental Consulting Ltd. completed sediment sampling for the Confederated Tribes of the Colville Reservation within the Canadian portion of the lower Columbia River Watershed Sixteen (16) samples were collected in this sampling event with duplicates. Six (6) sediment samples were taken from Lower Arrow Lake in a similar location to a USGS study conducted in 1992. Six (6) were sampled from the Kootenay River upstream of the City of Castlegar. Two (2) samples were collected in the Pend Oreille River (one behind Waneta Dam and One behind Seven Mile Dam). The final two (2) samples were taken from a beach south of the community of Trail B.C. Sediment sampling was completed during the month of January 2002.

This report presents information detailing the sampling and analysis techniques. The body of the report describes the sampling effort and includes some discussion of the laboratory analysis. The appendices present additional details regarding the analysis of the samples. The raw data, lab calibration data and other documentation, useful for the conduction of a quality analysis and quality control review of the data, are included in these appendices.

1 INTRODUCTION

Columbia Environmental Consulting Ltd. completed sediment sampling for the Confederated Tribes of the Colville Reservation within the Canadian portion of the lower Columbia River watershed. Sediment sampling was completed during the month of January 2002.

This report presents information detailing the sampling and analysis techniques. The body of the report describes the sampling effort and includes some discussion of the laboratory analysis. The appendices present additional details about the analysis of the samples. The raw data, lab calibration data, and other documentation useful for the conduction of a quality analysis and quality control review of the data, are included in these appendices.

2 OBJECTIVES

The objectives identified within the sampling plan were as follows:

1. Collect samples that were unlikely to have anthropogenic sources of contamination to develop an understanding of the background concentrations of metal/metalloid concentrations in sediments of the Columbia River.
2. Collect information on sediment grain size, total organic carbon, pH and eH.
3. Collect samples from below the community of Trail, B.C. to gain a better understanding of metal/metalloid concentrations in sediments of the Columbia River south of Trail and north of the U.S. border. These samples were collected in depositional areas containing silt-clays from the Columbia River at points between Trail and the Canada-US border.

Sampling locations that correspond to sampling data are shown in Figure 1 and Table 1.

3 METHODS

3.1 Sampling Methods and Procedures

Except as modified in this document the Environmental Protection Agency (EPA) Contract Laboratory Program (CLP) Guidance for Field Samplers (EPA 2001), Roy F. Weston's Standard Operating Procedure for Sediment Sampling (Weston 2001), and Lake and Stream Bottom Sediment Sampling Manual (Resource Inventory Committee 1997) were used as references for sampling methods and procedures. This document provides site-specific information to reinforce and in some cases supplement the assistance provided by these guidance documents.

Sixteen (16) samples were collected in this sampling event with duplicates. Six (6) sediment samples were taken from Lower Arrow Lake in similar location to a USGS study conducted in 1992. Six (6) were sampled from the Kootenay River upstream of the City of Castlegar. Two (2) samples were collected in the Pend Oreille River (one behind Waneta Dam and One behind Seven Mile Dam). The final two (2) samples were taken from a beach south of Trail.

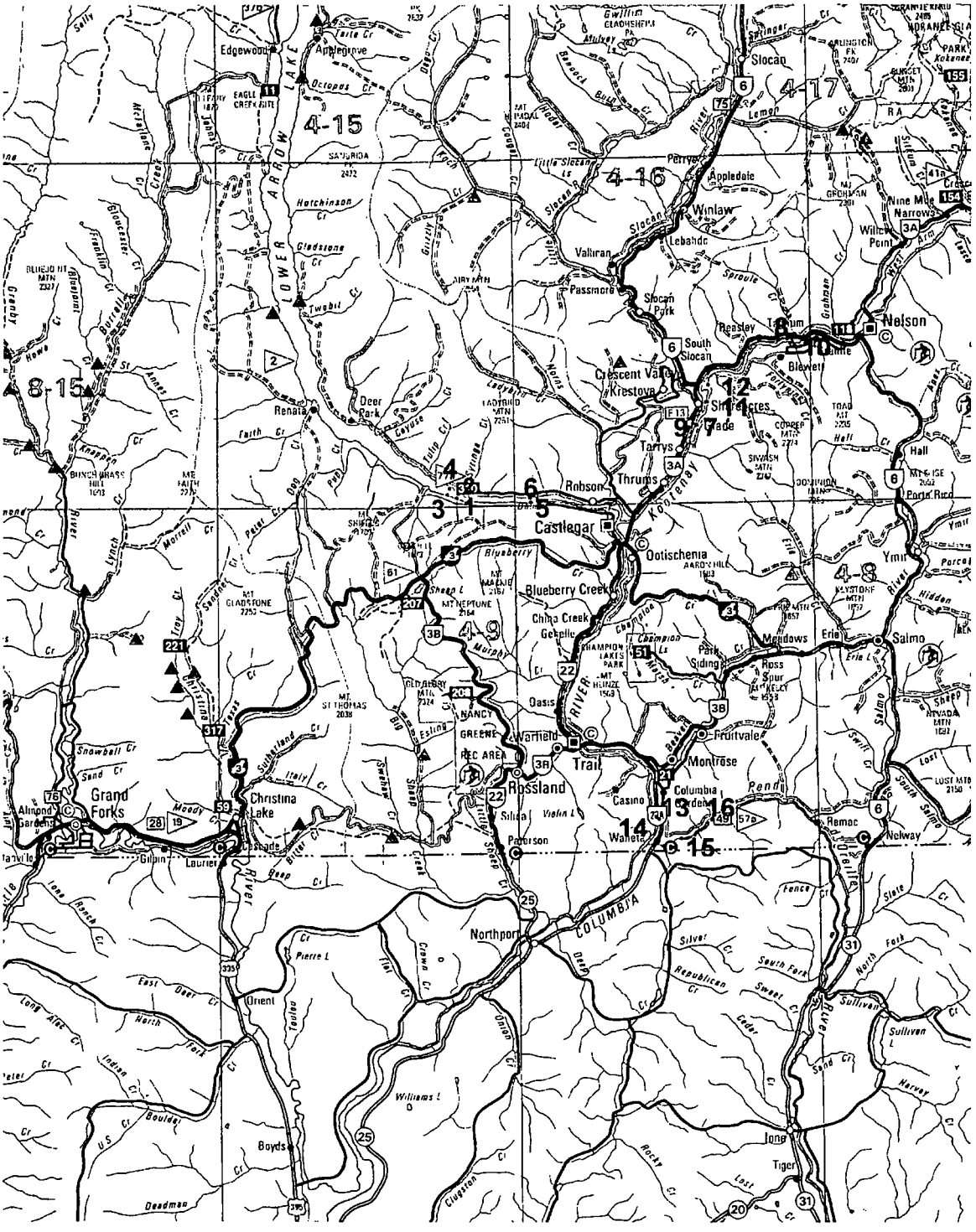


Figure 1. Sample site locations within the Upper Columbia Watershed.
(Sample site number • **16**)

Table 1. Sample location information

Map Site Number	CEC Sample ID Number	Cantest ID Number	Waterbody	GPS Coordinates
1	1A	201280066	Lower Arrow Lake	49° 20' 27" N 117° 52' 40" W
2	1B	201280069	Lower Arrow Lake	49° 20' 25" N 117° 53' 00" W
3	2A	201280068	Lower Arrow Lake	49° 20' 28" N 117° 53' 20" W
4	2B	201280070	Lower Arrow Lake	49° 23' 43" N 117° 32' 47" W
5	3A	201280071	Lower Arrow Lake	49° 20' 13" N 117° 49' 12" W
6	3B	201280072	Lower Arrow Lake	49° 20' 28" N 117° 48' 58" W
7	41	201280073	Kootenay River	49° 23' 39" N 117° 32' 35" W
8	42	201280074	Kootenay River	49° 27' 34" N 117° 30' 47" W
9	51	201280075	Kootenay River	49° 23' 43" N 117° 32' 47" W
10	52	201280076	Kootenay River	49° 27' 24" N 117° 30' 42" W
11	61	201280078	Kootenay River	49° 26' 20" N 117° 31' 35" W
12	62	201280079	Kootenay River	49° 25' 58" N 117° 31' 14" W
13	71	201280080	Upper Columbia River	49° 01' 53" N 117° 36' 37" W
14	81	201280081	Upper Columbia River	49° 01' 48" N 117° 36' 33" W
15	91	201280082	Pend Oreille River	49° 00' 36" N 117° 33' 48" W
16	101	201280083	Pend Oreille River	49° 02' 02" N 117° 30' 12" W

Sterile sample containers were obtained from the lab and used for this sampling event. Sampling was conducted in the background/reference areas first, followed by downriver sections. The samples were collected using a stainless steel Petite Ponar grab with a focus on sampling finer silt-clay sediments in depositional areas. All samples were maintained according to applicable chain of custody procedures and stored appropriately for shipment to the lab.

Duplicate samples were collected at each sample location to be used as references. One sample from each location was analyzed as described in this document. The duplicate samples were archived at CANTEST LTD. lab for 180 days. These samples were preserved under regulated conditions for future analysis if it is deemed necessary. The samplers verified that a minimum of 500 grams (approximately 1 lb) of sediment per sample was collected to ensure adequate analysis or preservation

Higher concentrations of contaminants in sediments are usually associated with fine-grained sands and clays therefore sampling focused on collecting those types of sediments. Sediments with these particle sizes are most likely to be found in depositional areas therefore, whenever possible, samples were collected from these areas. An effort was also made to collect samples that have particle sizes with a minimum of 80% fine sediments and a maximum of 20 % sands/gravels. Samplers in the field used their best judgment as to what constitutes a depositional area. In addition, samplers visually inspected sediments as they were collected to ensure that samples with the appropriate particle size were chosen where possible. Sediment particle size analysis and organic carbon content were measured in the laboratory. In addition, pH and eH measurements were recorded in the field (pH and eH were recorded immediately after recovery by inserting the probe directly into the sediment through the top of the grab sample).

The Petite Ponar grab was lowered at a slow rate to minimize disturbance, due to the effect of turbulence, and retrieved in a similar manner. Upon retrieval if the jaws of the Petite Ponar were not closed completely the sample was discarded. The discarded sample was dumped into a bucket if the sample was not successfully collected. The unwanted sample was later dumped after the successful collection of samples from the area. A container was placed under the sampler just as it breaks the water surface. Sampling notes, eH, pH, and pictures were immediately taken. A selection of materials from the top 1-2 cm of surface sediments was carefully scooped into the sampling bag. The sample bag was labeled and placed in a cooler. During stream sampling, samplers never walked upstream of the sampling location to avoid sediment disturbances.

3.2 Field Equipment

- Stainless Steel Petite Ponar sediment sampler.
- Sterile sample containers, latex gloves, plastic spatulas.
- Coleman 34 cooler, ice packs, plastic sampling tray.
- Lowrance depth sounder, lead weight and 30 m eslon measuring tape.
- Magellan 315 GPS.
- Minolta freedom 35mm camera (30-60mm zoom), Kodak 200 asa film.
- Calibrated alcohol thermometer.
- eH Meter (Cole Parmer field portable meters).

- pH Meter (Cole Parmer field portable meters).
- Sediment sample field forms.
- Alconox soap, distilled water, nitric acid, methanol, metal-free water.
- Safety equipment for the boat, life jackets, handheld radio, cell phone, bear spray, Level 1 first aid kit, and safety blankets.

3.3 Contamination prevention and Decontamination Procedures

Many sources of contamination can exist during field sampling and the following are some basic precautions considered prior to sampling:

- Sampling containers were new and pre cleaned by a laboratory.
- The inner portion of the sample container never touched anything (e.g. bare hands, gloves, etc.) other than the sample material.
- Sample containers were kept in a clean environment, away from dust, dirt, fumes and grime. Containers were stored in a clean shipping container (cooler) both before and after the collection of the sample. Vehicle cleanliness was maintained to aid in elimination contamination problems.
- Petroleum products (gasoline, oil, exhaust fumes) are prime sources of contamination that were avoided. Spills or dripping (potentially from boats) was avoided. Exhaust fumes and cigarette smoke and Air conditioning units were avoided.
- Samples were not permitted to get warm and were not allowed to freeze. They were stored in a cooler on ice packs according to protocols in Section 3.6.
- Samplers kept their hands clean and did not eat or smoke during sampling.
- Samplers clothing was changed if contamination was suspected. Disposable latex gloves were new for each sample as well as new sediment spatulas that were non-metal and laboratory sealed.

On a daily basis and between sampling areas, decontamination of the Petite Ponar was conducted according to the following steps:

- Clean with brush and Alconox soap.
- Rinse twice with distilled water.
- Rinse with nitric acid.
- Rinse thoroughly with metal-free water.
- Rinse with methanol.

After decontamination, sampling equipment was protected from recontamination. Any sampling equipment suspected of contamination was decontaminated again or rejected.

3.4 Investigation-Derived Wastes

Samplers made every effort to minimize the amount of wastes generated during sampling activities. All wastewater was saved in labeled containers and disposed of through a drain that travels to a publicly owned treatment works. Disposable personal protective clothing and sampling equipment was rendered unusable, bagged at the point of generation and disposed of appropriately.

3.5 Sampling Logs

As samples were collected, logs of all samples were taken. The sampling locations (GPS) and depths (depth sounder or weighted line) was noted and clearly documented in writing. In addition, the sampling effort and composition was photographically documented. The sampling log contained the following:

- Date and time of collection of each sediment sample.
- Names of person(s) collecting and logging the sample.
- Weather conditions.
- Sample station number.
- GPS coordinates of sample.
- Water depth.
- Physical sediment description including type, density, color, consistency, odor, vegetation, debris, biological activity or structures, presence of any other distinguishing characteristics or features.
- pH and eH readings taken in the field.
- Any deviation from the approved sampling plan.

3.6 Sample Transportation and Chain of Custody Procedures

Sample transportation and chain-of-custody procedures followed the appropriate protocols. The following practices with regards to transportation and chain-of-custody were as follows:

- As soon as samples are placed in the sample containers, they were packaged in a cooler with ice.
- Sample containers were packed to prevent breakage and transported in a sealed cooler.
- Ice was placed in separate plastic bags and sealed. The cooler containing sediment samples for analysis was delivered to the laboratory within 24 hours of being sealed.
- A sealed envelope containing chain-of-custody forms was enclosed in a plastic bag and taped to the inside lid of the cooler.
- Signed and dated seals were placed on all samples and the sample cooler prior to shipping.

- The shipping container was clearly labeled with sufficient information (name of project, time and date container was sealed, person sealing the container and consultant's office name and address) to enable positive identification.
- Upon transfer of sample possession to the analytical laboratory, the chain-of-custody form was completed by the persons transferring custody of the sample containers. The shipping container seal was broken and the condition of the samples was recorded by the receiver.
- Chain-of-custody forms were used internally in the lab to track sample handling and final disposition.

3.7 Laboratory Methods

Samples were analyzed for metal analysis in soil by Inductively coupled Plasma Mass Spectrometry (ICP-MS and Cold Vapor Atomic Fluorescence for mercury). Sediment particle size distribution was completed by the lab based on procedures described in the Manual on Soil Sampling and methods of Analysis, 2nd edition, 1978, Published by the Canadian Society of Soil Science. Soil pH was preformed in the lab using a deionized water leach with measurement by pH meter. Total Organic Carbon samples were digested in acid then analyzed using a Leco Induction Furnace combustion/volumetric analysis technique. Complete Laboratory Analysis Methods, machine calibration and spike calibration data, Raw Data, laboratory sampling results, and quality control sample data, and the Chain of Custody forms see Appendix 2

3.8 Sample Target Analyte List

The following table presents the Target Analyte List metals and the required detection limits of the samples.

Table 2. Target Analyte List for soil metals and their detection limits

TARGET ANALYTE LIST (TAL) METALS AND THEIR DETECTION LIMITS*	
ANALYTES	CONTRACT REQUIRED DETECTION LIMITS {ILM04.1} (ug/L)
Aluminum	200
Antimony	60
Arsenic	10
Barium	200
Beryllium	5
Cadmium	5
Calcium	5000
Chromium	10
Cobalt	50
Copper	25
Iron	100
Lead	3
Magnesium	5000
Manganese	15
Mercury	0.2
Nickel	40
Potassium	5000
Selenium	5
Silver	10
Sodium	5000
Thallium	10
Vanadium	50
Zinc	20

**TAL Metal detection limits are expressed as instrument detection limits obtained in pure water Detection limits for soils are adjusted for the amount of sample analyzed and percent moisture*

4 RESULTS AND QA/QC DOCUMENTATION

A summary of the laboratory analysis of the 16 sediment samples is presented within Table 3. The field sampling log is located within Appendix 1 and organized numerically by site number with the appropriate photographs. Laboratory methods undertaken by CANTEST LTD. are located within Appendix 2 The methods identify Canadian and US EPA CLP laboratory methods standards analysis used for sediment metals analysis. Appendix 2 also contains the CANTEST laboratory machine calibration and spike calibration data, Raw Data, laboratory sampling results. quality control sample data, and the Chain of Custody forms.

Table 3. Summary of sediment sample laboratory analysis

TABLE Results of SOIL Analyses					Client	Columbia Environmental			Download Date	02/07/2002		Project Name	0081 Columbia Metals			Samples received	01/28/2002
Sample ID		1A	1B	2A	2B	3A	3B	41	42	51	52	61	62	71	81	91	101
Site number on Map		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
CANTEST ID		201280065	201280069	201280068	201280070	201280071	201280072	201280073	201280074	201280075	201280076	201280078	201280079	201280080	201280081	201280082	201280083
Date Sampled		01/22/2002	01/22/2002	01/22/2002	01/22/2002	01/22/2002	01/22/2002	01/21/2002	01/24/2002	01/21/2002	01/24/2002	01/24/2002	01/24/2002	01/23/2002	01/23/2002	01/23/2002	01/23/2002
Parameter	Units																
Conventional Parameters																	
Total Organic Carbon C	% dry wt	0 22	0 72	0 09	0 57	0 12	0 63	0 18	0 07	0 05	0 15	0 07	0 14	0 14	0 07	0 16	0 06
pH	pH units	6 3	5 8	6 6	5 5	6 4	4 5	6 5	6 3	6 5	6 5	5 8	5 5	7 1	6 8	7 3	7 6
CSR Metals Analysis																	
Antimony Sb	ug/g	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Arsenic As	ug/g	1 6	2 6	1	1 4	1 3	1 1	1 3	1 6	1 3	1 8	1 9	1 4	12 5	10	6 9	8 6
Barium Ba	ug/g	28	82	15	30	19	50	27	20	34	18	16	54	102	103	158	79
Beryllium Be	ug/g	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Cadmium Cd	ug/g	< 0 4	< 0 4	< 0 4	< 0 4	< 0 4	< 0 4	< 0 4	< 0 4	< 0 4	< 0 4	< 0 4	< 0 4	1 7	1 2	1 9	< 0 4
Chromium Cr	ug/g	15	45	12	15	16	20	13	9	10	11	7	16	21	23	25	24
Cobalt Co	ug/g	< 1	4	< 1	< 1	< 1	< 1	1	2	< 1	2	< 1	2	3	4	3	5
Copper Cu	ug/g	7	25	7	9	7	13	11	15	7	21	10	12	252	261	26	39
Lead Pb	ug/g	19	44	12	21	9	21	14	16	12	15	9	12	194	128	98	12
Mercury Hg	ug/g	0 007	0 017	0 007	0 011	0 004	0 015	0 004	0 007	0 004	0 007	0 004	0 017	0 248	0 218	0 035	0 007
Molybdenum Mo	ug/g	< 4	< 4	< 4	< 4	< 4	< 4	< 4	< 4	< 4	< 4	< 4	< 4	< 4	< 4	< 4	< 4
Nickel Ni	ug/g	22	36	9	19	12	21	12	8	9	12	7	10	16	13	30	25
Selenium Se	ug/g	< 0 4	< 0 4	< 0 4	< 0 4	< 0 4	< 0 4	0 4	< 0 4	< 0 4	< 0 4	< 0 4	< 0 4	< 0 4	< 0 4	< 0 4	< 0 4
Silver Ag	ug/g	< 0 2	< 0 2	< 0 2	< 0 2	< 0 2	< 0 2	< 0 2	< 0 2	< 0 2	< 0 2	< 0 2	< 0 2	1 3	3 1	< 0 2	< 0 2
Thallium Tl	ug/g	< 0 2	0 2	< 0 2	< 0 2	< 0 2	< 0 2	< 0 2	< 0 2	< 0 2	< 0 2	< 0 2	< 0 2	0 4	< 0 2	< 0 2	< 0 2
Tin Sn	ug/g	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	5	9	< 5	< 5
Vanadium V	ug/g	7	34	8	8	7	11	15	13	8	17	10	20	10	12	23	34
Zinc Zn	ug/g	21	52	12	28	13	31	35	26	30	25	16	27	954	918	249	35
Aluminum Al	ug/g	2360	6180	1440	3180	2140	4750	3600	2350	2660	3280	2220	6100	4160	3580	8190	8740
Boron B	ug/g	29	101	24	30	23	38	38	32	29	40	25	47	89	91	85	95
Calcium Ca	ug/g	1760	5220	2080	1450	1610	1750	2110	1320	1480	1750	1760	1770	3600	3830	15300	5770
Iron Fe	ug/g	7530	22500	5530	7770	5580	10500	10600	8770	7730	11000	6480	12500	19000	19300	18600	21600

Results of SOIL Analyses					Client	Columbia Environmental			Download Date	02/07/2002		Project Name	0081 Columbia Metals			Samples received	01/28/2002
Sample ID		1A	1B	2A	2B	3A	3B	41	42	51	52	61	62	71	81	91	101
Site number on Map		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
CANTEST ID		201280066	201280069	201280068	201280070	201280071	201280072	201280073	201280074	201280075	201280076	201280078	201280079	201280080	201280081	201280082	201280083
Date Sampled		01/22/2002	01/22/2002	01/22/2002	01/22/2002	01/22/2002	01/22/2002	01/21/2002	01/24/2002	01/21/2002	01/24/2002	01/24/2002	01/24/2002	01/23/2002	01/23/2002	01/23/2002	01/23/2002
Parameter	Units																
Magnesium Mg	ug/g	2230	5540	1310	2030	1380	2770	2470	1500	1610	2800	1400	3130	2430	2020	12100	5620
Manganese Mn	ug/g	83	192	41	80	62	98	93	73	69	99	100	118	242	250	234	303
Phosphorus PO4	ug/g	1210	3860	2170	819	1370	1180	1560	956	1440	974	1360	1180	1160	1060	1440	1110
Potassium K	ug/g	484	2060	233	571	214	709	476	247	395	488	192	803	688	543	1330	988
Sodium Na	ug/g	< 5	15	< 5	< 5	< 5	6	< 5	< 5	< 5	< 5	< 5	< 5	53	66	76	56
Strontium Sr	ug/g	25	62	31	21	34	32	32	20	31	21	27	29	47	47	49	59
Titanium Ti	ug/g	266	271	153	303	137	399	252	97	202	192	138	339	326	261	334	360
Zirconium Zr	ug/g	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Particle Size Distribution																	
Gravel, >2 mm	%	7 5	23	90 9	0 3	4 5	1 5	0 3	23 2	2 9	62	1 1	4	0 4	3 5	46 3	42 8
Sand, <2 mm, >63 microns	%	88 2	70 7	8 9	93 7	91 7	85 7	88	72 9	94 3	37 3	90 7	41 3	94 1	91 7	49 9	47 9
Silt, <63 microns, >4 microns	%	2 1	3 8	0 1	4 2	2 2	9 9	9 4	2 9	2 4	0 4	6 5	45 6	4 5	4 6	2 6	7
Clay, <4 microns	%	2 2	2 5	0 1	1 8	1 6	2 9	2 3	1	0 4	0 3	1 7	9 1	1	0 2	1 2	2 3

APPENDIX 1: FIELD SAMPLING LOG AND PHOTOGRAPHS

Sampling Log

Sample Station Number / Site # 1a → #1 on Map

Site/Location	**Date** 01/22/02	**Time** 1217	**Crew** BJDH
	Roll 1	**Frame** 10	**Water Depth** 3M
	Lat/Long 49°20'27N / 117°52'40W	**UTM** 11/436237/5465729	**Weather Conditions** S 10 knots

Chemical Characteristics	**pH** 7.18	**eH** 038mV	Sample temp / water 3.9°C / 3.5°C

Physical Characteristics

Sediment Type	silty sand	**Density**	x
Consistency	x	**Color**	gray
Odor	none	**Vegetation**	none
Debris	bark/rocks	**Bio Activity**	none
Other Features	none		

Sample Station Number / Site # 1ad

Site/Location	**Date** 01/22/02	**Time** 1236	**Crew** BJDH
	Roll 1	**Frame** 11	**Water Depth** 3M
	Lat/Long SAME AS ABOVE	**UTM**	**Weather Conditions**

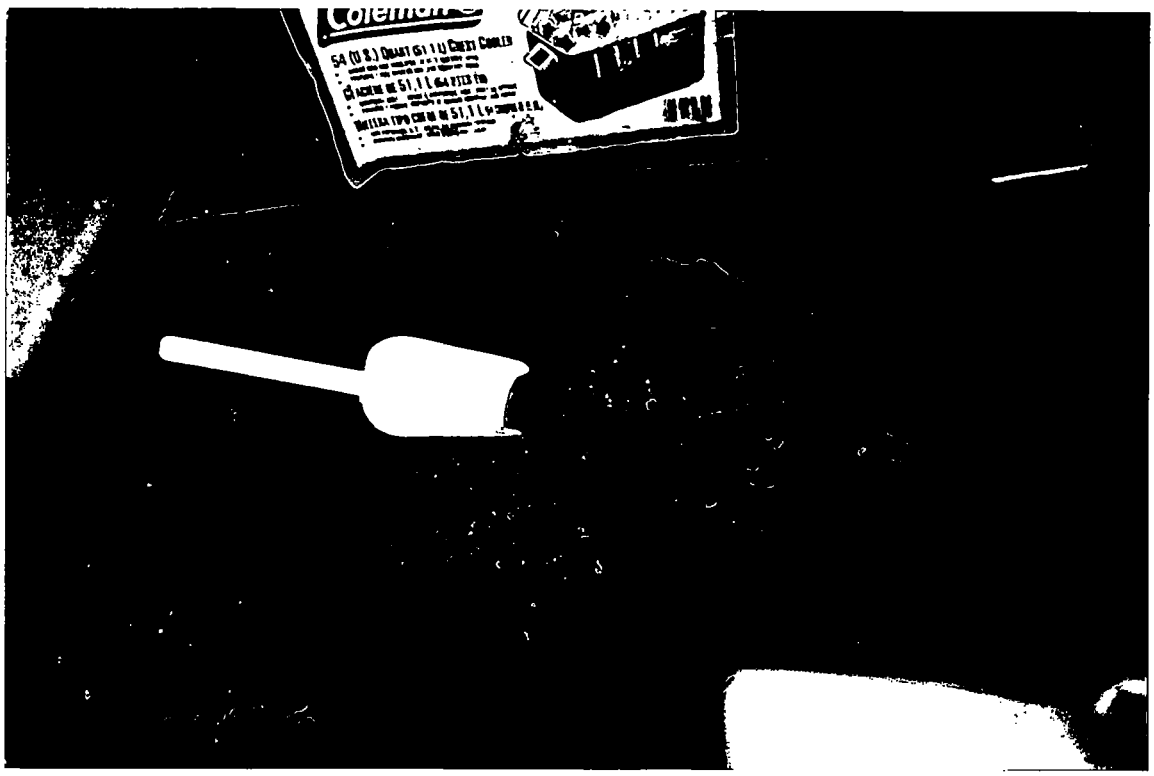
Chemical Characteristics	**pH** 7.37	**eH** -056 mV	Sample temp / water temp 3.7°C / 3.5°C

Physical Characteristics

Sediment Type	silt	**Density**	moderate
Consistency	unstable	**Color**	gray
Odor	x	**Vegetation**	y
Debris	x	**Bio Activity**	y
Other Features	y		

Sediment sample photos

Sample Site 1, Sample 1a, Roll 1 Frame 10



Sample Site 1, Sample 1ad, Roll 1 Frame 11

Sampling Log

Sample Station Number **Site #** 1b → #2 on Map

Site/Location	**Date** 01/22/02	**Time** 1143	**Crew** PS/PH
	Roll 1	**Frame** 9	**Water Depth** 3m
	Lat/Long 49° 20' 25N / 117° 3' 30W	**UTM** 1143592E / 5465666	**Weather Conditions** Wind South 10 knots

Chemical Characteristics	**pH** 6.92	**eH** -075	Sample Temp 4.1°C / Water Temp 3.5°C

Physical Characteristics

Sediment Type silt	**Density** moderate
Consistency unstable	**Color** grey/brown
Odor none (X)	**Vegetation** X
Debris X	**Bio Activity** clam in sample
Other Features X	

Sample Station Number **Site #** 1bd

Site/Location	**Date** 01/22/02	**Time** 1154	**Crew**
	Roll 1	**Frame** 9 clam	**Water Depth** 3m
	Lat/Long SAME AS ABOVE	**UTM**	**Weather Conditions**

Chemical Characteristics	**pH** 7.42	**eH** -070	Sample Temp 3.9°C / Water 3.5°C

Physical Characteristics

Sediment Type silt	**Density** moderate
Consistency unstable	**Color** grey/w fool's gold
Odor X	**Vegetation** X
Debris X	**Bio Activity** clam in sample
Other Features X	

Sediment sample photos

Sample Site 2, Sample 1b, Roll 1 Frame 8

Sample Site 2, Sample 1bd, Roll 1 Frame 9

Sampling Log

Sample Station Number / Site # 2a → #3 on Map

Site/Location	Date 01/22/02	Time 1118	Crew PS/DH
	Roll 1	Frame 7	Water Depth 3m
	Lat/Long 49° 20' 28N / 117° 53' 20W	UTM 435442E / 5465758N	Weather Conditions windy 10 (km/h)

Chemical Characteristics	pH 7.41	eH 182-V	Sample temp 4.2

Physical Characteristics

Sediment Type fines/gravel — Density high

Consistency unstable — Color orange/brown

Odor X — Vegetation X

Debris bark — Bio Activity X

Other Features X

Sample Station Number / Site # 2ad

Site/Location	Date 01/22/02	Time 1125	Crew —
	Roll 1	Frame	Water Depth 3m
	Lat/Long SAME AS ABOVE	UTM	Weather Conditions —

Chemical Characteristics	pH 7.11	eH 204	Sample temp 32°C

Physical Characteristics

Sediment Type gravel — Density high

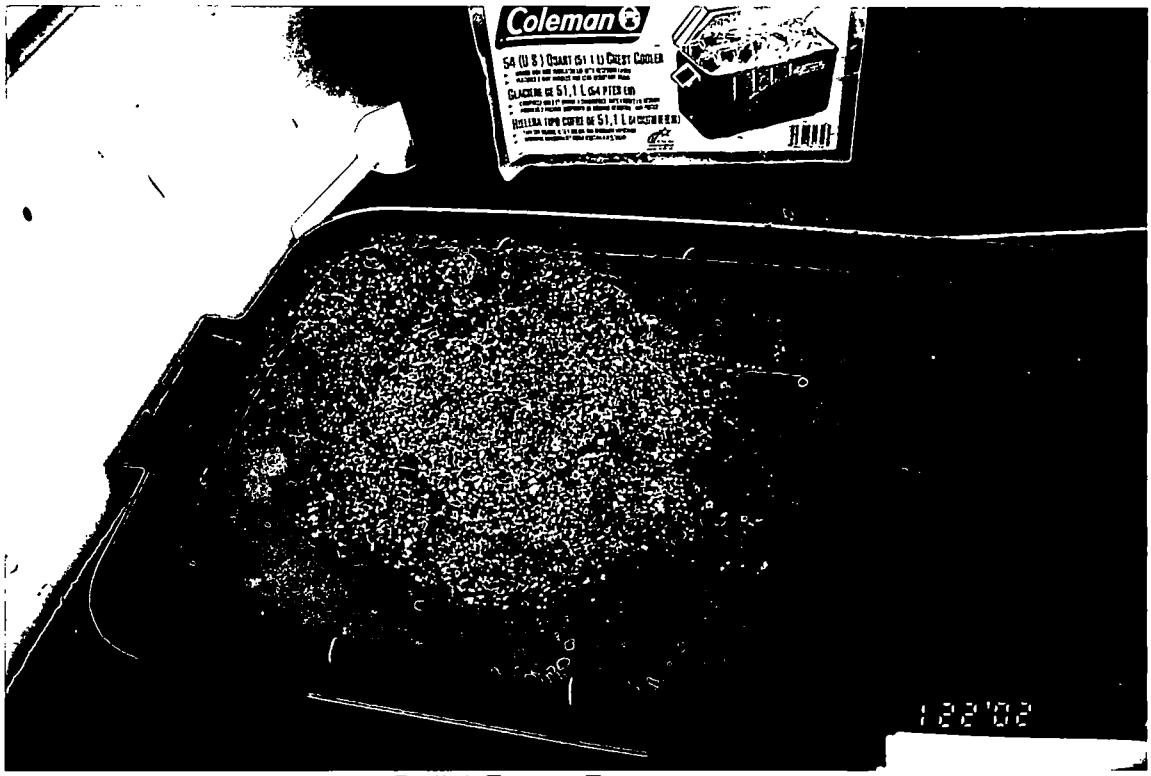
Consistency unstable — Color orange/brown

Odor X — Vegetation X

Debris X — Bio Activity X

Other Features X

Sediment sample photos



Sample Site 3, Sample 2a, Roll 1 Frame 7

Sampling Log

Sample Station Number **Site #** 2b → #4 on Map

Site/Location	Date 01/22/02	Time 1048	Crew GS/DH
	Roll 1	Frame 5	Water Depth 3m
	Lat/Long	UTM	Weather Conditions
	49° 23' 43N 117° 32' 47W / 11/435328/5466478 11		Windy 10 knots South

Chemical Characteristics	pH	eH	Sample Temp	Water Temp
	6.25	-175mV	3.9°C	3.5

Physical Characteristics

Sediment Type silty	Density moderate
Consistency unstable	Color light brown
Odor musty	Vegetation none
Debris ~~none~~ bark	Bio Activity none
Other Features none	

Sample Station Number **Site #** 2bd

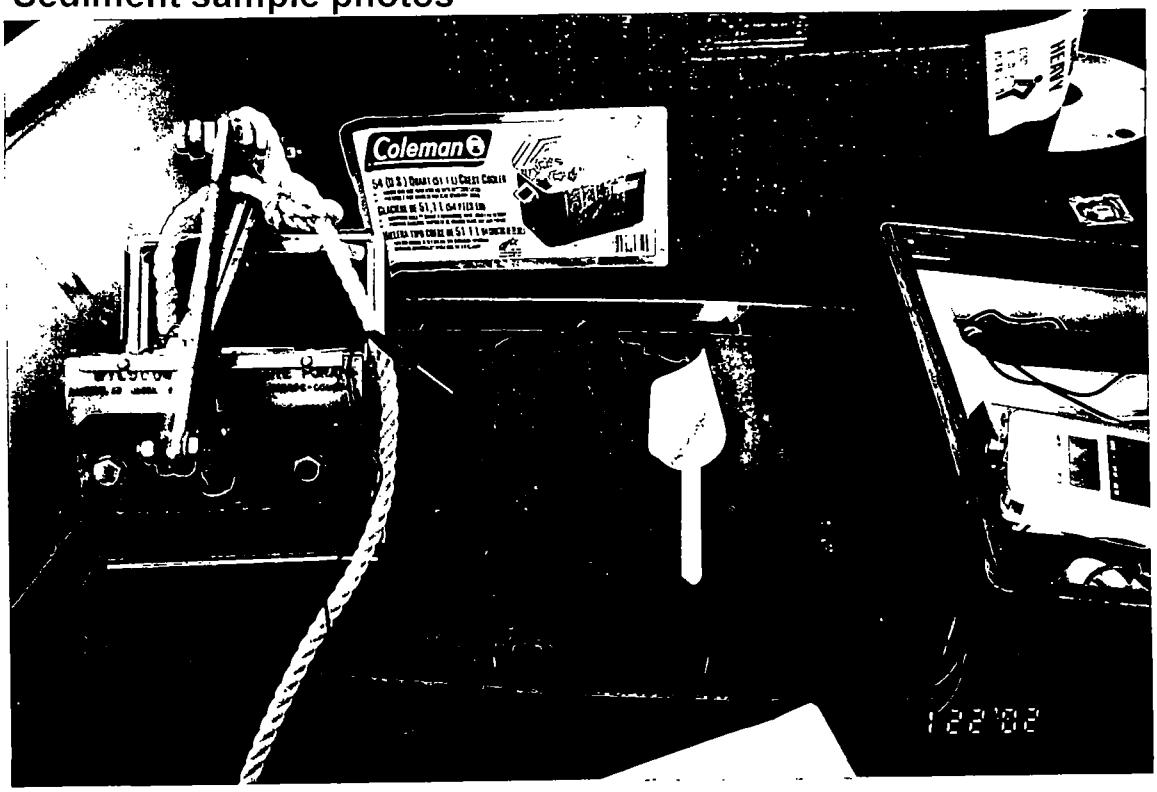
Site/Location	Date 01/22/02	Time 1104	Crew PS/DH
	Roll 1	Frame 6	Water Depth 6F (2m)
	Lat/Long	UTM	Weather Conditions
	SAME AS ABOVE		

Chemical Characteristics	pH	eH	Sample temp	Water temp
	7.02	-103mV	3.8°C	3.5°C

Physical Characteristics

Sediment Type silty	Density moderate
Consistency unstable	Color light brown
Odor musty	Vegetation none (x)
Debris bark	Bio Activity none (x)
Other Features none (x)	

Sediment sample photos



Sample Site 4, Sample 2b, Roll 1 Frame 5

Sample Site 4, Sample 2bd, Roll 1 Frame 6

Sampling Log

Sample Station Number **Site #** 3a → #5 on Map

Site/Location	Date 01/22/02	Time 1300	Crew NS/DH
	Roll 1	Frame 12	Water Depth 2m
	Lat/Long	UTM	Weather Conditions
49°20' 13N / 117°49' 12W / 11/440417E 546523/N			Snow/

Chemical Characteristics	pH	eH	sample temp / water temp
	7.68	-058	3.8°C / 3.5°C

Physical Characteristics

Sediment Type silty/sand	Density moderate
Consistency unstable	Color light brown
Odor none (X)	Vegetation X
Debris bark	Bio Activity X
Other Features X	

Sample Station Number **Site #** 3ad

Site/Location	Date 01/22/02	Time 1317	Crew
	Roll 1	Frame 13	Water Depth 2M
	Lat/Long	UTM	Weather Conditions
	SAME AS ABOVE		Snow/light wind

Chemical Characteristics	pH	eH	sample temp / water temp
	Busted	132	3.2°C / 3.5°C

Physical Characteristics

Sediment Type silt	Density moderate
Consistency unstable	Color light brown
Odor X	Vegetation X
Debris X	Bio Activity X
Other Features X	

Sediment sample photos

Sample Site 5, Sample 3a, Roll 1 Frame 12

Sample Site 5, Sample 3ad, Roll 1 Frame 13

Sampling Log

Sample Station Number	Site #	36-D #6 on Map	
Site/Location	Date 01/22/02	Time 1326	Crew BS/DH
	Roll 1	Frame 14	Water Depth 2m
	Lat/Long	UTM	Weather Conditions
	49° 20' 28N / 117° 48' 58W	11/440729E/5465869	Snow / Wind 10k

Chemical Characteristics	pH	eH	Sample temp	Water temp
	BUSTED	-142	3.7°C	3.5°C

Physical Characteristics

Sediment Type	Loam	Density	moderate
Consistency	unstable	Color	grey
Odor	none (X)	Vegetation	X
Debris	bark	Bio Activity	X
Other Features	(X)		

Sample Station Number	Site #	36d	
Site/Location	Date 01/22/02	Time 1342	Crew
	Roll 1	Frame 15	Water Depth 2m
	Lat/Long	UTM	Weather Conditions
	SAME AS ABOVE		

Chemical Characteristics	pH	eH	Sample temp	Water
	BUSTED	-119mV	3.2°C	3.5°C

Physical Characteristics

Sediment Type	silt	Density	moderate
Consistency	unstable	Color	grey/brown
Odor	X	Vegetation	X
Debris	X	Bio Activity	X
Other Features	X		

Sediment sample photos

Sample Site 6, Sample 3b, Roll 1 Frame 14

Sample Site 6, Sample 3bd, Roll 1 Frame 15

Sampling Log

Sample Station Number [redacted] **Site #** [redacted] 41 → # 7 on Map

Site/Location	Date	Time	Crew
East Side of Glade Ferry	01/21/02	15:22	DH
	Roll 1	Frame 1	Water Depth .2M
	Lat/Long	UTM	Weather Conditions
	49°23'39N 117°32'35W 11/460594/5471429N		-3 Sunny, no wind.

(opposite side to Hwy)

Chemical Characteristics	pH	eH	Temp	water temp
	7.12	-252 mV	31°C	4°C

Physical Characteristics

Sediment Type silt	Density X
Consistency mud	Color greenish brown
Odor sulphur	Vegetation fine roots
Debris none	Bio Activity none
Other Features X	

Sample Station Number [redacted] **Site #** [redacted] 41 duplicate

Site/Location	Date	Time	Crew
East side of Glade Ferry	01/21/02	1557	DH
	Roll 1	Frame 2	Water Depth .4m
	Lat/Long	UTM	Weather Conditions
	same as above		Same as above

(opposite side of Hwy)

Chemical Characteristics	pH	eH	Sample Temp	water temp
	7.32	-291	32°C	4°C

Physical Characteristics

Sediment Type silt	Density X
Consistency low unstable	Color greenish
Odor sulphur	Vegetation [illegible]
Debris none	Bio Activity [illegible]
Other Features X	

Sediment sample photos

Sample Site 7, Sample 41, Roll 1 Frame 1

Sample Site 7, Sample 41d, Roll 1 Frame 2

Sampling Log

Sample Station Number / Site # 42 → #8 on Map

Site/Location North Side of Blewett Bridge	**Date** 01/24/02	**Time** 08:34	**Crew** DH
	Roll 1	**Frame** 24 site	**Water Depth** 3M
	Lat/Long 49° 27' 34N / 117° 38' 47W	**UTM** 11/462829E/[illegible]	**Weather Conditions** Overcast/Snowing/-2°C

Chemical Characteristics	**pH** X	**eH** 329mv	Sample temp/water 13°C / 3°C

Physical Characteristics

Sediment Type	silt	**Density**	X
Consistency		**Color**	tan
Odor	X	**Vegetation**	moss
Debris	twigs	**Bio Activity**	X
Other Features	X		

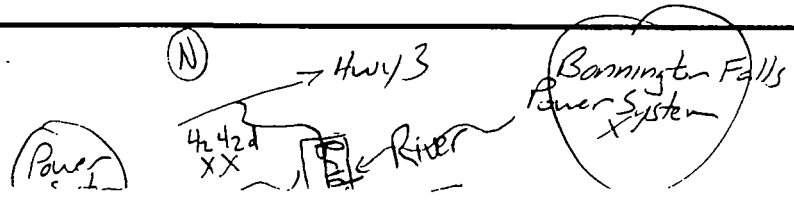
Sample Station Number / Site # 42d

Site/Location Blewett Bridge Northside	**Date** 01/24/02	**Time**	**Crew**
	Roll 1	**Frame** 25 bag	**Water Depth** 3M
	Lat/Long SAME AS ABOVE	**UTM**	**Weather Conditions**

Chemical Characteristics	**pH** X	**eH** 361	Sample/water 1.8°C / 3°C

Physical Characteristics

Sediment Type	silt	**Density**	X
Consistency	X	**Color**	tan
Odor	X	**Vegetation**	moss
Debris	twigs	**Bio Activity**	X
Other Features	X		



Sediment sample photos

Sample Site 8, Sample 42, Roll 1 Frame 24

Photo failed to develop
Sample Site 8, Sample 42d, Roll 1 Frame 25

Sampling Log

Sample Station Number **Site #** 51 → #(9) on Map

Site/Location West side of Glade Ferry (Hwy side)	**Date** 01/21/02	**Time** 1637	**Crew** DH
	Roll 1	**Frame** 3	**Water Depth** 3M
	Lat/Long 49° 23' 43N 117° 32' 47W	**UTM** 11 460366E / 5471543N	**Weather Conditions** overcast

Chemical Characteristics	**pH** 6.74	**eH** -204mV	Sample temp 40°C / water temp 4°C

Physical Characteristics

Sediment Type silt	**Density** X
Consistency unstable	**Color** green/black
Odor sulphur	**Vegetation** thin fibers
Debris none	**Bio Activity** none
Other Features none	

Sample Station Number **Site #** 51 duplicate

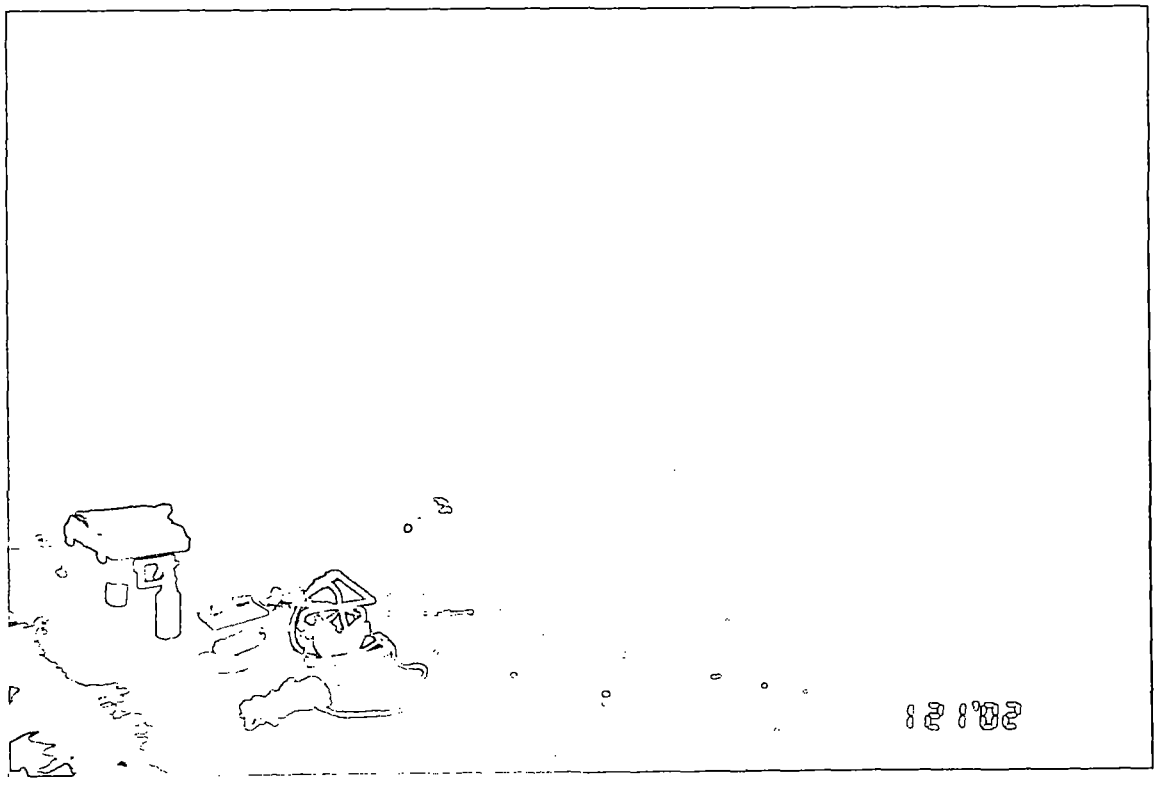
Site/Location West side of Glade Ferry (Hwy Side)	**Date** 01/21/02	**Time** 1707	**Crew**
	Roll 1	**Frame** 4	**Water Depth** .3m
	Lat/Long Same as above	**UTM**	**Weather Conditions**

Chemical Characteristics	**pH** 6.64	**eH** -227mV	Sample temp 40°C / water temp 4°C

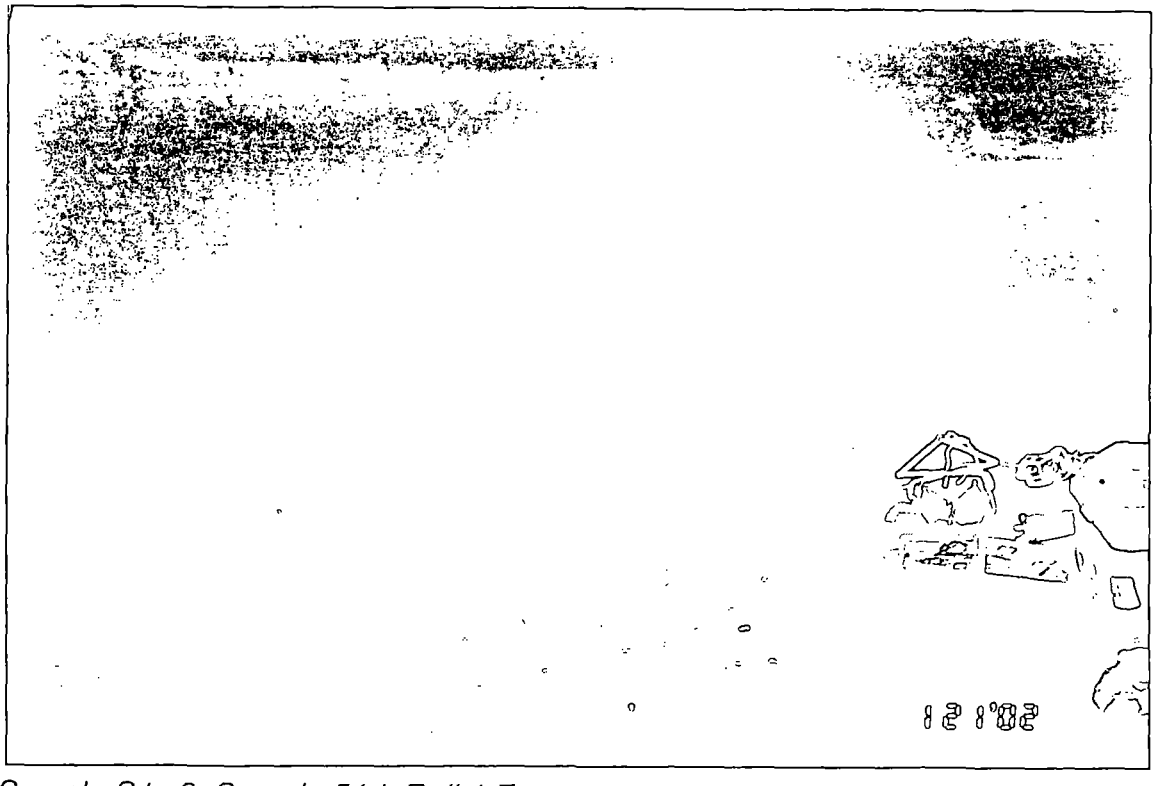
Physical Characteristics

Sediment Type silt	**Density** X
Consistency unstable	**Color** green/black
Odor sulphur	**Vegetation** none
Debris none	**Bio Activity** none
Other Features none	

Sediment sample photos



Sample Site 9, Sample 51, Roll 1 Frame 3



Sample Site 9, Sample 51d, Roll 1 Frame 4

Sampling Log

Sample Station Number **Site #** 52 → #(10) on Map

Site/Location (S)side Blewett Bridge	**Date** 01/24/02	**Time** 9 34	**Crew** DH
	Roll 2	**Frame** 1 Site	**Water Depth** .4M
	Lat/Long 49° 27' 24N / 117° 30' 42W	**UTM** 11/462917E/5478345	**Weather Conditions** overcast/light snow -2°C

Chemical Characteristics	**pH** X	**eH** 340mV	Sample 2.3°C / Water 3°C

Physical Characteristics

Sediment Type	sand/gravel	**Density**	X
Consistency		**Color**	orange/brown
Odor	X	**Vegetation**	aquatic plant vegetation
Debris	X	**Bio Activity**	X
Other Features	X		

Sample Station Number **Site #** 52d

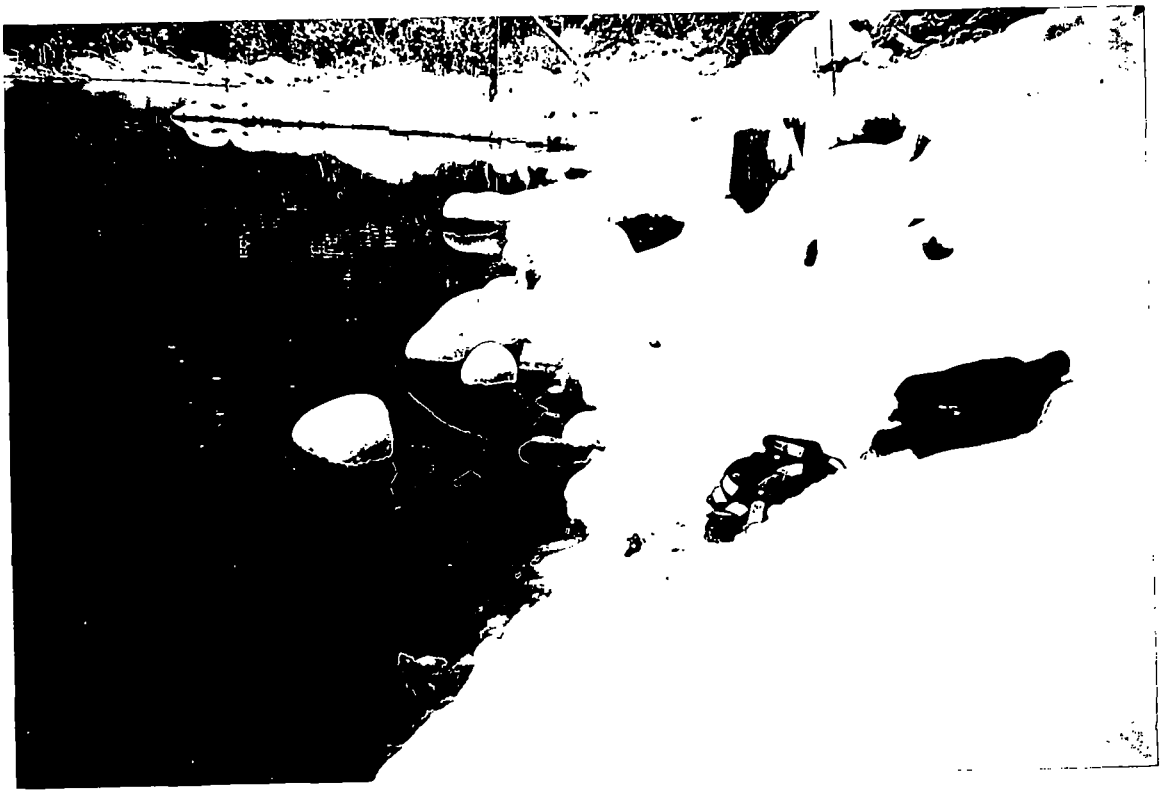
Site/Location (S)side Blewett Bridge	**Date** 01/24/02	**Time** 9:41	**Crew**
	Roll 2	**Frame** 2 (Sample)	**Water Depth** .3m
	Lat/Long SAME AS ABOVE	**UTM**	**Weather Conditions**

Chemical Characteristics	**pH** X	**eH** 312mV	Sample 2.8°C / Water 3°C

Physical Characteristics

Sediment Type	sand/gravel	**Density**	X
Consistency		**Color**	orange/brown
Odor	X	**Vegetation**	aquatic plant vegetation
Debris	X	**Bio Activity**	X
Other Features	X		

Sediment sample photos



Sample Site 10, Sample 52, Roll 2 Frame 1

Photo failed to develop
Sample Site 10, Sample 52d, Roll 2 Frame 2

Sampling Log

Sample Station Number **Site #** 61 → #(11) on Map

Site/Location at the end of Shoreacres Rd	**Date** 01/24/02	**Time** 11:06	**Crew** DH
	Roll 2	**Frame** 3 (Site)	**Water Depth** .3M
	Lat/Long	**UTM**	**Weather Conditions**
49° 26' 20N / 117° 31' 35W		11/461831E / 5476383	Rain/Snowing light +2°C

Chemical Characteristics	**pH** X	**eH** 309 mV	Sample / Water 3.3 / 4°C

Physical Characteristics

Sediment Type Silt	**Density** X
Consistency fine granuals	**Color** tan
Odor X	**Vegetation** X
Debris X	**Bio Activity** X
Other Features X	

Sample Station Number **Site #** 61 duplicate

Site/Location at the end of Shoreacres Rd	**Date** 01/24/02	**Time** 11:14	**Crew**
	Roll 2	**Frame** 4 bag/scoop	**Water Depth** .3M
	Lat/Long	**UTM**	**Weather Conditions**
	Same as A Bing		

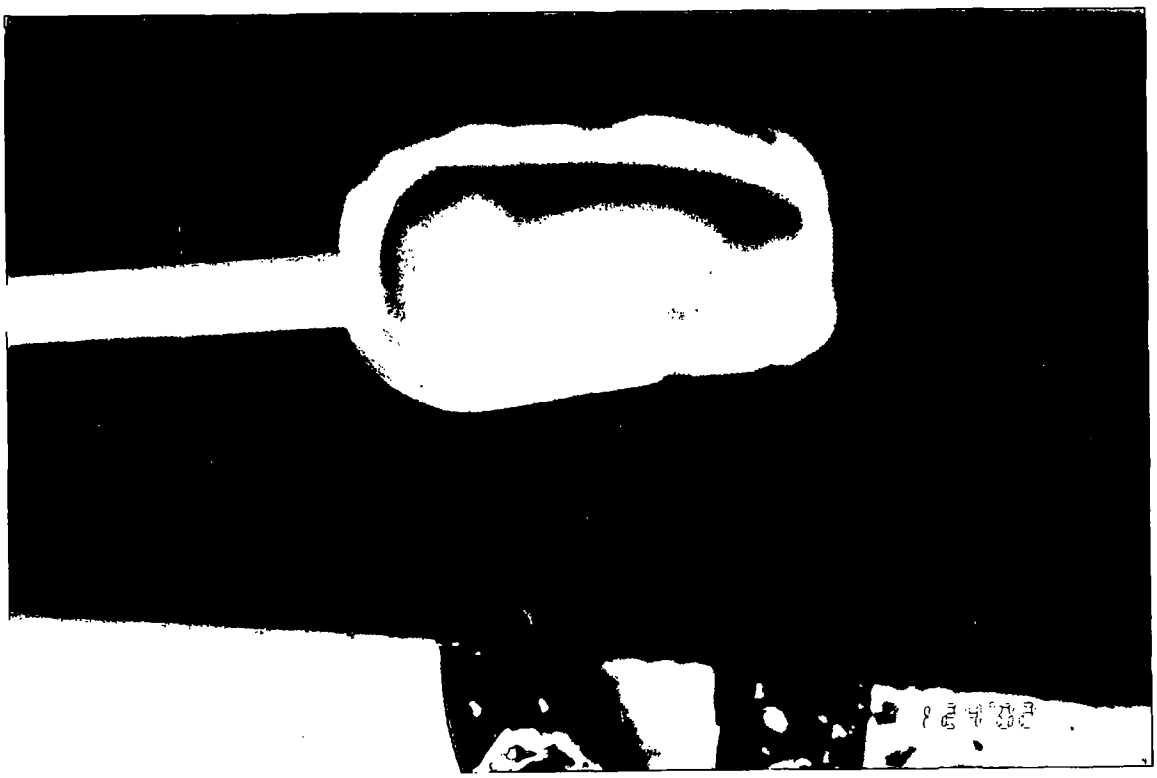
Chemical Characteristics	**pH** X	**eH** 285 mV	Sample / Water 3.5 / 4°C

Physical Characteristics

Sediment Type Silt	**Density** X
Consistency fine granuals	**Color** tan
Odor X	**Vegetation** X
Debris X	**Bio Activity** X
Other Features X	

Sediment sample photos

Sample Site 11, Sample 61, Roll 2 Frame 3



Sample Site 11, Sample 61d, Roll 2 Frame 4
Example of sediment

Sampling Log

Sample Station Number	Site #	62 - Δ #12 on Map	
Site/Location: Shoreacres area	Date: 01/24/02	Time: 1224	Crew: DH
	Roll: 2	Frame: 5 site	Water Depth: .3M
	Lat/Long: 49°25'58N / 117°31'14W	UTM: 11/462265/5475584	Weather Conditions: Overcast +3°C

Chemical Characteristics	pH: X	eH: 119mV	sample / water temp: 3.7°C / 4.0°C

Physical Characteristics

Sediment Type	Silt	Density	X
Consistency	X	Color	brown/grey
Odor	Stagnant	Vegetation	X
Debris	metal and broken glass around site	Bio Activity	X
Other Features	X		

Sample Station Number	Site #	62d	
Site/Location: Shoreacres area	Date: 01/24/02	Time: 1233	Crew
	Roll: 2	Frame: 6	Water Depth: .3M
	Lat/Long: SAME AS ABOVE	UTM	Weather Conditions

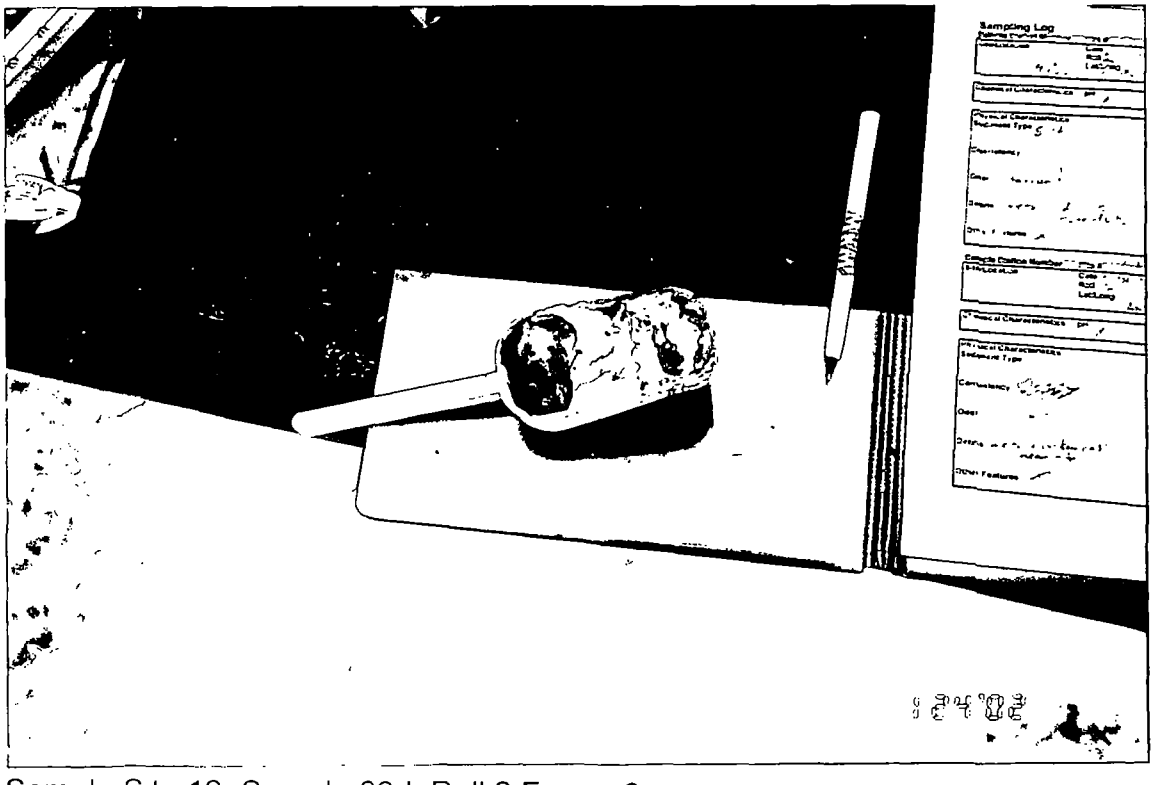
Chemical Characteristics	pH: X	eH: -084mV	sample / water temp: 3.6°C / 4.0°C

Physical Characteristics

Sediment Type	Silt	Density	X
Consistency	X	Color	brown/gray
Odor	Stagnant	Vegetation	X
Debris	metal + broken glass near site	Bio Activity	X
Other Features	X		

Sediment sample photos

Sample Site 12, Sample 62, Roll 2 Frame 5



Sample Site 12, Sample 62d, Roll 2 Frame 6
Example of sediment

Sampling Log

Sample Station Number **Site #** 71 → #13 on Map

Site/Location 2 miles North of Waneta Bridge, East Side of Columbia River	**Date** 01/23/02	**Time** 1436	**Crew** OH
	Roll 1	**Frame** 21	**Water Depth** 4M
	Lat/Long 49°01.882N / 117°36.622N	**UTM** 11/455265E 5431379N	**Weather Conditions** Snowing Moderate -2°C.

Chemical Characteristics	**pH** X	**eH** 082	Sample 3.6°C / Water 4°C

Physical Characteristics

Sediment Type Sand	**Density** X
Consistency X	**Color** green/brown
Odor X	**Vegetation** X
Debris X	**Bio Activity** X
Other Features X	

Sample Station Number **Site #** 71d

Site/Location 2 miles North of Waneta Bridge, East Side of Columbia River	**Date** 01/23/02	**Time**	**Crew**
	Roll 1	**Frame** 22	**Water Depth** 3m
	Lat/Long	**UTM**	**Weather Conditions**

Chemical Characteristics	**pH** X	**eH** 211	Sample 3.4 / Water [illegible]

Physical Characteristics

Sediment Type [illegible]	**Density** X
Consistency X	**Color** [illegible]
Odor X	**Vegetation** X
Debris X	**Bio Activity** X
Other Features X	

Sediment sample photos

Sample Site 13, Sample 71, Roll 1 Frame 21

Sample Site 13, Sample 71d, Roll 1 Frame 22

Sampling Log

Sample Station Number **Site #** 81 → #[illegible] on Map 5431315

Site/Location	Date	Time	Crew
2 miles North of Waneta Bridge East Side of Columbia River	01/23/02	1512	
	Roll 1	Frame 23	Water Depth .3m
	Lat/Long 49°01.80111/117°36.5557/11/455463/[illegible]	UTM	Weather Conditions Snowing Heavy - 2°C

Chemical Characteristics	pH	eH	Sample	Water
	X	-226mV	31°C	4°C

Physical Characteristics

Sediment Type Silt	Density
Consistency	Color dark brown
Odor X	Vegetation X
Debris X	Bio Activity X
Other Features X	

Sample Station Number **Site #** 81d

Site/Location	Date	Time	Crew
2 miles North of Waneta Bridge, East Side of Columbia River	01/23/02		
	Roll 1	Frame	Water Depth .3m
	Lat/Long SAME AS ABOVE	UTM	Weather Conditions

Chemical Characteristics	pH	eH	Sample	Water
	X	-115	2.7°C	4°C

Physical Characteristics

Sediment Type Silt	Density X
Consistency X	Color dark brown
Odor X	Vegetation X
Debris X	Bio Activity X
Other Features X	

Sediment sample photos

Photo failed to develop
Sample Site 14, Sample 81, Roll 1 Frame 23

Sampling Log

Sample Station Number / Site # 9i → #5 on Map

Site/Location	Date	Time	Crew
5.1 km E of Waneta Bridge and Waneta Dam	01/23/02	1129	DH
	Roll 1	Frame 16 (wide), 17 (zoom)	Water Depth .2M
	Lat/Long 49 00' 36N / 117°33'48W	UTM 11/458810E / 5428727N	Weather Conditions Sunny light cloudcover no wind

Chemical Characteristics	pH	eH	Sample Temp / Water Temp
	X	164	1.2°C / 1°C

Physical Characteristics

Sediment Type	silty/gravel	Density	X
Consistency	unstable	Color	dark brown
Odor	X	Vegetation	pond plant (sample)
Debris	X	Bio Activity	X
Other Features	X		

Sample Station Number / Site # 9id

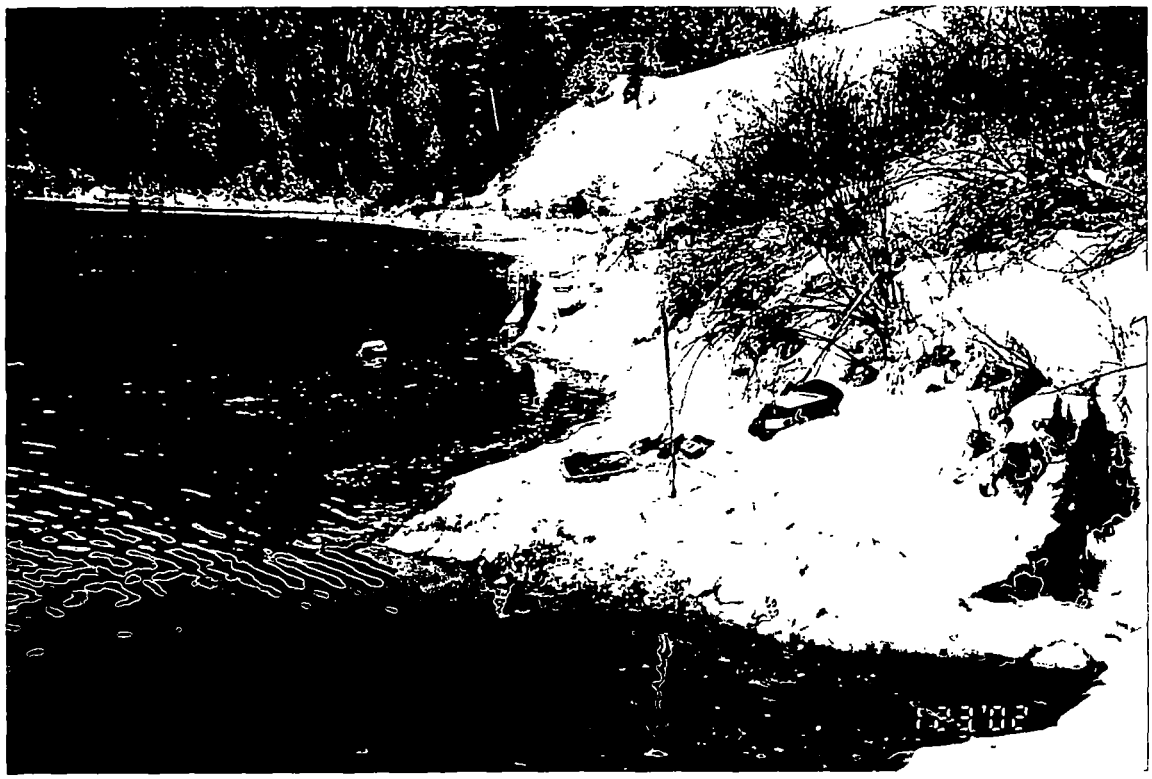
Site/Location	Date	Time	Crew
5.1 km E of Waneta Bridge, and Waneta Dam	01/23/02	1146	
	Roll 1	Frame 18	Water Depth . 2m
	Lat/Long SAME AS ABOVE	UTM	Weather Conditions

Chemical Characteristics	pH	eH	Sample Temp / Water Temp
	X	195	1.1°C / 1°C

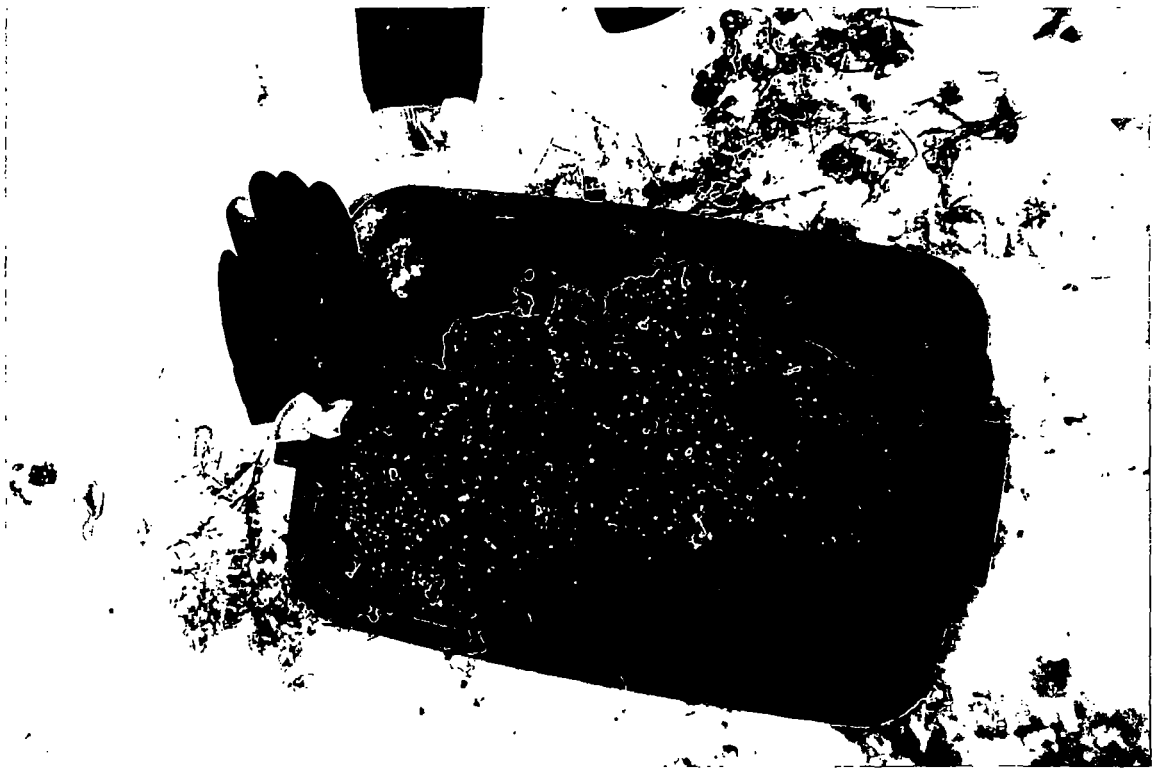
Physical Characteristics

Sediment Type	silty/gravel	Density	X
Consistency	unstable	Color	dark brown
Odor	X	Vegetation	plant roots
Debris	X	Bio Activity	X
Other Features	X		

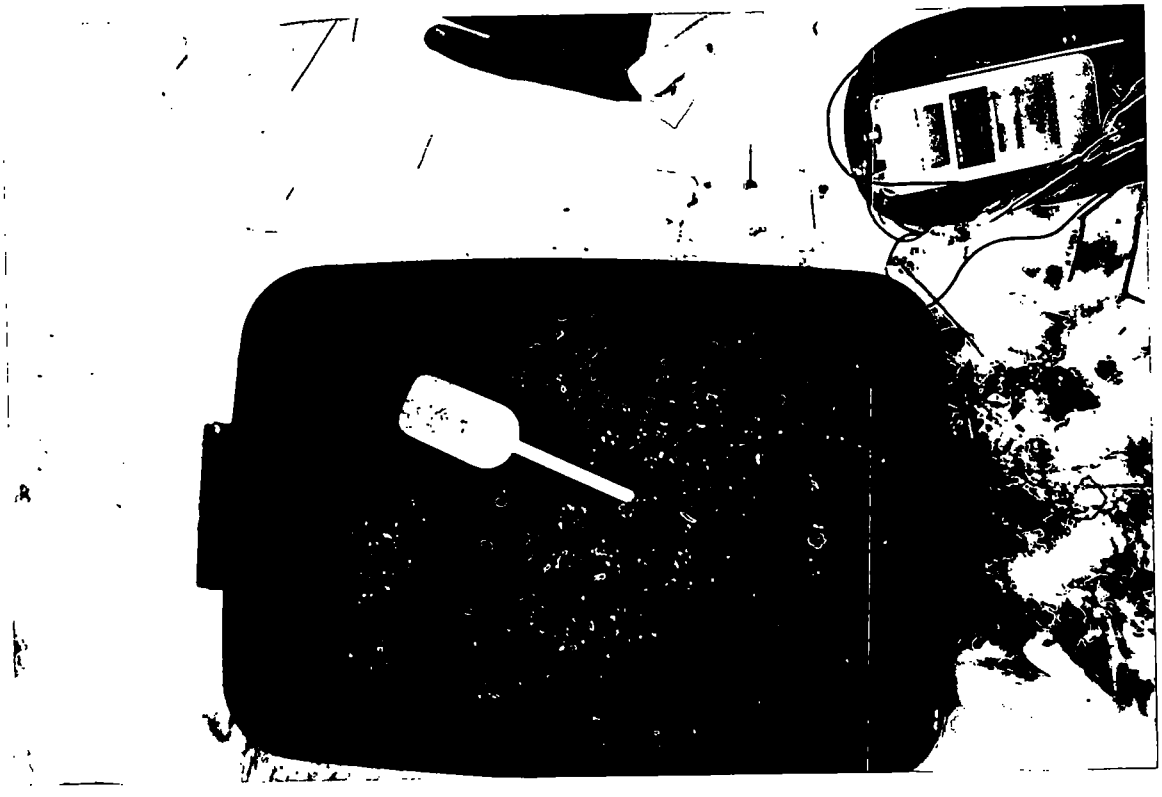
Sediment sample photos



Sample Site 15, Sample 91, Roll 1 Frame 16



Sample Site 15, Sample 91, Roll 1 Frame 17
Example of sediment



Sample Site 15, Sample 91d, Roll 1 Frame 18
Example of sediment

site is infront of glass.

Sampling Log

Sample Station Number - Site # 101 → #(16) on Map

Site/Location	Date	Time	Crew
7 mile Dam site	01/23/02	12 31	
	Roll 1	Frame 19 (wide shot)	Water Depth . 5m
	Lat/Long 49°02'02N / 117°30'12W	UTM 11 463206E / 5431330	Weather Conditions Overcast -4°C

Chemical Characteristics	pH	eH	Sample temp / Water temp
	X	224mV	3.8°C / 3°C

Physical Characteristics

Sediment Type silt	Density
Consistency fine	Color tan
Odor none (x)	Vegetation X
Debris X	Bio Activity X
Other Features X	

Sample Station Number - Site # 101d

Site/Location	Date	Time	Crew
7 mile Dam site	01/23/02	12:40	
	Roll 1	Frame 20 (scoop)	Water Depth . 5m
	Lat/Long SAME AS ABOVE	UTM	Weather Conditions

Chemical Characteristics	pH	eH	Sample temp / Water temp
	X	245mV	3.4°C / 3°C

Physical Characteristics

Sediment Type silt	Density
Consistency fine	Color tan
Odor X	Vegetation X
Debris X	Bio Activity X
Other Features X	

Sediment sample photos

Sample Site 16, Sample 101, Roll 1 Frame 19

Sample Site 15, Sample 101d, Roll 1 Frame 20
Example of sediment

APPENDIX 2: LABORATORY ANALYSIS METHODS, MACHINE CALIBRATION AND SPIKE CALIBRATION DATA, RAW DATA, LABORATORY SAMPLING RESULTS, QUALITY CONTROL SAMPLE DATA, AND CHAIN OF CUSTODY FORMS

Analysis Report

CANTEST

CANTEST LTD

Professional
Analytical
Services

4606 Canada Way
Burnaby, B C
V5G 1K5

Fax 604 731 2386

Tel 604 734 7276

1 800 665 8566

Lab Results

REPORT ON: Analysis of Soil Samples

REPORTED TO: Columbia Environmental
RR2 S85 C10
Penticton, B C.
V2A 6J7

Att'n: Mr. Dwight Shanner

CHAIN OF CUSTODY: 72550SEBC, 72551SEBC, 72552SEBC
PROJECT NAME: 0081 Columbia Metals
PROJECT NUMBER: 0081

NUMBER OF SAMPLES: 16

REPORT DATE: February 15, 2002

DATE SUBMITTED: January 28, 2002

GROUP NUMBER: 30128011

SAMPLE TYPE: Soil

NOTE: Test results contained in this report refer only to the testing of samples submitted.

TEST METHODS:

pH in Soil or Solid - analysis was performed based on procedures described in the Manual on Soil Sampling and Methods of Analysis, published by the Canadian Society of Soil Science,1993 The test was performed using a deionized water leach with measurement by pH meter.

Total Organic Carbon - samples were digested in acid then analyzed using a Leco Induction Furnace combustion/volumetric analysis technique.

Particle Size Distribution - analysis was performed using procedures described in the Manual of Soil Sampling and Methods of Analysis, 2nd edition, 1978, published by the Canadian Society of Soil Science. This test was performed by a subcontractor.

Silver in Soil - analysis was performed using Inductively Coupled Plasma Mass Spectrometry (ICP/MS).

Arsenic in Soil - analysis was performed using Inductively Coupled Plasma Mass Spectrometry (ICP/MS).

Cadmium in Soil - analysis was performed using Inductively Coupled Plasma Mass Spectrometry (ICP/MS).

Mercury in Soil - analysis was performed using Cold Vapour Atomic Fluorescence

Strong Acid Leachable Metals in Soil - analysis was performed using B.C. MOELP Method "Strong Acid Leachable Metals in Soil, Version 1.0". The method involves drying the sample at 60 C, sieving using a 2 mm (10 mesh) sieve and digestion using a mixture of hydrochloric and nitric acids Analysis was performed using

(Continued)

CANTEST LTD

Walter Brandl, B.Sc.
Manager, Environmental Services

A Member of the CANAM Group

REPORTED TO: Columbia Environmental

REPORT DATE: February 15, 2002

GROUP NUMBER: 30128011

CANTEST

Strong Acid Leachable Metals in Soil

Inductively Coupled Argon Plasma Spectroscopy (ICAP) or by specific techniques as described.

Selenium in Soil - analysis was using Inductively Coupled Plasma Mass Spectrometry (ICP/MS)

Thallium in Soil - analysis was performed using Inductively Coupled Plasma Mass Spectrometry (ICP/MS).

TEST RESULTS:

(See following pages)

REPORTED TO: Columbia Environmental

REPORT DATE: February 15, 2002

GROUP NUMBER: 30128011

CANTEST

Conventional Parameters in Soil

CLIENT SAMPLE IDENTIFICATION:	SAMPLE DATE	CANTEST ID	Total Organic Carbon C	pH
1A	Jan 22/02	201280066	0.22	6.3
2A	Jan 22/02	201280068	0.09	6.6
1B	Jan 22/02	201280069	0.72	5.8
2B	Jan 22/02	201280070	0.57	5.5
3A	Jan 22/02	201280071	0.12	6.4
3B	Jan 22/02	201280072	0.63	4.5
41	Jan 21/02	201280073	0.18	6.5
42	Jan 24/02	201280074	0.07	6.3
51	Jan 21/02	201280075	0.05	6.5
52	Jan 24/02	201280076	0.15	6.5
61	Jan 24/02	201280078	0.07	6.8
62	Jan 24/02	201280079	0.14	5.5
71	Jan 23/02	201280080	0.14	7.1
81	Jan 23/02	201280081	0.07	6.8
91	Jan 23/02	201280082	0.16	7.3
101	Jan 23/02	201280083	0.06	7.6
DETECTION LIMIT			0.01	0.1
UNITS			% dry wt.	pH units

% dry wt. = percent, dry weight basis

REPORTED TO: Columbia Environmental

REPORT DATE: February 15, 2002

GROUP NUMBER: 30128011

CANTEST

Particle Size Distribution in Soil

CLIENT SAMPLE IDENTIFICATION:	**1A**	**2A**	**1B**	**2B**	
DATE SAMPLED.	Jan 22/02	Jan 22/02	Jan 22/02	Jan 22/02	DETECTION LIMIT
CANTEST ID:	201280066	201280068	201280069	201280070	
Gravel, >2 mm	7 5	90.9	23.0	0.3	0.1
Sand, <2 mm, >63 microns	88.2	8.9	70.7	93 7	0.1
Silt, <63 microns, >4 microns	2.1	0.1	3.8	4.2	0.1
Clay, <4 microns	2.2	0.1	2.5	1.8	0.1

Results expressed as percent, on a weight basis (%)

REPORTED TO: Columbia Environmental

REPORT DATE: February 15, 2002

GROUP NUMBER: 30128011

CANTEST

Particle Size Distribution in Soil

CLIENT SAMPLE IDENTIFICATION:	**3A**	**3B**	**41**	**42**	
DATE SAMPLED:	Jan 22/02	Jan 22/02	Jan 21/02	Jan 24/02	DETECTION LIMIT
CANTEST ID.	201280071	201280072	201280073	201280074	
Gravel, >2 mm	4 5	1.5	0 3	23.2	0 1
Sand, <2 mm, >63 microns	91.7	85.7	88.0	72.9	0.1
Silt, <63 microns, >4 microns	2.2	9 9	9.4	2.9	0.1
Clay, <4 microns	1.6	2.9	2.3	1.0	0.1

Results expressed as percent, on a weight basis (%)

REPORTED TO: Columbia Environmental

REPORT DATE: February 15, 2002

GROUP NUMBER: 30128011

CANTEST

Particle Size Distribution in Soil

CLIENT SAMPLE IDENTIFICATION:	**51**	**52**	**61**	**62**	
DATE SAMPLED.	Jan 21/02	Jan 24/02	Jan 24/02	Jan 24/02	DETECTION LIMIT
CANTEST ID.	201280075	201280076	201280078	201280079	
Gravel, >2 mm	2.9	62.0	1.1	4.0	0.1
Sand, <2 mm, >63 microns	94.3	37.3	90.7	41.3	0.1
Silt, <63 microns, >4 microns	2.4	0 4	6.5	45.6	0.1
Clay, <4 microns	0 4	0.3	1.7	9 1	0.1

Results expressed as percent, on a weight basis (%)

REPORTED TO: Columbia Environmental

REPORT DATE: February 15, 2002

GROUP NUMBER: 30128011

CANTEST

Particle Size Distribution in Soil

CLIENT SAMPLE IDENTIFICATION:	**71**	**81**	**91**	**101**	
DATE SAMPLED:	Jan 23/02	Jan 23/02	Jan 23/02	Jan 23/02	DETECTION LIMIT
CANTEST ID:	201280080	201280081	201280082	201280083	
Gravel, >2 mm	0 4	3.5	46.3	42.8	0.1
Sand, <2 mm, >63 microns	94.1	91.7	49.9	47.9	0.1
Silt, <63 microns, >4 microns	4.5	4.6	2.6	7.0	0.1
Clay, <4 microns	1.0	0.2	1.2	2.3	0.1

Results expressed as percent, on a weight basis (%)

REPORTED TO: Columbia Environmental

REPORT DATE: February 15, 2002

GROUP NUMBER: 30128011

CANTEST

CSR Metals Analysis in Soil

CLIENT SAMPLE IDENTIFICATION:		1A	2A	1B	2B	
DATE SAMPLED:		Jan 22/02	Jan 22/02	Jan 22/02	Jan 22/02	DETECTION LIMIT
CANTEST ID:		201280066	201280068	201280069	201280070	
Antimony	Sb	<	<	<	<	10
Arsenic	As	1.6	1.0	2.6	1.4	0.2
Barium	Ba	28	15	82	30	1
Beryllium	Be	<	<	<	<	1
Cadmium	Cd	<	<	<	<	0.4
Chromium	Cr	15	12	45	15	2
Cobalt	Co	<	<	4	<	1
Copper	Cu	7	7	25	9	1
Lead	Pb	19	12	44	21	1
Mercury	Hg	0.007	0.007	0.017	0.011	0.001
Molybdenum	Mo	<	<	<	<	4
Nickel	Ni	22	9	36	19	2
Selenium	Se	<	<	<	<	0.4
Silver	Ag	<	<	<	<	0 2
Thallium	Tl	<	<	0.2	<	0.2
Tin	Sn	<	<	<	<	5
Vanadium	V	7	8	34	8	1
Zinc	Zn	21	12	52	28	1
Aluminum	Al	2360	1440	6180	3180	10
Boron	B	29	24	101	30	1
Calcium	Ca	1760	2080	5220	1450	1
Iron	Fe	7530	5530	22500	7770	2
Magnesium	Mg	2230	1310	5540	2030	0.1
Manganese	Mn	83	41	192	80	1
Phosphorus	PO4	1210	2170	3860	819	20
Potassium	K	484	233	2060	571	10
Sodium	Na	<	<	15	<	5
Strontium	Sr	25	31	62	21	1
Titanium	Ti	266	153	271	303	1
Zirconium	Zr	<	<	<	<	1

Results expressed as micrograms per gram, on a dry weight basis. ($\mu g/g$)
< = Less than detection limit

REPORTED TO: Columbia Environmental

REPORT DATE: February 15, 2002

GROUP NUMBER: 30128011

CANTEST

CSR Metals Analysis in Soil

CLIENT SAMPLE IDENTIFICATION:		3A	3B	41	42	
DATE SAMPLED:		Jan 22/02	Jan 22/02	Jan 21/02	Jan 24/02	DETECTION LIMIT
CANTEST ID:		201280071	201280072	201280073	201280074	
Antimony	Sb	<	<	<	<	10
Arsenic	As	1 3	1.1	1.3	1.6	0.2
Barium	Ba	19	50	27	20	1
Beryllium	Be	<	<	<	<	1
Cadmium	Cd	<	<	<	<	0.4
Chromium	Cr	16	20	13	9	2
Cobalt	Co	<	<	1	2	1
Copper	Cu	7	13	11	15	1
Lead	Pb	9	21	14	16	1
Mercury	Hg	0.004	0.015	0.004	0.007	0.001
Molybdenum	Mo	<	<	<	<	4
Nickel	Ni	12	21	12	8	2
Selenium	Se	<	<	0.4	<	0.4
Silver	Ag	<	<	<	<	0.2
Thallium	Tl	<	<	<	<	0.2
Tin	Sn	<	<	<	<	5
Vanadium	V	7	11	15	13	1
Zinc	Zn	13	31	35	26	1
Aluminum	Al	2140	4750	3600	2350	10
Boron	B	23	38	38	32	1
Calcium	Ca	1610	1750	2110	1320	1
Iron	Fe	5580	10500	10600	8770	2
Magnesium	Mg	1380	2770	2470	1500	0.1
Manganese	Mn	62	98	93	73	1
Phosphorus	PO4	1370	1180	1560	956	20
Potassium	K	214	709	476	247	10
Sodium	Na	<	6	<	<	5
Strontium	Sr	34	32	32	20	1
Titanium	Ti	137	399	252	97	1
Zirconium	Zr	<	<	<	<	1

Results expressed as micrograms per gram, on a dry weight basis. (μg/g)
< = Less than detection limit

REPORTED TO: Columbia Environmental

REPORT DATE: February 15, 2002

GROUP NUMBER: 30128011

CANTEST

CSR Metals Analysis in Soil

CLIENT SAMPLE IDENTIFICATION:		51	52	61	62	
DATE SAMPLED:		Jan 21/02	Jan 24/02	Jan 24/02	Jan 24/02	DETECTION LIMIT
CANTEST ID:		201280075	201280076	201280078	201280079	
Antimony	Sb	<	<	<	<	10
Arsenic	As	1.3	1 8	1.9	1.4	0.2
Barium	Ba	34	18	16	54	1
Beryllium	Be	<	<	<	<	1
Cadmium	Cd	<	<	<	<	0.4
Chromium	Cr	10	11	7	16	2
Cobalt	Co	<	2	<	2	1
Copper	Cu	7	21	10	12	1
Lead	Pb	12	15	9	12	1
Mercury	Hg	0.004	0.007	0.004	0.017	0.001
Molybdenum	Mo	<	<	<	<	4
Nickel	Ni	9	12	7	10	2
Selenium	Se	<	<	<	<	0.4
Silver	Ag	<	<	<	<	0.2
Thallium	Tl	<	<	<	<	0.2
Tin	Sn	<	<	<	<	5
Vanadium	V	8	17	10	20	1
Zinc	Zn	30	25	16	27	1
Aluminum	Al	2660	3280	2220	6100	10
Boron	B	29	40	25	47	1
Calcium	Ca	1480	1750	1760	1770	1
Iron	Fe	7730	11000	6480	12500	2
Magnesium	Mg	1610	2800	1400	3130	0.1
Manganese	Mn	69	99	100	118	1
Phosphorus	PO4	1440	974	1360	1180	20
Potassium	K	395	488	192	803	10
Sodium	Na	<	<	<	<	5
Strontium	Sr	31	21	27	29	1
Titanium	Ti	202	192	138	339	1
Zirconium	Zr	<	<	<	<	1

Results expressed as micrograms per gram, on a dry weight basis. (μg/g)
< = Less than detection limit

REPORTED TO: Columbia Environmental

REPORT DATE: February 15, 2002

GROUP NUMBER: 30128011

CANTEST

CSR Metals Analysis in Soil

CLIENT SAMPLE IDENTIFICATION:		71	81	91	101	
DATE SAMPLED:		Jan 23/02	Jan 23/02	Jan 23/02	Jan 23/02	DETECTION LIMIT
CANTEST ID.		201280080	201280081	201280082	201280083	
Antimony	Sb	<	<	<	<	10
Arsenic	As	12.5	10.0	6.9	8.6	0.2
Barium	Ba	102	103	158	79	1
Beryllium	Be	<	<	<	<	1
Cadmium	Cd	1.7	1 2	1.9	<	0.4
Chromium	Cr	21	23	25	24	2
Cobalt	Co	3	4	3	5	1
Copper	Cu	252	261	26	39	1
Lead	Pb	194	128	98	12	1
Mercury	Hg	0 248	0.218	0.035	0.007	0.001
Molybdenum	Mo	<	<	<	<	4
Nickel	Ni	16	13	30	25	2
Selenium	Se	<	<	<	<	0.4
Silver	Ag	1.3	3.1	<	<	0.2
Thallium	Tl	0 4	<	<	<	0.2
Tin	Sn	5	9	<	<	5
Vanadium	V	10	12	23	34	1
Zinc	Zn	954	918	249	35	1
Aluminum	Al	4160	3580	8190	8740	10
Boron	B	89	91	85	95	1
Calcium	Ca	3600	3830	15300	5770	1
Iron	Fe	19000	19300	18600	21600	2
Magnesium	Mg	2430	2020	12100	5620	0.1
Manganese	Mn	242	250	234	303	1
Phosphorus	PO4	1160	1060	1440	1110	20
Potassium	K	688	543	1330	988	10
Sodium	Na	53	66	76	56	5
Strontium	Sr	47	47	49	59	1
Titanium	Ti	326	261	334	360	1
Zirconium	Zr	<	<	<	<	1

Results expressed as micrograms per gram, on a dry weight basis. ($\mu g/g$)
< = Less than detection limit

REPORTED TO: Columbia Environmental

REPORT DATE: February 15, 2002

GROUP NUMBER: 30128011

CANTEST

Batch Quality Control for Conventional Parameters in Soil

Parameter	QC Type	QC Result	Units	Lower Limit	Upper Limit
Total Organic Carbon C	Blank	< 0.01	% dry wt.	0	0.01
	Duplicate	13.3	R.P.D.	0	20
	Duplicate	13.5	R.P.D.	0	20

% dry wt. = percent, dry weight basis
< = Less than detection limit
R.P.D. = Relative Percent Difference

REPORTED TO: Columbia Environmental

REPORT DATE: February 15, 2002

GROUP NUMBER: 30128011

CANTEST

Batch Quality Control for CSR Metals Analysis in Soil (QC# 29360)

Parameter		Duplicate (R.P.D.) 201280005	Duplicate Limits	Duplicate (R.P.D.) 201280021	Duplicate Limits	Duplicate (R.P.D.) 201280066	Duplicate Limits
Antimony	Sb	-	-	-	-	NC	30
Arsenic	As	1 6	30	0	30	6.5	30
Barium	Ba	0	30	0	30	3.5	30
Beryllium	Be	0	30	-	-	NC	30
Cadmium	Cd	PASS	30	NC	30	NC	30
Chromium	Cr	-	-	-	-	19.4	30
Cobalt	Co	-	-	-	-	NC	30
Copper	Cu	-	-	-	-	13.3	30
Mercury	Hg	4.2	30	0	30	0	30
Molybdenum	Mo	-	-	-	-	NC	30
Nickel	Ni	-	-	-	-	0	30
Selenium	Se	PASS	30	NC	30	NC	30
Silver	Ag	PASS	30	NC	30	NC	30
Thallium	Tl	NC	30	NC	30	NC	30
Tin	Sn	-	-	-	-	NC	30
Vanadium	V	-	-	-	-	28 6	30
Zinc	Zn	-	-	-	-	9.5	30

ug/g = micrograms per gram
R.P.D. = Relative Percent Difference
PASS = Duplicate sample results were in the range of one to five times the detection limit. R.P.D. calculation is not applicable in this range. Acceptance criteria is a maximum difference between the duplicates equivalent to the value of the detection limit.
NC = Not Calculated. Duplicate sample results were less than the detection limit. Relative Percent Difference calculation is not defined for analyte levels of less than detection limit.

REPORTED TO: Columbia Environmental

REPORT DATE: February 15, 2002

GROUP NUMBER: 30128011

CANTEST

Batch Quality Control for CSR Metals Analysis in Soil (QC# 29360)

Parameter		Duplicate (R.P.D.) 201280075	Duplicate Limits	Duplicate (R.P D) 201280116	Duplicate Limits	NIST 2711 Montana Soil-SALM (% Recovery)	NIST 2711 Montana Soil-SALM Limits
Antimony	Sb	NC	30	-	-	-	-
Arsenic	As	18.2	30	14.1	30	88	79 - 120
Barium	Ba	26 9	30	0	30	24	19 - 39
Beryllium	Be	NC	30	-	-	-	-
Cadmium	Cd	NC	30	0	30	95	74 - 114
Chromium	Cr	PASS	30	-	-	-	-
Cobalt	Co	NC	30	-	-	-	-
Copper	Cu	28.6	30	-	-	97	78 - 115
Mercury	Hg	0	30	-	-	102	74 - 114
Molybdenum	Mo	NC	30	-	-	-	-
Nickel	Ni	PASS	30	-	-	48	41 - 116
Selenium	Se	NC	30	PASS	30	80	80 - 120
Silver	Ag	NC	30	PASS	30	73	52 - 121
Thallium	Tl	NC	30	PASS	30	-	-
Tin	Sn	NC	30	-	-	-	-
Vanadium	V	11.8	30	-	-	44	39 - 97
Zinc	Zn	0	30	-	-	92	80 - 110

ug/g = micrograms per gram
R.P.D. = Relative Percent Difference
PASS = Duplicate sample results were in the range of one to five times the detection limit. R.P.D. calculation is not applicable in this range. Acceptance criteria is a maximum difference between the duplicates equivalent to the value of the detection limit.
NC = Not Calculated. Duplicate sample results were less than the detection limit. Relative Percent Difference calculation is not defined for analyte levels of less than detection limit.

REPORTED TO: Columbia Environmental

REPORT DATE: February 15, 2002

GROUP NUMBER: 30128011

CANTEST

Batch Quality Control Frequency Summary

SALM in Soil Digestion (Batch# 29360)

QC Type	No. Samples
NIST 2711 Montana Soil-SALM	1
Duplicate	5

Leco Analysis Soils/Solids (Batch# 29415)

QC Type	No. Samples
Blank	1
Duplicate	2

SALM Metals in Soil Sieve (Batch# 29327)

QC Type	No. Samples
Batch Size	16

Sublet Tests -Send Out (Batch# 29331)

QC Type	No. Samples
Batch Size	16

SALM in Soil Digestion (Batch# 29360)

QC Type	No. Samples
Batch Size	50

(Continued on next page)

REPORTED TO: Columbia Environmental

REPORT DATE: February 15, 2002

GROUP NUMBER: 30128011

CANTEST

Batch Quality Control Frequency Summary

Leco Analysis Soils/Solids (Batch# 29415)

QC Type	No. Samples
Batch Size	30

CANTEST

CANTEST LTD

Professional
Analytical
Services

4606 Canada Way
Burnaby B C
V5G 1K5

Fax 604 731 2386

Tel 604 734 7276

1 800 665 8566

May 10, 2002

Dwight Shanner
Columbia Environmental
RR2 S85 C10
Penticton, B.C
V2A 6J7

Dear Mr. Shanner;

Subject: Analysis methods and instrument calibration information

Here is the information you requested My apologies for the delay in couriering it out to you, some of the instrumental calibration information was not easily accessible due to the media on which it is stored

Lab Data

Methodology

- Procedure for the Preparation and Digestion of Geological Samples for the Determination of Environmental Parameters
- Procedure for Preparation and Digestion of Strong Acid Leachable Metals (SALM) in Soil
- Procedure for the Determination of Mercury by Atomic Fluorescence Spectrometry
- Leco Carbon Analysis Method
- Method Summary for Analysis of Various Sample Types by ICP
- Method Summary for Analysis of Soil Samples by ICP/MS

Raw Data

- Raw data from the ICP, work list number 62640
- Raw data for TOC analysis
- Mercury raw data (scan) including calibration information
- Raw data from ICPMS, work list number 62320

Calibration Information

- ICP instrumental Calibration information
- ICPMS instrumental Calibration information

Accreditation Certificates

- State of Washington – Department of Ecology
- Standards Council of Canada

Hopefully this will address any questions your client may have regarding the manner in which the analysis was performed

If you have any questions or require anything else, please don't hesitate to give me a call

Sincerely,
CANTEST LTD.

Jennifer Lewis
Coordinator, Quality Management Systems
jlewis@cantest com

CANTEST®

CAN TEST TRACE METALS DEPARTMENT
PROCEDURE FOR THE DETERMINATION OF MERCURY IN SOIL AND TISSUE DIGESTS

SAFETY PRECAUTIONS:

Exercise care when handling mercury solutions (toxic). Use hand and eye protection when using concentrated acids. Aqua regia must not be stored in closed containers.

APPLICATION NOTES:

The analysis procedures for soil and tissue digests are virtually identical. Soil and tissue digests are not normally analyzed during the same instrumental analysis session due to operational concerns

REVISIONS:

Rev 1 September 20, 1995 (interim).
Rev 2 October 24, 1995
Rev 3· October 21, 1997, minor revisions after audit
Rev. 4· March 5, 1999, minor revisions
Rev. 5 May 31, 1999, preparation of calibration standards modified.
Rev. 5. August 26, 1999, preparation of calibration standards modified
Rev. 7: April 3, 2000, fixed error regarding two versions of "rev. 5" as listed above

APPLICATION:

This procedure applies to analysis of mercury in soil or tissue digests and air filters prepared using aqua regia, nitric acid or nitric acid/hydrogen peroxide. Refer to separate digestion procedures: "Procedure for Nitric Acid/Hydrogen Peroxide Digestion of Tissue & Vegetation Samples for Analysis of Heavy Metals", and "Procedure for Digestion of Geological Samples for Analysis of Environmental Parameters".

PRINCIPLE:

Mercury compounds are oxidized during digestion, and then reduced to elemental mercury using stannous chloride during the analysis procedure. A stream of nitrogen introduced into the system passes through a reference cell and then after sparging the elemental mercury from the solution, passes through the sample cell. A UV monitor equipped with a mercury lamp provides the light source and absorbance at 253.7 nm is measured against the reference cell.

REFERENCES:

This procedure is based on:

Standard Methods for the Examination of Water and Wastewater, 20th ed 1998, Method 3112, pages 3-22 to 3-24.

ASTM STANDARDS. Designation D3223-86. Standard Test Method for Total Mercury in Water.

SAMPLE PREPARATION/DIGESTION METHODS:

CANTEST Method for Nitric Acid/Hydrogen Peroxide Digestion of Tissue & Vegetation Samples for Analysis of Heavy Metals. (65-P-001)
CANTEST Method for Digestion of Geological Samples for Analysis of Environmental Parameters (65-P-004)
CANTEST Procedure for Determination of Metals in Air Filters (65-P-014)

DETECTION LIMITS:

The instrument detection limit determined by MDL studies is less than 0 05 µg/L, quoted on a solution basis The reported detection limit for soil and tissue digests is higher, at 0.2 µg/L (i e 0 0002 mg/L), on a solution basis
For soil and tissue digests, the detection limit reported is on a solid basis, in micrograms per gram, and is dependent on sample weight digested, and final dilution volume

PROCEDURE FOR THE DETERMINATION OF MERCURY IN SOIL AND TISSUE DIGESTS (continued)

INTERFERENCES:

High chloride content in the samples may result in interferences due to the liberation of free chlorine which absorbs at 253 7 nm. Certain volatile organic materials which absorb at 253.7 nm may also interfere. If samples foam badly during analysis steps add 1 drop of Dow-Corning Antifoam B prior to applying the nitrogen stream

REGULATORY LIMITS-(for Mercury in Soil):

Criteria for Managing Contaminated Sites in B C (1989).

Level A	0 1 mg/kg
Level B	2 mg/kg
Level C	10 mg/kg

Criteria for Managing Contaminated Sites in B C (1995).

Agricultural	0 8 mg/kg
Urban Park	2 mg/kg
Residential	2 mg/kg
Commercial	10 mg/kg
Industrial	10 mg/kg

SAMPLE CONTAINERS / STORAGE / HOLDING TIMES:

Sample Containers
Soil, biological tissue, and vegetation samples may be collected in plastic or glass containers.

Storage and Holding Times-Prior to Digestion
Undried vegetation and biological tissue samples should be refrigerated if sample preparation commences within 5 days, or frozen if sample preparation will commence later. Holding time for dried or frozen vegetation or tissue samples is indefinite, but analysis should commence within 3 months.

For soil samples, holding time for dried or undried samples is indefinite, but analysis should commence within 3 months.

Holding Times-After Digestion
Time prior to analysis of digests after digestion is 24 hours maximum. Samples are to be analyzed the same day that they are diluted to final volume with water

Special Drying Requirements for Mercury Analysis
Samples for mercury analysis should not be oven-dried due to possible losses of mercury; air-drying is acceptable, but analysis of undried sample is preferred.

APPARATUS and INSTRUMENTATION:

Pharmacia Model 100M Mercury Monitor (or equivalent) Instrumentation consisting of consisting of UV Control Unit, UV Optical Unit, Chart Recorder, reaction vessel, 4-way stopcock

Drying Tube

Dry nitrogen supply

Glass pipettes· 1 mL, 5 mL, 10 mL

Volumetric flasks· 100 mL, 500 mL

1 mL pipette graduated in 0 1 mL increments

10 mL graduated pipette

500 mL beaker

PROCEDURE FOR THE DETERMINATION OF MERCURY IN SOIL AND TISSUE DIGESTS (continued)

GLASSWARE CLEANING PROCEDURES:

For instructions for cleaning glassware, refer to CanTest Trace Metals Department SOP Method for Cleaning and Acid Washing Glassware for Trace Metals Analysis (65-E-001).

REAGENTS:

Ultrapure water. Obtained from a Millipore Milli-Q Water Purification System
Stannous chloride ($SnCl_2$ $2H_2O$), reagent grade. BDH ASC 876 or equivalent.
Antifoam B: Dow Corning
Hydrochloric acid, HCl, concentrated, "Environmental Grade", for reagent preparation
Nitric acid, HNO_3, concentrated, "Environmental Grade", for standards preparation.
Hydrochloric acid, and nitric acid, concentrated, for acid washing only.

Safety Notes: Use hand and eye protection when using concentrated acids. Aqua regia must not be stored in closed containers.

PREPARATION OF REAGENT SOLUTIONS:

20% Stannous Chloride Solution:
Weigh 50 g of $SnCl_2 \cdot 2H_2O$ into a 250 mL beaker In a fumehood add 50 mL of "Environmental Grade" HCl and heat until dissolved with occasional swirling. Let cool and dilute to 250 mL with Ultrapure water. Transfer to a plastic bottle. Shelf life is six months; however, discard if solution turns yellow.

PREPARATION OF CALIBRATION STANDARD SOLUTIONS:

Method Note. The 1.00 mg/L Mercury Intermediate Solution is also used for water analysis

Stock Mercury Solution, 1000 mg/L as Hg
Purchase from commercial supplier, AA Hg 4, or equivalent. Shelf life is 1 year or as stated on label.

100 mg/L Mercury Intermediate Solution:
Pipette 10.00 mL of 1000 mg/L Mercury Stock Solution, add 2 mL of nitric acid, and dilute to 100.0 mL with Ultrapure water. Shelf life is 6 months.

1.00 mg/L Mercury Intermediate Solution:
Pipette 5.00 mL of 100 mg/L Mercury Intermediate Stock Solution, add 2 mL of nitric acid, and dilute to 500 mL with Ultrapure water. Shelf life is 6 months.

10 µg/L Mercury Working Solution.
Pipette 1.00 mL of 1.00 mg/L Mercury Intermediate Stock Solution into a 100 mL volumetric flask, add 10 mL of nitric acid, and dilute to volume with Ultrapure water. Prepare fresh daily.

Daily Mercury Calibration Standard Solutions:
To generate a calibration curve, pipette 1.00 mL, 2.00 mL, 3.00 mL, 4.00 mL, 5.00 mL, 6.00 mL, or 7.00 mL of 10 µg/L Mercury Working Solution into the reaction vessel of Mercury Monitor apparatus. Add Ultrapure water up to a volume of approximately 10 mL and proceed with analysis steps for each volume pipetted, as described in the Analysis Procedure below. This yields concentrations of 0.01 through 0.07 micrograms mercury respectively, and a calibration curve may be generated.

Calibration Verification Standard Solutions:
Prepare solutions as described above, using a second source for the Stock Solution (i.e having a different lot number) Analyze at least one level of Calibration Verification standard per run Calibration Verification Working Solution (10 µg/L) must be prepared daily

PROCEDURE FOR THE DETERMINATION OF MERCURY IN SOIL AND TISSUE DIGESTS (continued)

INSTRUMENT SET UP PROCEDURE:

1 Turn on Mercury Monitor and allow at least one-half hour (one hour preferred) warm-up prior to analysis.

2 Select a range / recorder sensitivity combination such that a 0 07 µg standard produces at least 3/4 full scale deflection (e.g use 0 08/10mV).

3 Check recorder zero and full scale settings and adjust if necessary. (See manufacturer's instructions.)

4. Replace desiccant if blue colour is no longer present.

5. Set pen at zero and check that zero setting allows for full chart deflection Turn chart paper feed on

ANALYSIS PROCEDURE:

For instructions on creating worklists refer to CANTEST Work Instructions 60-S-005.

Note: Soil and tissue digests are not normally analyzed during the same instrumental analysis session due to operational concerns

1. Create a worklist containing the samples that are to be analyzed.
2. Perform analysis using the Mercury Monitor apparatus. Set up the instrument as described in the section above. Pipette a suitable sample solution aliquot (e g. 0 10 mL to 10 00 mL) of sample into the reaction vessel so that a peak height of between 10 and 90 recorder units is achieved. Dilute high level samples into the desired range, within the range of the calibration curve. Analyze calibration standard solutions first, then the calibration verification solution, followed by digestion blanks, the certified reference material and then digested samples and digested quality control samples as appropriate.
3. Add approximately 0.5 mL of Stannous Chloride Solution and immediately attach aerator to vessel The cold vapour atomic absorption will result in a peak on the chart recorder
4. Analyze samples one at a time, rinsing reaction/aeration vessel between samples.
5. Record the sample identification and the sample aliquot on the resulting peak produced by the chart recorder.
6 To confirm the integrity of the calibration during the analysis batch, analyze at least two of the calibration standards at the end of the analysis run; for long runs analyze one or two of the calibration standards near the middle of the run.

CALCULATIONS:

Prepare a standard curve by plotting absorbance readings (in terms of peak height) against concentration of mercury in total micrograms. Graph may be plotted on graph paper, using a spreadsheet or it may be calculated using a programmable calculator with linear regression capabilities

The calibration curve criteria is a minimum correlation coefficient of 0.995

Calculate mercury concentrations as follows:

$$\mu g/mL\ Hg = \frac{\mu g\ Hg\ (read\ from\ graph)}{Sample\ aliquot\ (mL)}$$

$$\mu g/g\ Hg = \frac{\mu g/mL\ Hg\ (calculated)}{Dry\ wt\ of\ sample\ (g)} \times volume\ digested\ sample\ (mL)$$

Note: this final calculation may done automatically by the LIMS system.

For instructions about worklist data entry refer to CANTEST Work Instructions 60-S-005.

PROCEDURE FOR THE DETERMINATION OF MERCURY IN SOIL AND TISSUE DIGESTS (continued)

QUALITY CONTROL SECTION:

Contamination Control:
Rinse all glassware with aqua-regia and rinse thoroughly with Ultrapure water prior to use

Digestion Blanks:
Digest and analyze at least three mercury digestion blanks with the sample set.

Duplicate Samples:
Samples are to be digested and analyzed in duplicate at a minimuum frequency of one per 10 samples, if sample quantities permit.

Certified Reference Materials.
Certified Reference Materials are to be digested and analyzed at a frequency of at least one per batch of samples Usual CRM's are NRC TORT-1 (biological) and NIST 2711 (geological) Other CRM's are available as listed in the digestion procedures

Calibration Verification Standard Solutions:
Analyze at least one level of Calibration Verification standard per run Prepare solutions from Stock Solution obtained from a second source (i.e different lot number).

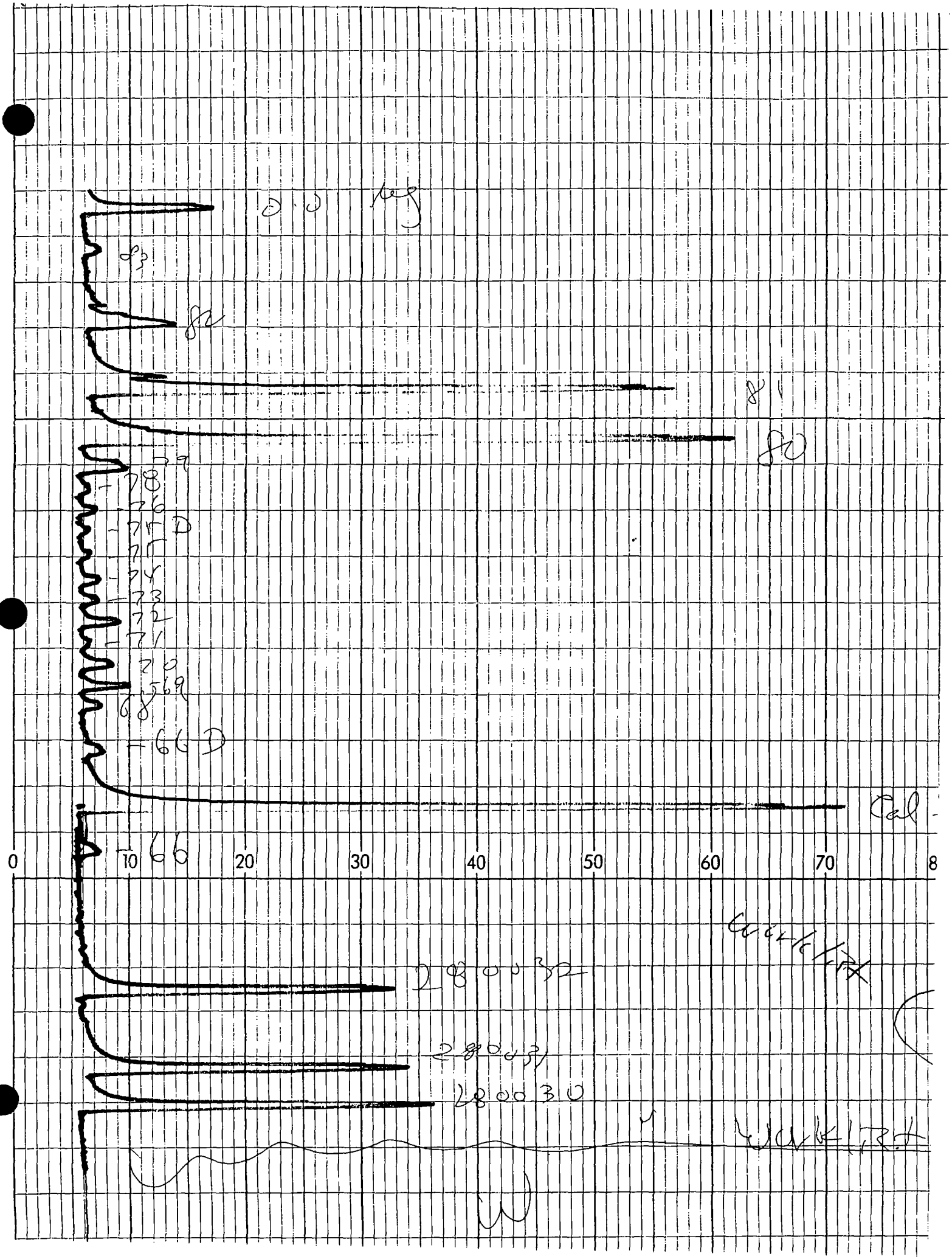
Instrument: HGAF Created by: mwk on Jan 29/02 03:20 pm

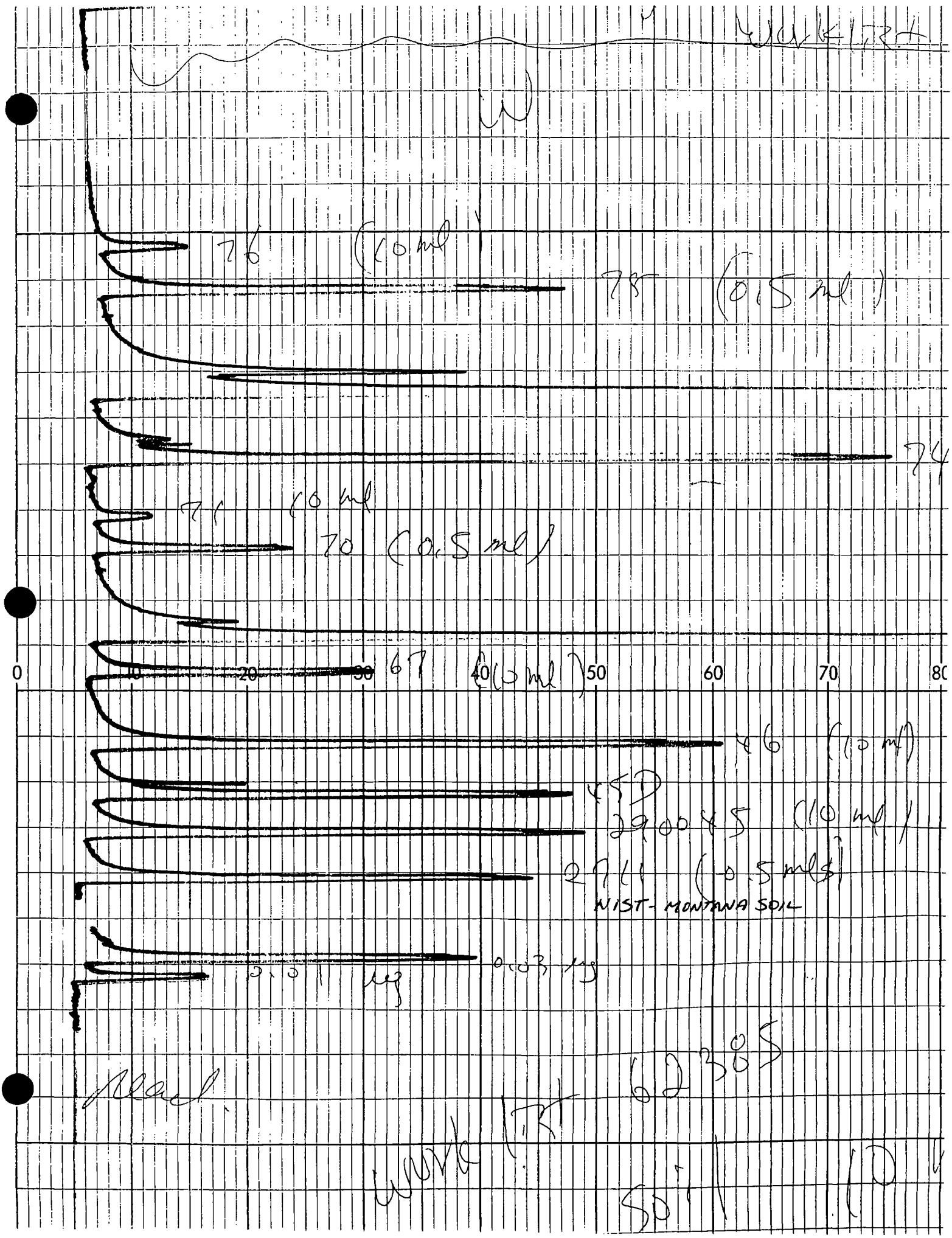
Sample#	A	Type	Client Sample ID	Batch#	IV	FV
201280030		SAMPLE	KEY004 Cell 13A S/P3 1	29360		
HG-AFCSR .131						
201280031		SAMPLE	KEY004 Cell 13A S/P3 2	29360		
HG-AFCSR .120						
201280032		SAMPLE	KEY004 Cell 13A S/P3 3	29360		
HG-AFCSR .117						
201280066		DUP	COL117 1A	29360		
HG-AFCSR .007						
201280066		SAMPLE	COL117 1A	29360		
HG-AFCSR .007						
201280068		SAMPLE	COL117 2A	29360		
HG-AFCSR .007						
201280069		SAMPLE	COL117 1B	29360		
HG-AFCSR .017						
201280070		SAMPLE	COL117 2B	29360		
HG-AFCSR .011						
201280071		SAMPLE	COL117 3A	29360		
HG-AFCSR .004						
201280072		SAMPLE	COL117 3B	29360		
HG-AFCSR .015						
201280073		SAMPLE	COL117 41	29360		
HG-AFCSR .004						
201280074		SAMPLE	COL117 42	29360		
HG-AFCSR .007						
201280075		DUP	COL117 51	29360		
HG-AFCSR .004						
201280075		SAMPLE	COL117 51	29360		
HG-AFCSR .004						
201280076		SAMPLE	COL117 52	29360		
HG-AFCSR .007						
201280078		SAMPLE	COL117 61	29360		
HG-AFCSR .004						

Instrument: HGAF Created by: mwk on Jan 29/02 03:20 pm

Sample#	A Type	Client Sample ID	Batch#	IV	FV
201280079	SAMPLE	COL117 62	29360		
HG-AFCSR .017					
201280080	SAMPLE	COL117 71	29360		
HG-AFCSR .248					
201280081	SAMPLE	COL117 81	29360		
HG-AFCSR .218					
201280082	SAMPLE	COL117 91	29360		
HG-AFCSR .035					
201280083	SAMPLE	COL117 101	29360		
HG-AFCSR .007					

****** End of worklist# 62304 ******


0.0 mg
83
82
81
80
79
78
76
75 D
75
74
73
72
71
70
69
68
66 D
Cal
66
0
10
20
30
40
50
60
70
8
280032
280031
280030
Work list



Work list
W
76 (10 ml)
75 (0.5 ml)
74
71 10 ml
70 (0.5 ml)
0
10
20
30
67 (10 ml)
40
50
60
70
80
46 (10 ml)
45D
29 00 45 (10 ml)
2711 (0.5 mls)
NIST- MONTANA SOIL
0.01 ug
0.03 ug
62385
Work list
Soil
10

QCHISTORY TABLE

Matrix Code	Test Code	Qc#	Qc Action#	Qc Actual	Qc Found	Qc
SOIL	HG-AFCSR	77840	0	004	004	0 0
SOIL	HG-AFCSR	77840	0	007	007	0 0
WATER	HG-WTA	77840	0	0 50	54	108

Query(F1) Help(F11) End(PF3)

al	Qc Found	Qc Yield	Lower Limit	Upper Limit
	004	0 000	0 000	30 000
	007	0 000	0 000	30 000
	54	108 000	90 000	110 000

Query(F1) Help(F11) End(PF3)

wer Limit	Upper Limit	Category Code	Qc Name	Qc Param	Inst C
000	30.000	DHGSAF	DUP	HG-AFCSR	HGAF
000	30 000	DHGSAF	DUP	HG-AFCSR	HGAF
000	110 000	VHGAF	CAL-VER	HG-WTA	HGAF

Query(F1) Help(F11) End(PF3)

Analysis Date	Status Flag	Worklist#	Worklist Sequence	Batch#
01-feb-2002 09 57 12	NEW	62304	14	29360
01-feb-2002 09 57 12	NEW	62304	5	29360
01-feb-2002 09 57 12	NEW	62304	1	

Query(F1) Help(F11) End(PF3)

st#	Worklist Sequence	Batch#	Sample#	Aliquot	Replicate	Last Ac
	14	29360	201280075	0	01-feb-	
	5	29360	201280066	0	01-feb-	
	1			01-feb-		

Query(F1) Help(F11) End(PF3)

CANTEST®

CANTEST TRACE METALS DEPARTMENT
PROCEDURE FOR THE PREPARATION AND DIGESTION OF GEOLOGICAL SAMPLES FOR THE DETERMINATION OF ENVIRONMENTAL PARAMETERS

SAFETY NOTES:

Concentrated acids are very corrosive. Use eye protection and gloves at all times. Perform work in a fumehood.

Care should be taken in handling the samples as some may be from heavily contaminated sites and thus may contain toxic compounds or be biologically active.

REVISIONS:

Revision 0:	1988
Revision 1	June 19, 1995
Revision 2:	October 31, 1995, extensive editorial revisions; limited content revisions
Revision 3:	August 12, 1997, revisions after audit
Revision 4:	September 27, 1999, minor revisions

APPLICATION:

The methods summarized here apply to the preparation and digestion of geological samples including dredgate materials for ocean dumping regulation, sediments, soils, sludges and similar materials for metals analysis.

In addition, the sample preparation methods may be used for analysis of various parameters including inorganic parameters ammonia and cyanide, and the organic parameters oil and grease, extractable hydrocarbons, and volatile organics

METHOD PRINCIPLE - METALS ANALYSIS:

For "Heavy Metal" parameters an undried sample is thoroughly mixed prior to an aqua regia (usually 1 part nitric acid and 2 parts hydrochloric acid) digestion. An air dried sample may be used.

REFERENCES:

This method uses the following procedures as guidelines:

"Manual on Soil Sampling and Methods of Analysis", Canadian Society of Soil Science, 2nd Edition, 1978

"Procedures for Handling and Chemical Analysis of Sediment and Water Samples", U.S EPA/Corps of Engineers, May 1981.

"Test Methods for Evaluating Solids Waste, Volume 1A", U.S. EPA, Third Edition, Nov 1986, Method #3050.

"A Manual on Analytical Methods Used by the Canadian Mining Industry", Canadian Mineral Analysts, (two volumes).

ASTM Methods, various sections.

SUPPORTING TEST METHODS:

CANTEST Work Instructions for Compositing of Soil Samples (65-S-013)

CANTEST Work Instructions for Batch Creation, Sample Preparation, Worklist Creation, and Worklist Data Entry in LIMS (60-S-005)

CANTEST Work Instructions for the Determination of Moisture in Soil Samples (60-S-003)

PROCEDURE for PREPARATION and DIGESTION of GEOLOGICAL SAMPLES for ANALYSIS of ENVIRONMENTAL PARAMETERS (continued)

ANALYSIS METHODS.

Analysis of the sample digests for metals are performed using the following methods:

CANTEST Procedure for the Analysis of Mercury in Soil and Tissue Digests (65-A-002)

CANTEST Procedure for the Analysis of Water Samples and Soil and Tissue Digests by Graphite Furnace Atomic Absorption Spectrophotometry (65-A-003)

CANTEST Method for the Determination of Metals by Flame Atomic Absorption Spectrophotometry (65-A-008)

CANTEST Method for the Determination of Sodium, Potassium and Lithium by Flame Atomic Emission (65-A-010)

CANTEST Method Summary for Analysis of Various Sample Types by ICP (65-S-060)

CANTEST ICPMS Operations Manual (65-N-100 to 65-N-124)

ELEMENTS DETERMINED:

The most common elements determined are arsenic, selenium, cadmium, mercury, lead, copper, zinc, and mercury.

ALTERNATIVE PREPARATION AND DIGESTION METHODS:

Sample preparation methods may include sieving, and grinding and pulverizing of dried sample material.

Other acid digestions may be used including aqua regia containing various amounts of nitric acid and hydrochloric acid (ranging from one part hydrochloric acid and three parts nitric acid to three parts hydrochloric acid and one part nitric acid), nitric plus perchloric acid, nitric acid-hydrogen peroxide, and "total acid digestion" using mixed acids including hydrofluoric acid

These alternative methods are described in separate documents

APPLICATION NOTES:

It should be noted that certain elements (e.g. barium, chromium and molybdenum) are often associated with the silicate matrix of sediment samples. Therefore the recoveries for some elements are often low when compared to the certified values using the described nitric/hydrochloric acid digestion scheme. From an environmental standpoint, this generally is not a major issue since the more readily available metals (ie arsenic, cadmium, copper, lead, mercury and zinc) are typically those of most concern. These available elements also generally show a 90+ percent recovery in all reference materials analysed. Note that no correction values are applied where specific elements have shown low recoveries.

SAMPLE CONTAINERS / STORAGE / HOLDING TIMES:

Plastic or glass jars with tight fitting lids, or plastic bags are acceptable

Prior to sample digestion, refrigerated or frozen storage is preferable, although storage at room temperature is acceptable.

Holding times prior to sample digestion are indefinite, mercury may be lost if sample material is heated. After digestion, samples must be analyzed within six months, except for mercury (EPA guideline) Mercury analysis must be completed the same day the digests are diluted to final volume, and within 48 hours of the start of sample digestion. (Mercury. Can Test guideline)

REAGENTS:

Ultrapure water: obtained from a Millipore Elix, water purification systems, or equivalent.

"Environmental"/"Trace Metal" grade nitric and hydrochloric acid

Reagent grade nitric and hydrochloric acid, for acid washing only.

PROCEDURE for PREPARATION and DIGESTION of GEOLOGICAL SAMPLES for ANALYSIS of ENVIRONMENTAL PARAMETERS (continued)

APPARATUS:

250 or 400 mL pyrex beakers with watch glass covers
Analytical balance (0.0001 gram sensitivity)
Hot plate
25 mL, 50mL, 100 mL volumetric flasks
Polypropylene bottles
Dispensing burettes
Notes All glassware should be acid washed; volumetric apparatus are Class A and acid washed

GLASSWARE CLEANING PROCEDURES:

Glassware (beakers, watch glasses, volumetric flasks) are acid washed using aqua regia, and thoroughly rinsed with Ultrapure water. Refer to Trace Metals Department SOP: Method for Cleaning and Acid Washing Glassware for Trace Metals Analysis (65-E-001).

SAMPLE PREPARATION PROCEDURES:

Sample Preparation Notes:

An official referenced procedure for sample preparation for environmental metals analysis has not developed by the regulatory bodies Procedures recognized in the assay and geochemical analysis field include sieving, crushing , grinding, and/or pulverizing These steps require a dry sample; these steps are not usually performed for environmental analysis.

Therefore, the guideline is that thorough mixing to provide a homogenous sample is required Due to detection limit considerations, most environmental metals analysis digestions require an undried sample size of at least five grams.

Undried Sample Material:

Undried sample material is used for many types of environmental analysis as many parameters, such as mercury could volatilize or degrade upon heating. Other parameters that may be affected by sample drying include the inorganic parameters ammonia and cyanide, and the organic parameters oil and grease, extractable hydrocarbons, and volatile organics.

Homogenization of Undried Soil:

1. Remove all sample material from sample container.
2. Place into a large clean non-metallic vessel (e.g. a glass pie plate).
3. Hand mix with the aid of an inert mixing device (i.e. wooden or plastic spoon)
4 Store mixed material in original sample container

Air-Dried Sample Material.

Air-dried sample material is analyzed for parameters including metals, Total Organic Carbon, and some Trace Organics parameters. For TOC, drying in an oven at 60 C is also acceptable.

Grinding of Dried Soil:

Sample preparation of dried material may be performed using a mortar and pestle. Using an automatic "ring and puck" Siebtek pulverizer, sample material may be ground to minus 100 mesh or finer, and mixed by rolling on a rolling cloth or paper fifty times if this is requested by client.

Note If the Siebtek pulveriser is used low level chromium results may be compromised.

PROCEDURE for PREPARATION and DIGESTION of GEOLOGICAL SAMPLES for ANALYSIS of ENVIRONMENTAL PARAMETERS (continued)

MOISTURE DETERMINATION:

Analysis results are normally reported on a "dry weight" basis. Moisture is required when undried soil samples are analyzed in order to convert the analysis data obtained in a "dry weight" basis.

1 Weigh, to 0 01 gram, a representative sample aliquot between 1 and 20 grams of undried material and place into a tared aluminum pan. Usually, a 15 to 20 gram sample is used

2. Place the pan in an oven at 105 °C overnight (up to 16 hours), and reweigh Record data in the "Moisture/LOI" Log Book. Weighing may also be done using a LIMS interfaced balance which automatically transfers results to the LIMS database. Note· the drying time can be much shorter, as short as 1 to 2 hours, if the sample is completely dried

3 Calculate the moisture content by dividing the weight loss by the original we sample weight If a LIMS interfaced balanced is used, the calculations are performed by the LIMS system

Refer to CANTEST Work Instructions 60-S-003 for moisture determination instructions for further details

AQUA REGIA DIGESTION PROCEDURE:

1. Weigh a portion of well-mixed undried sample into an acid washed 250 mL beaker. Usually, a 15 to 20 gram sample is used, but in cases of limited sample size a lower weight may be used. Record all weights to the nearest 3rd decimal (e.g 16.025g). Weighing may also be done using a LIMS interfaced balance which automatically transfers results to the LIMS database

2. Include the following Quality Control samples with each batch of samples analyzed:

   Blank: Digest as least two and normally three acid digestion blanks with each sample batch.

   Duplicate: For environmental analysis, digest at least one sample in ten in duplicate.

   For Ocean Dumping analysis, digest all samples in duplicate, plus take five replicates of at least one sample.

   Certified Reference Material· Digest at least one sample of a Certified Reference Material concurrently with each batch of samples
   For environmental analysis, digest 0.500 grams of NIST Montana Soil, and dilute to 50 mL.
   For Ocean Dumping analysis, digest 1.00 grams of BCSS-1 and MESS-1, dilute to 25 mL.

Note 1 PACS-1 is no longer available and thus not in daily use.

Note 2: Ensure the proper weights and dilutions are used!

3. Using dispensing burets, add approximately 10 mL of nitric acid and approximately 20 mL hydrochloric acid. Cover with watch glass Allow any initial reaction to subside. Note varying amounts of nitric and hydrochloric acids may be used depending on the composition of the soil samples

4. Place beaker on hot plate and heat gently until brown fumes disappear and volume is reduced to approximately 10 mL. If heavy brown fumes are still being produced a further 5 mL nitric acid may be added and digested further, until complete. Hot plate setting is set at approx 3/4 of maximum rheostat setting Digestion as described takes approximately 2 to 4 hours.

Note If samples "hop or bump" reduce the heat of the hot plate or move the samples to a cooler position on the plate and continue digestion

PROCEDURE for PREPARATION and DIGESTION of GEOLOGICAL SAMPLES for ANALYSIS of ENVIRONMENTAL PARAMETERS (continued)

Aqua Regia Digestion Procedure (continued):

5. Remove beaker from hot plate and allow solutions to cool. Transfer solution into a 100 mL volumetric flask, ensuring that a minimum amount of undigested material is transferred to the volumetric flask. **Note**: samples with a moisture content of greater than 50% should be diluted to 50 mL instead of 100 mL, using a 50 mL volumetric flask Carefully wash the undissolved residue remaining in the beaker with Ultrapure water from a wash bottle, and transfer washings to the volumetric flask Dilute to volume with Ultrapure water. Mix well and allow any solids to settle. Transfer solution to labelled (labels are generated using LIMS system) plastic bottles and proceed with instrumental analysis

Note: Certified Reference Materials are not diluted to 100 mL. Montana Soil (and PACS-1) are diluted to 50 mL, while BCSS-1 and MESS-1 are diluted to 25 mL.

Digestion Notes:

-sample solutions may be filtered (use 541 paper, wash with dilute aqua regia then water) and filter into volumetric flask.

-the aqua regia digest has been in use since mid-1993; previously the "reverse aqua regia" and nitric-perchloric digestions were used for environmental soil/sediemnt analysis.

-the large sample size (15 grams) is used to minimize sample homogeneity problems with undried, unground soil samples.

QUALITY CONTROL SECTION:

QC Sample Frequency

Blanks:
A minimum of two reagent blanks are run with each set

Duplicate Samples:
Usually 10% duplication rate (minimum of one) is used for each batch For Ocean Dumping analysis, digest all samples in duplicate, plus take five replicates of at least one sample.

Certified Reference Materials:
Digest at least one sample of a Certified Reference Material concurrently with each batch of samples For environmental analysis, digest NIST Montana Soil; for Ocean Dumping analysis, digest NRC BCSS-1 and NRC MESS-1.

Other Certified Reference Materials include NRC BEST-1, NRC WQB-2, NIST 1645 River Sediment Note that until May, 1997, NRC PACS-1 was the Reference Material in daily use. This material is no longer available and has been replaced by the NIST SRM Montana Soil.

QC Sample Criteria

Duplicate Samples:
Guideline 30% RPD maximum.

Certified Reference Materials
Current limits can be found in the LIMS system

CANTEST®

CAN TEST TRACE METALS DEPARTMENT
PROCEDURE FOR PREPARATION AND DIGESTION OF STRONG ACID LEACHABLE METALS (SALM) IN SOIL

SAFETY NOTES

Protective clothing such as lab coats, safety glasses, and gloves should be worn at all times, when working and handling samples, chemicals or reagents in the laboratory.
Acids are extremely corrosive and toxic, and should be handled in proper fumehoods.
Review all applicable Material Safety Data Sheets for acids prior to use.
Nitric and hydrochloric acid must not be premixed; they should be added individually to each sample vessel. Mixtures of nitric and hydrochloric acid must not be stored in closed containers.

REVISION HISTORY

Revision 0: July 26, 2001, document derived directly from the Official Method

APPLICATION

This Performance Based Method (PBM), "Strong Acid Leachable Metals in Soils" provides the sample preparation and digestion methodology for analysis of metals, including mercury, and other elements such as barium, phosphorus and sulphur, in soil. The strong acid leach results in a partial to complete extraction of target elements. **All results must be reported on a dry weight basis.**

PERFORMANCE BASED METHOD REQUIREMENTS

This method is written in a performance based method (PBM) format. A PBM includes both mandatory and non-mandatory elements. Provided that the mandatory elements are met, laboratories have the flexibility to select analytical methods, procedures and instrumentation of their preference. The most important of the mandatory elements are the data quality objectives (DQO's) specified by the Ministry and the criteria set out in this methodology. **The mandatory elements of this performance based method are specified in bold text. Where laboratories use modifications to this method, they must prove equivalency (as described in the Method Equivalency Section).**

HISTORICAL OVERVIEW AND EXPLANATORY NOTES

This method was prepared for the B.C. Ministry of Environment, Lands & Parks (BCMELP), specifically for analyses dealing with metals in soils for use under the Waste Management Act, Contaminated Sites Regulation (CSR). It has been suggested that it could be used as an appropriate method for other BCMELP regulatory purposes, and for similar initiatives in other jurisdictions. However it may not be suitable for certain study or project requirements.

The Contaminated Sites Regulation include "Water" and "Soil" as "Matrix Types" but "Soil" is only broadly defined (CSR, section 1). After consultation with BCMELP representatives it was decided that Carter's definition of "Soil", as being "minus 10 mesh" material, would be used for this method. Due to concerns with sub-sampling variance, it was decided that the minimum representative "minus 10 mesh" sample size taken for digestion be one gram of dry sample.

It was decided to use an "open-beaker digestion", a mixture of nitric acid and hydrochloric acid, and standardized digestion time and temperature. Laboratories are allowed some flexibility regarding apparatus and heating methods while limited variations in acid mixture composition, digestion time and temperature are permitted if method equivalency is proven. The inclusion of all undigested material in the final diluted extract was permitted to accommodate the use of calibrated digestion tubes.

METHOD FOR THE PREPARATION and DIGESTION of STRONG ACID LEACHABLE METALS IN SOIL (continued)

HISTORICAL OVERVIEW AND EXPLANATORY NOTES (continued):

Results of analyses of Certified Reference Materials using the common mixed acid digestion procedures indicate that barium, chromium, nickel, and vanadium are often incompletely recovered. For example barium typically yields recoveries ranging from 5% to 25%. Other "heavy metals: (e.g. copper, cadmium, lead, zinc, etc.) yield recoveries generally between 90 and 100% for most samples.

The toxicological significance of the low recoveries seen using this method for barium, chromium, nickel, and vanadium obtained using "open beaker mixed acid digestion" is relatively inconsequential The aim of this method is not necessarily to achieve "better recoveries" but rather to ensure consistent results between laboratories over the long term.

METHOD LIMITATIONS

Aluminum, barium, chromium, iron, manganese, nickel, vanadium and other refractory elements, are known to have low recovery by this procedure.

Preliminary studies have shown that antimony (Sb) and tin (Sn) may degrade over time once the extract has been diluted in the presence of the soil. Once the soil has been removed from the digestate, Sb and Sn appear to be more stable.

This method is not applicable to hexavalent chromium.

Samples high in organic matter (e.g. humus, peat) may yield lower recoveries of Strong Acid Leachable Metals.

Samples with high petroleum or non-petroleum hydrocarbon content ("Oil & Grease") may require specialized sample pre-treatment or different digestion procedures.

Sulphur determination by this test method is not 'elemental sulphur' analyzed by acetone extraction followed by colorimetric analysis.

DEFINITIONS

Certified Reference Material (CRM) - A reference material, one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation which is issued by a certifying body.

Reference Material (RM) - A material or substance, one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

Duplicate - a quality control sample, often chosen randomly, from a batch of samples and undergoing separate, but identical sample preparation and analysis whose purpose is to monitor method precision and sample homogeneity.

Method Blank - a quality control sample that is free of the target parameter or analyte and contains only the reagents used and undergoes the same analysis procedure as the unknown sample. The method blank is used to monitor possible contamination sources.

Soils – the minus 10 mesh fraction and as defined by the Contaminated Sites Regulation

Strong Acid Leachable Metals (SALM) - dissolves nearly all the "heavy metal" in solids including arsenic, cadmium, cobalt, copper, lead, mercury, selenium, silver and zinc, but does not dissolve all silicates minerals. Elements that are not recovered completely by this strong acid leachable digestion may include: antimony, barium, beryllium, chromium, iron, manganese, molybdenum, nickel, silver, thallium, tin, titanium and vanadium.

Total Acid Digestable Metals (TADM) - completely dissolves the silicate minerals, so that recoveries are complete. Acids used in TADM digestion include perchloric and hydrofluoric acid. TADM analyses are not part of this procedure.

METHOD FOR THE PREPARATION and DIGESTION of STRONG ACID LEACHABLE METALS IN SOIL (continued)

DEFINITIONS (continued)

Total Metals - the phrase "Total Metals" as used by the British Columbia Ministry of Environment, Lands and Parks (BCMELP) CSR refers to the SALM procedure and not the TADM procedure.

SUMMARY OF METHOD

Samples are dried at 60°C and sieved using a 2 mm (10 mesh) sieve. Solid samples are digested with the combination of nitric and hydrochloric acids with a 1:1 ratio of acids. For environmental purposes, strong acid leaches are used routinely since they have the advantage of speed, low cost, and superior reproducibility. All metals trapped within the refractory matrix are unlikely to have environmental consequences. Instrumental analysis of extracts produced using this digestion method can be performed by a variety of techniques.

REFERENCES

This method is performed according to:
"Strong Acid Leachable Metals (SALM) in Soil Version 1.0, B.C. Ministry of Environment, Lands and Parks, CSR Analytical Method 8, Effective June 26, 2001".

Other References

Carter, M.R., editor, Soil Sampling and Methods of Analysis, for Canadian Society of Soil Science, Lewis Publishers, ISBN 0-87371-861-5, pages 20-21

Province of British Columbia's Waste Management Act, Contaminated Sites Regulations (CSR) BC Reg. 375/96, 1996

SAMPLE COLLECTION AND HANDLING

Samples must be collected and stored such that degradation or alteration of the sample is minimized. Collect the sample in a clean polyethylene or glass container, and tightly cap immediately after sampling. It is recommended that glass containers be used, particularly if mercury analysis is required on the samples. Samples can be frozen or stored at 4°C. **The holding time prior to digestion must not exceed 28 days for mercury and 6 months for all other metals (from the time of sampling prior to digestion). Results reported for samples digested beyond holding times must be flagged.**

APPARATUS

Drying Oven, Baxter Gravity Convection Oven, Model DS-44, or equivalent, capable of maintaining a temperature of 60C.

Thermometers

Glass Bowls, and non-contaminating spatula, for mixing samples as received.

Sieve: **It is mandatory to use a 2 mm (or a "10 mesh") sieve.** It is recommended that a stainless steel screen/sieve with all tin solder be used. **Sieves must not be constructed of brass or contain tin lead solder.** Polypropylene or nylon sieves may also be used.

Hot Block Digestor: Environmental Express Hot Block Digestor Model SC 154, or equivalent

Note: The heat for digestion must be supplied by a heat source capable of maintaining a temperature of 90 ± 5°C.

Disposable Digestion Vessels: Environmental Express Polypropylene Digestion Vessels, approx 30mm x 150 mm digestion tubes, Model SC 475 (with graduations including 50 mL graduation), with screw caps

Note: Digestion vessels must be capable of supporting reflux action. The vessel design must be such that the sample must be completely covered by the digestion acid mixture at all times.

Centrifuge

METHOD FOR THE PREPARATION and DIGESTION of STRONG ACID LEACHABLE METALS IN SOIL (continued)

APPARATUS (continued)

Alternative Digestion Apparatus

Glass Beakers, 100 mL or 125 mL, fiitted with watchglasses

Hotplate, capable of maintaining a temperature of 90 +/- 5 C

Volumetric Flasks: 50 mL

REAGENTS

Nitric acid, HNO_3 (concentrated), Anachemia Environmental Grade or equivalent, .

Hydrochloric acid, HCl (concentrated), Anachemia Environmental Grade or equivalent,

Note: Hydrofluoric, perchloric and sulphuric acids must not to be used.

Laboratory Grade Water: Equivalent to "Type 1 Water" as descrinbed in the current edition of Standard Methods (APHA); Ultrapure Water obtained from a Millipore Milli-Q Water Purification System,

SAMPLE HOMOGENIZATION and SUB-SAMPLING PROCEDURE

1. **Inspect the sample and record any unusual or significant characteristics (e.g. lead shot pellets, metal turnings, screws, etc).**

2. **Remove any obviously foreign material such as vegetation.**

Application Note: Some samples may contain considerable organic material such as wood chips, and little "soil" material. It is permissible to perform the analysis according to this procedure but a Validation Comment regarding the sample characteristics is required on the client report.

3. **If the sample has separated into visually obvious layers (e.g., water/marine water, organic and sediment phases), the entire sample must be homogenized prior to sub-sampling. The aqueous phase must not be decanted.**

Note: Special project requirements may involve alternative procedures such as decanting of the aqueous fraction. **When these non-standard procedures have deviated from the prescribed method, the results must be clearly flagged.**

4, **Homogenize the entire sample** by vigorous stirring using a non-contaminated spatula. If it is not possible to homogenize the sample in the container it was received in, the sample can be transferred to a larger non-contaminating container prior to homogenization. **Clean the spatula and mixing container between samples.**

Application Note: The usual apparatus to be used for the homogenation step is a large glass bowl.

5. **Where moisture determination is required, a separate sub-sample must be taken prior to drying and sieving;** otherwise proceed to "Sample Preparation Procedure – Drying"

METHOD FOR THE PREPARATION and DIGESTION of STRONG ACID LEACHABLE METALS IN SOIL (continued)

SAMPLE PREPARATION PROCEDURE - DRYING

1. Dry the sample portion to be analyzed at a temperature of 60 ± 5°C to a constant weight. For drying temperatures other than 60 ± 5°C, a note should accompany the results. Freeze drying of samples is acceptable.

Note: Sample drying temperature must not exceed 60°C to minimize volatilization of certain analytes such as mercury [14].

2 Drying may not be necessary, as sample may be dry, and in some instances, the laboratory may wish to (and be able to) sieve a "moist" undried sample.

SAMPLE PREPARATION PROCEDURE – SIEVING

1. **Sieve each sample through a 2 mm ("10 mesh") sieve. DO NOT grind samples to pass through this sieve/screen size.** It is suggested that "easily friable materials" (dried clay clods, disintegrating rock, etc.) should be included "by being subjected to some sort of gentle mechanical action (rolling, etc.)" prior to screening. Dis-aggregation of sample is permissible prior to sieving.

Application Note: It is suggested that, when necessary, the sample be placed on a clean sheet of paper and "dis-aggregated" using a household rolling pin. The rolling pin must be cleaned after processing each sample. Alternatively, a mortar and pestle may be used (gently), but this apparatus may be difficult to clean.

2. Where available, it is recommended that a minimum of 25 grams of sieved sample be obtained for analysis.

3. Discard the "greater than 2 mm" fraction.

4. Field sampling personnel may pre-screen the samples in the field.

SAMPLE DIGESTION PROCEDURE

1. Weigh a minimum of 1.00 grams of dry sample, into a vessel capable of refluxing, such as a covered beaker or digestion tube. Include method blanks, duplicates and at least one reference material per batch of samples. Weight must be recorded to ± 0.05 grams.

Note 1: Current practice is to use labelled Disposable Digestion Vessels, as described under "Apparatus".

Note 2: In cases where one gram of sieved sample is not available it is permissible to perform the analysis as described but **a note must accompany the results.**

Note 3: It is permissible to use more than one gram of sample for digestion but the acid to sample ratio must be maintained as stated in step 2 of this section, and the sample must be covered by the acid mixture at all times.

SAMPLE DIGESTION PROCEDURE (continued)

2. Add equal volumes of concentrated nitric and concentrated hydrochloric acid. The minimum acid volumes required are 2.5 mL of concentrated nitric acid and 2.5 mL of concentrated hydrochloric acid. The acid ratio (by volume) should be one part nitric acid to one part hydrochloric acid. In addition the minimum acid to sample ratio must be a minimum of 5 mL of acid for every gram of dry sample. **Sample must be fully covered by the acid mixture.**

Note 4: It is permissible to use more than 5 mL of acid mixture per one gram of dry sample.

3. **Swirl acid and sample to mix gently. Allow the sample to sit at room temperature for at least one hour before heating.** Although the Official Method is not specific, it is suggested that the samples not be allowed to sit in acid at room temperature room for long periods, e.g. overnight.

4. Digest samples for two hours ± 15 minutes at a temperature of 90 ± 5°C **at atmospheric pressure.** A hotblock or waterbath are the preferred methods of heating. **The heat for digestion must be supplied by a heat source capable of maintaining a temperature of 90 ± 5°C.** Measure and record the temperature using a thermometer placed in at least one digestion tube containing water.

Application Note: When using the Disposable Digestion Vessels, place the screw cap on the Vessel such that the cap is not too tight such that pressure can build up, but not too loose such that any acid vapours can escape during the reflux action.

Alternative Digestion Procedure
As noted, beakers fitted with watchglasses, heated on a hot plate, may be used. Follow the procedures as described in this section. Monitor the temperature using a thermometer placed in a beaker of water, heated on the hot plate.

For Samples High in Organic Material, such as "Wood Chips", extra acid may be required for the digestion, with a total volume of up to 10 L or 15 mL.

Important Note: The volume graduations marked on beakers are not accurate; therefore the entire sample solution/undigested material mixture must be transferred to a volumetric apparatus. Normally, the Disposable Digestion Vessels, graduated at 50 mL are used. Alternatively, volumetric flasks (usually 50 mL) may be used for final dilution, to comply with the requirements of step 5 below.

5. Cool then dilute the entire sample by adding laboratory grade water directly into the graduated digestion vessel. The usual standard dilution volume used will 50.0 mL.. Include all undigested solid material as part of the final diluted volume. Sample extracts should not be stored in glass.

Application Note: It is current practice to centrifuge all sample solutions prior to analysis.

6. **When tin and antimony analyses are required, the sample extracts must be centrifuged or filtered within 4 hours of dilution to separate the digestate from the particulates.** This must be done to minimize tin and antimony losses. **The decanted or filtered digestates must be analyzed within 7 days.**

7. Analyze the final extract using appropriate analytical techniques (ICP, Graphite Furnace or Flame AA, ICP/MS, or Cold Vapour Atomic Fluorescence) Report the results on a dry weight basis.

8. Report any anomalies observed during the digestion and analysis.

METHOD FOR THE PREPARATION and DIGESTION of STRONG ACID LEACHABLE METALS IN SOIL (continued)

QUALITY CONTROL SECTION

Blanks:

Method Blanks must be analyzed with each batch to monitor contamination and background interferences. Method Blanks consist of the digestion acids digested concurrently in the digestion vessels with the sample batch.

Certified Reference Materials

Certified Reference Materials (CRM) or Reference Materials (RM) must be analyzed with every batch to check validity of test results, and the recovery of metals measured against the certified or accepted values.

Duplicate Samples:

Duplicates must be analyzed with every batch, at a frequency of 10%.

Calibration of Disposable Digestion Vessels

For each batch of Vessels received, gravimetrically calibrate at least one vessel at the 50 mL graduation.

Temperature Monitoring/Calibration of Hot Block Digestor

For each batch, measure and record the temperature using a thermometer placed in at least one digestion tube containing water. In addition, on a regular basis (minimum every six months), measure the temperature from at least four locations on the Hot Block Digester.

INSTRUMENTAL ANALYSIS REQUIREMENTS

Laboratory Method Detection Limit (MDL) should be at least five times lower than the applicable regulatory limits, (where possible, given the most economical and best technology currently available). For example, if the regulatory limit is 100 micrograms per gram (ug/g), the laboratory MDL must be not be greater than 20 ug/g; current technology may only allow laboratories to achieve a 50 ug/g MDL. Current Province of British Columbia CSR Regulatory Limits are listed in Appendix 3 of this method document.

CALCULATIONS

Report results on a dry weight basis.

$$\text{Concentration of analyte in sample } (\mu g/g) = \frac{A\ (ug/mL) \times \text{sample volume } (mL) \times \text{dilution factor}}{\text{dry weight of sample used } (g)}$$

where A = analyte concentration as determined by the instrument of choice

METHOD EQUIVALENCY PROCEDURE

Note: This "Method Equivalency Procedure" section is taken directly (including the text formatting) from the Official Method. Some editing has been done. Refer to the Official Method for the References and for Appendices 1 through 3, and 6, which are not included in this document.

1. Use of Alternative Methods

This method contains several prescribed and required elements that may not be modified.

Modification or omission is not permitted to anything described within the method text as "required" or preceded by the word "must". In this procedure, as noted above, all mandatory elements are specified in bold text.

All of the prescribed requirements of the method are summarized in section 1.1.

1.1 Prescribed Elements

Laboratories that report data for regulatory purposes may not alter any method conditions listed in this section without prior written permission by BCMELP:

1.1.1. Every laboratory that uses this method, whether modified or not, must validate the method to meet Appendix 5 Data Quality Objectives (DQO's).

1.1.2. Maximum holding time for samples prior to digestion is 6 months for all metals except mercury, which is 28 days. Where holding times are exceeded, data must be flagged.

1.1.3. The Sample Homogenization and Sub-Sampling procedure must be followed as described in the Sample Homogenization and Sub-Sampling PROCEDURE.

1.1.4. Certain elements of Sample Preparation - Drying must be followed as described in the Sample Preparation - Drying PROCEDURE.

1.1.5. Certain elements of Sample Preparation - Sieving Steps must be followed as described in Sample Preparation - Sieving PROCEDURE.

1.1.6. Certain elements of Sample Digestion Procedure must be followed as described in Sample Digestion PROCEDURE as follows:

1.1.6.1. The amount of sample digested must not be less than 1 gram dry weight, except in special cases as described in Sample Digestion Procedure Note 2.

1.1.6.2. Only nitric & hydrochloric acids can be used for the sample digestion (hydrofluoric, perchloric and sulphuric acids are not allowed)

1.1.6.3. The minimum acid to sample ratio must be 5:1. Use a minimum of 5 mL of concentrated acid for every 1 gram of dry sample. The sample to be digested must be fully covered by the total volume of acid mixture added.

1.1.6 4. Sample heating/digestion must be carried out at atmospheric pressure.

1.1.7. Certain elements of the Calculations and Reporting Procedure must be followed:

METHOD EQUIVALENCY PROCEDURE (continued)

1.1.7.1. Final data must be reported on a dry weight basis.

2. Performance Based Method Changes

This is a Performance Based Method. Unless prohibited in section 1.1 (above) or elsewhere, modifications to this method are permitted, provided that the laboratory possesses adequate documentation to demonstrate an equivalent level of performance. **Laboratories that modify this method must achieve all specified Quality Control requirements, and must maintain on file the Standard Operating Procedures which thoroughly describe any revised or alternate methods which are used at any time following the initial adoption of this method by BCMELP. This information must be available in the event of audit by BCMELP.**

2.1 Modifications Where Equivalence-Testing is Required

Except where expressly disallowed in section 1.1 or elsewhere, changes to the following components of this method are permitted, but only if the laboratory has conducted and documented a rigorous test for equivalence to this reference method:

2.1.1. PROCEDURE - Sample Digestion Procedure

2.1.1.1. The acid ratio may be changed from the 1:1 nitric acid/hydrochloric acid ratio as stated in the procedure. However, the acid ratio must not exceed a 3:1 ratio of either acid (i.e. 3:1 nitric acid/hydrochloric acid or 3:1 hydrochloric acid/nitric acid).

2.1.1.2. The use of concentrated nitric and hydrochloric acids may be changed to allow the use of diluted acids. A minimum of 5 mL concentrated acid per one gram of sample must be used.

2.1.1.3. The digestion time may be changed.

2.1.1.4. The digestion temperature may be changed.

2.1.1.5. Digestion procedures may be changed due to advances in technology (e.g. open vessel microwave assisted digestion).

An equivalence test for modifications to Sample Digestion Section of the PROCEDURE, involves a comparison of results from the modified method with results from the reference method for several appropriately selected samples, with all BC CSR-listed metals analyzed.

3. Evaluation Procedure

3.1. **Two evaluations must be performed, an Accuracy Evaluation, using Certified Reference Materials, and a Precision Evaluation using both Certified Reference Materials and Authentic Field Samples.**

METHOD EQUIVALENCY PROCEDURE (continued)

3.1.1. Accuracy Evaluation:
Analyze at least two soil/sediment Certified Reference Materials (CRM). Each CRM must be digested and analyzed in triplicate (at minimum) by both this reference method and by the modified method. Samples must include the following:

- **NIST 2711.**
- **CANMET TILL -1**

Other CRM's that may be used for equivalency testing in the future may include:

- NIST 2704 (terrestrial soil)
- NRC MESS-3 (marine sediment)
- NRC PACS-2 (contaminated marine sediment)

Note: Required QC Acceptance Criteria have not been developed for these CRM's.

The mean results of each element of each sample must meet the Appendix 5, Table 1 and Table 2, "Required QC Acceptance Criteria".

Note1: Failure of an individual element or elements under this stage of the equivalency test would not disqualify the Modified Procedure, but it would disqualify the individual element(s). Those elements not meeting this criteria are not to be reported if the Modified Procedure is used for client sample analysis. Failure under this section would disqualify the element even though the evaluation under "Precision Evaluation" might pass.

Note2: Laboratories may wish to validate and use a modified test method that includes only some, but not all elements in the CSR list. For example, projects requiring only the analysis of copper might use a validated modified procedure that uses only a one hour digestion time; other elements in the CSR list may not show equivalence using the modified procedure. Under these circumstances, the laboratory must ensure that the modified test method is used only for the validated elements.

3.1.2. Precision Evaluation:
Prepare (sieve), digest and analyze at least five unspiked field samples. Each sample must be digested and analyzed in triplicate (at minimum) by both this reference method and the modified method. Samples must include:

- **One or more clay samples.**
- **Two or more heavy metal contaminated soil or sediment samples.**
- **One or more hydrocarbon contaminated soils**
- **All CSR-listed metals must be present in at least one of the five samples at greater than five times the lab's reported detection limit (where possible).**

METHOD EQUIVALENCY PROCEDURE (continued)

For the "Precision Evaluation", use the data generated from both CRM and authentic samples as described in sections 3.1.1 and 3.1.2. **Compare the mean results for each element in each sample generated by the two methods. For each element, except where both means are less than 5 times the lab's commonly reported method detection limit for the analyte, one of the following must be satisfied:**

3.1.2.1. **The means for each element in each method must differ by less than 20% relative percent difference (RPD) at greater than five times the MDL,** where relative percent difference of X_1 and X_2 is defined as:

$$RPD = \frac{X_1 - X_2}{\text{Mean}(X_1, X_2)} \times 100\%$$

or,

3.1.2.2. **The difference between the means for each method must not be statistically significant at the 95% confidence level**, using a test for significance of the difference of two means, as described by John Keenan Taylor [13]. This test is summarized in Appendix 6.

3.1.2.3. The precision validation will typically generate seven data pairs for each element. **The maximum number of precision validation failures per element is limited to two.**

3.2.1. If results for one or more samples do not meet one of the above criteria, additional replicates of the same samples may be analyzed, with the tests applied to the larger populations. If necessary, either the Dixon or Grubbs outlier tests may be used to discard outlier data points.

3.2.2 If elements are not detected in authentic samples or certified reference materials, then these elements would be considered a conditional pass.

3.2.3. For all methods that include modifications that require equivalence testing, a detailed report that demonstrates equivalence to the reference method using the above procedure must be available to clients or to BCMELP on request.

Appendix 3

Table 1 Range of Soil Standards For BC Contaminated Sites Regulations (CSR)

Parameter	Agriculture (AL) in (ug/g)	Urban Park (PL) in (ug/g)	Residential (RL) in (ug/g)	Commercial (CL) in (ug/g)	Industrial (IL) in (ug/g)
Antimony	20	20	20	40	40
Arsenic	15 – 100	15 - 100	15 - 100	15 - 300	15 - 150
Barium	750	500	500	2,000	2,000
Beryllium	4	4	4	8	8
Boron	2				
Cadmium	1.5 - 4,500	1.5 - 4,000	1.5 - ..4,000	1.5 - 4,000	1.5 - 4,000
Chromium	9 – 750	60 - 250	60 - 250	60 - 800	60 - 800
Cobalt	40	50	50	300	300
Copper	40 - 350,000	90 - 350,000	90 - 350,000	90 - 350,000	90 - 350,000
Lead	100 - 100,000	100 - 100,000	100 - 100,000	100 - 100,000	100 - 100,000
Mercury	0.8	2	2	10	10
Molybdenum	5	10	10	40	40
Nickel	150	100	100	500	500
Selenium	2	3	3	10	10
Silver	20	20	20	40	40
Sulphur	500				
Thallium	2				
Tin	5	50	50	300	300
Vanadium	200	200	200		
Zinc	150 - 150,000	150 - 15,000	150 - 15,000	150 - 15,000	150 - 15,000

Appendix 4

Table 1 Certified and Noncertified Values for NIST 2711

Parameter	Element	Certified	Value (ug/g)
Aluminum	Al	Yes	6.53 ± 0.09 wt. %
Antimony	Sb	Yes	19.4 ± 1.8
Arsenic	As	Yes	105 ± 8
Barium	Ba	Yes	726 ± 38
Cadmium	Cd	Yes	41.70 ± 0.25
Calcium	Ca	Yes	2.88 ± 0.08 wt. %
Chromium	Cr	No	47
Cobalt	Co	No	10
Copper	Cu	Yes	114 ± 2
Iron	Fe	Yes	2.89 ± 0.06 wt. %
Lead	Pb	Yes	1162 ± 31
Magnesium	Mg	Yes	1.05 ± 0.03 wt. %
Manganese	Mn	Yes	638 ± 28
Mercury	Hg	Yes	6.25 ± 0.19
Molybdenum	Mo	No	1.6
Nickel	Ni	Yes	20.6 ± 1.1
Phosphorus	P	Yes	0.086 ± 0.007 wt. %
Potassium	K	Yes	2.45 ± 0.08 wt. %
Selenium	Se	Yes	1.52 ± 0.14
Silicon	Si	Yes	30.44 ± 0.19 wt. %
Silver	Ag	Yes	4.63 ± 0.39
Sodium	Na	Yes	1.14 ± 0.03 wt. %
Strontium	Sr	Yes	245.3 ± 0.7
Sulphur	S	Yes	0.042 ± 0.001 wt. %
Thallium	Tl	Yes	2.47 ± 0.15
Titanium	Ti	Yes	0.306 ± 0.023 wt. %
Uranium	U	No	2.6
Vanadium	V	Yes	81.6 ± 2.9
Zinc	Zn	Yes	350.4 ± 4.8

Appendix 4 (Continued)

Table 2 Certified and Noncertified Values for CANMET TILL -1

Parameter	Element	Total (ug/g)	Conc Acid (ug/g)	Dilute Acid (ug/g)	EPA 3050 (ug/g)	EPA 3051 (ug/g)
Aluminum	Al	7.25%	-		18,883	18,050
Antimony	Sb	7.8	-			
Arsenic	As	18	13			
Barium	Ba	702	84		84.3	77.8
Beryllium	Be	2.4	-		1.1	<0.2
Cadmium	Cd		<0.2		<0.33	<0.35
Calcium	Ca	1.94%	-		4145	3817
Chromium	Cr	65	30		29.3	29.3
Cobalt	Co	18	12	12	11.7	12.3
Copper	Cu	47	48	49	44.0	44.8
Iron	Fe	4.81%	3.1%	3.4%	29167	37,900
Lead	Pb	22	12	14	24.0	<10.0
Magnesium	Mg	1.30%	-		6,250	6,990
Manganese	Mn	1,420	950	1,020	1,060	1,060
Mercury	Hg	-	92 ppb			
Molybdenum	Mo	2	<2	1	8.7	<2.5
Nickel	Ni	24	18	17	14.0	18.7
Phosphorus	P	930	-		914	834
Potassium	K	1.84%	-		1,188	640
Silver	Ag	-	0.2	<0.2		
Sodium	Na	2.01%	-		530	575
Strontium	Sr	291	-			
Sulphur	S	<0.05%	-			
Titanium	Ti	5,990	-			
Uranium	U	2.2	-			
Vanadium	V	99	48		89	70
Zinc	Zn	98	70	71	65.2	69.8

Total - Total metals Conc Acid - concentrated HNO_3 and HCl
Dilute Acid - dilute HNO_3 and HCl
USEPA 3050 - Method digestion - ICP-AES Analysis
USEPA 3051 - Method digestion (microwave) - ICP-AES Analysis

Appendix 5

Table 1 Required QC Acceptance Criteria (DQO's)for NIST 2711

Parameter	Element	CSR Regulated	Minimum (ug/g)	Maximum (ug/g)
Aluminum	Al	No	11,000	23,000
Antimony	Sb	Yes	15*	23*
Arsenic	As	Yes	83	110
Boron	B	Yes		
Barium	Ba	Yes	170	220
Beryllium	Be	Yes	0.61	1.35
Cadmium	Cd	Yes	32	47
Calcium	Ca	No	16,000	26,000
Chromium	Cr	Yes	16	27
Cobalt	Co	Yes	6.3	10.1
Copper	Cu	Yes	89	130
Iron	Fe	No	16,000	28,000
Lead	Pb	Yes	890	1,400
Magnesium	Mg	No	6,076	9,114
Manganese	Mn	No	410	614
Mercury	Hg	Yes	5.3	7.2
Molybdenum	Mo	Yes	0.5	2.7
Nickel	Ni	Yes	8.4	24
Phosphorus	P	No	510	860
Potassium	K	No		
Selenium	Se	Yes	1.2*	1.8*
Silicon	Si	No		
Silver	Ag	Yes	2.4	5.6
Sodium	Na	No		
Strontium	Sr	No	33	49
Sulphur	S	No	203	655
Tin	Sn	Yes	2.0*	3.0*
Titanium	Ti	No	238	356
Uranium	U	No		
Vanadium	V	Yes	32	55
Zinc	Zn	Yes	290	350

*** Certified values for NIST and recommended tolerances (± 20%), values in µg/g**

Appendix 5 (continued)

Table 2 Required QC Acceptance Criteria(DQO's)for CANMET TILL-1

Parameter	Element	CSR Regulated	Minimum (ug/g)	Maximum (ug/g)
Aluminum	Al	No	14,000	21,000
Antimony	Sb	Yes	6.2*	9.4*
Arsenic	As	Yes	10	19
Boron	B	Yes		
Barium	Ba	Yes	62	101
Beryllium	Be	Yes	0.25	0.73
Cadmium	Cd	Yes	0.01	0.65
Calcium	Ca	No	2,100	4,400
Chromium	Cr	Yes	22	34
Cobalt	Co	Yes	8.4	17
Copper	Cu	Yes	36	54
Iron	Fe	No	23,000	43,000
Lead	Pb	Yes	7.8	20.5
Magnesium	Mg	No	4,629	6,943
Manganese	Mn	No	870	1,310
Mercury	Hg	Yes	0.03	0.16
Molybdenum	Mo	Yes	0.1	1.8
Nickel	Ni	Yes	8.9	26.9
Phosphorus	P	No	600	990
Potassium	K	No	321	873
Selenium	Se	Yes		
Silicon	Si	No		
Silver	Ag	Yes	0.01	0.43
Sodium	Na	No	143	527
Strontium	Sr	No	8	12
Sulphur	S	No	96	292
Tin	Sn	Yes		
Titanium	Ti	No	570	860
Uranium	U	No		
Vanadium	V	Yes	33	73
Zinc	Zn	Yes	55	80

***Provisional Values for Till-1 and recommended tolerances (±20%), values in µg/g**

CANTEST

CANTEST TRACE METALS DEPARTMENT
METHOD SUMMARY FOR ANALYSIS OF VARIOUS SAMPLE TYPES
BY ICP

METHOD SUMMARY

This Method Summary briefly describes analysis procedures by ICP. The Method Summary is complementary to the extensive "ICP Operations Manual".

REVISION HISTORY:

July 2, 1998, revision 0
February 6, 2001, revision 1, added discussion of IRIS ICP

APPLICATION:

This method describes analysis of a wide variety of materials by ICP. The sample types include environmental samples (water, wastewater, TCLP/LEP leachates, soils and sediments, plant and animal tissues), geological materials and industrial minerals (major, minor, and trace components), brines and salt solutions, steels and alloys, food, vitamin, and mineral samples, oil and organic digests, and miscellaneous samples. Detection limits for most elements are in the 1 to 30 microgram per liter (0.001 to 0.030 milligram per liter) range.

PRINCIPLE and APPLICATION NOTES

Principles

Currently, the ICP instrument in use is a Thermo Jarrell-Ash IRIS ICP. The IRIS ICP is an echelle grating instrument that uses a Charged Induction Detector (CID) detector.

The sample solution is transferred using a peristaltic pump to a nebulizer that produces a fine aerosol. The aerosol is swept through an Inductively Coupled Argon Plasma torch mounted radially.

In the IRIS ICP, the image of the plasma is focused on the entrance slit of the spectrophotometer using a parabolic mirror. The emissions are diffracted using an echelle grating/prism, and transmitted onto a single CCD detector. A specified location (specified pixels on the CCD "camera") corresponds to a specific emission wavelength associated with electronic transitions of a certain element. (See Handout on IRIS Optics (DCN: 65-Z-001-00)

The spectrometer then identifies and quantifies specified elemental components in the solution.

The ICP is calibrated prior to analysis using a blank solution, mixed multi-element standards and one or more single-element solutions. The Thermo Jarrell-Ash IRIS ICP has high calibration standard concentration levels ranging from 1.0 mg/L up to 250 mg/L, depending on the element and location on the CID detector. Some elements are calibrated using multi-point calibration curves and others are calibrated using a single point per element.

This produces a wavelength calibration curve for each element. In the IRIS ICP the analytical calibration curves have been found to be linear.

METHOD SUMMARY FOR ANALYSIS BY ICP (continued)
PRINCIPLE and APPLICATION NOTES (continued)

Matrix Matching

Calibration standard/sample "matrix matching" is used for most sample types. The basic matrix used is 4% nitric acid. For difficult sample matrices specific matrix matching is used. The most common sample type to use specific matrix matching is geological material.

Computerization

The instrumentation features sophisticated computer hardware and software that operates the instrumentation systems, calibrates the instrument, acquires analysis data, and calculates and reports the final results. Depending on the analysis program, results may be produced in units of milligrams per liter, or for specific analysis, directly in percent , or other units.

With an Autosampler accessory, the instrumentation may be operated in a "semi-automated" fashion.

Sample Preparation

Sample preparation procedures for the diverse sample types are not included in this written procedure, but several are referenced in the section below and in the ICP Operations Manual.

Normal Analysis Range/Sample Solution Dilution

In most cases, the upper analysis range is the upper calibration point concentration although results may be reported at higher levels (e.g. for IRIS ICP, up to twice this level for certain elements). . Samples containing higher levels of analyte are normally diluted, using an automatic diluter.

In certain instances (described as "Assay" analysis), dilution must be performed using pipettes and volumetric flasks. For Assay Analysis, samples are to be diluted to levels under upper calibration point, and to levels close to the upper calibration point, if possible.

Background Correction

Background correction is used for most analysis programs. Background correction is performed beside the analytical wavelength, as appropriate. Note that interelement corrections are affected by background correction positions.

REFERENCES: (refer also to the ICP Operations Manual)

ICP analysis techniques described have been developed internally in most instances. One official reference for water analysis is:

- U.S. EPA Method 200.7, Determination of Trace Metals in Waters and Wastes by Inductively-Coupled Plasma Atomic Emission Spectroscopy

SAMPLE PREPARATION REFERENCES (refer also to the ICP Operations Manual)

Water Analysis:

- Can Test Method for the Preparation of Dissolved Metals in Water (65-P-005).
- Can Test Method for the Preparation of Total Metals in Water-Microwave Digestion (65-P-007).
- Can Test Method for the Preparation of Total Metals in Water-Open Beaker Digestion (65-P-006).
- Can Test Method Summary. Leachate Extraction Procedure (65-S-011).
- Can Test Method Summary: Toxicity Characteristic Leaching Procedure (65-S-012).

Note: These references also include information on "SAMPLE CONTAINERS/HOLDING TIMES"

METHOD SUMMARY FOR ANALYSIS BY ICP (continued)
SAMPLE PREPARATION REFERENCES (continued):

Environmental Analysis:

- Can Test Method for Nitric Acid/Hydrogen Peroxide Digestion of Tissue and Vegetation Samples for Analysis of Heavy Metals (65-P-001).
- Can Test Method for the Preparation and Digestion of Geological Samples for Analysis of Environmental Parameters (65-P-004).
- Can Test Method for the Determination of Metals in Air – Collection and Digestion (65-P-014)

Geological Analysis:

- Can Test Method for Total Acid Digestion of Geological Samples
- Can Test Method for Teflon Bomb Digestion of Geological Samples for Major Component Analysis

Industrial Analysis

- Can Test Method: Multielement Wet Chemical Analysis of Steel Samples

SAMPLE SOLUTION STORAGE / HOLDING TIMES:

After preparation or digestion, sample solutions are stored in acid washed polypropylene bottles; some Assay solutions (e.g. alloy analysis) are typically stored in volumetric flasks. . Water samples are preserved with nitric acid at a concentration of 4%. In most cases, prepared and preserved samples may be analyzed within six months of sample preparation; caution should be exercised for certain elements and sample types (e.g. tin in alloys).

INSTRUMENTATION/SOFTWARE:

Thermo Jarrell Ash IRIS ICP System

Thermo Jarrell Ash IRIS Purged ICP, RF Generator, CID Chiller, Recirculation Pump, On-Line Peristaltic Pump, TJA Cyclonic Spray Chamber, PC computer, Laser Printer, TJA version 2.2.1 Thermospec software.

METHOD SUMMARY FOR ANALYSIS BY ICP (continued)
ELEMENTS DETERMINED/METHOD DETECTION LIMITS/REPORTING LIMITS/UPPER RANGE:
"Water Program"

Element	Instrument Method DL Determined June 23/98 (2xSD) (mg/L)	**Current Reported DL (10xSD) (mg/L)**	Calibration Standard Point (mg/L)	Upper Range Limit (Water Analysis) (mg/L)
Aluminum	0 041	**0.2**	10.00	250
Antimony	0.017	**0.2**	10.00	20
Arsenic	0.023	**0.3**	10.00	20
Barium	0.0004	**0001**	10.00	20
Beryllium	0.0008	**0.003**	10.00	20
Bismuth **(note)**	0.1	**(1.0)**	10.00	20
Boron	0.0018	**0.010**	10.00	20
Boron (high)	-----	**(1.0)**	10.00	20
Cadmium	0.0042	**0.03**	10.00	20
Calcium	0.0004	**0.01**	50.00	250
Chromium	0.0046	**0.03**	10.00	20
Cobalt	0.0032	**0.02**	10.00	20
Copper	0.0012	**0.02**	10.00	20
Iron	0.004	**0.03**	10.00	250
Iron (high)	----	**(1)**	10.00	(250)
Potassium **(note)**	High	**(3)**	50.00	150
Magnesium	-----	**0.05**	50.00	250
Manganese	0.0006	**0.003**	10.00	20
Molybdenum	0.0052	**0.04**	10.00	20
Lead	0.013	**0.08**	10.00	20
Nickel	0.0018	**0.03**	10.00	20
Phosphorus PO4	0.076	**0.4**	30.60	20
Sodium	0.023	**0.1**	50.00	100
Silicon SiO2	0.017	**0.1**	21.40	20
Silver	0.0036	**0.03**	10.00	20
Strontium	0.0004	**0.001**	10.00	20
Tin	0.011	**0.03**	10.00	20
Titanium	0.0006	**0.006**	10.00	5
Tungsten	0.04	**0.25**	10.00	20
Vanadium	0.00016	**0.01**	10.00	20
Zinc	0.0034	**0.02**	10.00	20
Zirconium	0.001	**0.02**	10.00	20

Note 1: The elements potassium and bismuth are not normally reported as they are unreliable.

Note 2: Instrument MDL referenced here is 2 x SD of 10 runs on an Ultrapure water blank.

METHOD SUMMARY FOR ANALYSIS BY ICP (continued)
PREPARATION OF CALIBRATION STANDARD SOLUTIONS: Application Notes

Stock Standard Solutions:

10,000 mg/L, 1000 mg/L Individual Stock Solutions or 2500 mg/L and 100 mg/L Mixed Stock Solutions: Either prepare from pure materials or purchase certified high purity ICP or ICPMS solutions from chemical suppliers. Shelf life is as stated on the suppliers certificate or one year.

Mixed and Individual Intermediate Standard Solutions:

Shelf life for these solutions is stated to be one year.

Working Standard Solutions:

Shelf life for these mixed solutions (at minimum concentrations of 10.00 mg/L) is stated to be one year; solutions are normally prepared more frequently.

Preparation:
For preparation details, refer to the ICP Operating Procedures Manual.

ANALYSIS PROGRAMS:

The ICP instrumentation is computer controlled. A "Program" includes element information, analysis acquisition time for the program, calibration standard details and levels, and interference correction routines. Gor the IRIS ICP they are described in the IRIS ICP Operating and Maintenance documents.

Instrument Startup

Calibration and Analysis

Instrument Shutdown

Maintenance Operations

Analysis Scheme:

Calibration Scheme:

The ICP is calibrated (standardized) prior to analysis runs. The calibration integrity is confirmed by the analyst before the sample analysis sequence is initiated. The calibration consists of:

-analysis of a calibration blank, appropriate for the program
-analysis of one or more multi-point mixed or single element calibration standard solutions
-after standardization, the calibration solutions are re-analyzed
-analysis of a suitable Certified Reference Material, if available; e.g. HPSTMP or CWW-TM-D

The analyst reviews the calibration data to ensure:

-the analysis of the calibration standards are acceptable. (e.g. 9.80 to 10.30 mg/L)
-the Certified Reference Material results (if analyzed) are acceptable.

Sample Analysis Sequence

Sample Analysis runs are then initiated. Normal operation includes analysis of one of the calibration standards after every twelve samples. The usual acceptance criteria for the calibration checks are plus or minus 3%. The calibration standards are usually recalibrated if these limits are exceed.

METHOD SUMMARY FOR ANALYSIS BY ICP (continued)

Sample Dilution

As noted, samples may be diluted with an automatic diluter, if required. For some analysis, dilutions are performed routinely.

For environmental soil analysis a two times dilution is prepared due to the instrument characteristics. Undiluted soil digests are not to be routinely analyzed.

Analyte "Carryover"

High level analytes may produce carryover on subsequent samples. Boron is especially difficult in this regard.

INSTRUMENT DATA OUTPUT/EVALUATION/REPORTING: (Summary)

Spectral Interference Correction

Interelement interference corrections are performed automatically by instrument software. Some interelement interferences are significant. Caution must be exercised in these cases.

Reporting Procedures

ICP analysts evaluate and review the data prior to reporting:

-carefully examine the analysis results where dilutions are performed; report results for each element using the appropriate dilution.
-critically examine samples containing high level analytes that have significant interelement interferences on other elements; manual corrections may be required; some data may be unreportable, e.g. where high levels of tungsten are present.

IRIS ICP Cautionary Notes

1. The automatic diluter apparatus must be properly set up such that the various connectors and components do not leak.

2. When an automatic dilution is performed by the instrument the data output from the instrument may be confusing. Samples at acceptable levels in the undiluted sample are reported in their original form. That is, the result obtained on the undiluted sample analysis run are reported directly from that run on the diluted analysis printout. For those elements that required dilution, their results are reported on the dliuted sample analysis printout. That is, the diluted sample analysis printout reports the result concentration data that was present in the original sample, but is is obtained from two (or more) analysis runs. Analysts must exercise caution.

QUALITY CONTROL SECTION:

Typically Example: Quality Control Samples for Water Analysis (Total and Dissolved Metals):

Blanks: Digestion (Total) or Filtration (Dissolved) Blanks: Minimum of two per preparation batch.

Duplicates: Minimum of one per batch, or at a frequency of 10 %.

ICP Sample Spikes: Minimum of one per batch, or at a frequency of 10 %.

Certified Reference Materials: Water Metals Certified Reference Materials are available from various sources, for example CWW-TM-P and materials from High Purity Standards Inc.

METHOD SUMMARY FOR ANALYSIS BY ICP (continued)
Performance Evaluation Samples

Water and Soil Performance Evaluation Samples are available from CAEAL, and from other sources, "Round Robin" samples are available from various sources.

Method: WATER07 Sample Name: BLANK Operator:
Comment:
Run Time: 02/06/02 09:24 Type: Std Mode: IR Corr.Fact: 1.000000

Elem	Ag3280	Al3961	As1890	B_2088
Line	328.068 { 79}	396.152 { 66}	189.042 {137}	208.893 {124}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	8.118	-1.398	.1388	.0722

Elem	B_2497	Ba2335	Be2348	Be2348
Line	249.773 {104}	233.527 {111}	234.861 {110}	234.861 {111}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	-1.172	.3665	1.601	.3998

Elem	Be2494	Bi2230	Ca2112	Ca3158
Line	249.454 {104}	223.061 {116}	211.276 {123}	315.887 { 82}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	-.3331	-.3554	-.1888	4.085

Elem	Cd2144	Cd2265	Cd2288	Co2286
Line	214.438 {121}	226.502 {114}	228.802 {113}	228.616 {113}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	-.0888	-.0833	-.2813	-.7311

Elem	Cr2677	Cr2835	Cr2843	Cu2247
Line	267.716 { 97}	283.563 { 92}	284.325 { 91}	224.700 {115}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	-.1277	-1.349	4.703	.6663

Elem	Cu3247	Fe2585	Fe2599	Fe2714
Line	324.754 { 80}	258.588 {100}	259.940 {100}	271.441 { 96}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	-18.97	-1.738	-.3794	1.510

Elem	Ge2094	In2306	K_7664	K_7698
Line	209.426 {124}	230.606 {113}	766.490 { 34}	769.896 { 34}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	-.0278	.3387	84.00	7.875

Elem	Li6707	Mg2852	Mg5183	Mn2576
Line	670.784 { 39}	285.213 { 91}	518.362 { 50}	257.610 {101}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	-7.565	-1.655	-12.37	-2.276

Elem	Mn2939	Mo2020	Na5889	Na5895
Line	293.930 { 88}	202.030 {128}	588.995 { 44}	589.592 { 44}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	-.6700	-.1036	124.3	103.6

Elem	Ni2316	P_1859	P_2149	Pb2203
Line	231.604 {112}	185.943 {139}	214.914 {121}	220.353 {118}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	-1.027	.0851	-.6034	.2554

Elem	S_1807	Sb2068	Sc2552	Sc4020
Line	180.731 {143}	206.833 {125}	255.237 {102}	402.040 { 65}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	.0722	.1249	.7051	1.264

Sample Name: BLANK Run Time: 02/06/02 09:24

Elem	Sc4246	Sc4314	Se1960	Si2516
Line	424.683 { 61}	431.409 { 60}	196.090 {132}	251.612 {103}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	4.010	-1.830	.0167	.4553

Elem	Sn1899	Sr3464	Sr4215	Th2837
Line	189.989 {136}	346.446 { 75}	421.552 { 62}	283.730 { 92}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	-.0278	4.242	4.060	1.351

Elem	Ti3234	U_4090	V_2924	Y_2422
Line	323.452 { 80}	409.014 { 64}	292.402 { 89}	242.220 {107}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	18.97	.0943	-1.081	-2.360

Elem	Y_3710	Zn2138	Zr3438
Line	371.030 { 70}	213.856 {121}	343.823 { 76}
Units	Cts/S	Cts/S	Cts/S
Avg	.3938	.9272	-1.007

Method: WATER07 Sample Name: STD1 Operator:
Comment:
Date Time: 02/06/02 09:26 Type: Std Mode: IR Corr.Fact: 1.000000

Elem	Ag3280	Al3961	As1890	B_2088
Line	328.068 { 79}	396.152 { 66}	189.042 {137}	208.893 {124}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	362.4	4.093	1.618	4.903

Elem	B_2497	Ba2335	Be2348	Be2348
Line	249.773 {104}	233.527 {111}	234.861 {110}	234.861 {111}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	118.6	148.3	874.9	394.2

Elem	Be2494	Bi2230	Cd2144	Cd2265
Line	249.454 {104}	223.061 {116}	214.438 {121}	226.502 {114}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	68.65	3.337	97.60	64.64

Elem	Cd2288	Co2286	Cr2677	Cr2835
Line	228.802 {113}	228.616 {113}	267.716 { 97}	283.563 { 92}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	59.52	32.95	111.8	127.9

Elem	Cr2843	Cu2247	Cu3247	Fe2585
Line	284.325 { 91}	224.700 {115}	324.754 { 80}	258.588 {100}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	126.0	17.03	11.20	26.57

Elem	Fe2599	Li6707	Mn2576	Mn2939
Line	259.940 {100}	670.784 { 39}	257.610 {101}	293.930 { 88}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	168.0	10.76	469.6	116.6

Elem	Mo2020	Ni2316	Pb2203	Sb2068
Line	202.030 {128}	231.604 {112}	220.353 {118}	206.833 {125}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	9.391	34.37	4.014	1.777

Elem	Se1960	Sr3464	Sr4215	Ti3234
Line	196.090 {132}	346.446 { 75}	421.552 { 62}	323.452 { 80}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	.9661	13.27	381.7	395.9

Elem	U_4090	V_2924	Zn2138
Line	409.014 { 64}	292.402 { 89}	213.856 {121}
Units	Cts/S	Cts/S	Cts/S
Avg	.6766	140.4	47.29

Method: WATER07 Sample Name: STD2 Operator:
Comment:
Time: 02/06/02 09:29 Type: Std Mode: IR Corr.Fact: 1.000000

Elem	Ag3280	Al3961	Ba2335	Be2494
Line	328.068 { 79}	396.152 { 66}	233.527 {111}	249.454 {104}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	3211.	48.36	1456.	691.4

Elem	Bi2230	Co2286	Cu2247	Cu3247
Line	223.061 {116}	228.616 {113}	224.700 {115}	324.754 { 80}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	34.42	334.8	145.5	487.4

Elem	Fe2585	Fe2599	Mn2939	Ni2316
Line	258.588 {100}	259.940 {100}	293.930 { 88}	231.604 {112}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	315.4	1773.	1129.	351.6

Elem	Pb2203	Sr3464	Th2837	U_4090
Line	220.353 {118}	346.446 { 75}	283.730 { 92}	409.014 { 64}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	35.01	111.0	162.4	6.701

Elem	V_2924	Zn2138
Line	292.402 { 89}	213.856 {121}
Units	Cts/S	Cts/S
Avg	1408.	548.9

Analysis Report 02/06/02 10:03:08 page 1

Method: WATER07 Sample Name: HPSTMD -1 Operator:
Comment:
Time: 02/06/02 10:01 Type: QC Mode: CONC Corr.Fact: 1.000000

Elem	Ag	Al	As	B	Ba	Be
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .2687	kQ 1.174	kQ .2142	k 1.011	k 1.032	kQ .2805
Check ?	QC Pass	QC Fail	QC Fail	QC Pass	QC Pass	QC Fail
Value	.2500	1.000	.2500	1.000	1.000	.2500
Range	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%

Elem	Bi	Ca	Cd	Co	Cr	Cu
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k .0250	k .2650	k 1.051	k 1.076	kQ 1.151
Check ?	None	None	QC Pass	QC Pass	QC Pass	QC Fail
Value			.2500	1.000	1.000	1.000
Range			10.00%	10.00%	10.00%	10.00%

Elem	Fe	Ge	In	K	Li	Mg
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .9119	.0041	<.0000	k<.0000	k .0003	k<.0000
Check ?	QC Pass	None	None	None	None	None
Value	1.000					
Range	10.00%					

Elem	Mn	Mo	Na	Ni	P	Pb
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 1.051	k 1.013	k<.0000	k 1.028	k .0987	kQ 1.107
Check ?	QC Pass	QC Pass	None	QC Pass	None	QC Fail
Value	1.000	1.000		1.000		1.000
Range	10.00%	10.00%		10.00%		10.00%

Elem	S	Sb	Sc	Se	Si	Sn
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .0221	k .2706	.0070	kQ .1432	k .0040	k .0070
Check ?	None	QC Pass	None	QC Fail	None	None
Value		.2500		.2500		
Range		10.00%		10.00%		

Elem	Sr	Th	Ti	U	V	Y
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 1.093	k<.0000	k<.0000	k .1452	k 1.039	<.0000
Check ?	QC Pass	None	None	None	QC Pass	None
Value	1.000				1.000	
Range	10.00%				10.00%	

Elem	Zn	Zr
Units	ppm	ppm
Avg	kQ .8917	k<.0000
Check ?	QC Fail	None
Value	1.000	
Range	10.00%	

Method: WATER07 Sample Name: STD3 Operator:
Comment:
Date Time: 02/06/02 09:32 Type: Std Mode: IR Corr.Fact: 1.000000

Elem	As1890	B_2088	B_2497	Cd2144
Line	189.042 {137}	208.893 {124}	249.773 {104}	214.438 {121}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	15.48	48.74	1240.	788.9

Elem	Cd2265	Cd2288	Cr2677	Cr2835
Line	226.502 {114}	228.802 {113}	267.716 { 97}	283.563 { 92}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	669.9	633.7	1129.	1165.

Elem	Cr2843	Li6707	Mo2020	Sb2068
Line	284.325 { 91}	670.784 { 39}	202.030 {128}	206.833 {125}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	1104.	168.0	97.78	16.99

Elem	Se1960
Line	196.090 {132}
Units	Cts/S
Avg	11.04

Method: WATER07 Sample Name: STD4 Operator:
Comment:
Run Time: 02/06/02 09:34 Type: Std Mode: IR Corr.Fact: 1.000000

Elem	S_1807
Line	180.731 {143}
Units	Cts/S
Avg	6.349

Analysis Report 02/06/02 09:38:45 page 1

Method: WATER07 Sample Name: STD5 Operator:
Comment:
Run Time: 02/06/02 09:37 Type: Std Mode: IR Corr.Fact: 1.000000

Elem	Zr3438
Line	343.823 { 76}
Units	Cts/S
Avg	1926.

Analysis Report 02/06/02 09:41:16 page 1

Method: WATER07 Sample Name: STD6 Operator:
Comment:
Time: 02/06/02 09:39 Type: Std Mode: IR Corr.Fact: 1.000000

Elem	P_1859	P_2149	Si2516	Sn1899
Line	185.943 {139}	214.914 {121}	251.612 {103}	189.989 {136}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	4.555	11.36	441.5	37.20

Method: WATER07 Sample Name: STD7 Operator:
Comment:
Run Time: 02/06/02 09:42 Type: Std Mode: IR Corr.Fact: 1.000000

Elem	Ca2112	Ca3158	K_7664	K_7698
Line	211.276 {123}	315.887 { 82}	766.490 { 34}	769.896 { 34}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	1.929	511.5	138.7	29.97

Elem	Mg2852	Mg5183	Na5889	Na5895
Line	285.213 { 91}	518.362 { 50}	588.995 { 44}	589.592 { 44}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	1418.	68.56	532.0	392.1

Method: WATER07 Sample Name: STD8 Operator:
Comment:
Run Time: 02/06/02 09:44 Type: Std Mode: IR Corr.Fact: 1.000000

Elem	Ca2112	Ca3158	Fe2585	Fe2714
Line	211.276 {123}	315.887 { 82}	258.588 {100}	271.441 { 96}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	10.40	2514.	1802.	263.4

Elem	K_7664	K_7698	Mg5183	Na5889
Line	766.490 { 34}	769.896 { 34}	518.362 { 50}	588.995 { 44}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	388.4	116.1	409.0	2246.

Elem	Na5895
Line	589.592 { 44}
Units	Cts/S
Avg	1596.

Analysis Report 02/06/02 09:49:03 page 1

Method: WATER07 Sample Name: STD9 Operator:
Comment:
R Time: 02/06/02 09:47 Type: Std Mode: IR Corr.Fact: 1.000000

Elem	Ca2112	Fe2714	K_7698	Mg5183
Line	211.276 {123}	271.441 { 96}	769.896 { 34}	518.362 { 50}
Units	Cts/S	Cts/S	Cts/S	Cts/S
Avg	99.54	981.5	1085.	3912.

Analysis Report . . 02/06/02 09:53:36 page 1

Method: WATER07 Sample Name: STD3 Operator:
Comment:
Run Time: 02/06/02 09:51 Type: QC Mode: CONC Corr.Fact: 1.000000

Elem	Ag	Al	As	B	Ba	Be
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .2251	k .3535	k 10.25	k 10.26	k<.0000	k .0031
Check ?	None	None	QC Pass	QC Pass	None	None
Value			10.00	10.00		
Range			3.000%	3.000%		

Elem	Bi	Ca	Cd	Co	Cr	Cu
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .4330	k<.0000	kQ 10.34	k<.0000	kQ 10.35	k .0013
Check ?	None	None	QC Fail	None	QC Fail	None
Value			10.00		10.00	
Range			3.000%		3.000%	

Elem	Fe	Ge	In	K	Li	Mg
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .1247	.0024	<.0000	k .3330	k 11.95	k<.0000
Check ?	None	None	None	None	None	None
Value						
Range						

Elem	Mn	Mo	Na	Ni	P	Pb
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k 10.24	k<.0000	k<.0000	k<.0000	k .0407
Check ?	None	QC Pass	None	None	None	None
Value		10.00				
Range		3.000%				

Elem	S	Sb	Sc	Se	Si	Sn
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .0929	kQ 10.41	.0062	kQ 10.43	k .1881	k<.0000
Check ?	None	QC Fail	None	QC Fail	None	None
Value		10.00		10.00		
Range		3.000%		3.000%		

Elem	Sr	Th	Ti	U	V	Y
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .0029	k<.0000	kQ>5.000	k .0265	k<.0000	<.0000
Check ?	None	None	QC Fail	None	None	None
Value			10.00			
Range			3.000%			

Elem	Zn	Zr
Units	ppm	ppm
Avg	k<.0000	k<.0000
Check ?	None	None
Value		
Range		

Analysis Report 02/06/02 09:58:08 page 1

Method: WATER07 Sample Name: BLANK Operator:
Comment:
Run Time: 02/06/02 09:56 Type: QC Mode: CONC Corr.Fact: 1.000000

Elem	Ag	Al	As	B	Ba	Be
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k<.0000	k<.0000	k .0046	k<.0000	k<.0000
Check ?	None	QC Pass	QC Pass	QC Pass	None	None
Value		.0000	.0000	.0000		
Range		±.1140	±.2300	±.0120		

Elem	Bi	Ca	Cd	Co	Cr	Cu
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k .0001	k .0013	k .0020	k .0001	k .0154
Check ?	QC Pass	None	QC Pass	QC Pass	QC Pass	QC Pass
Value	.0000		.0000	.0000	.0000	.0000
Range	±.5200		±.0120	±.0200	±.0900	±.0400

Elem	Fe	Ge	In	K	Li	Mg
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .0029	<.0000	.0087	k<.0000	k .0094	k .0009
Check ?	QC Pass	None	None	None	None	None
Value	.0000					
Range	±.0080					

Elem	Mn	Mo	Na	Ni	P	Pb
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k .0196	k<.0000	k .0037	k<.0000	k .0089
Check ?	None	QC Pass	None	QC Pass	QC Pass	QC Pass
Value		.0000		.0000	.0000	.0000
Range		±.0740		±.0200	±1.000	±.1600

Elem	S	Sb	Sc	Se	Si	Sn
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .0663	k<.0000	.0082	k .0062	k .0015	k .0070
Check ?	None	QC Pass	None	QC Pass	QC Pass	QC Pass
Value		.0000		.0000	.0000	.0000
Range		±.2700		±.4900	±.0340	±.1300

Elem	Sr	Th	Ti	U	V	Y
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k<.0000	k .0016	k .2130	k<.0000	.0001
Check ?	None	None	QC Pass	None	QC Pass	None
Value			.0000		.0000	
Range			±.0120		±.0650	

Elem	Zn	Zr
Units	ppm	ppm
Avg	k .0015	k .0006
Check ?	QC Pass	QC Pass
Value	.0000	.0000
Range	±.0100	±.5600

Analysis Report 02/06/02 10:00:38 page 1

Method: WATER07 Sample Name: ZERO CHECK Operator:
Comment:
Run Time: 02/06/02 09:58 Type: QC Mode: CONC Corr.Fact: 1.000000

Elem	Ag	Al	As	B	Ba	Be
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .0011	kQ .9423	k<.0000	kQ .0461	k .0818	k<.0000
Check ?	None	QC Fail	QC Pass	QC Fail	None	None
Value		.0000	.0000	.0000		
Range		±.1140	±.2300	±.0120		

Elem	Bi	Ca	Cd	Co	Cr	Cu
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k 1.655	k .0019	k .0001	k .0002	k .0013
Check ?	QC Pass	None	QC Pass	QC Pass	QC Pass	QC Pass
Value	.0000		.0000	.0000	.0000	.0000
Range	±.5200		±.0120	±.0200	±.0900	±.0400

Elem	Fe	Ge	In	K	Li	Mg
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	kQ .0157	<.0000	<.0000	k .0423	k .0199	k .1576
Check ?	QC Fail	None	None	None	None	None
Value	.0000					
Range	±.0080					

Elem	Mn	Mo	Na	Ni	P	Pb
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k .0086	k .0349	k .0026	k .0555	k<.0000
Check ?	None	QC Pass	None	QC Pass	QC Pass	QC Pass
Value		.0000		.0000	.0000	.0000
Range		±.0740		±.0200	±1.000	±.1600

Elem	S	Sb	Sc	Se	Si	Sn
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .0619	k<.0000	.0048	k<.0000	kQ .1173	k .0139
Check ?	None	QC Pass	None	QC Pass	QC Fail	QC Pass
Value		.0000		.0000	.0000	.0000
Range		±.2700		±.4900	±.0340	±.1300

Elem	Sr	Th	Ti	U	V	Y
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .0698	k .0077	k .0017	k<.0000	k<.0000	.0012
Check ?	None	None	QC Pass	None	QC Pass	None
Value			.0000		.0000	
Range			±.0120		±.0650	

Elem	Zn	Zr
Units	ppm	ppm
Avg	kQ .0178	k<.0000
Check ?	QC Fail	QC Pass
Value	.0000	.0000
Range	±.0100	±.5600

Analysis Report 02/06/02 15:42:36 page 1

Method: WATER07 Sample Name: 201280066 DUP Operator:
Comment:
Time: 02/06/02 15:40 Type: Unk Mode: CONC Corr.Fact: 2.000000

Elem	Ag	Al	As	B	Ba	Be
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .0775	k 50.02	k<.0000	k .6277	k .5791	k<.0000

Elem	Bi	Ca	Cd	Co	Cr	Cu
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k 33.97	k .0100	k .0168	k .3316	k<.0000

0.15

Elem	Fe	Ge	In	K	Li	Mg
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 165.6	<.0000	.0503	k 10.28	k .4142	k 49.85

Elem	Mn	Mo	Na	Ni	P	Pb
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 1.779	k .0521	k<.0000	k .2172	k 8.346	k<.0000

0.438

Elem	S	Sb	Sc	Se	Si	Sn
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k<.0000	<.0000	k<.0000	k 3.604	k<.0000

Elem	Sr	Th	Ti	U	V	Y
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .5204	k<.0000	k 5.575	k<.0000	k .1617	<.0000

	Zn	Zr
Units	ppm	ppm
Avg	k .4447	k<.0000

Mg/g = 21.4

ICPMS
in Solution
0.4286

Analysis Report 02/06/02 15:45:06 page 1

Method: WATER07 Sample Name: 201280066 SAMPLE Operator:
Comment:
R Time: 02/06/02 15:43 Type: Unk Mode: CONC Corr.Fact: 2.000000

Elem	Ag	Al	As	B	Ba	Be
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .0831	k 44.38	k<.0000	k .5325	k .5500	k<.0000

Elem	Bi	Ca	Cd	Co	Cr	Cu
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k 36.56	k .0139	k .0113	k .2815	k<.0000

0.14

Elem	Fe	Ge	In	K	Li	Mg
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 135.5	<.0000	.0474	k 9.074	k .3865	k 39.24

Elem	Mn	Mo	Na	Ni	P	Pb
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 1.538	k .0066	k<.0000	k .1786	k 7.513	k<.0000

0.411

Elem	S	Sb	Sc	Se	Si	Sn
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k<.0000	<.0000	k<.0000	k 3.389	k .0080

Elem	Sr	Th	Ti	U	V	Y
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .4945	k<.0000	k 5.051	k<.0000	k .1247	<.0000

E	Zn	Zr
Units	ppm	ppm
Avg	k .3964	k<.0000

Pb = 0.3156 mg/L
= 15.8 µg/g

Analysis Report 02/06/02 15:47:35 page 1

Method: WATER07 Sample Name: 201280068 SAMPLE Operator:
Comment:
R[illegible] Time: 02/06/02 15:45 Type: Unk Mode: CONC Corr.Fact: 2.000000

Elem	Ag	Al	As	B	Ba	Be
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .0417	k 28.85	k<.0000	k .4741	k .3080	k<.0000

Elem	Bi	Ca	Cd	Co	Cr	Cu
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k 41.69	k .0288	k .0187	k .2434	k<.0000 0.136

Elem	Fe	Ge	In	K	Li	Mg
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 110.5	<.0000	.0423	k 4.662	k .3423	k 26.11

Elem	Mn	Mo	Na	Ni	P	Pb
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .8288	k .0096	k<.0000	k .0408	k 14.18	k<.0000

Elem	S	Sb	Sc	Se	Si	Sn
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k<.0000	<.0000	k<.0000 0.184	k 2.845	k .0000

Elem	Sr	Th	Ti	U	V	Y
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .6164	k<.0000	k 3.063	k<.0000	k .1683	<.0000

E[illegible]	Zn	Zr
Units	ppm	ppm
Avg	k .2495	k<.0000

Pb = 0.2464

= 12.3

Analysis Report 02/06/02 15:50:11 page 1

Method: WATER07 Sample Name: 201280069 SAMPLE Operator:
Comment:
Run Time: 02/06/02 15:48 Type: Unk Mode: CONC Corr.Fact: 2.000000

Elem	Ag	Al	As	B	Ba	Be
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .0377	k 123.5	k<.0000	k 2.021	k 1.637	k<.0000

Elem	Bi	Ca	Cd	Co	Cr	Cu
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k 104.3	k .0345	k .0893	k .8949	k .0797

0.5096

Elem	Fe	Ge	In	K	Li	Mg
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 449.9	<.0000	.1021	k 41.21	k .5441	k 110.8

Elem	Mn	Mo	Na	Ni	P	Pb
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 3.849	k<.0000	k .3097	k .1405	k 25.23	k<.0000

0.7286

Elem	S	Sb	Sc	Se	Si	Sn
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 4.211	k<.0000	<.0000	k<.0000	k 5.100	k .0050

Elem	Sr	Th	Ti	U	V	Y
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 1.237	k<.0000	k 5.429	k<.0000	k .6749	<.0000

Elem	Zn	Zr
Units	ppm	ppm
Avg	k 1.047	k<.0000

Pb = 0.8718

43.6 mg/L

Analysis Report 02/06/02 15:52:42 page 1

Method: WATER07 Sample Name: 201280070 SAMPLE Operator:
Comment:
R Time: 02/06/02 15:50 Type: Unk Mode: CONC Corr.Fact: 2.000000

Elem	Ag	Al	As	B	Ba	Be
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .0988	k 63.58	k<.0000	k .6010	k .5910	k<.0000

Elem	Bi	Ca	Cd	Co	Cr	Cu
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k 29.01	k .0116	k .0164	k .3091	k<.0000

0.180

Elem	Fe	Ge	In	K	Li	Mg
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 155.4	<.0000	.0452	k 11.42	k .4218	k 40.69

Elem	Mn	Mo	Na	Ni	P	Pb
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 1.593	k .0073	k<.0000	k .1343	k 5.356	k<.0000

0.3816

Elem	S	Sb	Sc	Se	Si	Sn
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k<.0000	<.0000	k<.0000	k 4.307	k .0020

Elem	Sr	Th	Ti	U	V	Y
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .4255	k<.0000	k 6.050	k<.0000	k .1513	<.0000

Elem	Zn	Zr
Units	ppm	ppm
Avg	k .5512	k<.0000

Pb = 0.4272

21.1 µg/g

Analysis Report 02/06/02 15:55:11 page 1

Method: WATER07 Sample Name: 201280071 SAMPLE Operator:
Comment:
Run Time: 02/06/02 15:53 Type: Unk Mode: CONC Corr.Fact: 2.000000

Elem	Ag	Al	As	B	Ba	Be
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .0262	k 42.73	k<.0000	k .4697	k .3840	k<.0000

Elem	Bi	Ca	Cd	Co	Cr	Cu
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k 32.21	k .0227	k .0073	k .3120	k<.0000

Elem	Fe	Ge	In	K	Li	Mg
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 111.5	<.0000	.0211	k 4.277	k .3272	k 27.68

0.131

Elem	Mn	Mo	Na	Ni	P	Pb
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 1.234	k .0104	k<.0000	k .0756	k 8.965	k<.0000

0.2446

Elem	S	Sb	Sc	Se	Si	Sn
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k<.0000	<.0000	k<.0000	k 3.352	k .0259

Elem	Sr	Th	Ti	U	V	Y
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .6770	k<.0000	k 2.748	k<.0000	k .1456	<.0000

Elem	Zn	Zr
Units	ppm	ppm
Avg	k .2589	k<.0000

Pb - 0.18184

9.1 µg/L

Analysis Report 02/06/02 15:57:42 page 1

Method: WATER07 Sample Name: 201280072 SAMPLE Operator:
Comment:
Run Time: 02/06/02 15:55 Type: Unk Mode: CONC Corr.Fact: 2.000000

Elem	Ag	Al	As	B	Ba	Be
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .1056	k 95.01	k<.0000	k .7508	k .9986	k<.0000

Elem	Bi	Ca	Cd	Co	Cr	Cu
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k 34.99	k .0116	k .0128	k .4027	k .0738

0.265

Elem	Fe	Ge	In	K	Li	Mg
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 210.0	<.0000	.0649	k 14.17	k .5095	k 55.49

Elem	Mn	Mo	Na	Ni	P	Pb
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 1.958	k .0096	k .1271	k .1661	k 7.712	k<.0000

0.4262

Elem	S	Sb	Sc	Se	Si	Sn
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k<.0000	<.0000	k<.0000	k 5.825	k .0030

Elem	Sr	Th	Ti	U	V	Y
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .6448	k<.0000	k 7.989	k<.0000	k .2146	<.0000

Elem	Zn	Zr
Units	ppm	ppm
Avg	k .6126	k<.0000

Pb = 0.4148

20.7 µg/g

Analysis Report 02/06/02 16:00:11 page 1

Method: WATER07 Sample Name: 201280073 SAMPLE Operator:
Comment:
P[illegible] Time: 02/06/02 15:58 Type: Unk Mode: CONC Corr.Fact: 2.000000

Elem	Ag	Al	As	B	Ba	Be
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .0502	k 72.06	k<.0000	k .7666	k .5349	k<.0000

Elem	Bi	Ca	Cd	Co	Cr	Cu
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k 42.28	k .0159	k .0203	k .2689	k .0357

0.210

Elem	Fe	Ge	In	K	Li	Mg
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 211.5	<.0000	.0547	k 9.518	k .4470	k 49.33

Elem	Mn	Mo	Na	Ni	P	Pb
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 1.865	k .0043	k<.0000	k .0507	k 10.21	k<.0000

0.235

Elem	S	Sb	Sc	Se	Si	Sn
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k<.0000	<.0000	k<.0000	k 4.633	k .0030

Elem	Sr	Th	Ti	U	V	Y
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .6354	k<.0000	k 5.036	k<.0000	k .2999	<.0000

E[illegible]n	Zn	Zr
Units	ppm	ppm
Avg	k .6985	k<.0000

Pb = 0.2726

13.6 µg/g

Analysis Report 02/06/02 16:02:40 page 1

Method: WATER07 Sample Name: 201280074 SAMPLE Operator:
Comment:
Run Time: 02/06/02 16:00 Type: Unk Mode: CONC Corr.Fact: 2.000000

Elem	Ag	Al	As	B	Ba	Be
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k 46.92	k<.0000	k .6367	k .3912	k<.0000

Elem	Bi	Ca	Cd	Co	Cr	Cu
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k 26.38	k .0077	k .0338	k .1894	k .0969

0.3072

Elem	Fe	Ge	In	K	Li	Mg
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 175.4	<.0000	.0408	k 4.940	k .3814	k 30.03

Elem	Mn	Mo	Na	Ni	P	Pb
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 1.469	k .0081	k<.0000	k .0184	k 6.250	k<.0000

0.159

Elem	S	Sb	Sc	Se	Si	Sn
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k<.0000	<.0000	k<.0000	k 3.203	k .0199

Elem	Sr	Th	Ti	U	V	Y
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .3912	k<.0000	k 1.948	k<.0000	k .2533	<.0000

Elem	Zn	Zr
Units	ppm	ppm
Avg	k .5230	k<.0000

Pb = 0.3168

15.8 µg/L

Analysis Report 02/06/02 16:05:09 page 1

Method: WATER07 Sample Name: 201280075 DUP Operator:
Comment:
Run Time: 02/06/02 16:03 Type: Unk Mode: CONC Corr.Fact: 2.000000

Elem	Ag	Al	As	B	Ba	Be
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .0478	k 52.53	k<.0000	k .5890	k .5876	k<.0000

Elem	Bi	Ca	Cd	Co	Cr	Cu
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k 31.29	k .0110	k .0185	k .1972	k<.0000

Elem	Fe	Ge	In	K	Li	Mg
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 155.1	<.0000	.0547	k 7.830	k .3840	k 32.30

0.151

Elem	Mn	Mo	Na	Ni	P	Pb
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 1.288	k .0073	k<.0000	k .0376	k 9.515	k<.0000

0.176

Elem	S	Sb	Sc	Se	Si	Sn
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k<.0000	<.0000	k<.0000	k 3.896	k<.0000

Elem	Sr	Th	Ti	U	V	Y
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .6453	k<.0000	k 4.028	k<.0000	k .1780	<.0000

Elem	Zn	Zr
Units	ppm	ppm
Avg	k .6035	k<.0000

Pb = 0.234

11.7 µg/g

Analysis Report 02/06/02 16:07:38 page 1

Method: WATER07 Sample Name: 201280075 SAMPLE Operator:
Comment:
Date Time: 02/06/02 16:05 Type: Unk Mode: CONC Corr.Fact: 2.000000

Elem	Ag	Al	As	B	Ba	Be
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .0415	k 53.68	k<.0000	k .5750	k .7654	k<.0000

Elem	Bi	Ca	Cd	Co	Cr	Cu
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k 27.96	k .0116	k .0197	k .1938	k .0110 0.124

Elem	Fe	Ge	In	K	Li	Mg
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 153.9	<.0000	.0394	k 7.983	k .3587	k 31.93

Elem	Mn	Mo	Na	Ni	P	Pb
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 1.468	k<.0000	k<.0000	k .0413 0.194	k 9.348	k<.0000

Elem	S	Sb	Sc	Se	Si	Sn
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k<.0000	<.0000	k<.0000	k 3.360	k .0149

Elem	Sr	Th	Ti	U	V	Y
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .5929	k<.0000	k 4.054	k<.0000	k .1525	<.0000

Elem	Zn	Zr
Units	ppm	ppm
Avg	k .6037	k<.0000

Pb = 0.2378

11.9 ug/L

Analysis Report 02/06/02 16:10:09 page 1

Method: WATER07 Sample Name: 201280076 SAMPLE Operator:
Comment:
R[illegible] Time: 02/06/02 16:08 Type: Unk Mode: CONC Corr.Fact: 2.000000

Elem	Ag	Al	As	B	Ba	Be
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .0255	k 65.51	k<.0000	k .8056	k .3545	k<.0000

Elem	Bi	Ca	Cd	Co	Cr	Cu
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k 35.05	k .0112	k .0318	k .2246	k .1626

0.414

Elem	Fe	Ge	In	K	Li	Mg
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 220.3	<.0000	.0598	k 9.751	k .3716	k 55.94

Elem	Mn	Mo	Na	Ni	P	Pb
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 1.975	k .0202	k<.0000	k .0416	k 6.365	k<.0000

0.248

Elem	S	Sb	Sc	Se	Si	Sn
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k<.0000	<.0000	k<.0000	k 4.395	k .0169

Elem	Sr	Th	Ti	U	V	Y
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .4133	k<.0000	k 3.843	k<.0000	k .3383	<.0000

E[illegible]m	Zn	Zr
Units	ppm	ppm
Avg	k .5037	k<.0000

Pb = 0.3006

15.0 mg/L

Analysis Report 02/06/02 16:21:46 page 1

Method: WATER07 Sample Name: 201280078 SAMPLE Operator:
Comment:
R Time: 02/06/02 16:20 Type: Unk Mode: CONC Corr.Fact: 2.000000

Elem	Ag	Al	As	B	Ba	Be
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .0268	k 44.45	k<.0000	k .4951	k .3191	k<.0000

Elem	Bi	Ca	Cd	Co	Cr	Cu
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k 35.15	k .0127	k .0176	k .1463	k .0215

0.202

Elem	Fe	Ge	In	K	Li	Mg
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 129.5	<.0000	.0328	k 3.849	k .3360	k 27.97

Elem	Mn	Mo	Na	Ni	P	Pb
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 2.005	k .0202	k<.0000	k .0211	k 8.902	k<.0000

0.140

Elem	S	Sb	Sc	Se	Si	Sn
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k<.0000	<.0000	k<.0000	k 3.193	k<.0000

Elem	Sr	Th	Ti	U	V	Y
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .5413	k<.0000	k 2.766	k<.0000	k .2005	<.0000

Elem	Zn	Zr
Units	ppm	ppm
Avg	k .3155	k<.0000

Pb = 0.17816

8.9 µg/l

Analysis Report 02/06/02 16:24:19 page 1

Method: WATER07 Sample Name: 201280079 SAMPLE Operator:
Comment:
Run Time: 02/06/02 16:22 Type: Unk Mode: CONC Corr.Fact: 2.000000

Elem	Ag	Al	As	B	Ba	Be
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .1055	k 121.9	k<.0000	k .9429	k 1.075	k<.0000

Elem	Bi	Ca	Cd	Co	Cr	Cu
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k 35.46	k .0063	k .0390	k .3294	k .1074

0.239

Elem	Fe	Ge	In	K	Li	Mg
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 250.2	<.0000	.0678	k 16.06	k .5473	k 62.50

Elem	Mn	Mo	Na	Ni	P	Pb
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 2.363	k .0111	k<.0000	k .0388	k 7.692	k<.0000

0.1949

Elem	S	Sb	Sc	Se	Si	Sn
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k<.0000	<.0000	k<.0000	k 5.597	k<.0000

Elem	Sr	Th	Ti	U	V	Y
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .5783	k<.0000	k 6.787	k<.0000	k .4036	<.0000

Elem	Zn	Zr
Units	ppm	ppm
Avg	k .5345	k<.0000

Pb=0.229

11.5 lb/g

Analysis Report 02/06/02 16:26:51 page 1

Method: WATER07 Sample Name: 201280080 SAMPLE Operator:
Comment:
Run Time: 02/06/02 16:25 Type: Unk Mode: CONC Corr.Fact: 2.000000

Elem	Ag	Al	As	B	Ba	Be
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .0878	k 83.29	k<.0000	k 1.787	k 2.033	k<.0000

Elem	Bi	Ca	Cd	Co	Cr	Cu
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k 71.93	k .0478	k .0600	k .4290	k 2.493

5.042

Elem	Fe	Ge	In	K	Li	Mg
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 380.4	<.0000	.1123	k 13.76	k .4413	k 48.59

Elem	Mn	Mo	Na	Ni	P	Pb
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 4.847	k .0301	k 1.068	k<.0000	k 7.575	k 1.528

0.3118

Elem	S	Sb	Sc	Se	Si	Sn
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 2.433	k<.0000	<.0000	k<.0000	k 8.755	k .1014

Elem	Sr	Th	Ti	U	V	Y
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .9330	k<.0000	k 6.525	k<.0000	k .1956	<.0000

Elem	Zn	Zr
Units	ppm	ppm
Avg	k 19.07	k<.0000

Pb: 3.878

194.mg/g

Analysis Report 02/06/02 16:29:22 page 1

Method: WATER07 Sample Name: 201280081 SAMPLE Operator:
Comment:
Run Time: 02/06/02 16:27 Type: Unk Mode: CONC Corr.Fact: 2.000000

Elem	Ag	Al	As	B	Ba	Be
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .0826	k 71.65	k<.0000	k 1.825	k 2.050	k<.0000

Elem	Bi	Ca	Cd	Co	Cr	Cu
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k 76.63	k .0453	k .0719	k .4525	k 1.724

Elem	Fe	Ge	In	K	Li	Mg
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 386.6	<.0000	.1079	k 10.86	k .4042	k 40.44

5.218

Elem	Mn	Mo	Na	Ni	P	Pb
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 5.004	k .0316	k 1.322	k<.0000	k 6.920	k 1.057

0.254

Elem	S	Sb	Sc	Se	Si	Sn
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 3.264	k<.0000	<.0000	k<.0000	k 7.883	k .1830

Elem	Sr	Th	Ti	U	V	Y
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .9355	k<.0000	k 5.221	k<.0000	k .2332	<.0000

Elem	Zn	Zr
Units	ppm	ppm
Avg	k 18.35	k<.0000

Pb 2.550
128 µg/g

Analysis Report 02/06/02 16:32:03 page 1

Method: WATER07 Sample Name: 201280082 SAMPLE Operator:
Comment:
Run Time: 02/06/02 16:30 Type: Unk Mode: CONC Corr.Fact: 2.000000

Elem	Ag	Al	As	B	Ba	Be
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .0752	k 163.8	k<.0000	k 1.707	k 3.155	k<.0000

Elem	Bi	Ca	Cd	Co	Cr	Cu
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k 306.1	k .0323	k .0649	k .4920	k .1716 0.524

Elem	Fe	Ge	In	K	Li	Mg
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 372.5	<.0000	.0991	k 26.64	k .5309	k 241.7

Elem	Mn	Mo	Na	Ni	P	Pb
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 4.689	k .0134	k 1.512	k .0850 0.596	k 9.431	k .4600

Elem	S	Sb	Sc	Se	Si	Sn
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 13.06	k<.0000	<.0000	k<.0000	k 3.875	k<.0000

Elem	Sr	Th	Ti	U	V	Y
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .9778	k<.0000	k 6.674	k<.0000	k .4690	<.0000

Elem	Zn	Zr
Units	ppm	ppm
Avg	k 4.975	k<.0000

Pb = 1.962
98.1 mg/L

Analysis Report 02/06/02 16:34:40 page 1

Method: WATER07 Sample Name: 201280083 SAMPLE Operator:
Comment:
Run Time: 02/06/02 16:32 Type: Unk Mode: CONC Corr.Fact: 2.000000

Elem	Ag	Al	As	B	Ba	Be
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k .0699	k 174.8	k<.0000	k 1.896	k 1.577	k<.0000

Elem	Bi	Ca	Cd	Co	Cr	Cu
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k<.0000	k 115.4	k .0431	k .1011	k .4773	k .2403

0.778

Elem	Fe	Ge	In	K	Li	Mg
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 432.9	<.0000	.1203	k 19.75	k .5151	k 112.3

Elem	Mn	Mo	Na	Ni	P	Pb
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 6.056	k<.0000	k 1.127	k .0032	k 7.286	k<.0000

0.913

Elem	S	Sb	Sc	Se	Si	Sn
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 2.724	k<.0000	<.0000	k<.0000	k 3.657	k<.0000

Elem	Sr	Th	Ti	U	V	Y
Units	ppm	ppm	ppm	ppm	ppm	ppm
Avg	k 1.187	k<.0000	k 7.205	k<.0000	k .6745	<.0000

Elem	Zn	Zr
Units	ppm	ppm
Avg	k .6931	k<.0000

Pb: 0.2388

11.9 ppb

Autosampler Report Sample file:62640 06/07/02 10:47:50

Smp	Sample name	Sample Weight	Nominal Weight	Initial Volume	Final Volume	Adj. Factor	Corr. Factor
1	201280066 DUP	1	1	1	2	1	2
2	201280066 SAMPLE	1	1	1	2	1	2
3	201280068 SAMPLE	1	1	1	2	1	2
4	201280069 SAMPLE	1	1	1	2	1	2
5	201280070 SAMPLE	1	1	1	2	1	2
6	201280071 SAMPLE	1	1	1	2	1	2
7	201280072 SAMPLE	1	1	1	2	1	2
8	201280073 SAMPLE	1	1	1	2	1	2
9	201280074 SAMPLE	1	1	1	2	1	2
10	201280075 DUP	1	1	1	2	1	2
11	201280075 SAMPLE	1	1	1	2	1	2
12	201280076 SAMPLE	1	1	1	2	1	2
13	201280078 SAMPLE	1	1	1	2	1	2
14	201280079 SAMPLE	1	1	1	2	1	2
15	201280080 SAMPLE	1	1	1	2	1	2
16	201280081 SAMPLE	1	1	1	2	1	2
17	201280082 SAMPLE	1	1	1	2	1	2
18	201280083 SAMPLE	1	1	1	2	1	2
19	201300097 SAMPLE	1	1	1	2	1	2
20	201300099 SAMPLE	1	1	1	2	1	2
21	201310180 SAMPLE	1	1	1	2	1	2
22	201310064 SAMPLE	1	1	1	2	1	2
23	201310239 SAMPLE	1	1	1	2	1	2
24	201310244 SAMPLE	1	1	1	2	1	2
25	201310247 SAMPLE	1	1	1	2	1	2

CANTEST

CANTEST - TRACE METALS DEPARTMENT
METHOD SUMMARY FOR THE ANALYSIS OF SOIL SAMPLES BY ICP/MS

METHOD SUMMARY

This Method Summary briefly describes soil analysis procedures by ICP/MS. This Method Summary is complementary to the extensive "ICP/MS Operations Manual".

REVISION HISTORY

Revision 0: September 7, 2001

APPLICATION

This method describes analysis of soil samples by ICP/MS. Samples are analyzed after appropriate sample preparation.

REFERENCES

ICP/MS Operations Manual.

CanTest Procedure Strong Acid Leachable Metals (SALM) in Soil (65-P-015).

CanTest Procedure for the Preparation and Digestion of Geological Samples for Determination of Environmental Parameters (65-P-004-04) NOTE: replaced in B.C. by DCN65-P-015

CanTest Procedure for the Preparation and Digestion of Strong Acid Leachable Metals (SALM) (65-P-015).

CanTest Work Instructions for Batch Creation, Sample Preparation, Worklist Creation, Worklist Data Entry and Uploading in LIMS (60-S-005).

PRINCIPLE and APPLICATION NOTES

The sample solution is transferred using a peristaltic pump to a nebulizer which produces a fine aerosol. The aerosol is swept through an Inductively Coupled Argon Plasma torch mounted axially and at the entrance to a quadrupole mass spectrometer detector. The aerosol, including ionized metal atoms produced by the plasma, is introduced into the high vacuum region of the mass spectrometer through an interface described as "water-cooled cones". The mass spectrometer then identifies and quantifies specified metals and non metal components in the solution.

The ICP/MS is calibrated prior to analysis using mixed calibration standard solutions prepared at several levels to produce multi-point calibration curves for each element. Internal Standards, consisting of rare elements or isotopes in solution, are added on-line on a continuous basis, that is to all sample solutions, to adjust for possible matrix effects and to enhance long-term instrument stability.

The instrumentation features sophisticated computer hardware and "HP Chemstation" software that operates the instrumentation systems, calibrates the instrument, acquires analysis data, and calculates and reports the final results.

The software also allows unattended operation; normal operating procedures include overnight operation with automatic instrument shut-down. "Enviroquant" computer software evaluates the validity of quality control sample results and flags data that exceeds set limits.

For the preparation of soil samples an oven-dried, air-dried or an undried sample may be used, depending on the analysis and project requirements. In many cases grinding, blending or homogenization must be done prior to digestion. The digestion involves heating the samples with

METHOD SUMMARY FOR THE ANALYSIS OF SOIL SAMPLES BY ICP/MS (continued)

Analysis Scheme (continued):

Sample Analysis Sequence

The Sample Analysis Sequence is then initiated. The sequence includes analysis of a blank and one of the calibration standards after every ten to twelve samples.

Quality Control samples, as described in the Quality Control section, are incorporated into the sequence. These samples include sample preparation blanks (analyzed first in the sequence), duplicate samples and certified reference materials. The HP ICPMS Enviroquant software calculates and evaluates the QC sample results in an automated fashion.

INSTRUMENT DATA OUTPUT/EVALUATION/REPORTING: (Summary)

With the present software configuration, the ICP/MS operates and reports in micrograms per liter (µg/L); data must be converted to micrograms per gram (µg/g) before reporting, taking sample weights and volumes into account. Results may either be entered manually or may be automatically uploaded into LIMS. For instruction on Worklist Data Entry and Uploading in LIMS refer to the CanTest Work Instruction referenced above.

Interference Correction

Interference corrections are performed automatically by the HP operating software; standard correction equations are used, except for arsenic. Chloride interference on arsenic is monitored daily by analysis of a 0.1% HCl solution. Bromine interference on selenium is monitored by the analysis of a 0.02mN KBr solution. The interference factor is calculated and entered into the correction equation daily.

Reporting Procedures

ICPMS analysts evaluate and review the data prior to reporting:

-examine the replicate analysis for each result: high RSD (greater than 10%) may indicate carry over
-where multiple isotopes are analyzed, report the lowest result.
-overrange results are to be reanalyzed by ICP or Flame AA, or diluted and reanalyzed by ICPMS
-the concentrations in the original sample are automatically corrected for the usual ten times dilution by the ICPMS sequence/report generation scheme.

QUALITY CONTROL

Blanks: A minimum of two digestion blanks are prepared and analyzed with each batch of samples.

Duplicates: Duplicate samples are prepared and analyzed at a frequency of 10% with a minimum of one per batch.

Certified Reference Materials: Minimum of one per batch, matched as closely as possible to sample matrix. Some reference materials that may be used are:

NIST2711

Performance Evaluation Samples, Soil Analysis

CAEAL

METHOD SUMMARY FOR THE ANALYSIS OF SOIL SAMPLES BY ICP/MS (continued)

PRINCIPLE and APPLICATION NOTES (continued)

nitric acid. Sample preparation procedures are not included in this summary but are referenced above.

Samples undergo a separate dilution prior ICP/MS analysis, samples are generally diluted ten-times with Ultrapure water using a diluter.

ELEMENTS DETERMINED/METHOD DETECTION LIMITS/REPORTING LIMITS/UPPER RANGE:

Element	Instrument Detection Limits (mg/L)	Detection Limits (Digested Sample diluted ten times) (mg/L)	Reported Detection Limits (based on 1g to 50 mL - dry weight basis) (µg/g)	Upper Range Limit (mg/L)
Arsenic	0.00003	0.01	0.1	2
Cadmium	0.00002	0.02	0.2	2
Molybdenum	0.00009	0.01	0.1	2
Selenium	0.00042	0.02	0.2	2
Silver	0.00002	0.01	0.1	2
Thallium	0.00003	0.01	0.1	2

Method Detection limits experimentally determined May & July 1997 using the CAEAL calculation procedure.

UPPER RANGE OF ANALYSIS

Samples that exceed the defined Upper Range of Analysis may be further diluted and reanalyzed by ICPMS but are more commonly analyzed using another technique such as Inductively Coupled Plasma (ICP) or Flame Atomic Absorption Spectrometry (Flame AA).

SAMPLE SOLUTION STORAGE / HOLDING TIMES

After digestion, sample solutions are stored in acid washed polypropylene bottles. Digested samples contain nitric acid, added during preparation, which acts as a preservative. Prepared and preserved samples must be analyzed within six months of sample preparation.

Samples diluted specifically for ICP/MS analysis should be analyzed within one day, but may be stored up to six months if they are protected from evaporation and contamination.

REAGENTS

Ultrapure water· Obtained from a Millipore Milli-Q Water Purification System.

Nitric acid, "Environmental " grade, Anachemia or equivalent.

Refer to ICP/MS Operating Procedures Manual for complete details on preparation of reagent solutions.

METHOD SUMMARY FOR THE ANALYSIS OF SOIL SAMPLES BY ICP/MS (continued)

APPARATUS

Diluter: Barnstead/Thermolyne Repipet dispenser & diluter or equivalent.
Volumetric Flasks, Pipettes (Class A): for preparation of calibration standard solutions.
Autosampler tubes: 14 mL and 50 mL, Cetac

INSTRUMENTATION/SOFTWARE

Agilent Model 4500 or 7500 ICP/MS System, with auxiliary Cetac Autosampler, PC computer and HP laser printer.
HP Chemstation and Enviroquant software.

Refer to the ICP/MS Operating Procedures Manual for further details .

PREPARATION OF CALIBRATION STANDARD SOLUTIONS: Application Notes

Stock Standard Solutions:

1000 mg/L and 100 mg/L Individual and Mixed ICP Grade Stock Solutions are currently used. These solutions may be purchased from chemical suppliers such as SCP. Alternatively these solutions may be prepared from pure staring materials. Shelf life is as stated on the supplier's certificate or one year.

Mixed and Individual Intermediate Standard Solutions:

Shelf life for these solutions (generally concentrations are at levels of 10 mg/L) is one year. For preparation details, refer to the ICP/MS Operating Procedures Manual.

Working Standard Solutions:

Shelf life for these mixed solutions (at minimum concentrations of 20.00 ug/L) is two months. For preparation details, refer to the ICP/MS Operating Procedures Manual.

Application Note: Evaluation of the daily multi-point calibration curves for each element may show that a certain calibration point does not meet the curve criteria; this may indicate possible contamination. Under these circumstances, the daily calibration standard solutions may have to be re-prepared.

SAMPLE PREPARATION

Samples are prepared according to the CanTest procedure referenced above. For instruction on creating sample preparation batches on LIMS refer to the CanTest Work Instructions referenced above. The digested samples are diluted ten-times with Ultrapure water prior to analysis, using a Barnstead/Thermolyne Repipet dispenser & diluter, or equivalent, with a sample uptake volume set at 1 mL and a diluent uptake volume set at 9 mL. Note that due to the acid concentration of the digested solutions, dilution with water only will yield equivalent sample/standard acid content.

METHOD SUMMARY FOR THE ANALYSIS OF SOIL SAMPLES BY ICP/MS (continued)

ANALYSIS PROGRAMS

The ICP/MS instrumentation is computer controlled and may be fully automated. A program or "Method" includes element and isotope information, analysis acquisition or "counting" time per element, calibration standard details and levels, and interference correction routines.

An analysis/autosampler run or "Sequence" is set up prior to an analysis batch. The Sequence includes the analysis of blank solutions and various calibration standard solutions at periodic intervals.

As noted, separate instrument Quality Control "Enviroquant" software may assist in the automated processes by setting criteria for recalibration and quality control analysis.

ANALYSIS PROCEDURE: (Summary)

The following topics are described extensively in the ICPMS Operations Manual:

Instrument Startup

Instrument Setup (may refer to computer-generated Daily Tune Report)

Instrument Tuning

Calibration

Autosampler setup and "Sequencing"

Instrument Shutdown

Analysis Scheme:

Calibration Sequence:

A separate calibration sequence is performed to calibrate the ICP/MS. The calibration integrity is confirmed by the analyst before the sample analysis sequence is initiated. The calibration sequence consists of:

-at least three calibration blanks.
-multi-point mixed or single element calibration standard solutions
-Certified Reference Materials, usually NIST 1643 Trace Elements in Water and High Purity Standards Certified Wastewater Solutions.

The analyst reviews the calibration data to ensure:

-the calibration curves meet linearity requirements; each calibration curve is examined.
-the calibration blanks are acceptable; the blank with the lowest count level is chosen for calibration
-the Internal Standard counts are examined; calibration IS values should be within 20% for each level of calibration solution.
-the Certified Reference Material results are acceptable.

Edit Levels

Mass	Element	Curve Fit	Units	IS	Min Conc	Concentration of Standard Solution Level 1	Level 2	Level 3	Level 4	Level 5
7	Li	Y=aX+[blank]	ppb	45	0.00	0.00	20.00	100.00	200.00	—
9	Be	Y=aX+[blank]	ppb	45	0.00	0.00	20.00	100.00	200.00	—
11	B	Y=aX+[blank]	ppb	45	0.00	0.00	20.00	100.00	200.00	—
23	Na	Y=aX+[blank]	ppb	45	0.00	0.00	1000.00	5000.00	1.00E+04	—
24	Mg	Y=aX+[blank]	ppb	45	0.00	0.00	1000.00	5000.00	1.00E+04	—
27	Al	Y=aX+[blank]	ppb	45	0.00	0.00	20.00	100.00	200.00	—
29	SiO2	Y=aX+[blank]	ppb	45	0.00	0.00	—	—	—	2140.00
31	PO4	Y=aX+[blank]	ppb	45	0.00	0.00	—	—	—	—
35	Cl	Excluded		—	0.00	—	—	—	—	—
39	K	Y=aX+[blank]	ppb	45	0.00	0.00	1000.00	5000.00	1.00E+04	—
43	Ca	Y=aX+[blank]	ppb	45	0.00	0.00	1000.00	5000.00	1.00E+04	—
45	Sc	Y=aX		—	0.00	50.00	50.00	50.00	50.00	50.00
47	Ti	Y=aX+[blank]	ppb	45	0.00	0.00	20.00	100.00	200.00	—
51	V	Y=aX+[blank]	ppb	45	0.00	0.00	20.00	100.00	200.00	—
52	Cr	Y=aX+[blank]	ppb	45	0.00	0.00	20.00	100.00	200.00	—
53	Cr	Y=aX+[blank]	ppb	45	0.00	0.00	20.00	100.00	200.00	—
55	Mn	Y=aX+[blank]	ppb	45	0.00	0.00	20.00	100.00	200.00	—
57	Fe	Y=aX+[blank]	ppb	45	0.00	0.00	1020.00	5100.00	1.02E+04	—

Calibration Title:

WATER10.M

☐ Weight

Enter

OK Cancel Help Added Element: Add Conc Multiply

all in ppb

Edit Levels

Mass Element	Curve Fit	Units	IS	Min Conc	Concentration of Standard Solution Level 1	Level 2	Level 3	Level 4	Level 5
57 Fe	Y=aX+[blank]	ppb	45	0.00	0.00	1020.00	5100.00	1.02E+04	—
59 Co	Y=aX+[blank]	ppb	89	0.00	0.00	20.00	100.00	200.00	—
60 Ni	Y=aX+[blank]	ppb	89	0.00	0.00	20.00	100.00	200.00	—
62 Ni	Y=aX+[blank]	ppb	89	0.00	0.00	20.00	100.00	200.00	—
63 Cu	Y=aX+[blank]	ppb	89	0.00	0.00	20.00	100.00	200.00	—
65 Cu	Y=aX+[blank]	ppb	89	0.00	0.00	20.00	100.00	200.00	—
66 Zn	Y=aX+[blank]	ppb	72	0.00	0.00	20.00	100.00	200.00	—
72 Ge	Y=aX		—	0.00	50.00	50.00	50.00	50.00	50.00
75 As	Y=aX+[blank]	ppb	72	0.00	0.00	20.00	100.00	200.00	—
77	Excluded		—	0.00	—	—	—	—	—
82 Se	Y=aX+[blank]	ppb	72	0.00	0.00	20.00	100.00	200.00	—
83	Excluded		—	0.00	—	—	—	—	—
85 Rb	Y=aX+[blank]	ppb	89	0.00	0.00	—	—	—	—
88 Sr	Y=aX+[blank]	ppb	89	0.00	0.00	20.00	100.00	200.00	—
89 Y	Y=aX		—	0.00	50.00	50.00	50.00	50.00	50.00
90 Zr	Y=aX+[blank]	ppb	89	0.00	0.00	—	—	—	—
95 Mo	Y=aX+[blank]	ppb	89	0.00	0.00	20.00	100.00	200.00	—
97 Mo	Y=aX+[blank]	ppb	89	0.00	0.00	20.00	100.00	200.00	—

Calibration Title:

WATER10.M

☐ Weight

Enter

OK Cancel Help

Added Element: Add Conc. Multiple

Edit Levels

Mass Element	Curve Fit	Units	IS	Min Conc	Concentration of Standard Solution Level 1	Level 2	Level 3	Level 4	Level 5
97 Mo	Y=aX+[blank]	ppb	89	0.00	0.00	20.00	100.00	200.00	—
98 Mo	Y=aX+[blank]	ppb	89	0.00	0.00	20.00	100.00	200.00	—
99 (Mo)	Y=aX+[blank]	ppb	89	0.00	0.00	20.00	100.00	200.00	—
101 Ru	Y=aX+[blank]	ppb	89	0.00	0.00	—	—	—	—
105	Excluded		—	0.00	—	—	—	—	—
106 (Cd)	Y=aX+[blank]	ppb	72	0.00	0.00	20.00	100.00	200.00	—
107 Ag	Y=aX+[blank]	ppb	89	0.00	0.00	20.00	100.00	200.00	—
108 (Cd)	Y=aX+[blank]	ppb	72	0.00	0.00	20.00	100.00	200.00	—
109 Ag	Y=aX+[blank]	ppb	89	0.00	0.00	20.00	100.00	200.00	—
111 Cd	Y=aX+[blank]	ppb	72	0.00	0.00	20.00	100.00	200.00	—
114 Cd	Y=aX+[blank]	ppb	72	0.00	0.00	20.00	100.00	200.00	—
115 In	Y=aX		—	0.00	50.00	50.00	50.00	50.00	50.00
118 Sn	Y=aX+[blank]	ppb	115	0.00	0.00	—	—	—	—
120 Sn	Y=aX+[blank]	ppb	115	0.00	0.00	—	—	—	—
121 Sb	Y=aX+[blank]	ppb	115	0.00	0.00	20.00	100.00	200.00	—
123 Sb	Y=aX+[blank]	ppb	115	0.00	0.00	20.00	100.00	200.00	—
125 Te	Y=aX+[blank]	ppb	115	0.00	0.00	20.00	100.00	200.00	—
126 Te	Y=aX+[blank]	ppb	115	0.00	0.00	20.00	100.00	200.00	—

Calibration Title:

WATER10.M

☐ Weight

Enter

OK Cancel Help Added Element: Add Conc Multiply

Edit Levels

Mass Element	Curve Fit	Units	IS	Min Conc	Concentration of Standard Solution Level 1	Level 2	Level 3	Level 4	Level 5
115 In	Y=aX		—	0.00	50.00	50.00	50.00	50.00	50.00
118 Sn	Y=aX+[blank]	ppb	115	0.00	0.00	—	—	—	—
120 Sn	Y=aX+[blank]	ppb	115	0.00	0.00	—	—	—	—
121 Sb	Y=aX+[blank]	ppb	115	0.00	0.00	20.00	100.00	200.00	—
123 Sb	Y=aX+[blank]	ppb	115	0.00	0.00	20.00	100.00	200.00	—
125 Te	Y=aX+[blank]	ppb	115	0.00	0.00	20.00	100.00	200.00	—
126 Te	Y=aX+[blank]	ppb	115	0.00	0.00	20.00	100.00	200.00	—
133 Cs	Y=aX+[blank]	ppb	115	0.00	0.00	—	—	—	—
137 Ba	Y=aX+[blank]	ppb	115	0.00	0.00	20.00	100.00	200.00	—
159 Tb	Y=aX		—	0.00	50.00	50.00	50.00	50.00	—
203 Tl	Y=aX+[blank]	ppb	159	0.00	0.00	20.00	100.00	200.00	—
205 Tl	Y=aX+[blank]	ppb	159	0.00	0.00	20.00	100.00	200.00	—
206 (Pb)	Y=aX+[blank]	ppb	159	0.00	0.00	20.00	100.00	200.00	—
207 (Pb)	Y=aX+[blank]	ppb	159	0.00	0.00	20.00	100.00	200.00	—
208 Pb	Y=aX+[blank]	ppb	159	0.00	0.00	20.00	100.00	200.00	—
209 Bi	Y=aX+[blank]	ppb	159	0.00	0.00	20.00	100.00	200.00	—
232 Th	Y=aX+[blank]	ppb	159	0.00	0.00	20.00	100.00	200.00	—
238 U	Y=aX+[blank]	ppb	159	0.00	0.00	20.00	100.00	200.00	—

Calibration Title:

WATER10.M

☐ Weight

Enter

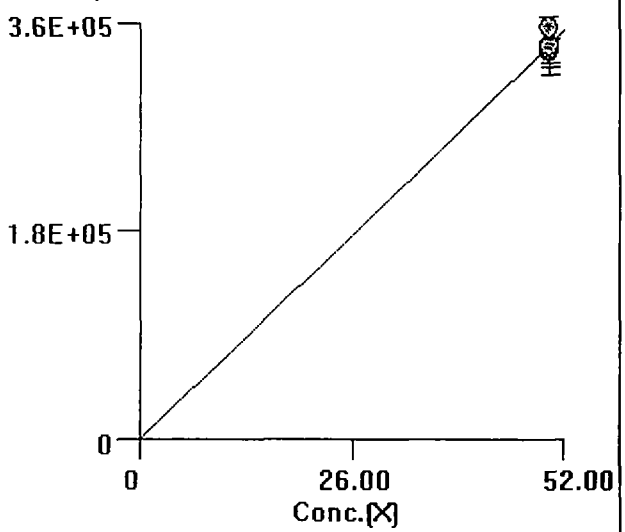
OK Cancel Help Added Element: Add Conc Multiply

Alex Wong

External Calibration

Mass	Element	IS	Units
45	Sc	—	

Count/CPS(Y) unweighted
count/CPS



	Lv.	Conc.	Count/CPS		RSD %
	1	50.00	3.33E+05	P	2.87
	2	50.00	3.35E+05	P	6.41
	3	50.00	3.38E+05	P	5.50
	4	50.00	3.53E+05	P	2.67
*	5	—	—		—
*	6	—	—		—
*	7	—	—		—
*	8	—	—		—
*	9	—	—		—
*	10	—	—		—
	11	—	2.34E+05	P	11.60
	12	—	2.36E+05	P	5.19
*	13	—	—		—
*	14	—	—		—
*	15	—	—		—
*	16	—	—		—
*	17	—	—		—
*	18	—	—		—
*	19	—	—		—
*	20	—	—		—

Curve Fit: Y=aX

Enter

Restore Reject

Y = 6.799E+003*X
X = 1.471E-004*Y

Min Conc: 0.00

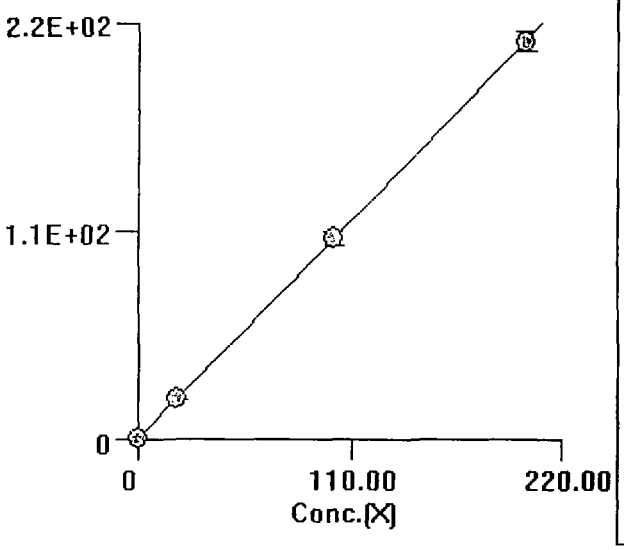
Next Prev OK Cancel Help

Alex Wong

External Calibration

Mass	Element	IS	Units
60	Ni	72	

Ratio(Y) unweighted



	Lv.	Conc.	Ratio		RSD %
	1	0.00	1.08E-01	P	9.52
	2	20.00	2.17E+01	P	2.59
	3	100.00	1.06E+02	P	3.57
	4	200.00	2.09E+02	P	2.40
*	5	—	—		—
*	6	—	—		—
*	7	—	—		—
*	8	—	—		—
*	9	—	—		—
*	10	—	—		—
	11	—	4.44E-02	P	22.00
	12	—	4.91E-02	P	13.00
*	13	—	—		—
*	14	—	—		—
*	15	—	—		—
*	16	—	—		—
*	17	—	—		—
*	18	—	—		—
*	19	—	—		—
*	20	—	—		—

Curve Fit: Y=aX+b

r = 1.0000

Y = 1.046E+000*X +6.352E-001

X = 9.564E-001*Y -6.075E-001

Enter

Restore Reject

Min Conc: 0.00

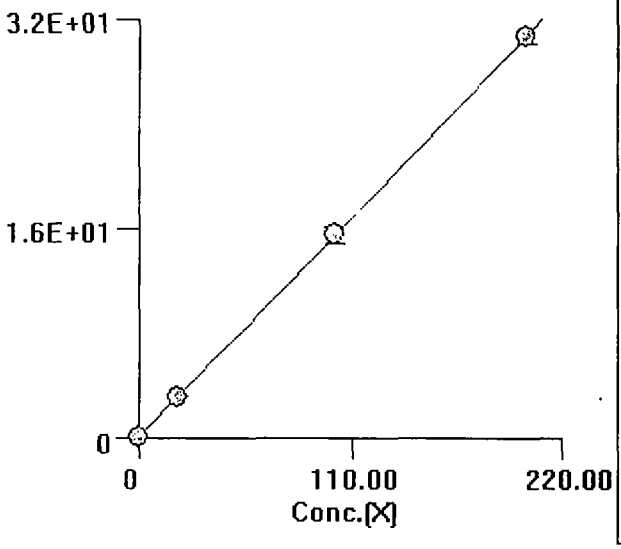
Next Prev OK Cancel Help

Alex Wong

External Calibration

Mass	Element	IS	Units
62	Ni	72	

Ratio(Y) unweighted



	Lv.	Conc.	Ratio		RSD %
	1	0.00	3.58E-02	P	14.40
	2	20.00	3.18E+00	P	9.43E-01
	3	100.00	1.55E+01	P	4.13
	4	200.00	3.05E+01	P	1.54
*	5	—	—		—
*	6	—	—		—
*	7	—	—		—
*	8	—	—		—
*	9	—	—		—
*	10	—	—		—
	11	—	1.07E-01	P	6.21
	12	—	1.28E-01	P	6.65
*	13	—	—		—
*	14	—	—		—
*	15	—	—		—
*	16	—	—		—
*	17	—	—		—
*	18	—	—		—
*	19	—	—		—
*	20	—	—		—

Curve Fit: Y=aX+b

r = 1.0000

Y = 1.524E-001*X +1.269E-001

X = 6.561E+000*Y -8.325E-001

Enter

Restore Reject

Min Conc: 0.00

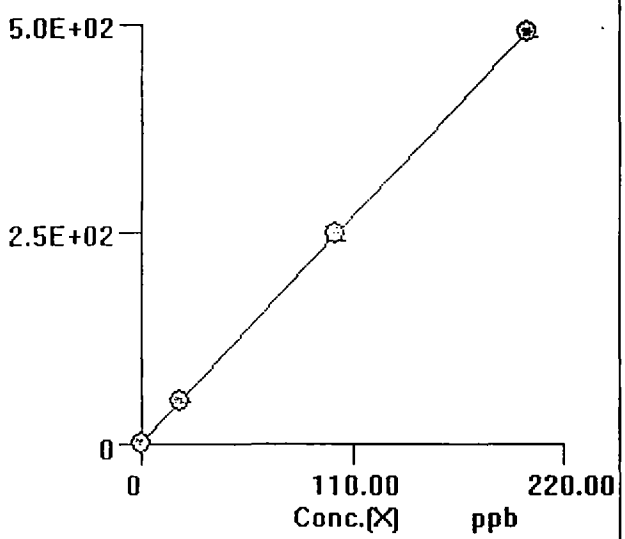
Next Prev OK Cancel Help

Alex Wong

External Calibration

Mass	Element	IS	Units
63	Cu	72	ppb

Ratio(Y) unweighted



	Lv.	Conc.	Ratio		RSD %
	1	0.00	6.49E-01	P	4.74
	2	20.00	5.13E+01	P	1.02
	3	100.00	2.49E+02	P	3.54
	4	200.00	4.89E+02	P	1.23
*	5	—	—		—
*	6	—	—		—
*	7	—	—		—
*	8	—	—		—
*	9	—	—		—
*	10	—	—		—
	11	—	3.42E-01	P	6.38
	12	—	3.92E-01	P	9.97
*	13	—	—		—
*	14	—	—		—
*	15	—	—		—
*	16	—	—		—
*	17	—	—		—
*	18	—	—		—
*	19	—	—		—
*	20	—	—		—

Curve Fit: Y=aX+b

r = 1.0000

Y = 2.443E+000*X +2.232E+000

X = 4.094E-001*Y -9.139E-001

Enter

Restore Reject

Min Conc: 0.00

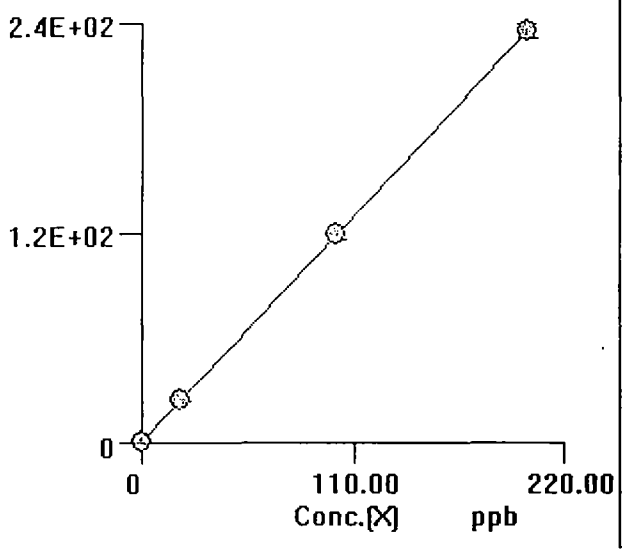
Next Prev OK Cancel Help

Alex Wong

External Calibration

Mass	Element	IS	Units
65	Cu	72	ppb

Ratio(Y) unweighted



	Lv.	Conc.	Ratio		RSD %
	1	0.00	3.03E-01	P	6.75
	2	20.00	2.42E+01	P	1.57
	3	100.00	1.19E+02	P	2.21
	4	200.00	2.35E+02	P	1.52
*	5	—	—		—
*	6	—	—		—
*	7	—	—		—
*	8	—	—		—
*	9	—	—		—
*	10	—	—		—
	11	—	1.60E-01	P	13.10
	12	—	1.79E-01	P	6.12
*	13	—	—		—
*	14	—	—		—
*	15	—	—		—
*	16	—	—		—
*	17	—	—		—
*	18	—	—		—
*	19	—	—		—
*	20	—	—		—

Curve Fit: Y=aX+b

r = 1.0000

Y = 1.172E+000*X +7.802E-001

X = 8.535E-001*Y -6.659E-001

Enter

Restore Reject

Min Conc: 0.00

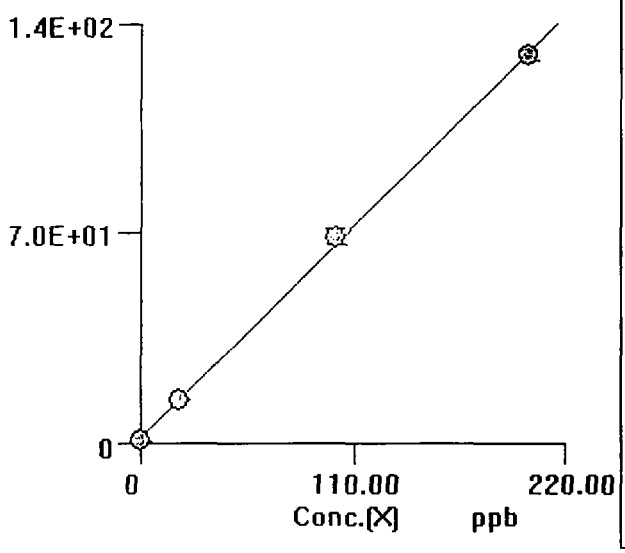
Next Prev OK Cancel Help

Alex Wong

External Calibration

Mass	Element	IS	Units
66	Zn	72	ppb

Ratio(Y) unweighted



	Lv.	Conc.	Ratio		RSD %
	1	0.00	8.58E-01	P	8.01
	2	20.00	1.46E+01	P	1.73
	3	100.00	6.84E+01	P	3.95
	4	200.00	1.29E+02	P	1.17
*	5	—	—		—
*	6	—	—		—
*	7	—	—		—
*	8	—	—		—
*	9	—	—		—
*	10	—	—		—
	11	—	4.71E-01	P	19.10
	12	—	5.33E-01	P	3.02
*	13	—	—		—
*	14	—	—		—
*	15	—	—		—
*	16	—	—		—
*	17	—	—		—
*	18	—	—		—
*	19	—	—		—
*	20	—	—		—

Curve Fit: Y=aX+b

r = 0.9996

Y = 6.416E-001*X +1.891E+000

X = 1.559E+000*Y -2.947E+000

Enter

Restore Reject

Min Conc: 0.00

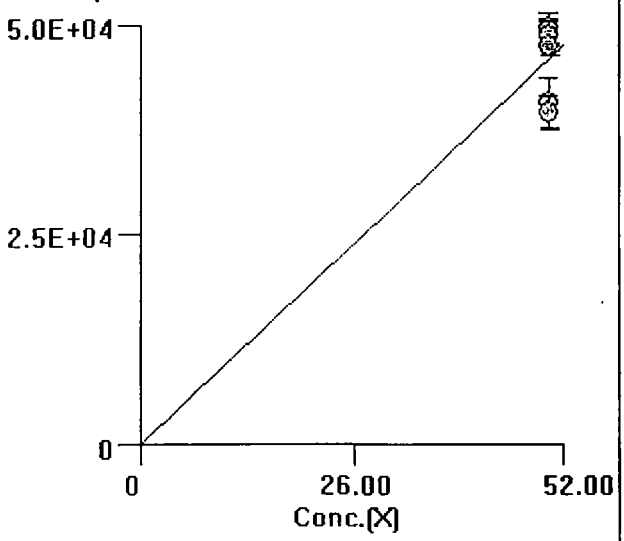
Next Prev OK Cancel Help

Alex Wong

External Calibration

Mass	Element	IS	Units
72	Ge	—	

Count/CPS(Y) unweighted
count/CPS



	Lv.	Conc.	Count/CPS		RSD %
	1	50.00	4.88E+04	P	3.15
	2	50.00	4.94E+04	P	3.72
	3	50.00	4.84E+04	P	3.69
	4	50.00	4.72E+04	P	2.32
*	5	—	—		—
*	6	—	—		—
*	7	—	—		—
*	8	—	—		—
*	9	—	—		—
*	10	—	—		—
	11	50.00	4.07E+04	P	7.32
	12	50.00	3.94E+04	P	5.13
*	13	—	—		—
*	14	—	—		—
*	15	—	—		—
*	16	—	—		—
*	17	—	—		—
*	18	—	—		—
*	19	—	—		—
*	20	—	—		—

Curve Fit: Y=aX

Enter

Restore Reject

Y = 9.132E+002*X
X = 1.095E-003*Y

Min Conc: 0.00

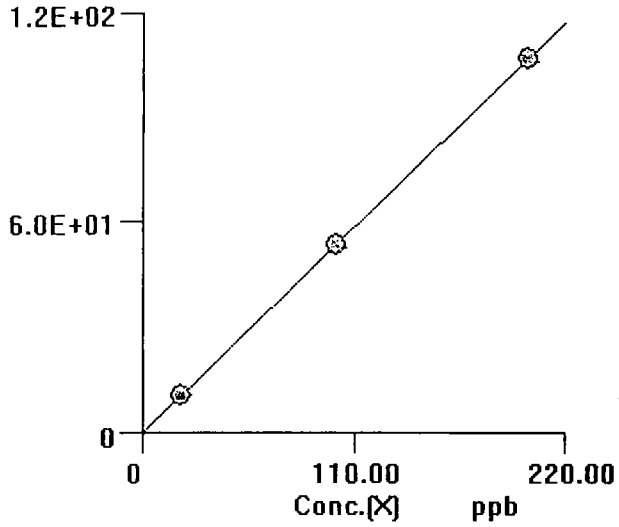
Next Prev OK Cancel Help

Alex Wong

External Calibration

Mass	Element	IS	Units
75	As	72	ppb

Ratio(Y) unweighted



	Lv.	Conc.	Ratio		RSD %
	1	0.00	-5.69E-02	P	-5.97E+01
	2	20.00	1.08E+01	P	6.80E-01
	3	100.00	5.35E+01	P	1.76
	4	200.00	1.07E+02	P	8.12E-01
*	5	—	—		—
*	6	—	—		—
*	7	—	—		—
*	8	—	—		—
*	9	—	—		—
*	10	—	—		—
	11	—	-2.83E-01	P	-5.13E+01
	12	—	-1.24E-01	P	-3.31E+01
*	13	—	—		—
*	14	—	—		—
*	15	—	—		—
*	16	—	—		—
*	17	—	—		—
*	18	—	—		—
*	19	—	—		—
*	20	—	—		—

Curve Fit: Y=aX+b

r = 1.0000

Y = 5.330E-001*X +5.115E-002

X = 1.876E+000*Y -9.597E-002

Enter

Restore Reject

Min Conc: 0.00

Next Prev

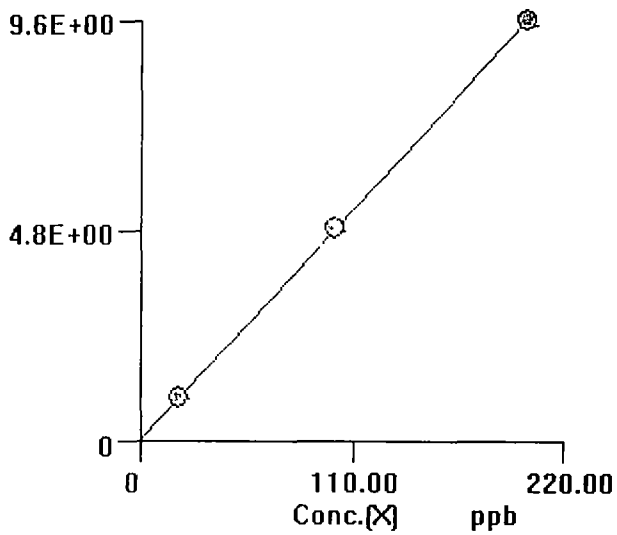
OK Cancel Help

Alex Wong

External Calibration

Mass	Element	IS	Units
82	Se	72	ppb

Ratio(Y) unweighted



	Lv.	Conc.	Ratio		RSD %
	1	0.00	-4.25E-03	P	-3.56E+02
	2	20.00	9.93E-01	P	3.21
	3	100.00	4.87E+00	P	1.86
	4	200.00	9.59E+00	P	1.19
*	5	—	—		—
*	6	—	—		—
*	7	—	—		—
*	8	—	—		—
*	9	—	—		—
*	10	—	—		—
	11	—	-5.76E-03	P	-1.76E+02
	12	—	-7.26E-03	P	-1.80E+02
*	13	—	—		—
*	14	—	—		—
*	15	—	—		—
*	16	—	—		—
*	17	—	—		—
*	18	—	—		—
*	19	—	—		—
*	20	—	—		—

Curve Fit: Y=aX+b

r = 1.0000

Y = 4.794E-002*X +2.745E-002

X = 2.086E+001*Y -5.726E-001

Enter

Restore Reject

Min Conc: 0.00

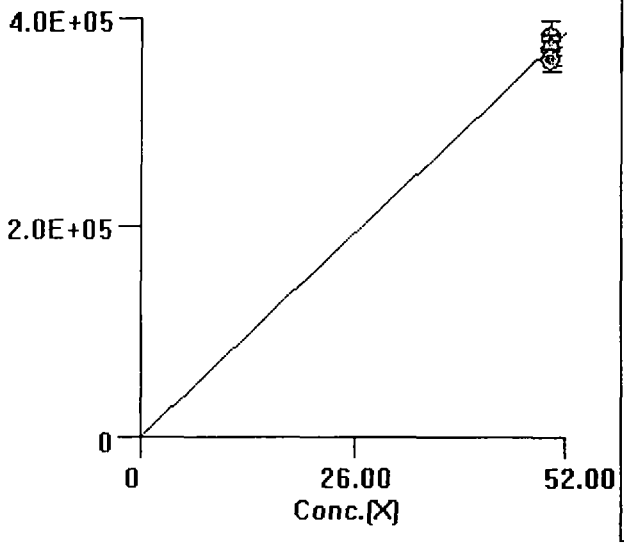
Next Prev OK Cancel Help

Alex Wong

External Calibration

Mass	Element	IS	Units
89	Y	—	

Count/CPS(Y) unweighted
count/CPS



	Lv.	Conc.	Count/CPS		RSD %
	1	50.00	3.78E+05	P	1.73
	2	50.00	3.80E+05	P	4.23
	3	50.00	3.69E+05	P	3.81
	4	50.00	3.59E+05	P	2.77
*	5	—	—		—
*	6	—	—		—
*	7	—	—		—
*	8	—	—		—
*	9	—	—		—
*	10	—	—		—
	11	—	3.77E+05	P	7.51
	12	—	3.58E+05	P	4.26
*	13	—	—		—
*	14	—	—		—
*	15	—	—		—
*	16	—	—		—
*	17	—	—		—
*	18	—	—		—
*	19	—	—		—
*	20	—	—		—

Curve Fit: Y=aX

Enter

Restore Reject

Y = 7.427E+003*X
X = 1.346E-004*Y

Min Conc: 0.00

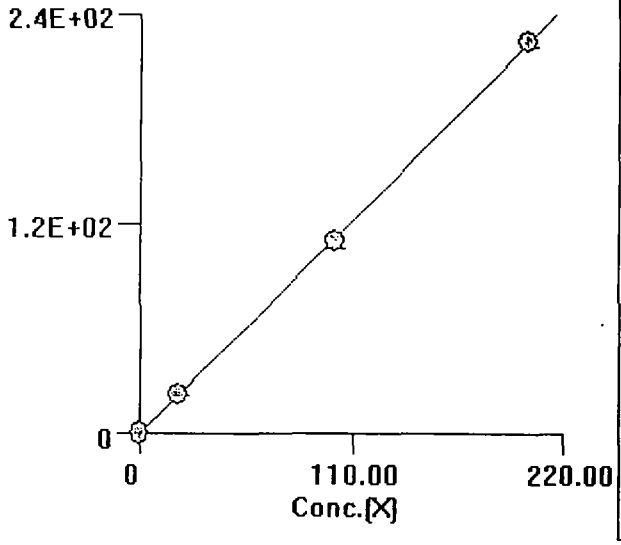
Next Prev OK Cancel Help

Alex Wong

External Calibration

Mass	Element	IS	Units
95	Mo	72	

Ratio(Y) unweighted



	Lv.	Conc.	Ratio	RSD %
	1	0.00	2.15E-02	P 27.00
	2	20.00	2.19E+01	P 8.51E-01
	3	100.00	1.10E+02	P 3.09
	4	200.00	2.23E+02	P 9.31E-01
*	5	—	—	—
*	6	—	—	—
*	7	—	—	—
*	8	—	—	—
*	9	—	—	—
*	10	—	—	—
	11	—	1.28E-01	P 15.50
	12	—	1.06E-01	P 12.80
*	13	—	—	—
*	14	—	—	—
*	15	—	—	—
*	16	—	—	—
*	17	—	—	—
*	18	—	—	—
*	19	—	—	—
*	20	—	—	—

Curve Fit: Y=aX+b

r = 1.0000

Y = 1.114E+000*X -4.574E-001

X = 8.980E-001*Y +4.108E-001

Enter

Restore Reject

Min Conc: 0.00

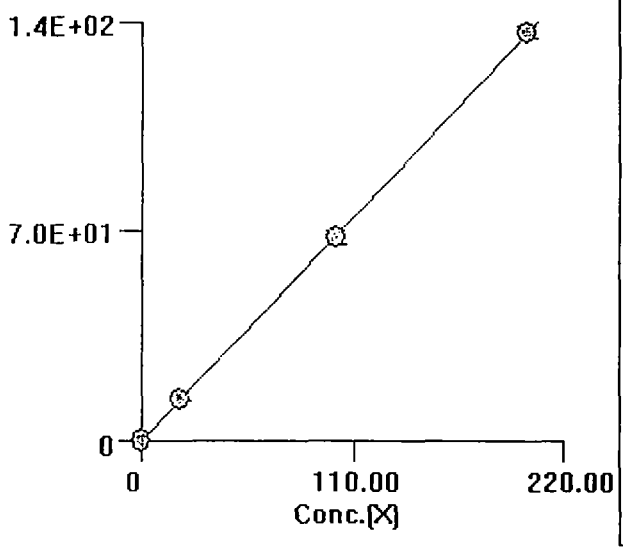
Next Prev OK Cancel Help

Alex Wong

External Calibration

Mass	Element	IS	Units
97	Mo	72	

Ratio(Y) unweighted



	Lv.	Conc.	Ratio		RSD %
	1	0.00	1.37E-02	P	24.10
	2	20.00	1.36E+01	P	2.09
	3	100.00	6.76E+01	P	3.38
	4	200.00	1.36E+02	P	1.31
*	5	—	—		—
*	6	—	—		—
*	7	—	—		—
*	8	—	—		—
*	9	—	—		—
*	10	—	—		—
	11	—	8.96E-02	P	13.30
	12	—	7.33E-02	P	21.50
*	13	—	—		—
*	14	—	—		—
*	15	—	—		—
*	16	—	—		—
*	17	—	—		—
*	18	—	—		—
*	19	—	—		—
*	20	—	—		—

Curve Fit: Y=aX+b

r = 1.0000

Y = 6.790E-001*X -5.875E-002

X = 1.473E+000*Y +8.652E-002

Enter

Restore Reject

Min Conc: 0.00

Next Prev

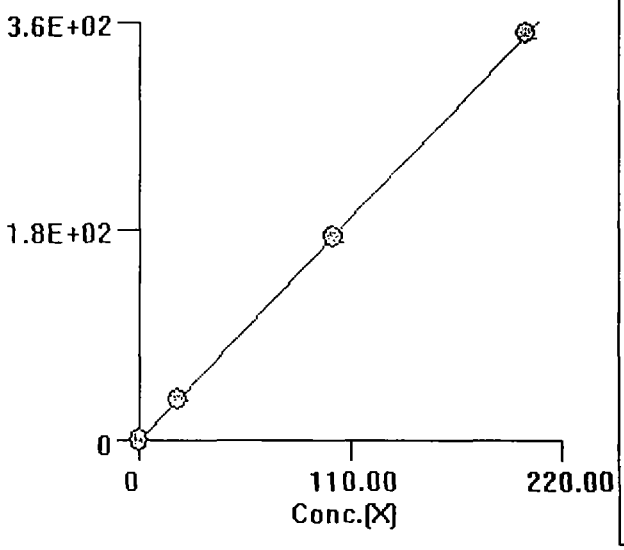
OK Cancel Help

Alex Wong

External Calibration

Mass	Element	IS	Units
98	Mo	72	

Ratio(Y) unweighted



	Lv.	Conc.	Ratio		RSD %
	1	0.00	2.56E-02	P	12.60
	2	20.00	3.47E+01	P	1.74
	3	100.00	1.74E+02	P	2.75
	4	200.00	3.48E+02	P	9.77E-01
*	5	—	—		—
*	6	—	—		—
*	7	—	—		—
*	8	—	—		—
*	9	—	—		—
*	10	—	—		—
	11	—	1.95E-01	P	13.20
	12	—	1.50E-01	P	7.75
*	13	—	—		—
*	14	—	—		—
*	15	—	—		—
*	16	—	—		—
*	17	—	—		—
*	18	—	—		—
*	19	—	—		—
*	20	—	—		—

Curve Fit: Y=aX+b

r = 1.0000

Y = 1.742E+000*X -1.604E-001

X = 5.741E-001*Y +9.209E-002

Enter

Restore Reject

Min Conc: 0.00

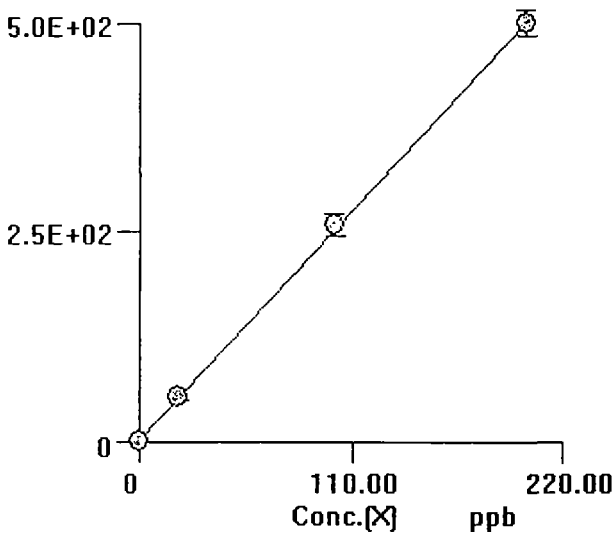
Next Prev OK Cancel Help

Alex Wong

External Calibration

Mass	Element	IS	Units
107	Ag	72	ppb

Ratio(Y) unweighted



	Lv.	Conc.	Ratio		RSD %
	1	0.00	1.39E-01	P	8.45
	2	20.00	5.27E+01	P	3.24
	3	100.00	2.58E+02	P	4.97
	4	200.00	4.99E+02	P	2.99
*	5	—	—		—
*	6	—	—		—
*	7	—	—		—
*	8	—	—		—
*	9	—	—		—
*	10	—	—		—
	11	—	1.65E-01	P	8.93
	12	—	1.65E-01	P	11.80
*	13	—	—		—
*	14	—	—		—
*	15	—	—		—
*	16	—	—		—
*	17	—	—		—
*	18	—	—		—
*	19	—	—		—
*	20	—	—		—

Curve Fit: Y=aX+b

r = 0.9998

Y = 2.493E+000*X +3.003E+000

X = 4.012E-001*Y -1.205E+000

Enter

Restore Reject

Min Conc: 0.00

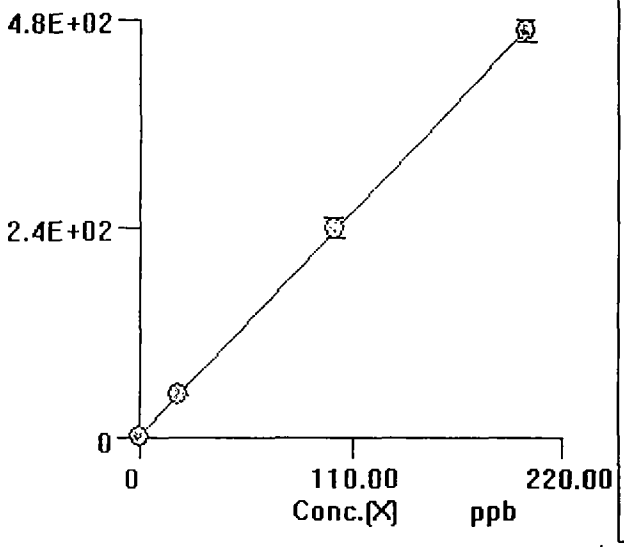
Next Prev OK Cancel Help

Alex Wong

External Calibration

Mass Element	IS	Units
109 Ag	72	ppb

Ratio(Y) unweighted



	Lv.	Conc.	Ratio		RSD %
	1	0.00	1.38E-01	P	10.10
	2	20.00	4.99E+01	P	3.69
	3	100.00	2.39E+02	P	4.51
	4	200.00	4.65E+02	P	2.74
*	5	—	—		—
*	6	—	—		—
*	7	—	—		—
*	8	—	—		—
*	9	—	—		—
*	10	—	—		—
	11	—	1.46E-01	P	7.52
	12	—	1.50E-01	P	1.58
*	13	—	—		—
*	14	—	—		—
*	15	—	—		—
*	16	—	—		—
*	17	—	—		—
*	18	—	—		—
*	19	—	—		—
*	20	—	—		—

Curve Fit: Y=aX+b

r = 0.9999

Y = 2.320E+000*X +2.921E+000

X = 4.310E-001*Y -1.259E+000

Enter

Restore Reject

Min Conc: 0.00

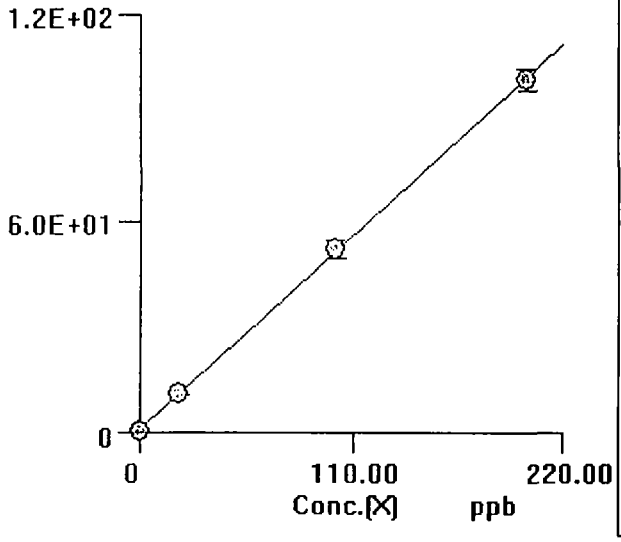
Next Prev OK Cancel Help

Alex Wong

External Calibration

Mass	Element	IS	Units
111	Cd	72	ppb

Ratio(Y) unweighted



	Lv.	Conc.	Ratio		RSD %
	1	0.00	5.16E-02	P	7.02
	2	20.00	1.11E+01	P	3.88
	3	100.00	5.25E+01	P	4.87
	4	200.00	1.01E+02	P	3.17
*	5	—	—		—
*	6	—	—		—
*	7	—	—		—
*	8	—	—		—
*	9	—	—		—
*	10	—	—		—
	11	—	8.13E-02	P	3.50
	12	—	8.03E-02	P	22.50
*	13	—	—		—
*	14	—	—		—
*	15	—	—		—
*	16	—	—		—
*	17	—	—		—
*	18	—	—		—
*	19	—	—		—
*	20	—	—		—

Curve Fit: Y=aX+b

r = 0.9998

Y = 5.024E-001*X +8.713E-001

X = 1.990E+000*Y -1.734E+000

Enter

Restore Reject

Min Conc: 0.00

Next Prev

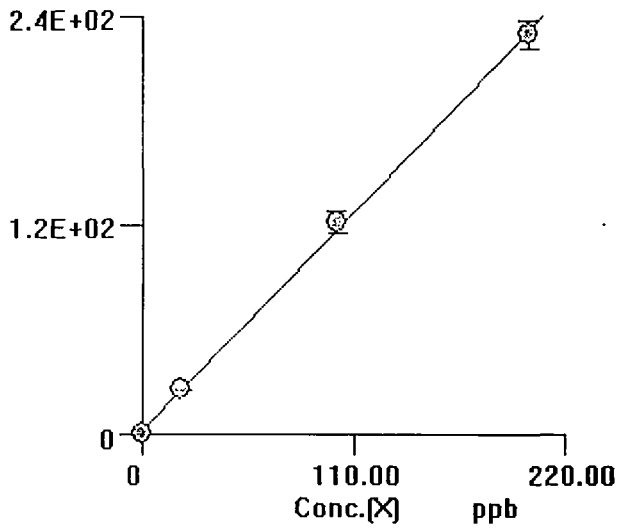
OK Cancel Help

Alex Wong

External Calibration

Mass	Element	IS	Units
114	Cd	72	ppb

Ratio(Y) unweighted



	Lv.	Conc.	Ratio		RSD %
	1	0.00	3.08E-02	P	21.10
	2	20.00	2.56E+01	P	3.24
	3	100.00	1.22E+02	P	5.11
	4	200.00	2.29E+02	P	3.35
*	5	—	—		—
*	6	—	—		—
*	7	—	—		—
*	8	—	—		—
*	9	—	—		—
*	10	—	—		—
	11	—	6.21E-01	P	7.45
	12	—	1.13E+00	P	3.64
*	13	—	—		—
*	14	—	—		—
*	15	—	—		—
*	16	—	—		—
*	17	—	—		—
*	18	—	—		—
*	19	—	—		—
*	20	—	—		—

Curve Fit: Y=aX+b

r = 0.9994

Y = 1.142E+000*X +2.636E+000

X = 8.756E-001*Y -2.308E+000

Enter

Restore Reject

Min Conc: 0.00

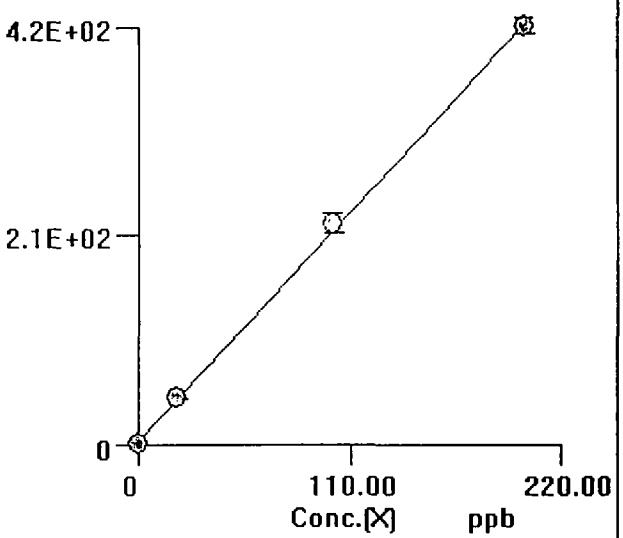
Next Prev OK Cancel Help

Alex Wong

External Calibration

Mass	Element	IS	Units
203	Tl	72	ppb

Ratio(Y) unweighted



	Lv.	Conc.	Ratio		RSD %
	1	0.00	4.75E-02	P	15.20
	2	20.00	4.71E+01	P	2.70
	3	100.00	2.21E+02	P	4.37
	4	200.00	4.19E+02	P	1.83
*	5	—	—		—
*	6	—	—		—
*	7	—	—		—
*	8	—	—		—
*	9	—	—		—
*	10	—	—		—
	11	—	3.20E-01	P	15.70
	12	—	2.38E-01	P	8.65
*	13	—	—		—
*	14	—	—		—
*	15	—	—		—
*	16	—	—		—
*	17	—	—		—
*	18	—	—		—
*	19	—	—		—
*	20	—	—		—

Curve Fit: Y=aX+b

r = 0.9996

Y = 2.094E+000*X +4.467E+000

X = 4.776E-001*Y -2.134E+000

Enter

Restore Reject

Min Conc: 0.00

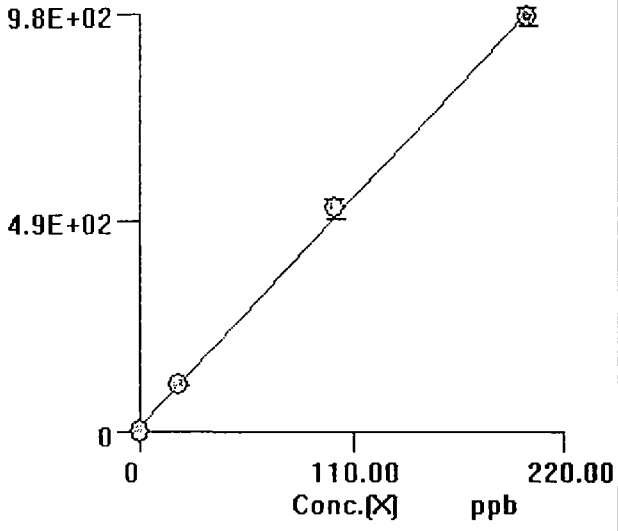
Next Prev OK Cancel Help

Alex Wong

External Calibration

Mass	Element	IS	Units
205	Tl	72	ppb

Ratio(Y) unweighted



	Lv.	Conc.	Ratio		RSD %
	1	0.00	9.31E-02	P	14.40
	2	20.00	1.11E+02	P	2.44
	3	100.00	5.18E+02	P	4.50
	4	200.00	9.67E+02	P	2.27
*	5	—	—		—
*	6	—	—		—
*	7	—	—		—
*	8	—	—		—
*	9	—	—		—
*	10	—	—		—
	11	—	7.68E-01	P	15.60
	12	—	5.41E-01	P	8.03
*	13	—	—		—
*	14	—	—		—
*	15	—	—		—
*	16	—	—		—
*	17	—	—		—
*	18	—	—		—
*	19	—	—		—
*	20	—	—		—

Curve Fit: Y=aX+b

r = 0.9993

Y = 4.825E+000*X +1.288E+001

X = 2.072E-001*Y -2.668E+000

Enter

Restore Reject

Min Conc: 0.00

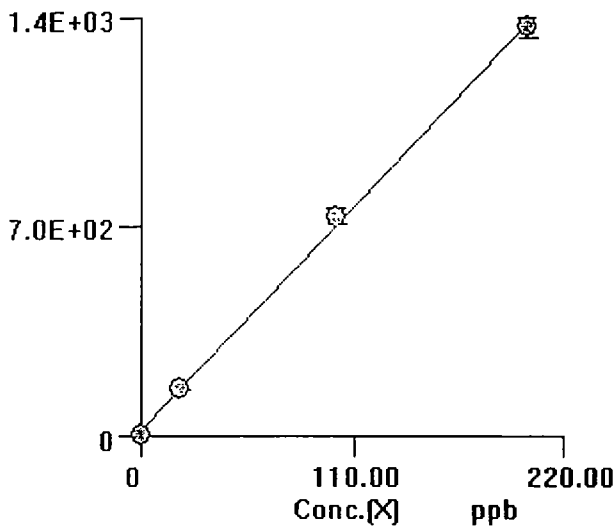
Next Prev OK Cancel Help

Alex Wong

External Calibration

Mass	Element	IS	Units
208	Pb	72	ppb

Ratio(Y) unweighted



	Lv.	Conc.	Ratio		RSD %
	1	0.00	3.30E-01	P	8.77
	2	20.00	1.56E+02	P	2.07
	3	100.00	7.32E+02	P	3.95
	4	200.00	1.36E+03	P	2.34
*	5	—	—		—
*	6	—	—		—
*	7	—	—		—
*	8	—	—		—
*	9	—	—		—
*	10	—	—		—
	11	—	1.10E+00	P	19.20
	12	—	8.94E-01	P	6.62
*	13	—	—		—
*	14	—	—		—
*	15	—	—		—
*	16	—	—		—
*	17	—	—		—
*	18	—	—		—
*	19	—	—		—
*	20	—	—		—

Curve Fit: Y=aX+b

r = 0.9992

Y = 6.792E+000*X +1.895E+001

X = 1.472E-001*Y -2.790E+000

Enter

Restore Reject

Min Conc: 0.00

Next Prev

OK Cancel Help

Calibration Blank QC Report

Data File:	D:\ICPCHEM\1\DATA\02A2913a.B\001CAL
Date Acquired:	Jan 29 2002 01:32 pm
Operator:	ASW
Sample Name:	CALIB BLANK1
Misc Info:	JAN 23/02
Vial Number	4501
Current Method:	D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File:	D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal Update:	Jan 28 2002 01:37 pm
Sample Type:	CalBlk
Total Dil Factor:	1.00

QC&ISTD Elements

Element		CPS Mean		SD	RSD(%)
7	Li	61.11	P	5.09	8.33
9	Be	4.81	P	1.70	35.25
11	B	3034.72	P	348.40	11.48
23	Na	11116.67	P	846.80	7.62
24	Mg	3123.23	P	739.90	23.69
27	Al	2582.77	P	387.70	15.01
29	SiO2	33732.34	P	259.10	0.77
31	PO4	1942.75	P	38.48	1.98
39	K	353958.31	P	8128.00	2.30
43	Ca	285.00	P	25.00	8.77
45	Sc	299502.00	P	8954.00	2.99
47	Ti	31.48	P	5.48	17.41
51	V	1102.42	P	38.36	3.48
52	Cr	3153.35	P	57.09	1.81
53	Cr	77.33	P	10.73	13.88
55	Mn	560.02	P	72.65	12.97
57	Fe	2568.32	P	38.40	1.50
59	Co	20.74	P	5.48	26.43
60	Ni	57.11	P	5.43	9.51
62	Ni	23.56	P	1.39	5.89
63	Cu	84.89	P	4.44	5.23
65	Cu	45.11	P	6.34	14.05
66	Zn	137.04	P	9.45	6.90
72	Ge	56429.84	P	2197.00	3.89
75	As	-39.30	P	10.88	27.69
82	Se	15.32	P	1.23	8.02
85	Rb	30.00	P	5.88	19.60
88	Sr	91.11	P	18.36	20.15
89	Y	520317.09	P	9705.00	1.87
90	Zr	13.33	P	10.00	75.00
95	Mo	20.74	P	5.25	25.32
97	Mo	12.96	P	1.70	13.09
98	Mo	29.78	P	5.02	16.86

107	Ag	24 00	P	4.16	17.35
109	Ag	21.33	P	5.81	27.24
111	Cd	49.62	P	9.92	19.99
114	Cd	22.22	P	5.75	25.87
115	In	469878 41	P	28060.00	5.97
118	Sn	58.89	P	9.10	15.44
120	Sn	90.37	P	6.12	6.77
121	Sb	44.44	P	5.88	13.23
123	Sb	25.93	P	9.45	36.45
125	Te	17.11	P	4.82	28.19
126	Te	30.00	P	6.36	21.20
133	Cs	64.44	P	6.67	10.35
137	Ba	15.56	P	1.93	12.38
159	Tb	1112218.00	P	14830.00	1.33
203	Tl	28 00	P	9.61	34.34
205	Tl	61.56	P	7.13	11.58
208	Pb	202.67	P	15.33	7.56
209	Bi	205.56	P	10.18	4.95
232	Th	187.78	P	25.99	13.84
238	U	17.04	P	3.40	19.93

Calibration Blank QC Report

Data File:	D:\ICPCHEM\1\DATA\02A2913a.B\002CAL
Date Acquired:	Jan 29 2002 01:40 pm
Operator:	ASW
Sample Name:	CALIB BLANK2
Misc Info:	JAN 23/02
Vial Number:	4502
Current Method:	D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File:	D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal Update:	Jan 29 2002 01:38 pm
Sample Type:	CalBlk
Total Dil Factor:	1.00

QC&ISTD Elements

Element		CPS Mean		SD	RSD(%)
7	Li	76.67	P	13.33	17.39
9	Be	10.74	P	0.64	5.97
11	B	2624.66	P	347.80	13.25
23	Na	12406.52	P	1072.00	8.64
24	Mg	5113.16	P	277.90	5.44
27	Al	5487.69	P	574.70	10.47
29	SiO2	32757.49	P	895.40	2.73
31	PO4	1917.18	P	127.30	6.64
39	K	351036.09	P	17710.00	5.05
43	Ca	255.56	P	17.35	6.79
45	Sc	303384.09	P	15750.00	5.19
47	Ti	52.22	P	3.85	7.37
51	V	1136.06	P	56.22	4.95
52	Cr	3171.13	P	59.42	1.87
53	Cr	78.89	P	4.91	6.23
55	Mn	724.47	P	67.53	9.32
57	Fe	2855.76	P	68.43	2.40
59	Co	58.52	P	12.97	22.16
60	Ni	36.67	P	4.67	12.73
62	Ni	27.33	P	1.76	6.45
63	Cu	108.22	P	4.91	4.54
65	Cu	53.33	P	5.81	10.90
66	Zn	114.45	P	5.88	5.14
72	Ge	56750.13	P	3642.00	6.42
75	As	-102.19	P	26.83	26.25
82	Se	-3.63	P	11.83	325.79
85	Rb	70.37	P	6.42	9.12
88	Sr	134.45	P	7.70	5.73
89	Y	530887.88	P	17430.00	3.28
90	Zr	25.56	P	6.94	27.15
95	Mo	34.07	P	0.64	1.88
97	Mo	17.41	P	7.56	43.45
98	Mo	42.48	P	5.99	14.10

107	Ag	53 78	P	10.80	20.08
109	Ag	46.67	P	4.81	10.30
111	Cd	62.81	P	6.62	10.54
114	Cd	45.11	P	8.39	18.60
115	In	501302.50	P	23120.00	4.61
118	Sn	50.74	P	16.49	32.50
120	Sn	79.26	P	10.91	13.77
121	Sb	55.56	P	9.10	16.37
123	Sb	37.41	P	2.31	6.18
125	Te	11.33	P	5.03	44.41
126	Te	34.00	P	7.02	20.66
133	Cs	121.11	P	35.08	28.97
137	Ba	18.89	P	11.71	61.99
159	Tb	1114289.00	P	17330.00	1.56
203	Tl	56.00	P	4.67	8.33
205	Tl	116.45	P	16.06	13.79
208	Pb	251.11	P	15.24	6.07
209	Bi	144.45	P	39.77	27.53
232	Th	179.26	P	17.23	9.61
238	U	38.52	P	11.56	30.01

Calibration Blank QC Report

Data File:	D:\ICPCHEM\1\DATA\02A2913a.B\003CAL
Date Acquired:	Jan 29 2002 01:47 pm
Operator:	ASW
Sample Name:	CALIB BLANK3
Misc Info:	JAN 23/02
Vial Number:	4503
Current Method:	D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File:	D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal Update:	Jan 29 2002 01:45 pm
Sample Type:	CalBlk
Total Dil Factor:	1.00

QC&ISTD Elements

Element		CPS Mean		SD	RSD(%)
7	Li	53.33	P	12.02	22.54
9	Be	8.15	P	1.28	15.75
11	B	2433.52	P	366.90	15.08
23	Na	12283.83	P	839.50	6.83
24	Mg	4812.77	P	521.40	10.83
27	Al	4304.59	P	287.90	6.69
29	SiO2	31869.52	P	1673.00	5.25
31	PO4	2037.98	P	314.70	15.44
39	K	343480.41	P	17540.00	5.11
43	Ca	243.89	P	23.94	9.82
45	Sc	317396.81	P	13690.00	4.31
47	Ti	52.96	P	13.02	24.58
51	V	1125.99	P	37.55	3.33
52	Cr	3205.14	P	75.72	2.36
53	Cr	72.44	P	6.34	8.75
55	Mn	627.80	P	30.79	4.90
57	Fe	2807.60	P	116.80	4.16
59	Co	48.15	P	12.64	26.25
60	Ni	27.33	P	2.91	10.63
62	Ni	30.67	P	3.46	11.30
63	Cu	93.33	P	7.21	7.73
65	Cu	50.89	P	5.59	10.99
66	Zn	94.82	P	15.73	16.59
72	Ge	58867.53	P	3781.00	6.42
75	As	-82.26	P	59.92	72.84
82	Se	-0.84	P	17.35	2072.30
85	Rb	54.07	P	8.98	16.61
88	Sr	103.34	P	23.33	22.58
89	Y	556922.69	P	18060.00	3.24
90	Zr	31.11	P	13.47	43.30
95	Mo	25.93	P	10.50	40.50
97	Mo	13.70	P	2.31	16.88
98	Mo	39.09	P	8.56	21.91

107	Ag	58.00	P	6.00	10.35
109	Ag	45.78	P	9.48	20.72
111	Cd	60.43	P	3.91	6.46
114	Cd	37.56	P	7.78	20.73
115	In	551784.50	P	33190.00	6.02
118	Sn	68.15	P	3.57	5.24
120	Sn	87.78	P	4.44	5.06
121	Sb	54.07	P	2.80	5.17
123	Sb	42.59	P	3.90	9.16
125	Te	11.11	P	0.77	6.93
126	Te	25.11	P	4.68	18.65
133	Cs	110.74	P	13.58	12.26
137	Ba	24.44	P	1.93	7.87
159	Tb	1171044.00	P	10170.00	0.87
203	Tl	47.11	P	6.71	14.25
205	Tl	100.00	P	20.30	20.30
208	Pb	228.67	P	39.28	17.18
209	Bi	105.56	P	20.09	19.03
232	Th	145.19	P	24.60	16.94
238	U	31.85	P	10.26	32.21

Calibration Standard QC Report

Data File: D:\ICPCHEM\1\DATA\02A2913a.B\004CALS.D\004CALS.D#
Date Acquired: Jan 29 2002 01:54 pm
Operator: ASW
Sample Name: CALIB BLANK4
Misc Info: JAN 23/02
Vial Number: 4504
Current Method: D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File: D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal Update: Jan 29 2002 01:52 pm
Sample Type: CalStd
Total Dil Factor: 1.00

QC&ISTD Elements

Element		CPS Mean		SD	RSD(%)
7	Li	46.67	P	12.02	25.76
9	Be	2.59	P	1.70	65.46
11	B	2257.95	P	385.10	17.06
23	Na	12106.52	P	472.90	3.91
24	Mg	3790.18	P	386.60	10.20
27	Al	3343.68	P	438.50	13.11
29	SiO2	30423.05	P	1885.00	6.20
31	PO4	1890.20	P	193.10	10.22
39	K	334402.81	P	23040.00	6.89
43	Ca	229.45	P	16.36	7.13
45	Sc	293896.00	P	21070.00	7.17
47	Ti	35.56	P	9.49	26.70
51	V	1089.18	P	39.22	3.60
52	Cr	3126.46	P	60.38	1.93
53	Cr	64.89	P	3.36	5.17
55	Mn	578.91	P	71.83	12.41
57	Fe	2607.21	P	109.40	4.20
59	Co	25.56	P	1.93	7.53
60	Ni	17.78	P	4.91	27.64
62	Ni	24.89	P	2.34	9.41
63	Cu	73.78	P	14.30	19.38
65	Cu	42.22	P	4.91	11.64
66	Zn	134.08	P	7.40	5.52
72	Ge	54453.64	P	5139.00	9.44
75	As	-83.61	P	52.02	62.22
82	Se	-0.91	P	17.30	1908.00
85	Rb	35.93	P	11.19	31.15
88	Sr	95.56	P	12.62	13.21
89	Y	526341.81	P	28790.00	5.47
90	Zr	23.33	P	11.55	49.50
95	Mo	18.15	P	9.45	52.07
97	Mo	10.37	P	3.57	34.44
98	Mo	28.62	P	5.97	20.86

107 Ag	40.00	P	6.11	15.28
109 Ag	45.78	P	2.69	5.88
111 Cd	50.89	P	7.34	14.43
114 Cd	31.33	P	3.53	11.26
115 In	533347.00	P	21080.00	3.95
118 Sn	62.96	P	4.63	7.35
120 Sn	90.74	P	12.64	13.93
121 Sb	49.63	P	6.79	13.68
123 Sb	28 89	P	2.22	7.69
125 Te	8 89	P	2.04	22.92
126 Te	20.89	P	4.29	20.52
133 Cs	83.70	P	12.24	14.62
137 Ba	24.44	P	10.18	41.65
159 Tb	1130485.00	P	26150.00	2.31
203 Tl	34.00	P	2.67	7.84
205 Tl	71.78	P	5.39	7.51
208 Pb	196.67	P	4.67	2.37
209 Bi	67.78	P	20.09	29.64
232 Th	86.67	P	8.68	10.01
238 U	21.85	P	5.01	22.93

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	293896.00	7.17	317396.81	92.6	70 - 130	
72 Ge	54453.64	9.44	58867.53	92.5	70 - 130	
89 Y	526341.81	5.47	556922.69	94.5	70 - 130	
115 In	533347.00	3.95	551784.38	96.7	70 - 130	
159 Tb	1130485.00	2.31	1171044.00	96.5	70 - 130	

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2913a.B\003CALB.D\003CALB.D#

--- :Element Failures --- :Max. Number of Failures Allowed
0 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: Pass

ISTD: Pass

Calibration Standard QC Report

Data File: D:\ICPCHEM\1\DATA\02A2913a.B\005CALS.D\005CALS.D#
Date Acquired: Jan 29 2002 02:01 pm
Operator: ASW
Sample Name: STD#2
Misc Info: PRP: NOV 04/01
Vial Number: 1301
Current Method: D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File: D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal Update: Jan 29 2002 02:00 pm
Sample Type: CalStd
Total Dil Factor: 1.00

QC&ISTD Elements

Element		CPS Mean		SD	RSD(%)
7	Li	102677.10	P	7470.00	7.28
9	Be	32506.36	P	2780.00	8.55
11	B	29207.87	P	3889.00	13.32
23	Na	6003318.00	A	527400.00	8.79
24	Mg	3707111.00	A	354700.00	9.57
27	Al	104745.10	P	7642.00	7.30
29	SiO2	31680.53	P	2859.00	9.02
31	PO4	5862.38	P	651.10	11.11
39	K	6398010.00	A	619800.00	9.69
43	Ca	13095.18	P	1367.00	10.44
45	Sc	312543.00	P	29350.00	9.39
47	Ti	10983.93	P	688.20	6.27
51	V	153852.30	P	6963.00	4.53
52	Cr	133760.50	P	5726.00	4.28
53	Cr	15165.08	P	673.30	4.44
55	Mn	177354.00	P	7623.00	4.30
57	Fe	181977.50	P	6235.00	3.43
59	Co	140609.30	P	5491.00	3.91
60	Ni	30126.49	P	1589.00	5.27
62	Ni	4406.46	P	229.80	5.22
63	Cu	68481.30	P	4057.00	5.92
65	Cu	33414.02	P	2174.00	6.51
66	Zn	21888.72	P	1151.00	5.26
72	Ge	57412.43	P	6056.00	10.55
75	As	18120.05	P	1297.00	7.16
82	Se	2080.87	P	164.30	7.90
85	Rb	177936.30	P	12420.00	6.98
88	Sr	237260.50	P	13910.00	5.86
89	Y	542166.19	P	46670.00	8.61
90	Zr	106.67	P	13.33	12.50
95	Mo	38775.27	P	1806.00	4.66
97	Mo	24074.04	P	843.00	3.50
98	Mo	62408.57	P	2096.00	3.36

107 Ag	116240.20	P	3091.00	2.66
109 Ag	111125.10	P	3419.00	3.08
111 Cd	25461.55	P	1012.00	3.97
114 Cd	60029.11	P	2766.00	4.61
115 In	537723.50	P	14410.00	2.68
118 Sn	61.11	P	5.88	9.62
120 Sn	130.37	P	23.94	18.36
121 Sb	77626.09	P	2501.00	3.22
123 Sb	60367.68	P	1239.00	2.05
125 Te	4194.20	P	405.60	9.67
126 Te	11369.05	P	992.30	8.73
133 Cs	324962.09	P	5287.00	1.63
137 Ba	42270.59	P	1272.00	3.01
159 Tb	1130789.00	P	48490.00	4.29
203 Tl	96797.64	P	475.80	0.49
205 Tl	236133.80	P	393.90	0.17
208 Pb	298728.91	P	2314.00	0.77
209 Bi	219286.20	P	14950.00	6.82
232 Th	152899.30	P	7583.00	4.96
238 U	120285.00	P	2372.00	1.97

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	312543.00	9.39	317396.81	98.5	70 - 130	
72 Ge	57412.43	10.55	58867.53	97.5	70 - 130	
89 Y	542166.19	8.61	556922.69	97.4	70 - 130	
115 In	537723.50	2.68	551784.38	97.5	70 - 130	
159 Tb	1130789.00	4.29	1171044.00	96.6	70 - 130	

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2913a.B\003CALB.D\003CALB.D#

--- :Element Failures --- :Max. Number of Failures Allowed
0 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: Pass

ISTD: Pass

Calibration Standard QC Report

Data File: D:\ICPCHEM\1\DATA\02A2913a.B\006CALS.D\006CALS.D#
Date Acquired: Jan 29 2002 02:08 pm
Operator: ASW
Sample Name: STD#3
Misc Info: PRP: NOV 04/01
Vial Number: 1302
Current Method: D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File: D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal Update: Jan 29 2002 02:07 pm
Sample Type: CalStd
Total Dil Factor: 1.00

QC&ISTD Elements

Element		CPS Mean		SD	RSD(%)
7	Li	487707.00	P	45590.00	9.35
9	Be	157400.09	P	16380.00	10.41
11	B	130451.70	P	19100.00	14.64
23	Na	29604360.00	A	3117000.00	10.53
24	Mg	18587950.00	A	1959000.00	10.54
27	Al	648274.38	P	61610.00	9.50
29	SiO2	32959.08	P	2313.00	7.02
31	PO4	4175.75	P	277.80	6.65
39	K	29311240.00	A	2600000.00	8.87
43	Ca	108662.90	P	7986.00	7.35
45	Sc	328578.91	P	26930.00	8.20
47	Ti	52500.74	P	3079.00	5.86
51	V	724086.81	P	34790.00	4.80
52	Cr	617829.69	P	27040.00	4.38
53	Cr	71161.11	P	2979.00	4.19
55	Mn	857265.63	P	34980.00	4.08
57	Fe	839178.50	P	34860.00	4.15
59	Co	660902.50	P	27230.00	4.12
60	Ni	140531.91	P	6475.00	4.61
62	Ni	20493.83	P	791.70	3.86
63	Cu	316518.91	P	13600.00	4.30
65	Cu	154730.30	P	9267.00	5.99
66	Zn	169407.59	P	7133.00	4.21
72	Ge	58940.12	P	5700.00	9.67
75	As	85165.20	P	6297.00	7.39
82	Se	9592.89	P	769.40	8.02
85	Rb	833177.00	P	52210.00	6.27
88	Sr	1137683.00	P	72750.00	6.39
89	Y	568123.13	P	40160.00	7.07
90	Zr	293.34	P	14.53	4.95
95	Mo	184278.50	P	9528.00	5.17
97	Mo	115010.70	P	4562.00	3.97
98	Mo	296139.09	P	8656.00	2.92

107 Ag	532432.31	P	19150.00	3.60
109 Ag	506391 50	P	20610.00	4.07
111 Cd	116515.40	P	6202.00	5.32
114 Cd	274781.00	P	13910.00	5.06
115 In	550159.38	P	18470.00	3.36
118 Sn	829.65	P	40.08	4.83
120 Sn	1418.57	P	27.05	1.91
121 Sb	350634.50	P	15320.00	4.37
123 Sb	272461.19	P	9936.00	3.65
125 Te	20653.84	P	1037.00	5.02
126 Te	56567.38	P	2218.00	3.92
133 Cs	1457574.00	P	8694.00	0.60
137 Ba	196961.80	P	868.00	0.44
159 Tb	1147621.00	P	25700.00	2.24
203 Tl	441874.69	P	6637.00	1.50
205 Tl	1078294.00	P	7132.00	0.66
208 Pb	1363963.00	P	24270.00	1.78
209 Bi	1051845.00	P	33730.00	3.21
232 Th	789229.31	P	15560.00	1.97
238 U	550925.19	P	15800.00	2.87

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	328578.91	8.20	317396.81	103.5	70 - 130	
72 Ge	58940.12	9.67	58867.53	100.1	70 - 130	
89 Y	568123.13	7.07	556922.69	102.0	70 - 130	
115 In	550159.38	3.36	551784.38	99.7	70 - 130	
159 Tb	1147621.00	2.24	1171044.00	98.0	70 - 130	

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2913a.B\003CALB.D\003CALB.D#

--- :Element Failures --- :Max. Number of Failures Allowed
0 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: Pass

ISTD: Pass

Calibration Standard QC Report

Data File: D:\ICPCHEM\1\DATA\02A2913a.B\007CALS.D\007CALS.D#
Date Acquired: Jan 29 2002 02:16 pm
Operator: ASW
Sample Name: STD#4
Misc Info: PRP: NOV 04/01
Vial Number: 1303
Current Method: D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File: D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal Update. Jan 29 2002 02:14 pm
Sample Type: CalStd
Total Dil Factor: 1.00

QC&ISTD Elements

Element		CPS Mean		SD	RSD(%)
7	Li	1128467.00	P	59310.00	5.26
9	Be	352641.09	P	20550.00	5.83
11	B	305183.31	P	22220.00	7.28
23	Na	68627928.00	A	3340000.00	4.87
24	Mg	42636780.00	A	1806000.00	4.24
27	Al	1443148.00	P	59820.00	4.15
29	SiO2	34695.24	P	1982.00	5.71
31	PO4	6660.06	P	195.40	2.93
39	K	65355360.00	A	3426000.00	5.24
43	Ca	237075.20	P	12350.00	5.21
45	Sc	371489.00	P	18410.00	4.96
47	Ti	114809.40	P	3712.00	3.23
51	V	1565990.00	P	23060.00	1.47
52	Cr	1326374.00	P	4396.00	0.33
53	Cr	153782.70	P	745.10	0.48
55	Mn	1823618.00	P	11290.00	0.62
57	Fe	1788074.00	P	15080.00	0.84
59	Co	1394113.00	P	2066.00	0.15
60	Ni	297015.00	P	2362.00	0.80
62	Ni	43362.28	P	727.80	1.68
63	Cu	658194.31	P	11900.00	1.81
65	Cu	322839.50	P	6376.00	1.98
66	Zn	338785.09	P	7713.00	2.28
72	Ge	63173.40	P	3580.00	5.67
75	As	177256.00	P	8199.00	4.63
82	Se	19624.64	P	1179.00	6.01
85	Rb	1734996.00	P	72110.00	4.16
88	Sr	2368801.00	P	102200.00	4.31
89	Y	608984.63	P	32190.00	5.29
90	Zr	375.57	P	32.89	8.76
95	Mo	391135.31	P	10680.00	2.73
97	Mo	242055.09	P	3487.00	1.44
98	Mo	623373.88	P	6157.00	0.99

107 Ag	1076507 00	P	44620.00	4.14
109 Ag	1022148.00	P	45870.00	4.49
111 Cd	232516 50	P	12220.00	5.26
114 Cd	541106.69	P	28640.00	5.29
115 In	563311 50	P	24160.00	4.29
118 Sn	1497.84	P	83.37	5.57
120 Sn	2593.87	P	119.10	4.59
121 Sb	687943.00	P	36050.00	5.24
123 Sb	532278.69	P	22100.00	4.15
125 Te	39909.07	P	726.30	1.82
126 Te	109321.60	P	884.10	0.81
133 Cs	2817110.00	P	29460.00	1.05
137 Ba	380012.19	P	2384.00	0.63
159 Tb	1145934.00	P	18010.00	1.57
203 Tl	879246.38	P	19610.00	2.23
205 Tl	2139832.00	P	31160.00	1.46
208 Pb	2694368.00	P	70620.00	2.62
209 Bi	2110682.00	P	9893.00	0.47
232 Th	1588587.00	P	61180.00	3.85
238 U	1090654.00	P	42280.00	3.88

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	371489.00	4.96	317396.81	117.0	70 - 130	
72 Ge	63173.40	5 67	58867.53	107.3	70 - 130	
89 Y	608984.63	5.29	556922.69	109.3	70 - 130	
115 In	563311.50	4.29	551784.38	102.1	70 - 130	
159 Tb	1145934.00	1.57	1171044.00	97.9	70 - 130	

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2913a.B\003CALB.D\003CALB.D#

--- :Element Failures --- :Max. Number of Failures Allowed
0 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: **Pass**
ISTD: **Pass**

CCB QC Report

Data File: D:\ICPCHEM\1\DATA\02A2913a.B\016_CCB.D\016_CCB.D#
Date Acquired: Jan 29 2002 03:25 pm
Operator:
Sample Name: DILUTION BLANK
Misc Info:
Vial Number. 4401
Current Method: D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File: D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal Update: Jan 29 2002 03:04 pm
Sample Type: CCB
Total Dil Factor: 1.00

QC Elements

Element	Conc.	RSD(%)	High Limit	Flag
7 Li	0.02 ppb	23.13	0.10	
9 Be	0.01 ppb	38.49	0.90	
11 B	-0.26 ppb	56.45	10.00	
23 Na	0.25 ppb	22.10	45.00	
24 Mg	-0.21 ppb	72.53	50.00	
27 Al	0.02 ppb	151.32	15.00	
29 SiO2	-146.60 ppb	0.23	200.00	
31 PO4	1.56 ppb	52.06	50.00	
39 K	1.06 ppb	308.89	45.00	
43 Ca	-0.82 ppb	64.78	48.00	
47 Ti	0.00 ppb	463.64	1.00	
51 V	0.01 ppb	106.01	1.00	
52 Cr	-0.04 ppb	40.85	1.00	
53 Cr	0.95 ppb	7.49	1.00	
55 Mn	0.00 ppb	70.28	1.00	
57 Fe	-1.37 ppb	54.84	99.00	
59 Co	0.01 ppb	15.74	1.00	
60 Ni	0.01 ppb	11.39	1.00	
62 Ni	-0.02 ppb	85.50	1.00	
63 Cu	0.01 ppb	21.55	1.00	
65 Cu	0.01 ppb	16.17	1.00	
66 Zn	0.01 ppb	110.97	0.80	
75 As	0.04 ppb	97.63	1.00	
82 Se	0.05 ppb	218.51	0.90	
85 Rb	0.01 ppb	13.04	#######	
88 Sr	0.01 ppb	16.36	1.00	
90 Zr	0.01 ppb	42.80	2.00	
95 Mo	0.03 ppb	38.30	1.05	
97 Mo	0.03 ppb	23.79	1.05	
98 Mo	0.03 ppb	15.69	1.00	
107 Ag	0.01 ppb	37.06	1.00	
109 Ag	0.01 ppb	32.12	1.00	
111 Cd	0.03 ppb	36.64	1.00	

114 Cd	0.01 ppb	35.68	1.00
118 Sn	0.01 ppb	35.96	5.00
120 Sn	0.01 ppb	28.98	5.00
121 Sb	0.02 ppb	8.06	1.00
123 Sb	0.02 ppb	9.69	1.00
125 Te	0.01 ppb	50.20	1.00
126 Te	0.02 ppb	24.23	1.00
133 Cs	0.01 ppb	8.99	#######
137 Ba	0.04 ppb	10.32	0.80
203 Tl	0.01 ppb	18.12	1.00
205 Tl	0.01 ppb	24.40	1.00
208 Pb	0.01 ppb	23.48	1.00
209 Bi	0.01 ppb	19.43	0.70
232 Th	0.01 ppb	24.80	0.45
238 U	0.01 ppb	6.28	0.45

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	375733.81	3.90	317396.81	118.4	70 - 130	
72 Ge	66995.76	4.66	58867.53	113.8	70 - 130	
89 Y	634789 31	3.65	556922.69	114.0	70 - 130	
115 In	579209.19	6.34	551784.38	105.0	70 - 130	
159 Tb	1210569.00	0.80	1171044.00	103.4	70 - 130	

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2913a.B\003CALB.D\003CALB.D#

0 :Element Failures 0 :Max. Number of Failures Allowed
0 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: Pass
ISTD: Pass

CCV QC Report

Data File. D:\ICPCHEM\1\DATA\02A2913a.B\020CCV2.D\020CCV2.D#
Date Acquired: Jan 29 2002 03:55 pm
Operator:
Sample Name· HPSTMA -1
Misc Info: SEPT 01/01
Vial Number: 1107
Current Method: D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File: D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal Update: Jan 29 2002 03:04 pm
Sample Type CCV2
Total Dil Factor: 1.00

QC Elements

Element	Conc.	RSD(%)	Expected	QC Range(%)	Flag
7 Li	0.02 ppb	16.79	---	0 - 0	
9 Be	10.82 ppb	5.16	10.00	80 - 120	
11 B	55.32 ppb	11.00	50.00	80 - 120	
23 Na	4.10 ppb	5.91	---	##### - #####	
24 Mg	9.06 ppb	6.25	---	##### - #####	
27 Al	42.25 ppb	4.65	50.00	80 - 120	
29 SiO2	-130.30 ppb	22.32	---	0 - 0	
31 PO4	14.63 ppb	19.55	---	0 - 0	
39 K	1.21 ppb	288.28	---	0 - 0	
43 Ca	176.90 ppb	5.15	---	0 - 0	
47 Ti	0.01 ppb	288.83	---	0 - 0	
51 V	53.05 ppb	2.32	50.00	80 - 120	
52 Cr	53.18 ppb	2.84	50.00	80 - 120	
53 Cr	53.33 ppb	3.13	50.00	80 - 120	
55 Mn	52.64 ppb	2.82	50.00	80 - 120	
57 Fe	53.98 ppb	4.96	50.00	80 - 120	
59 Co	52.69 ppb	4.74	50.00	80 - 120	
60 Ni	52.57 ppb	4.26	50.00	80 - 120	
62 Ni	52.66 ppb	3.08	50.00	80 - 120	
63 Cu	53.34 ppb	4.00	50.00	80 - 120	
65 Cu	53.34 ppb	3.56	50.00	80 - 120	
66 Zn	35.56 ppb	3.02	50.00	80 - 120	Fail
75 As	10.20 ppb	0.49	10.00	80 - 120	
82 Se	10.46 ppb	2.36	10.00	80 - 120	
85 Rb	0.01 ppb	13.04	---	##### - #####	
88 Sr	51.60 ppb	1.67	50.00	80 - 120	
90 Zr	0.00 ppb	116.30	---	0 - 0	
95 Mo	51.87 ppb	0.43	50.00	80 - 120	
97 Mo	51.66 ppb	0.64	50.00	80 - 120	
98 Mo	52.10 ppb	2.06	50.00	80 - 120	
107 Ag	11.12 ppb	7.29	10.00	80 - 120	
109 Ag	11.14 ppb	7.52	10.00	80 - 120	
111 Cd	10.82 ppb	11.73	10.00	80 - 120	

114 Cd	10.85	ppb	12.50	10.00	80 -	120
118 Sn	0.15	ppb	2.02	---	0 -	0
120 Sn	0.16	ppb	6.60	---	0 -	0
121 Sb	9.94	ppb	1.73	10.00	80 -	120
123 Sb	9.99	ppb	2.02	10.00	80 -	120
125 Te	0.01	ppb	74.07	---	0 -	0
126 Te	0.01	ppb	76.13	---	0 -	0
133 Cs	0.01	ppb	7.10	---	##### -	#####
137 Ba	50.94	ppb	5.12	50.00	80 -	120
203 Tl	10 74	ppb	1.35	10.00	80 -	120
205 Tl	10.81	ppb	0.98	10.00	80 -	120
208 Pb	54 26	ppb	2.18	50.00	80 -	120
209 Bi	0.00	ppb	43.85	---	0 -	0
232 Th	0.00	ppb	135.39	---	0 -	0
238 U	0.01	ppb	20.77	---	0 -	0

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	352680.00	3.05	317396.81	111.1	70 - 130	
72 Ge	62793.03	7.49	58867.53	106.7	70 - 130	
89 Y	593665.00	4.70	556922.69	106.6	70 - 130	
115 In	573472.00	5.44	551784.38	103.9	70 - 130	
159 Tb	1190076.00	0.72	1171044.00	101.6	70 - 130	

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2913a.B\003CALB.D\003CALB.D#

1 :Element Failures 0 :Max. Number of Failures Allowed
0 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:
Analytes: Fail
ISTD: Pass

CCV QC Report

Data File: D.\ICPCHEM\1\DATA\02A2916a.B\039CCV1.D\039CCV1.D#
Date Acquired: Jan 29 2002 09:20 pm
Operator: ASW
Sample Name: STD3
Misc Info.
Vial Number: 1302
Current Method: D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File: D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal Update: Jan 29 2002 05:03 pm
Sample Type. CCV1
Total Dil Factor: 1.00

QC Elements

Element	Conc.	RSD(%)	Expected	QC Range(%)	Flag
7 Li	108.00 ppb	5.65	100.00	85 - 115	
9 Be	106.00 ppb	3.81	100.00	85 - 115	
11 B	110.30 ppb	1.57	100.00	85 - 115	
23 Na	5642.00 ppb	4.62	5000.00	85 - 115	
24 Mg	5571.00 ppb	3.56	5000.00	85 - 115	
27 Al	110.30 ppb	2.44	100.00	85 - 115	
29 SiO2	-41.76 ppb	10.30	---	0 - 0	
31 PO4	39.12 ppb	13.59	---	0 - 0	
39 K	5287.00 ppb	3.64	5000.00	85 - 115	
43 Ca	5219.00 ppb	1.53	5000.00	85 - 115	
47 Ti	102.50 ppb	2.76	100.00	85 - 115	
51 V	101.40 ppb	4.13	100.00	85 - 115	
52 Cr	101.10 ppb	5.30	100.00	85 - 115	
53 Cr	100.10 ppb	5.79	100.00	85 - 115	
55 Mn	99.82 ppb	5.39	100.00	85 - 115	
57 Fe	5001.00 ppb	5.81	5100.00	85 - 115	
59 Co	104.70 ppb	8.21	100.00	85 - 115	
60 Ni	105.20 ppb	7.86	100.00	85 - 115	
62 Ni	104.40 ppb	7.10	100.00	85 - 115	
63 Cu	105.30 ppb	6.94	100.00	85 - 115	
65 Cu	104.60 ppb	5.95	100.00	85 - 115	
66 Zn	104.20 ppb	5.68	100.00	85 - 115	
75 As	102.70 ppb	3.05	100.00	85 - 115	
82 Se	101.60 ppb	1.87	100.00	85 - 115	
85 Rb	102.10 ppb	2.67	---	##### - #####	
88 Sr	102.00 ppb	3.07	100.00	85 - 115	
90 Zr	0.04 ppb	5.15	---	0 - 0	
95 Mo	100.80 ppb	1.83	100.00	85 - 115	
97 Mo	100.30 ppb	3.45	100.00	85 - 115	
98 Mo	100.70 ppb	3.22	100.00	85 - 115	
107 Ag	101.20 ppb	9.58	100.00	85 - 115	
109 Ag	100.50 ppb	10.07	100.00	85 - 115	
111 Cd	99.15 ppb	10.27	100.00	85 - 115	

114 Cd	97 75	ppb	10.58	100.00	85 -	115
118 Sn	0.25	ppb	5.21	---	0 -	0
120 Sn	0.29	ppb	1.92	---	0 -	0
121 Sb	100.10	ppb	2.78	100.00	85 -	115
123 Sb	98.87	ppb	1.77	100.00	85 -	115
125 Te	93.98	ppb	7.52	100.00	85 -	115
126 Te	93.72	ppb	6.73	100.00	85 -	115
133 Cs	94.85	ppb	0.92	---	##### -	#####
137 Ba	91.84	ppb	1.96	100.00	85 -	115
203 Tl	110.90	ppb	5.09	100.00	85 -	115
205 Tl	110.90	ppb	4.24	100.00	85 -	115
208 Pb	110.80	ppb	5.60	100.00	85 -	115
209 Bi	107.60	ppb	2.38	100.00	85 -	115
232 Th	106.50	ppb	3.62	100.00	85 -	115
238 U	106.20	ppb	6.13	100.00	85 -	115

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	506128.09	1.80	348070.81	145.4	70 - 130	ISFail
72 Ge	81884.24	3.56	64011.38	127.9	70 - 130	
89 Y	789034.50	3.65	610073.63	129.3	70 - 130	
115 In	697144.00	3.98	578951.50	120.4	70 - 130	
159 Tb	1215991.00	1.82	1206407.00	100.8	70 - 130	

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2916a.B\003CALB.D\003CALB.D#

0 :Element Failures 0 :Max. Number of Failures Allowed
1 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: Pass
ISTD: Fail

CCB QC Report

Data File: D:\ICPCHEM\1\DATA\02A2916a.B\084_CCB.D\084_CCB.D#
Date Acquired: Jan 30 2002 03:00 am
Operator: ASW
Sample Name: 1%HNO3
Misc Info:
Vial Number: 5
Current Method: D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File: D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal Update: Jan 29 2002 05:03 pm
Sample Type: CCB
Total Dil Factor: 1.00

QC Elements

Element	Conc.	RSD(%)	High Limit	Flag
7 Li	-0.01 ppb	36.04	0.10	
9 Be	-0.01 ppb	2.10	0.90	
11 B	-0.14 ppb	110.33	10.00	
23 Na	-2.46 ppb	3.90	45.00	
24 Mg	-0.47 ppb	36.13	50.00	
27 Al	-0.19 ppb	19.14	15.00	
29 SiO2	-119.20 ppb	5.78	200.00	
31 PO4	4.35 ppb	14.04	50.00	
39 K	9.77 ppb	27.29	45.00	
43 Ca	-4.96 ppb	9.43	48.00	
47 Ti	-0.02 ppb	75.59	1.00	
51 V	-0.05 ppb	22.04	1.00	
52 Cr	-0.11 ppb	27.95	1.00	
53 Cr	-0.29 ppb	2.54	1.00	
55 Mn	-0.02 ppb	14.19	1.00	
57 Fe	-2.59 ppb	28.14	99.00	
59 Co	-0.01 ppb	14.49	1.00	
60 Ni	-0.02 ppb	16.26	1.00	
62 Ni	0.02 ppb	95.25	1.00	
63 Cu	-0.02 ppb	15.29	1.00	
65 Cu	-0.02 ppb	11.88	1.00	
66 Zn	-0.04 ppb	11.84	0.80	
75 As	-0.01 ppb	741.25	1.00	
82 Se	-0.03 ppb	348.16	0.90	
85 Rb	0.00 ppb	48.36	#######	
88 Sr	-0.02 ppb	5.93	1.00	
90 Zr	0.00 ppb	32.38	2.00	
95 Mo	0.01 ppb	40.24	1.05	
97 Mo	-0.01 ppb	21.13	1.05	
98 Mo	-0.02 ppb	6.81	1.00	
107 Ag	-0.01 ppb	4.03	1.00	
109 Ag	-0.01 ppb	13.91	1.00	
111 Cd	0.02 ppb	20.29	1.00	

114 Cd	-0.01 ppb	21.07	1.00
118 Sn	0 01 ppb	44.54	5.00
120 Sn	0.01 ppb	63.17	5.00
121 Sb	-0.02 ppb	14.99	1.00
123 Sb	-0.02 ppb	4.92	1.00
125 Te	-0.02 ppb	14.75	1.00
126 Te	-0.02 ppb	44.88	1.00
133 Cs	-0.01 ppb	4.98	#######
137 Ba	-0.02 ppb	6.38	0.80
203 Tl	-0.01 ppb	7.69	1.00
205 Tl	-0 01 ppb	17.51	1.00
208 Pb	-0.02 ppb	10.03	1.00
209 Bi	0.00 ppb	55.66	0.70
232 Th	0 00 ppb	22.77	0.45
238 U	0.00 ppb	26.20	0.45

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	582436.38	4.50	348070.81	167.3	70 - 130	ISFail
72 Ge	87915.38	3.60	64011.38	137.3	70 - 130	ISFail
89 Y	868510.50	4.53	610073.63	142.4	70 - 130	ISFail
115 In	755312.69	3.27	578951.50	130.5	70 - 130	ISFail
159 Tb	1196494.00	1.91	1206407.00	99.2	70 - 130	

ISTD Ref File . D:\ICPCHEM\1\DATA\02A2916a.B\003CALB.D\003CALB.D#

0 :Element Failures 0 :Max. Number of Failures Allowed
4 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: Pass
ISTD: Fail

Sample QC Report

Data File:	D:\ICPCHEM\1\DATA\02A2916a.B\085SMPL.D\085SMPL.D#
Date Acquired:	Jan 30 2002 03:08 am
Acq. Method:	WATER10.M
Operator:	ASW
Sample Name:	29360 BLK-1
Misc Info:	29360
Vial Number:	3201
Current Method:	D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File.	D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal. Update:	Jan 29 2002 05:03 pm
Sample Type:	Sample
Dilution Factor:	20.00
Autodil Factor:	Undiluted
Final Dil Factor:	20.00

QC Elements

Element	Corr Conc	Raw Conc	Units	RSD(%)	High Limit	Flag
7 Li	-0.04	0.00	ppb	57.05	200.00	
9 Be	-0.23	-0.01	ppb	11.65	200.00	
11 B	-3.22	-0.16	ppb	85.14	400.00	
23 Na	-4.26	-0.21	ppb	81.90	30000.00	
24 Mg	-1.19	-0.06	ppb	149.12	20000.00	
27 Al	59.56	2.98	ppb	9.16	1000.00	
29 SiO2	-2,026.00	-101.30	ppb	9.53	20000.00	
31 PO4	261.60	13.08	ppb	15.52	4000.00	
39 K	194.40	9.72	ppb	3.49	15000.00	
43 Ca	-52.20	-2.61	ppb	20.48	50000.00	
47 Ti	1.46	0.07	ppb	5.18	200.00	
51 V	2.89	0.14	ppb	16.91	200.00	
52 Cr	-0.17	-0.01	ppb	198.42	200.00	
53 Cr	180.32	9.02	ppb	1.04	200.00	
55 Mn	0.62	0.03	ppb	30.27	1000.00	
57 Fe	16.33	0.82	ppb	99.25	10000.00	
59 Co	-0.11	-0.01	ppb	9.70	200.00	
60 Ni	0.05	0.00	ppb	30.06	200.00	
62 Ni	1.22	0.06	ppb	32.13	200.00	
63 Cu	2.95	0.15	ppb	4.76	2000.00	
65 Cu	2.81	0.14	ppb	5.72	2000.00	
66 Zn	4.83	0.24	ppb	1.37	2000.00	
75 As	-0.35	-0.02	ppb	158.92	200.00	
82 Se	-1.45	-0.07	ppb	106.44	200.00	
85 Rb	0.03	0.00	ppb	18.73	200.00	
88 Sr	-0.11	-0.01	ppb	30.58	600.00	
90 Zr	0.23	0.01	ppb	65.71	200.00	
95 Mo	0.68	0.03	ppb	40.09	200.00	
97 Mo	-0.11	-0.01	ppb	130.94	200.00	
98 Mo	-0.35	-0.02	ppb	14.87	200.00	

107 Ag	0.04	0.00	ppb	127.70	200.00
109 Ag	0.01	0.00	ppb	449.68	200.00
111 Cd	0.35	0.02	ppb	33.60	200.00
114 Cd	-0.10	-0.01	ppb	20.51	200.00
118 Sn	0.44	0.02	ppb	23.16	200.00
120 Sn	0.46	0.02	ppb	2.48	200.00
121 Sb	-0.25	-0.01	ppb	6.53	200.00
123 Sb	-0.25	-0.01	ppb	10.53	200.00
125 Te	-0.47	-0.02	ppb	41.93	200.00
126 Te	-0.26	-0.01	ppb	43.89	200.00
133 Cs	-0.14	-0.01	ppb	1.98	200.00
137 Ba	0 20	0.01	ppb	47.73	400.00
203 Tl	-0.06	0.00	ppb	52.95	200.00
205 Tl	-0.03	0.00	ppb	69.75	200.00
208 Pb	0.69	0.03	ppb	18.06	200.00
209 Bi	0.22	0.01	ppb	37.30	200.00
232 Th	-0.02	0.00	ppb	140.88	200.00
238 U	-0.09	0.00	ppb	13.85	200.00

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	559402.19	1.40	348070.81	160.7	70 - 130	ISFail
72 Ge	82281.63	1.39	64011.38	128.5	70 - 130	
89 Y	819729.69	1.97	610073.63	134.4	70 - 130	ISFail
115 In	716449.00	5.10	578951.50	123.7	70 - 130	
159 Tb	1109533.00	0.70	1206407.00	92.0	70 - 130	

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2916a.B\003CALB.D\003CALB.D#

0 :Element Failures — 0 :Max. Number of Failures Allowed
2 :ISTD Failures — 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: Pass
ISTD: Fail

Sample QC Report

Data File:	D:\ICPCHEM\1\DATA\02A2916a.B\090SMPL.D\090SMPL.D#
Date Acquired:	Jan 30 2002 03:45 am
Acq. Method:	WATER10.M
Operator:	ASW
Sample Name:	29360 BLK-2
Misc Info:	29360
Vial Number:	3202
Current Method:	D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File:	D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal. Update:	Jan 29 2002 05:03 pm
Sample Type:	Sample
Dilution Factor:	20.00
Autodil Factor:	Undiluted
Final Dil Factor:	20.00

QC Elements

Element	Corr Conc	Raw Conc	Units	RSD(%)	High Limit	Flag
7 Li	0.18	0.01	ppb	20.27	200.00	
9 Be	-0.04	0.00	ppb	90.30	200.00	
11 B	-0.55	-0.03	ppb	647.36	400.00	
23 Na	-21.72	-1.09	ppb	17.47	30000.00	
24 Mg	-9.65	-0.48	ppb	33.87	20000.00	
27 Al	2.60	0.13	ppb	25.17	1000.00	
29 SiO2	-1,395.20	-69.76	ppb	4.24	20000.00	
31 PO4	144.96	7.25	ppb	6.54	4000.00	
39 K	172.76	8.64	ppb	28.05	15000.00	
43 Ca	-66.22	-3.31	ppb	9.35	50000.00	
47 Ti	0.28	0.01	ppb	57.25	200.00	
51 V	1.05	0.05	ppb	69.69	200.00	
52 Cr	0.64	0.03	ppb	124.65	200.00	
53 Cr	100.98	5.05	ppb	4.51	200.00	
55 Mn	0.48	0.02	ppb	42.92	1000.00	
57 Fe	3.30	0.16	ppb	832.63	10000.00	
59 Co	-0.06	0.00	ppb	46.75	200.00	
60 Ni	0.22	0.01	ppb	48.26	200.00	
62 Ni	1.13	0.06	ppb	15.55	200.00	
63 Cu	1.43	0.07	ppb	13.11	2000.00	
65 Cu	1.44	0.07	ppb	22.37	2000.00	
66 Zn	1.74	0.09	ppb	20.08	2000.00	
75 As	-0.02	0.00	ppb	2056.30	200.00	
82 Se	0.15	0.01	ppb	1562.80	200.00	
85 Rb	0.12	0.01	ppb	18.32	200.00	
88 Sr	-0.20	-0.01	ppb	14.61	600.00	
90 Zr	0.09	0.00	ppb	66.41	200.00	
95 Mo	3.50	0.17	ppb	14.47	200.00	
97 Mo	2.23	0.11	ppb	9.73	200.00	
98 Mo	1 71	0.09	ppb	6.34	200.00	

107 Ag	0.10	0.00	ppb	43.79	200.00
109 Ag	0.09	0.00	ppb	65.34	200.00
111 Cd	0.35	0.02	ppb	57.81	200.00
114 Cd	0.01	0.00	ppb	832.66	200.00
118 Sn	0.19	0.01	ppb	28.27	200.00
120 Sn	0.24	0.01	ppb	7.50	200.00
121 Sb	-0.05	0.00	ppb	63.42	200.00
123 Sb	0.01	0.00	ppb	389.10	200.00
125 Te	2.12	0.11	ppb	12.51	200.00
126 Te	2.45	0.12	ppb	13.09	200.00
133 Cs	0.01	0.00	ppb	169.94	200.00
137 Ba	-0.14	-0.01	ppb	150.37	400.00
203 Tl	0.20	0.01	ppb	34.29	200.00
205 Tl	0.18	0.01	ppb	36.44	200.00
208 Pb	0.12	0.01	ppb	107.31	200.00
209 Bi	2.00	0.10	ppb	6.54	200.00
232 Th	0.76	0.04	ppb	10.93	200.00
238 U	0.11	0.01	ppb	67.19	200.00

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	450107.09	5.48	348070.81	129.3	70 - 130	
72 Ge	75487.37	5.66	64011.38	117.9	70 - 130	
89 Y	729900.19	6.00	610073.63	119.6	70 - 130	
115 In	653864.69	3.44	578951.50	112.9	70 - 130	
159 Tb	1174549.00	1.74	1206407.00	97.4	70 - 130	

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2916a.B\003CALB.D\003CALB.D#

0 :Element Failures — 0 :Max. Number of Failures Allowed
0 :ISTD Failures — 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: Pass
ISTD. Pass

Sample QC Report

Data File:	D:\ICPCHEM\1\DATA\02A2916a.B\091SMPL.D\091SMPL.D#
Date Acquired:	Jan 30 2002 03:52 am
Acq. Method:	WATER10.M
Operator:	ASW
Sample Name:	29360 BLK-3
Misc Info:	29360
Vial Number:	3203
Current Method.	D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File.	D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal Update:	Jan 29 2002 05:03 pm
Sample Type:	Sample
Dilution Factor:	20 00
Autodil Factor:	Undiluted
Final Dil Factor:	20.00

QC Elements

Element	Corr Conc	Raw Conc	Units	RSD(%)	High Limit	Flag
7 Li	0.12	0.01	ppb	27.21	200.00	
9 Be	-0.04	0.00	ppb	128.64	200.00	
11 B	-5.60	-0.28	ppb	65.12	400.00	
23 Na	-25.28	-1.26	ppb	2.78	30000.00	
24 Mg	-7.13	-0.36	ppb	27.30	20000.00	
27 Al	2 03	0.10	ppb	45.82	1000.00	
29 SiO2	-1,589.20	-79.46	ppb	1.69	20000.00	
31 PO4	181.78	9.09	ppb	25.82	4000.00	
39 K	159.48	7.97	ppb	24.58	15000.00	
43 Ca	-78.12	-3.91	ppb	15.61	50000.00	
47 Ti	0.21	0.01	ppb	125.39	200.00	
51 V	2.10	0.11	ppb	33.31	200.00	
52 Cr	-0.14	-0.01	ppb	515.44	200.00	
53 Cr	140.04	7.00	ppb	0.56	200.00	
55 Mn	0.02	0.00	ppb	945.54	1000.00	
57 Fe	-24.34	-1.22	ppb	114.54	10000.00	
59 Co	-0.06	0.00	ppb	52.25	200.00	
60 Ni	-0.24	-0.01	ppb	46.30	200.00	
62 Ni	1.09	0.05	ppb	41.07	200.00	
63 Cu	0.90	0.05	ppb	11.19	2000.00	
65 Cu	0.93	0.05	ppb	3.77	2000.00	
66 Zn	2.20	0.11	ppb	13.29	2000.00	
75 As	0.26	0.01	ppb	199.22	200.00	
82 Se	0 42	0.02	ppb	412.03	200.00	
85 Rb	0.10	0.01	ppb	15.35	200.00	
88 Sr	-0.23	-0.01	ppb	9.68	600.00	
90 Zr	0.05	0.00	ppb	123.07	200.00	
95 Mo	2.96	0.15	ppb	8.37	200.00	
97 Mo	1.23	0.06	ppb	19.56	200.00	
98 Mo	0 78	0.04	ppb	28.32	200.00	

107 Ag	0.06	0.00	ppb	6.80	200.00
109 Ag	0.05	0.00	ppb	92.11	200.00
111 Cd	0.35	0.02	ppb	61.02	200.00
114 Cd	-0.02	0.00	ppb	382.37	200.00
118 Sn	0.00	0.00	ppb	3806.90	200.00
120 Sn	0.04	0.00	ppb	38.43	200.00
121 Sb	-0.12	-0.01	ppb	59.31	200.00
123 Sb	-0.05	0.00	ppb	175.27	200.00
125 Te	1.10	0.05	ppb	3.65	200.00
126 Te	1.35	0.07	ppb	12.47	200.00
133 Cs	-0.02	0.00	ppb	85.33	200.00
137 Ba	-0.25	-0.01	ppb	21.36	400.00
203 Tl	0.06	0.00	ppb	18.03	200.00
205 Tl	0.08	0.00	ppb	4.94	200.00
208 Pb	-0.02	0.00	ppb	388.44	200.00
209 Bi	1.13	0.06	ppb	7.32	200.00
232 Th	0.48	0.02	ppb	8.11	200.00
238 U	0.02	0.00	ppb	55.59	200.00

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	500532.09	5.44	348070.81	143.8	70 - 130	ISFail
72 Ge	78814.51	5.17	64011.38	123.1	70 - 130	
89 Y	772912.00	6.50	610073.63	126.7	70 - 130	
115 In	684775.00	2.11	578951.50	118.3	70 - 130	
159 Tb	1129552.00	0.80	1206407.00	93.6	70 - 130	

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2916a.B\003CALB.D\003CALB.D#

0 :Element Failures 0 :Max. Number of Failures Allowed
1 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: Pass
ISTD. Fail

Sample QC Report

Data File:	D:\ICPCHEM\1\DATA\02A2916a.B\138SMPL.D\138SMPL.D#
Date Acquired:	Jan 30 2002 10:09 am
Acq. Method:	WATER10.M
Operator:	ASW
Sample Name:	201280066 SAMPLE
Misc Info:	29360
Vial Number:	4101
Current Method:	D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File:	D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal. Update:	Jan 29 2002 05:03 pm
Sample Type:	Sample
Dilution Factor:	20.00
Autodil Factor:	Undiluted
Final Dil Factor:	20.00

QC Elements

Element	Corr Conc	Raw Conc	Units	RSD(%)	High Limit	Flag
7 Li	233.20	11.66	ppb	2.47	200.00	
9 Be	3.54	0.18	ppb	0.90	200.00	
11 B	27.80	1.39	ppb	11.19	400.00	
23 Na	1,670.20	83.51	ppb	3.01	30000.00	
24 Mg	72,980.00	3649.00	ppb	3.97	20000.00	
27 Al	60,880.00	3044.00	ppb	2.07	1000.00	>LRS
29 SiO2	6,546.00	327.30	ppb	9.00	20000.00	
31 PO4	55,560.00	2778.00	ppb	2.85	4000.00	
39 K	16,978.00	848.90	ppb	4.21	15000.00	
43 Ca	31,500.00	1575.00	ppb	0.86	50000.00	
47 Ti	7,862.00	393.10	ppb	0.88	200.00	>LRS
51 V	336.80	16.84	ppb	1.17	200.00	
52 Cr	382.40	19.12	ppb	0.48	200.00	
53 Cr	393.40	19.67	ppb	0.39	200.00	
55 Mn	2,492.00	124.60	ppb	0.64	1000.00	
57 Fe	189,440.00	9472.00	ppb	0.96	10000.00	
59 Co	76.72	3.84	ppb	1.53	200.00	
60 Ni	441.60	22.08	ppb	1.23	200.00	
62 Ni	456.20	22.81	ppb	1.84	200.00	
63 Cu	144.24	7.21	ppb	1.58	2000.00	
65 Cu	143.96	7.20	ppb	1.51	2000.00	
66 Zn	453.40	22.67	ppb	0.46	2000.00	
75 As	30.08	1.50	ppb	5.10	200.00	
82 Se	1.10	0.05	ppb	254.46	200.00	
85 Rb	214.00	10.70	ppb	1.32	200.00	
88 Sr	416.80	20.84	ppb	1.34	600.00	
90 Zr	85.16	4.26	ppb	1.81	200.00	
95 Mo	6.77	0.34	ppb	2.98	200.00	
97 Mo	6.22	0.31	ppb	5.72	200.00	
98 Mo	5.60	0.28	ppb	1.46	200.00	

107 Ag	0.35	0.02	ppb	16.96	200.00
109 Ag	0.42	0.02	ppb	18.83	200.00
111 Cd	3.94	0.20	ppb	5.18	200.00
114 Cd	3.20	0.16	ppb	6.25	200.00
118 Sn	9.83	0.49	ppb	4.34	200.00
120 Sn	9.56	0.48	ppb	4.87	200.00
121 Sb	5.65	0.28	ppb	3.64	200.00
123 Sb	5.81	0.29	ppb	4.21	200.00
125 Te	0.26	0.01	ppb	138.69	200.00
126 Te	0.55	0.03	ppb	20.48	200.00
133 Cs	15.11	0.76	ppb	2.01	200.00
137 Ba	754.40	37.72	ppb	2.00	400.00
203 Tl	2.09	0.10	ppb	3.46	200.00
205 Tl	2.04	0.10	ppb	2.01	200.00
- 208 Pb	315.60	15.78	ppb	0.67	200.00
209 Bi	2.44	0.12	ppb	8.89	200.00
232 Th	109.92	5.50	ppb	3.78	200.00
238 U	34.04	1.70	ppb	5.23	200.00

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	382294.50	1.89	348070.81	109.8	70 - 130	
72 Ge	63296.31	1.81	64011.38	98.9	70 - 130	
89 Y	686547.13	3.57	610073.63	112.5	70 - 130	
115 In	520484.09	3.43	578951.50	89.9	70 - 130	
159 Tb	913863.13	1.47	1206407.00	75.8	70 - 130	

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2916a.B\003CALB.D\003CALB.D#

2 :Element Failures 0 :Max. Number of Failures Allowed
0 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:
Analytes: Fail
ISTD: Pass

Sample QC Report

Data File:	D:\ICPCHEM\1\DATA\02A2916a.B\139SMPL.D\139SMPL.D#
Date Acquired:	Jan 30 2002 10:17 am
Acq. Method:	WATER10.M
Operator:	ASW
Sample Name:	201280066 DUP
Misc Info:	29360
Vial Number:	4102
Current Method:	D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File:	D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal. Update:	Jan 29 2002 05:03 pm
Sample Type:	Sample
Dilution Factor:	20.00
Autodil Factor:	Undiluted
Final Dil Factor:	20.00

QC Elements

Element	Corr Conc	Raw Conc	Units	RSD(%)	High Limit	Flag
7 Li	273.20	13.66	ppb	2.15	200.00	
9 Be	4.07	0.20	ppb	3.21	200.00	
11 B	75.48	3.77	ppb	8.12	400.00	
23 Na	1,950.60	97.53	ppb	3.32	30000.00	
24 Mg	71,440.00	3572.00	ppb	1.92	20000.00	
27 Al	66,020.00	3301.00	ppb	3.36	1000.00	>LRS
29 SiO2	7,428.00	371.40	ppb	16.23	20000.00	
31 PO4	59,780.00	2989.00	ppb	1.17	4000.00	
39 K	18,112.00	905.60	ppb	2.50	15000.00	
43 Ca	39,500.00	1975.00	ppb	3.96	50000.00	
47 Ti	8,610.00	430.50	ppb	3.56	200.00	>LRS
51 V	322.40	16.12	ppb	4.11	200.00	
52 Cr	387.60	19.38	ppb	3.72	200.00	
53 Cr	401.80	20.09	ppb	3.02	200.00	
55 Mn	2,658.00	132.90	ppb	6.06	1000.00	
57 Fe	189,820.00	9491.00	ppb	5.85	10000.00	
59 Co	77.58	3.88	ppb	6.22	200.00	
60 Ni	438.80	21.94	ppb	5.71	200.00	
62 Ni	448.80	22.44	ppb	7.11	200.00	
63 Cu	150.38	7.52	ppb	5.35	2000.00	
65 Cu	150.68	7.53	ppb	5.23	2000.00	
66 Zn	491.20	24.56	ppb	6.24	2000.00	
75 As	32.64	1.63	ppb	5.64	200.00	
82 Se	2.35	0.12	ppb	57.59	200.00	
85 Rb	224.00	11.20	ppb	3.07	200.00	
88 Sr	469.20	23.46	ppb	3.03	600.00	
90 Zr	77.38	3.87	ppb	2.56	200.00	
95 Mo	7.11	0.36	ppb	5.91	200.00	
97 Mo	6.57	0.33	ppb	6.98	200.00	
98 Mo	5.76	0.29	ppb	4.68	200.00	

107 Ag	0.39	0.02	ppb	27.42	200.00
109 Ag	0.36	0.02	ppb	14.99	200.00
111 Cd	4.08	0.20	ppb	11.67	200.00
114 Cd	3.26	0.16	ppb	6.38	200.00
118 Sn	8.36	0.42	ppb	3.58	200.00
120 Sn	7.78	0.39	ppb	4.53	200.00
121 Sb	6.01	0.30	ppb	4.29	200.00
123 Sb	5.78	0.29	ppb	8.29	200.00
125 Te	0.13	0.01	ppb	232.71	200.00
126 Te	0.09	0.00	ppb	197.41	200.00
133 Cs	14.50	0.72	ppb	3.39	200.00
137 Ba	848.40	42.42	ppb	1.58	400.00
203 Tl	1.92	0.10	ppb	4.04	200.00
205 Tl	2.19	0.11	ppb	4.00	200.00
208 Pb	428.60	21.43	ppb	5.26	200.00
209 Bi	2.45	0.12	ppb	4.00	200.00
232 Th	91.12	4.56	ppb	3.47	200.00
238 U	26.86	1.34	ppb	8.79	200.00

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	380845.81	5.87	348070.81	109.4	70 - 130	
72 Ge	61773.51	6.42	64011.38	96.5	70 - 130	
89 Y	664538.31	6.91	610073.63	108.9	70 - 130	
115 In	517361.19	0.86	578951.50	89.4	70 - 130	
159 Tb	860637.00	1.73	1206407.00	71.3	70 - 130	

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2916a.B\003CALB.D\003CALB.D#

2 :Element Failures 0 :Max. Number of Failures Allowed
0 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: Fail
ISTD: Pass

Sample QC Report

Data File:	D:\ICPCHEM\1\DATA\02A2916a.B\140SMPL.D\140SMPL.D#
Date Acquired:	Jan 30 2002 10:25 am
Acq. Method:	WATER10.M
Operator:	ASW
Sample Name:	201280068 SAMPLE
Misc Info.	29360
Vial Number:	4103
Current Method:	D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File:	D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal. Update:	Jan 29 2002 05:03 pm
Sample Type:	Sample
Dilution Factor:	20.00
Autodil Factor:	Undiluted
Final Dil Factor:	20.00

QC Elements

Element	Corr Conc	Raw Conc	Units	RSD(%)	High Limit	Flag
7 Li	128.84	6.44	ppb	5.09	200.00	
9 Be	2.78	0.14	ppb	6.55	200.00	
11 B	5.79	0.29	ppb	58.29	400.00	
23 Na	1,590.60	79.53	ppb	9.05	30000.00	
24 Mg	46,880.00	2344.00	ppb	6.07	20000.00	
27 Al	43,560.00	2178.00	ppb	4.27	1000.00	>LRS
29 SiO2	4,140.00	207.00	ppb	35.47	20000.00	
31 PO4	99,220.00	4961.00	ppb	2.50	4000.00	>LRS
39 K	10,420.00	521.00	ppb	5.97	15000.00	
43 Ca	44,140.00	2207.00	ppb	3.93	50000.00	
47 Ti	5,182.00	259.10	ppb	6.54	200.00	>LRS
51 V	378.60	18.93	ppb	8.00	200.00	
52 Cr	336.80	16.84	ppb	8.57	200.00	
53 Cr	347.80	17.39	ppb	8.78	200.00	
55 Mn	1,405.00	70.25	ppb	8.95	1000.00	
57 Fe	173,460.00	8673.00	ppb	8.75	10000.00	
59 Co	63.26	3.16	ppb	7.04	200.00	
60 Ni	184.16	9.21	ppb	5.84	200.00	
62 Ni	190.82	9.54	ppb	5.54	200.00	
63 Cu	140.48	7.02	ppb	7.35	2000.00	
65 Cu	139.60	6.98	ppb	7.28	2000.00	
66 Zn	308.80	15.44	ppb	7.03	2000.00	
75 As	19.66	0.98	ppb	4.35	200.00	
82 Se	0.15	0.01	ppb	2680.20	200.00	
85 Rb	109.38	5.47	ppb	4.11	200.00	
88 Sr	616.40	30.82	ppb	5.31	600.00	
90 Zr	31.70	1.59	ppb	0.89	200.00	
95 Mo	6.41	0.32	ppb	5.50	200.00	
97 Mo	5.32	0.27	ppb	7.50	200.00	
98 Mo	4.93	0.25	ppb	9.20	200.00	

107 Ag	0.23	0.01	ppb	16.43	200.00
109 Ag	0.20	0.01	ppb	34.29	200.00
111 Cd	2.09	0.10	ppb	12.32	200.00
114 Cd	1.62	0.08	ppb	18.00	200.00
118 Sn	3.31	0.17	ppb	3.70	200.00
120 Sn	3.23	0.16	ppb	4.84	200.00
121 Sb	4.13	0.21	ppb	1.03	200.00
123 Sb	3.80	0.19	ppb	8.78	200.00
125 Te	-0.06	0.00	ppb	360.37	200.00
126 Te	0.21	0.01	ppb	100.37	200.00
133 Cs	7.99	0.40	ppb	6.14	200.00
137 Ba	460.40	23.02	ppb	3.95	400.00
203 Tl	0.97	0.05	ppb	2.96	200.00
205 Tl	1.07	0.05	ppb	8.18	200.00
208 Pb	246.40	12.32	ppb	7.58	200.00
209 Bi	1.53	0.08	ppb	10.01	200.00
232 Th	113.22	5.66	ppb	3.82	200.00
238 U	20.02	1.00	ppb	8.09	200.00

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	375907.69	4.83	348070.81	108.0	70 - 130	
72 Ge	61388.31	3.52	64011.38	95.9	70 - 130	
89 Y	628459.19	4.71	610073.63	103.0	70 - 130	
115 In	516190.09	1.25	578951.50	89.2	70 - 130	
159 Tb	859130.19	2.16	1206407.00	71.2	70 - 130	

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2916a.B\003CALB.D\003CALB.D#

3 :Element Failures 0 :Max. Number of Failures Allowed
0 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: Fail
ISTD: Pass

Sample QC Report

Data File:	D:\ICPCHEM\1\DATA\02A2916a.B\141SMPL.D\141SMPL.D#
Date Acquired:	Jan 30 2002 10:32 am
Acq. Method:	WATER10.M
Operator:	ASW
Sample Name:	201280069 SAMPLE
Misc Info:	29360
Vial Number:	4104
Current Method:	D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File:	D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal. Update:	Jan 29 2002 05:03 pm
Sample Type:	Sample
Dilution Factor:	20.00
Autodil Factor:	Undiluted
Final Dil Factor:	20.00

QC Elements

Element	Corr Conc	Raw Conc	Units	RSD(%)	High Limit	Flag
7 Li	388.00	19.40	ppb	3.42	200.00	
9 Be	8.88	0.44	ppb	1.73	200.00	
11 B	1.33	0.07	ppb	153.05	400.00	
23 Na	2,668.00	133.40	ppb	0.88	30000.00	
24 Mg	193,100.00	9655.00	ppb	2.53	20000.00	
27 Al	168,820.00	8441.00	ppb	2.05	1000.00	>LRS
29 SiO2	10,414.00	520.70	ppb	4.93	20000.00	
31 PO4	163,800.00	8190.00	ppb	1.66	4000.00	>LRS
39 K	69,380.00	3469.00	ppb	2.75	15000.00	
43 Ca	103,760.00	5188.00	ppb	0.65	50000.00	
47 Ti	8,500.00	425.00	ppb	0.66	200.00	>LRS
51 V	1,391.80	69.59	ppb	2.53	200.00	
52 Cr	1,290.60	64.53	ppb	1.37	200.00	
53 Cr	1,295.00	64.75	ppb	1.34	200.00	
55 Mn	6,324.00	316.20	ppb	3.35	1000.00	
57 Fe	594,000.00	29700.00	ppb	2.78	10000.00	>LRS
59 Co	259.20	12.96	ppb	2.96	200.00	
60 Ni	728.60	36.43	ppb	3.10	200.00	
62 Ni	737.20	36.86	ppb	3.55	200.00	
63 Cu	512.80	25.64	ppb	3.86	2000.00	
65 Cu	509.60	25.48	ppb	2.77	2000.00	
66 Zn	1,192.40	59.62	ppb	3.35	2000.00	
75 As	52.26	2.61	ppb	1.38	200.00	
82 Se	3.81	0.19	ppb	44.92	200.00	
85 Rb	644.80	32.24	ppb	1.77	200.00	
88 Sr	1,282.80	64.14	ppb	1.60	600.00	
90 Zr	11.81	0.59	ppb	0.82	200.00	
95 Mo	13.33	0.67	ppb	3.50	200.00	
97 Mo	12.84	0.64	ppb	5.95	200.00	
98 Mo	11.92	0.60	ppb	6.01	200.00	

107 Ag	0.95	0.05	ppb	14.92	200.00
109 Ag	0.95	0.05	ppb	6.07	200.00
111 Cd	8.34	0.42	ppb	4.40	200.00
114 Cd	7.48	0.37	ppb	5.10	200.00
118 Sn	7.42	0.37	ppb	6.28	200.00
120 Sn	7.32	0.37	ppb	1.95	200.00
121 Sb	15.72	0.79	ppb	2.64	200.00
123 Sb	15.63	0.78	ppb	3.41	200.00
125 Te	-0.12	-0.01	ppb	93.26	200.00
126 Te	0.16	0.01	ppb	121.01	200.00
133 Cs	33.38	1.67	ppb	1.65	200.00
137 Ba	2,386.00	119.30	ppb	1.16	400.00
203 Tl	4.94	0.25	ppb	3.70	200.00
205 Tl	5.12	0.26	ppb	0.46	200.00
208 Pb	871.80	43.59	ppb	3.45	200.00
209 Bi	3.30	0.17	ppb	3.50	200.00
232 Th	115.46	5.77	ppb	2.15	200.00
238 U	38.42	1.92	ppb	5.06	200.00

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	396541.19	2.95	348070.81	113.9	70 - 130	
72 Ge	62169.58	3.28	64011.38	97.1	70 - 130	
89 Y	701462.38	4.76	610073.63	115.0	70 - 130	
115 In	525036.19	0.93	578951.50	90.7	70 - 130	
159 Tb	844869.19	1.47	1206407.00	70.0	70 - 130	

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2916a.B\003CALB.D\003CALB.D#

4 :Element Failures 0 :Max. Number of Failures Allowed
0 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: Fail
ISTD: Pass

Sample QC Report

Data File:	D:\ICPCHEM\1\DATA\02A2916a.B\142SMPL.D\142SMPL.D#
Date Acquired:	Jan 30 2002 10:40 am
Acq. Method:	WATER10.M
Operator:	ASW
Sample Name:	201280070 SAMPLE
Misc Info:	29360
Vial Number:	4105
Current Method:	D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File:	D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal. Update:	Jan 29 2002 05:03 pm
Sample Type:	Sample
Dilution Factor:	20.00
Autodil Factor:	Undiluted
Final Dil Factor:	20.00

QC Elements

Element	Corr Conc	Raw Conc	Units	RSD(%)	High Limit	Flag
7 Li	240.40	12.02	ppb	1.90	200.00	
9 Be	5.27	0.26	ppb	6.93	200.00	
11 B	-3.53	-0.18	ppb	101.08	400.00	
23 Na	1,874.20	93.71	ppb	3.01	30000.00	
24 Mg	70,700.00	3535.00	ppb	0.65	20000.00	
27 Al	89,480.00	4474.00	ppb	1.61	1000.00	>LRS
29 SiO2	4,842.00	242.10	ppb	18.53	20000.00	
31 PO4	45,300.00	2265.00	ppb	0.63	4000.00	
39 K	21,980.00	1099.00	ppb	2.29	15000.00	
43 Ca	30,360.00	1518.00	ppb	2.90	50000.00	
47 Ti	10,152.00	507.60	ppb	2.16	200.00	>LRS
51 V	376.00	18.80	ppb	0.65	200.00	
52 Cr	423.20	21.16	ppb	1.62	200.00	
53 Cr	448.00	22.40	ppb	2.46	200.00	
55 Mn	2,728.00	136.40	ppb	2.13	1000.00	
57 Fe	215,000.00	10750.00	ppb	1.72	10000.00	>LRS
59 Co	95.36	4.77	ppb	4.05	200.00	
60 Ni	381.60	19.08	ppb	2.89	200.00	
62 Ni	392.60	19.63	ppb	3.02	200.00	
63 Cu	180.22	9.01	ppb	2.91	2000.00	
65 Cu	183.06	9.15	ppb	2.20	2000.00	
66 Zn	679.40	33.97	ppb	2.02	2000.00	
75 As	28.50	1.43	ppb	6.35	200.00	
82 Se	3.10	0.15	ppb	61.74	200.00	
85 Rb	269.60	13.48	ppb	2.15	200.00	
88 Sr	403.20	20.16	ppb	3.24	600.00	
90 Zr	49.76	2.49	ppb	1.12	200.00	
95 Mo	5.97	0.30	ppb	7.77	200.00	
97 Mo	5.21	0.26	ppb	3.22	200.00	
98 Mo	4.60	0.23	ppb	8.59	200.00	

107 Ag	0.67	0.03	ppb	18.57	200.00
109 Ag	0.70	0.03	ppb	9.83	200.00
111 Cd	6.05	0.30	ppb	7.91	200.00
114 Cd	5.97	0.30	ppb	4.12	200.00
118 Sn	23.72	1.19	ppb	8.08	200.00
120 Sn	22.22	1.11	ppb	3.73	200.00
121 Sb	8.70	0.44	ppb	3.59	200.00
123 Sb	8.34	0.42	ppb	3.15	200.00
125 Te	-0.28	-0.01	ppb	51.63	200.00
126 Te	0.04	0.00	ppb	500.34	200.00
133 Cs	18.31	0.92	ppb	4.34	200.00
137 Ba	936.60	46.83	ppb	5.94	400.00
203 Tl	2.30	0.12	ppb	5.53	200.00
205 Tl	2.45	0.12	ppb	3.85	200.00
208 Pb	421.20	21.06	ppb	2.82	200.00
209 Bi	1.92	0.10	ppb	5.48	200.00
232 Th	76.82	3.84	ppb	2.53	200.00
238 U	17.92	0.90	ppb	4.30	200.00

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	363793.09	1.57	348070.81	104.5	70 - 130	
72 Ge	59419.03	1.62	64011.38	92.8	70 - 130	
89 Y	632884.38	1.27	610073.63	103.7	70 - 130	
115 In	506579.50	7.19	578951.50	87.5	70 - 130	
159 Tb	880116.63	2.35	1206407.00	73.0	70 - 130	

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2916a.B\003CALB.D\003CALB.D#

3 :Element Failures 0 :Max. Number of Failures Allowed
0 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: Fail
ISTD: Pass

Sample QC Report

Data File:	D:\ICPCHEM\1\DATA\02A2916a.B\143SMPL.D\143SMPL.D#
Date Acquired.	Jan 30 2002 10:48 am
Acq. Method:	WATER10.M
Operator:	ASW
Sample Name:	201280071 SAMPLE
Misc Info:	29360
Vial Number:	4106
Current Method:	D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File:	D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal. Update:	Jan 29 2002 05:03 pm
Sample Type:	Sample
Dilution Factor:	20.00
Autodil Factor:	Undiluted
Final Dil Factor:	20.00

QC Elements

Element	Corr Conc	Raw Conc	Units	RSD(%)	High Limit	Flag
7 Li	173.36	8.67	ppb	2.59	200.00	
9 Be	3.25	0.16	ppb	4.92	200.00	
11 B	-6.33	-0.32	ppb	36.12	400.00	
23 Na	1,583.00	79.15	ppb	3.74	30000.00	
24 Mg	49,960.00	2498.00	ppb	0.91	20000.00	
27 Al	63,760.00	3188.00	ppb	0.71	1000.00	>LRS
29 SiO2	4,438.00	221.90	ppb	7.94	20000.00	
31 PO4	64,760.00	3238.00	ppb	0.88	4000.00	
39 K	9,070.00	453.50	ppb	1.29	15000.00	
43 Ca	34,340.00	1717.00	ppb	0.44	50000.00	
47 Ti	4,726.00	236.30	ppb	1.12	200.00	>LRS
51 V	343.00	17.15	ppb	2.50	200.00	
52 Cr	454.00	22.70	ppb	2.15	200.00	
53 Cr	480.80	24.04	ppb	2.78	200.00	
55 Mn	2,082.00	104.10	ppb	1.75	1000.00	
57 Fe	171,720.00	8586.00	ppb	4.28	10000.00	
59 Co	62.50	3.13	ppb	4.47	200.00	
60 Ni	244.60	12.23	ppb	3.65	200.00	
62 Ni	252.60	12.63	ppb	2.22	200.00	
63 Cu	131.84	6.59	ppb	2.38	2000.00	
65 Cu	130.88	6.54	ppb	0.92	2000.00	
66 Zn	314.80	15.74	ppb	2.77	2000.00	
75 As	25.76	1.29	ppb	4.86	200.00	
82 Se	1.62	0.08	ppb	230.85	200.00	
85 Rb	99.96	5.00	ppb	1.96	200.00	
88 Sr	667.80	33.39	ppb	0.75	600.00	
90 Zr	29.74	1.49	ppb	4.42	200.00	
95 Mo	6.78	0.34	ppb	6.23	200.00	
97 Mo	5.74	0.29	ppb	3.68	200.00	
98 Mo	5.04	0.25	ppb	4.28	200.00	

107 Ag	0.36	0.02	ppb	18.85	200.00
109 Ag	0.32	0.02	ppb	23.02	200.00
111 Cd	2.99	0.15	ppb	12.06	200.00
114 Cd	2.32	0.12	ppb	6.29	200.00
118 Sn	4.13	0.21	ppb	1.13	200.00
120 Sn	4.23	0.21	ppb	2.88	200.00
121 Sb	5.19	0.26	ppb	3.07	200.00
123 Sb	4.98	0.25	ppb	1.83	200.00
125 Te	-0.25	-0.01	ppb	16.78	200.00
126 Te	-0.06	0.00	ppb	121.16	200.00
133 Cs	9.76	0.49	ppb	1.76	200.00
137 Ba	569.20	28.46	ppb	1.07	400.00
203 Tl	0.95	0.05	ppb	6.84	200.00
205 Tl	1.02	0.05	ppb	6.00	200.00
208 Pb	181.84	9.09	ppb	2.61	200.00
209 Bi	1.41	0.07	ppb	19.95	200.00
232 Th	94.54	4.73	ppb	1.29	200.00
238 U	18.43	0.92	ppb	3.70	200.00

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	383673.69	3.04	348070.81	110.2	70 - 130	
72 Ge	62344.01	2.83	64011.38	97.4	70 - 130	
89 Y	641585.38	3.93	610073.63	105.2	70 - 130	
115 In	530695.19	1.67	578951.50	91.7	70 - 130	
159 Tb	868958.00	0.66	1206407.00	72.0	70 - 130	

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2916a.B\003CALB.D\003CALB.D#

2 :Element Failures 0 :Max. Number of Failures Allowed
0 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: Fail
ISTD: Pass

Sample QC Report

Data File:	D:\ICPCHEM\1\DATA\02A2916a.B\144SMPL.D\144SMPL.D#
Date Acquired:	Jan 30 2002 10:56 am
Acq. Method:	WATER10.M
Operator:	ASW
Sample Name:	201280072 SAMPLE
Misc Info	29360
Vial Number:	4107
Current Method:	D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File:	D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal. Update:	Jan 29 2002 05:03 pm
Sample Type:	Sample
Dilution Factor:	20.00
Autodil Factor:	Undiluted
Final Dil Factor:	20.00

QC Elements

Element	Corr Conc	Raw Conc	Units	RSD(%)	High Limit	Flag
7 Li	278.00	13.90	ppb	3.45	200.00	
9 Be	8.44	0.42	ppb	4.13	200.00	
11 B	-1.41	-0.07	ppb	230.21	400.00	
23 Na	2,220.00	111.00	ppb	0.62	30000.00	
24 Mg	84,480.00	4224.00	ppb	0.66	20000.00	
27 Al	118,140.00	5907.00	ppb	2.19	1000.00	>LRS
29 SiO2	7,016.00	350.80	ppb	4.37	20000.00	
31 PO4	55,500.00	2775.00	ppb	2.12	4000.00	
39 K	23,160.00	1158.00	ppb	0.26	15000.00	
43 Ca	32,240.00	1612.00	ppb	1.89	50000.00	
47 Ti	11,886.00	594.30	ppb	1.48	200.00	>LRS
51 V	466.00	23.30	ppb	1.75	200.00	
52 Cr	493.20	24.66	ppb	1.95	200.00	
53 Cr	527.40	26.37	ppb	1.85	200.00	
55 Mn	2,940.00	147.00	ppb	3.11	1000.00	
57 Fe	249,000.00	12450.00	ppb	2.99	10000.00	>LRS
59 Co	113.28	5.66	ppb	3.13	200.00	
60 Ni	426.20	21.31	ppb	3.87	200.00	
62 Ni	443.00	22.15	ppb	4.16	200.00	
63 Cu	265.20	13.26	ppb	2.97	2000.00	
65 Cu	265.20	13.26	ppb	2.82	2000.00	
66 Zn	651.20	32.56	ppb	3.45	2000.00	
75 As	22.26	1.11	ppb	8.54	200.00	
82 Se	1.74	0.09	ppb	152.28	200.00	
85 Rb	273.60	13.68	ppb	1.68	200.00	
88 Sr	510.40	25.52	ppb	1.41	600.00	
90 Zr	69.32	3.47	ppb	2.08	200.00	
95 Mo	6.78	0.34	ppb	2.66	200.00	
97 Mo	5.94	0.30	ppb	3.38	200.00	
98 Mo	5.68	0.28	ppb	2.34	200.00	

107 Ag	1.23	0.06	ppb	8.03	200.00
109 Ag	1.27	0.06	ppb	8.51	200.00
111 Cd	7.40	0.37	ppb	5.23	200.00
114 Cd	6.87	0.34	ppb	5.70	200.00
118 Sn	8.08	0.40	ppb	0.63	200.00
120 Sn	7.72	0.39	ppb	2.13	200.00
121 Sb	8.97	0.45	ppb	2.95	200.00
123 Sb	8.92	0.45	ppb	4.22	200.00
125 Te	-0.02	0.00	ppb	462.52	200.00
126 Te	0.09	0.00	ppb	162.42	200.00
133 Cs	20.42	1.02	ppb	1.13	200.00
137 Ba	1,405.40	70.27	ppb	1.40	400.00
203 Tl	2.51	0.13	ppb	4.59	200.00
205 Tl	2.73	0.14	ppb	0.91	200.00
208 Pb	414.80	20.74	ppb	2.96	200.00
209 Bi	2.36	0.12	ppb	5.61	200.00
232 Th	114.08	5.70	ppb	1.27	200.00
238 U	56.56	2.83	ppb	4.13	200.00

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	362714.19	5.50	348070.81	104.2	70 - 130	
72 Ge	59268.64	5.38	64011.38	92.6	70 - 130	
89 Y	661886.13	6.53	610073.63	108.5	70 - 130	
115 In	505628.50	1.16	578951.50	87.3	70 - 130	
159 Tb	873512.81	1.54	1206407.00	72.4	70 - 130	

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2916a.B\003CALB.D\003CALB.D#

3 :Element Failures 0 :Max. Number of Failures Allowed
0 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: Fail
ISTD: Pass

Sample QC Report

Data File:	D:\ICPCHEM\1\DATA\02A2916a.B\145SMPL.D\145SMPL.D#
Date Acquired:	Jan 30 2002 11:03 am
Acq. Method:	WATER10.M
Operator:	ASW
Sample Name:	201280073 SAMPLE
Misc Info:	29360
Vial Number:	4108
Current Method:	D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File:	D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal. Update:	Jan 29 2002 05:03 pm
Sample Type:	Sample
Dilution Factor:	20.00
Autodil Factor:	Undiluted
Final Dil Factor:	20.00

QC Elements

Element	Corr Conc	Raw Conc	Units	RSD(%)	High Limit	Flag
7 Li	238.40	11.92	ppb	6.47	200.00	
9 Be	5.40	0.27	ppb	3.65	200.00	
11 B	-4.37	-0.22	ppb	27.08	400.00	
23 Na	1,685.20	84.26	ppb	4.85	30000.00	
24 Mg	76,500.00	3825.00	ppb	1.69	20000.00	
27 Al	90,080.00	4504.00	ppb	2.26	1000.00	>LRS
29 SiO2	6,078.00	303.90	ppb	15.04	20000.00	
31 PO4	70,820.00	3541.00	ppb	1.75	4000.00	
39 K	16,122.00	806.10	ppb	1.49	15000.00	
43 Ca	37,700.00	1885.00	ppb	0.46	50000.00	
47 Ti	7,450.00	372.50	ppb	0.70	200.00	>LRS
51 V	598.00	29.90	ppb	1.62	200.00	
52 Cr	288.00	14.40	ppb	2.08	200.00	
53 Cr	316.00	15.80	ppb	2.01	200.00	
55 Mn	2,780.00	139.00	ppb	2.36	1000.00	
57 Fe	253,600.00	12680.00	ppb	3.05	10000.00	>LRS
59 Co	86.18	4.31	ppb	4.04	200.00	
60 Ni	235.00	11.75	ppb	4.83	200.00	
62 Ni	247.00	12.35	ppb	3.69	200.00	
63 Cu	211.20	10.56	ppb	3.68	2000.00	
65 Cu	210.20	10.51	ppb	2.39	2000.00	
66 Zn	731.80	36.59	ppb	1.97	2000.00	
75 As	25.22	1.26	ppb	4.27	200.00	
82 Se	8.20	0.41	ppb	29.56	200.00	
85 Rb	203 60	10.18	ppb	0.76	200.00	
88 Sr	529.60	26.48	ppb	0.28	600.00	
90 Zr	39.90	2.00	ppb	1.87	200.00	
95 Mo	8.87	0.44	ppb	2.99	200.00	
97 Mo	7.91	0.40	ppb	1.67	200.00	
98 Mo	7 65	0.38	ppb	1.49	200.00	

107 Ag	1.01	0.05	ppb	9.05	200.00
109 Ag	0.99	0.05	ppb	6.54	200.00
111 Cd	6.63	0.33	ppb	6.20	200.00
114 Cd	5.88	0.29	ppb	5.86	200.00
118 Sn	4.42	0.22	ppb	3.69	200.00
120 Sn	4.25	0.21	ppb	2.76	200.00
121 Sb	2.35	0.12	ppb	1.37	200.00
123 Sb	2.58	0.13	ppb	3.07	200.00
125 Te	-0.06	0.00	ppb	243.04	200.00
126 Te	0.00	0.00	ppb	3044.60	200.00
133 Cs	20.58	1.03	ppb	3.60	200.00
137 Ba	707.40	35.37	ppb	5.07	400.00
203 Tl	1.68	0.08	ppb	11.75	200.00
205 Tl	1.78	0.09	ppb	1.39	200.00
208 Pb	272.60	13.63	ppb	3.91	200.00
209 Bi	2.60	0.13	ppb	7.98	200.00
232 Th	63.76	3.19	ppb	1.32	200.00
238 U	30.98	1.55	ppb	5.33	200.00

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	370160.81	5.26	348070.81	106.3	70 - 130	
72 Ge	61123.55	3.74	64011.38	95.5	70 - 130	
89 Y	641219.38	3.47	610073.63	105.1	70 - 130	
115 In	519278.19	6.69	578951.50	89.7	70 - 130	
159 Tb	879786.38	0.40	1206407.00	72.9	70 - 130	

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2916a.B\003CALB.D\003CALB.D#

3 :Element Failures 0 :Max. Number of Failures Allowed
0 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: Fail
ISTD: Pass

Sample QC Report

Data File:	D:\ICPCHEM\1\DATA\02A2916A.B\146SMPL.D\146SMPL.D#
Date Acquired:	Jan 30 2002 11:12 am
Acq. Method:	WATER10.M
Operator:	ASW
Sample Name:	SALM-2711 29360
Misc Info:	
Vial Number:	4207
Current Method:	D:\ICPCHEM\1\DATA\02A2916A.B\WATER10.M
Calibration File:	D:\ICPCHEM\1\DATA\02A2916a.B\WATER10.C
Last Cal. Update:	Jan 29 2002 06:03 pm
Sample Type:	Sample
Dilution Factor:	20.00
Autodil Factor:	Undiluted
Final Dil Factor:	20.00

QC Elements

Element	Corr Conc	Raw Conc	Units	RSD(%)	High Limit	Flag
7 Li	191.26	9.56	ppb	5.71	200.00	
9 Be	12.53	0.63	ppb	6.41	200.00	
11 B	83.02	4.15	ppb	9.22	400.00	
23 Na	2,510.00	125.50	ppb	4.06	30000.00	
24 Mg	86,960.00	4348.00	ppb	3.33	20000.00	
27 Al	145,480.00	7274.00	ppb	2.72	1000.00	>LRS
29 SiO2	20,680.00	1034.00	ppb	10.39	20000.00	
31 PO4	25,180.00	1259.00	ppb	3.38	4000.00	
39 K	42,940.00	2147.00	ppb	3.34	15000.00	
43 Ca	130,920.00	6546.00	ppb	3.83	50000.00	
47 Ti	3,082.00	154.10	ppb	5.01	200.00	
51 V	512.40	25.62	ppb	4.47	200.00	
52 Cr	237.80	11.89	ppb	5.23	200.00	
53 Cr	247.40	12.37	ppb	7.11	200.00	
55 Mn	5,766.00	288.30	ppb	6.69	1000.00	
57 Fe	252,000.00	12600.00	ppb	6.56	10000.00	>LRS
59 Co	99.84	4.99	ppb	6.16	200.00	
60 Ni	198.32	9.92	ppb	6.60	200.00	
62 Ni	207.80	10.39	ppb	4.73	200.00	
63 Cu	1,330.80	66.54	ppb	5.81	2000.00	
65 Cu	1,323.00	66.15	ppb	4.52	2000.00	
66 Zn	2,230.00	111.50	ppb	5.53	2000.00	
75 As	1,107.40	55.37	ppb	3.91	200.00	
82 Se	13.93	0.70	ppb	14.21	200.00	
85 Rb	270.00	13.50	ppb	4.07	200.00	
88 Sr	451.60	22.58	ppb	3.02	600.00	
90 Zr	78.94	3.95	ppb	2.39	200.00	
95 Mo	12.63	0.63	ppb	6.03	200.00	
97 Mo	12.36	0.62	ppb	3.95	200.00	
98 Mo	11.61	0.58	ppb	2.49	200.00	

107 Ag	44.44	2.22	ppb	7.85	200.00	
109 Ag	43.82	2.19	ppb	8.59	200.00	
111 Cd	466.60	23.33	ppb	9.33	200.00	
114 Cd	454.80	22.74	ppb	9.64	200.00	
118 Sn	24.30	1.22	ppb	4.34	200.00	
120 Sn	23.18	1.16	ppb	4.33	200.00	
121 Sb	149.40	7.47	ppb	4.31	200.00	
123 Sb	144.42	7.22	ppb	5.65	200.00	
125 Te	10.72	0.54	ppb	12.01	200.00	
126 Te	10.89	0.54	ppb	7.12	200.00	
133 Cs	26.68	1.33	ppb	3.56	200.00	
137 Ba	1,918.60	95.93	ppb	3.56	400.00	
203 Tl	21.66	1.08	ppb	6.28	200.00	
205 Tl	26.28	1.31	ppb	3.41	200.00	
208 Pb	14,550.00	727.50	ppb	5.75	200.00	>LRS
209 Bi	29.56	1.48	ppb	4.16	200.00	
232 Th	107.74	5.39	ppb	4.07	200.00	
238 U	14.49	0.72	ppb	8.99	200.00	

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	345959.69	6.18	348070.81	99.4	70 - 130	
72 Ge	57209.01	4.94	64011.38	89.4	70 - 130	
89 Y	671518.63	5.44	610073.63	110.1	70 - 130	
115 In	493501.50	1.00	578951.50	85.2	70 - 130	
159 Tb	871031.13	1.52	1206407.00	72.2	70 - 130	

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2916a.B\003CALB.D\003CALB.D#

3 :Element Failures 0 :Max. Number of Failures Allowed
0 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: Fail
ISTD: Pass

Sample QC Report

Data File:	D:\ICPCHEM\1\DATA\02A2916a.B\148SMPL.D\148SMPL.D#
Date Acquired:	Jan 30 2002 11:27 am
Acq. Method:	WATER10.M
Operator:	ASW
Sample Name:	201280074 SAMPLE
Misc Info:	29360
Vial Number:	4109
Current Method:	D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File:	D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal. Update:	Jan 29 2002 05:03 pm
Sample Type:	Sample
Dilution Factor:	20.00
Autodil Factor:	Undiluted
Final Dil Factor:	20.00

QC Elements

Element	Corr Conc	Raw Conc	Units	RSD(%)	High Limit	Flag
7 Li	164.26	8.21	ppb	4.49	200.00	
9 Be	6.10	0.31	ppb	4.81	200.00	
11 B	-6.59	-0.33	ppb	24.85	400.00	
23 Na	1,349.80	67.49	ppb	4.25	30000.00	
24 Mg	49,780.00	2489.00	ppb	4.96	20000.00	
27 Al	64,360.00	3218.00	ppb	1.20	1000.00	>LRS
29 SiO2	5,038.00	251.90	ppb	11.07	20000.00	
31 PO4	46,380.00	2319.00	ppb	1.10	4000.00	
39 K	9,676.00	483.80	ppb	3.85	15000.00	
43 Ca	26,060.00	1303.00	ppb	1.95	50000.00	
47 Ti	3,162.00	158.10	ppb	4.21	200.00	
51 V	508.60	25.43	ppb	5.08	200.00	
52 Cr	205.60	10.28	ppb	5.61	200.00	
53 Cr	229.80	11.49	ppb	4.60	200.00	
55 Mn	2,390.00	119.50	ppb	7.52	1000.00	
57 Fe	225,600.00	11280.00	ppb	8.10	10000.00	>LRS
59 Co	79.10	3.96	ppb	6.69	200.00	
60 Ni	159.02	7.95	ppb	5.36	200.00	
62 Ni	161.66	8.08	ppb	4.76	200.00	
63 Cu	310.00	15.50	ppb	5.41	2000.00	
65 Cu	307.20	15.36	ppb	4.40	2000.00	
66 Zn	611.80	30.59	ppb	5.66	2000.00	
75 As	31.86	1.59	ppb	3.33	200.00	
82 Se	1.02	0.05	ppb	248.09	200.00	
85 Rb	119.60	5.98	ppb	3.62	200.00	
88 Sr	374.60	18.73	ppb	2.68	600.00	
90 Zr	24.48	1.22	ppb	3.65	200.00	
95 Mo	8.34	0.42	ppb	9.35	200.00	
97 Mo	7.89	0.39	ppb	3.03	200.00	
98 Mo	7.33	0.37	ppb	8.76	200.00	

107 Ag	0.79	0.04	ppb	13.62	200.00
109 Ag	0.73	0.04	ppb	17.37	200.00
111 Cd	3.10	0.16	ppb	12.07	200.00
114 Cd	2.69	0.13	ppb	13.65	200.00
118 Sn	6.02	0.30	ppb	8.10	200.00
120 Sn	10.23	0.51	ppb	68.52	200.00
121 Sb	2.21	0.11	ppb	11.93	200.00
123 Sb	2.02	0.10	ppb	13.42	200.00
125 Te	0.56	0.03	ppb	122.50	200.00
126 Te	1.23	0.06	ppb	10.16	200.00
133 Cs	12.62	0.63	ppb	2.75	200.00
137 Ba	594.40	29.72	ppb	2.77	400.00
203 Tl	0.90	0.05	ppb	11.70	200.00
205 Tl	1.00	0.05	ppb	15.23	200.00
208 Pb	316.80	15.84	ppb	6.46	200.00
209 Bi	3.61	0.18	ppb	4.24	200.00
232 Th	90.30	4.52	ppb	3.19	200.00
238 U	23.10	1.16	ppb	8.83	200.00

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	347002.00	8.14	348070.81	99.7	70 - 130	
72 Ge	57246.24	6.72	64011.38	89.4	70 - 130	
89 Y	589391.81	7.98	610073.63	96.6	70 - 130	
115 In	481140.31	0.75	578951.50	83.1	70 - 130	
159 Tb	880334.69	4.15	1206407.00	73.0	70 - 130	

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2916a.B\003CALB.D\003CALB.D#

2 :Element Failures 0 :Max. Number of Failures Allowed
0 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: Fail
ISTD: Pass

Sample QC Report

Data File:	D:\ICPCHEM\1\DATA\02A2916a.B\149SMPL.D\149SMPL.D#
Date Acquired:	Jan 30 2002 11:35 am
Acq. Method:	WATER10.M
Operator:	ASW
Sample Name:	201280075 SAMPLE
Misc Info:	29360
Vial Number:	4110
Current Method:	D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File:	D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal. Update:	Jan 29 2002 05:03 pm
Sample Type:	Sample
Dilution Factor:	20.00
Autodil Factor:	Undiluted
Final Dil Factor:	20.00

QC Elements

Element	Corr Conc	Raw Conc	Units	RSD(%)	High Limit	Flag
7 Li	229.20	11.46	ppb	4.50	200.00	
9 Be	4.98	0.25	ppb	9.20	200.00	
11 B	-6.70	-0.34	ppb	53.00	400.00	
23 Na	1,343.60	67.18	ppb	2.25	30000.00	
24 Mg	56,460.00	2823.00	ppb	1.72	20000.00	
27 Al	76,540.00	3827.00	ppb	3.50	1000.00	>LRS
29 SiO2	5,294.00	264.70	ppb	3.94	20000.00	
31 PO4	68,300.00	3415.00	ppb	4.50	4000.00	
39 K	15,984.00	799.20	ppb	2.19	15000.00	
43 Ca	31,260.00	1563.00	ppb	1.74	50000.00	
47 Ti	6,498.00	324.90	ppb	4.60	200.00	>LRS
51 V	384.60	19.23	ppb	5.09	200.00	
52 Cr	223.40	11.17	ppb	5.06	200.00	
53 Cr	251.20	12.56	ppb	5.97	200.00	
55 Mn	2,100.00	105.00	ppb	6.98	1000.00	
57 Fe	199,060.00	9953.00	ppb	7.29	10000.00	
59 Co	69.88	3.49	ppb	4.99	200.00	
60 Ni	194.02	9.70	ppb	4.41	200.00	
62 Ni	200.20	10.01	ppb	3.94	200.00	
63 Cu	124.18	6.21	ppb	5.12	2000.00	
65 Cu	124.14	6.21	ppb	4.65	2000.00	
66 Zn	701.40	35.07	ppb	4.04	2000.00	
75 As	20.82	1.04	ppb	8.35	200.00	
82 Se	0.70	0.04	ppb	894.63	200.00	
85 Rb	191.18	9.56	ppb	2.77	200.00	
88 Sr	584.60	29.23	ppb	3.28	600.00	
90 Zr	36.14	1.81	ppb	1.42	200.00	
95 Mo	4.72	0.24	ppb	4.10	200.00	
97 Mo	4.53	0.23	ppb	1.18	200.00	
98 Mo	3 92	0.20	ppb	4.31	200.00	

107 Ag	0.66	0.03	ppb	8.44	200.00
109 Ag	0.59	0.03	ppb	6.67	200.00
111 Cd	5.86	0.29	ppb	3.35	200.00
114 Cd	5.36	0.27	ppb	12.31	200.00
118 Sn	4.66	0.23	ppb	3.48	200.00
120 Sn	4.34	0.22	ppb	3.57	200.00
121 Sb	2.05	0.10	ppb	12.23	200.00
123 Sb	2.15	0.11	ppb	1.07	200.00
125 Te	0.22	0.01	ppb	106.68	200.00
126 Te	-0.01	0.00	ppb	456.07	200.00
133 Cs	13.73	0.69	ppb	3.15	200.00
137 Ba	816.40	40.82	ppb	5.47	400.00
203 Tl	1 65	0.08	ppb	3.77	200.00
205 Tl	1.74	0.09	ppb	5.82	200.00
208 Pb	237.80	11.89	ppb	4.43	200.00
209 Bi	1.52	0.08	ppb	9.40	200.00
232 Th	149.62	7.48	ppb	2.65	200.00
238 U	30.06	1.50	ppb	7.75	200.00

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	388985.31	10.00	348070.81	111.8	70 - 130	
72 Ge	59667.31	7.09	64011.38	93.2	70 - 130	
89 Y	627165.38	7.06	610073.63	102.8	70 - 130	
115 In	507380.31	4.22	578951.50	87.6	70 - 130	
159 Tb	847358.69	1.66	1206407.00	70.2	70 - 130	

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2916a.B\003CALB.D\003CALB.D#

2 :Element Failures 0 :Max. Number of Failures Allowed
0 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: Fail
ISTD. Pass

Sample QC Report

Data File:	D:\ICPCHEM\1\DATA\02A2916a.B\150SMPL.D\150SMPL.D#
Date Acquired:	Jan 30 2002 11:43 am
Acq. Method:	WATER10.M
Operator:	ASW
Sample Name:	201280075 DUP
Misc Info:	29360
Vial Number:	4111
Current Method:	D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File:	D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal. Update:	Jan 29 2002 05:03 pm
Sample Type:	Sample
Dilution Factor:	20.00
Autodil Factor:	Undiluted
Final Dil Factor:	20.00

QC Elements

Element	Corr Conc	Raw Conc	Units	RSD(%)	High Limit	Flag
7 Li	183.96	9.20	ppb	5.11	200.00	
9 Be	4.92	0.25	ppb	9.27	200.00	
11 B	-4.66	-0.23	ppb	104.25	400.00	
23 Na	1,115.80	55.79	ppb	9.18	30000.00	
24 Mg	49,280.00	2464.00	ppb	6.56	20000.00	
27 Al	71,260.00	3563.00	ppb	5.33	1000.00	>LRS
29 SiO2	5,500.00	275.00	ppb	17.14	20000.00	
31 PO4	60,900.00	3045.00	ppb	4.41	4000.00	
39 K	14,734.00	736.70	ppb	6.32	15000.00	
43 Ca	26,660.00	1333.00	ppb	5.65	50000.00	
47 Ti	6,364.00	318.20	ppb	4.39	200.00	>LRS
51 V	333.60	16.68	ppb	3.71	200.00	
52 Cr	206.80	10.34	ppb	4.41	200.00	
53 Cr	239.00	11.95	ppb	5.36	200.00	
55 Mn	2,306.00	115.30	ppb	3.72	1000.00	
57 Fe	193,180.00	9659.00	ppb	5.21	10000.00	
59 Co	64.70	3.24	ppb	4.49	200.00	
60 Ni	175.86	8.79	ppb	5.19	200.00	
62 Ni	180.78	9.04	ppb	4.53	200.00	
63 Cu	151.36	7.57	ppb	4.31	2000.00	
65 Cu	151.00	7.55	ppb	3.75	2000.00	
66 Zn	681.00	34.05	ppb	3.64	2000.00	
75 As	30.20	1.51	ppb	7.72	200.00	
82 Se	-1.55	-0.08	ppb	77.98	200.00	
85 Rb	200.80	10.04	ppb	4.76	200.00	
88 Sr	523.60	26.18	ppb	4.22	600.00	
90 Zr	42.72	2.14	ppb	6.91	200.00	
95 Mo	5.33	0.27	ppb	9.70	200.00	
97 Mo	4 47	0.22	ppb	7.87	200.00	
98 Mo	4.12	0.21	ppb	4.03	200.00	

107 Ag	0.76	0.04	ppb	10.71	200.00
109 Ag	0.65	0.03	ppb	2.66	200.00
111 Cd	6.33	0.32	ppb	9.52	200.00
114 Cd	6.07	0.30	ppb	5.49	200.00
118 Sn	6.43	0.32	ppb	42.15	200.00
120 Sn	4.68	0.23	ppb	7.32	200.00
121 Sb	2.70	0.13	ppb	3.74	200.00
123 Sb	2.78	0.14	ppb	2.52	200.00
125 Te	-0.15	-0.01	ppb	379.03	200.00
126 Te	0.04	0.00	ppb	209.80	200.00
133 Cs	15.10	0.76	ppb	6.98	200.00
137 Ba	1,185.00	59.25	ppb	8.43	400.00
203 Tl	1.52	0.08	ppb	2.89	200.00
205 Tl	1.63	0.08	ppb	9.60	200.00
208 Pb	234.00	11.70	ppb	5.03	200.00
209 Bi	1.98	0.10	ppb	2.92	200.00
232 Th	86.48	4.32	ppb	2.94	200.00
238 U	20.64	1.03	ppb	5.26	200.00

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	314359.91	4.72	348070.81	90.3	70 - 130	
72 Ge	52202.04	3.69	64011.38	81.6	70 - 130	
89 Y	536811.13	3.70	610073.63	88.0	70 - 130	
115 In	440229.50	8.62	578951.50	76.0	70 - 130	
159 Tb	871988.50	4.56	1206407.00	72.3	70 - 130	

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2916a.B\003CALB.D\003CALB.D#

2 :Element Failures 0 :Max. Number of Failures Allowed
0 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: Fail
ISTD. Pass

Sample QC Report

Data File:	D:\ICPCHEM\1\DATA\02A2916a.B\151SMPL.D\151SMPL.D#
Date Acquired:	Jan 30 2002 11:51 am
Acq. Method:	WATER10.M
Operator:	ASW
Sample Name:	201280076 SAMPLE
Misc Info:	29360
Vial Number:	4112
Current Method:	D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File:	D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal. Update:	Jan 29 2002 05:03 pm
Sample Type:	Sample
Dilution Factor:	20.00
Autodil Factor:	Undiluted
Final Dil Factor:	20.00

QC Elements

Element	Corr Conc	Raw Conc	Units	RSD(%)	High Limit	Flag
7 Li	178.84	8.94	ppb	1.47	200.00	
9 Be	4.35	0.22	ppb	3.21	200.00	
11 B	-3.22	-0.16	ppb	159.93	400.00	
23 Na	1,337.00	66.85	ppb	1.92	30000.00	
24 Mg	87,280.00	4364.00	ppb	1.65	20000.00	
27 Al	83,840.00	4192.00	ppb	1.60	1000.00	>LRS
29 SiO2	4,684.00	234.20	ppb	10.65	20000.00	
31 PO4	50,680.00	2534.00	ppb	1.37	4000.00	
39 K	16,414.00	820.70	ppb	0.93	15000.00	
43 Ca	32,340.00	1617.00	ppb	0.51	50000.00	
47 Ti	5,722.00	286.10	ppb	2.05	200.00	>LRS
51 V	667.40	33.37	ppb	3.26	200.00	
52 Cr	221.20	11.06	ppb	4.85	200.00	
53 Cr	245.20	12.26	ppb	4.73	200.00	
55 Mn	3,078.00	153.90	ppb	6.02	1000.00	
57 Fe	269,000.00	13450.00	ppb	6.53	10000.00	>LRS
59 Co	96.54	4.83	ppb	5.75	200.00	
60 Ni	247.80	12.39	ppb	5.33	200.00	
62 Ni	250.00	12.50	ppb	3.84	200.00	
63 Cu	414.40	20.72	ppb	3.77	2000.00	
65 Cu	417.60	20.88	ppb	4.46	2000.00	
66 Zn	547.60	27.38	ppb	4.50	2000.00	
75 As	36.20	1.81	ppb	6.51	200.00	
82 Se	1.85	0.09	ppb	97.94	200.00	
85 Rb	186.16	9.31	ppb	0.71	200.00	
88 Sr	364.20	18.21	ppb	0.72	600.00	
90 Zr	25.74	1.29	ppb	0.43	200.00	
95 Mo	14.82	0.74	ppb	4.94	200.00	
97 Mo	14.53	0.73	ppb	3.38	200.00	
98 Mo	13.66	0.68	ppb	2.13	200.00	

107 Ag	1.00	0.05	ppb	4.76	200.00
109 Ag	0.90	0.05	ppb	10.54	200.00
111 Cd	1.85	0.09	ppb	16.13	200.00
114 Cd	1.33	0.07	ppb	9.38	200.00
118 Sn	4.33	0.22	ppb	2.45	200.00
120 Sn	3.97	0.20	ppb	2.93	200.00
121 Sb	1.73	0.09	ppb	14.04	200.00
123 Sb	1.46	0.07	ppb	11.32	200.00
125 Te	0.10	0.01	ppb	236.65	200.00
126 Te	0.18	0.01	ppb	1.56	200.00
133 Cs	17.68	0.88	ppb	5.21	200.00
137 Ba	505.60	25.28	ppb	5.60	400.00
203 Tl	1.17	0.06	ppb	9.31	200.00
205 Tl	1.27	0.06	ppb	4.09	200.00
208 Pb	300.60	15.03	ppb	3.77	200.00
209 Bi	3.95	0.20	ppb	6.57	200.00
232 Th	53.78	2.69	ppb	1.71	200.00
238 U	14.83	0.74	ppb	6.45	200.00

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	316983.81	12.07	348070.81	91.1	70 - 130	
72 Ge	51267.81	9.39	64011.38	80.1	70 - 130	
89 Y	518690.09	9.88	610073.63	85.0	70 - 130	
115 In	442120.09	3.76	578951.50	76.4	70 - 130	
159 Tb	884152.00	1.97	1206407.00	73.3	70 - 130	

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2916a.B\003CALB.D\003CALB.D#

3 :Element Failures 0 :Max. Number of Failures Allowed
0 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: Fail
ISTD: Pass

Sample QC Report

Data File:	D:\ICPCHEM\1\DATA\02A2916a.B\152SMPL.D\152SMPL.D#
Date Acquired:	Jan 30 2002 11:58 am
Acq. Method.	WATER10.M
Operator:	ASW
Sample Name:	201280078 SAMPLE
Misc Info:	29360
Vial Number:	4201
Current Method:	D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File:	D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal. Update:	Jan 29 2002 05:03 pm
Sample Type:	Sample
Dilution Factor:	20.00
Autodil Factor:	Undiluted
Final Dil Factor:	20.00

QC Elements

Element	Corr Conc	Raw Conc	Units	RSD(%)	High Limit	Flag
7 Li	157.66	7.88	ppb	3.91	200.00	
9 Be	5.22	0.26	ppb	4.63	200.00	
11 B	-2.26	-0.11	ppb	253.71	400.00	
23 Na	1,628.60	81.43	ppb	2.71	30000.00	
24 Mg	52,180.00	2609.00	ppb	6.21	20000.00	
27 Al	69,140.00	3457.00	ppb	2.16	1000.00	>LRS
29 SiO2	3,214.00	160.70	ppb	26.67	20000.00	
31 PO4	68,780.00	3439.00	ppb	3.49	4000.00	
39 K	8,764.00	438.20	ppb	2.63	15000.00	
43 Ca	38,740.00	1937.00	ppb	2.93	50000.00	
47 Ti	4,870.00	243.50	ppb	3.78	200.00	>LRS
51 V	445.20	22.26	ppb	5.18	200.00	
52 Cr	179.24	8.96	ppb	6.50	200.00	
53 Cr	206.60	10.33	ppb	6.91	200.00	
55 Mn	3,542.00	177.10	ppb	7.53	1000.00	
57 Fe	183,240.00	9162.00	ppb	8.23	10000.00	
59 Co	73.92	3.70	ppb	5.64	200.00	
60 Ni	139.70	6.99	ppb	7.40	200.00	
62 Ni	148.36	7.42	ppb	7.93	200.00	
63 Cu	205.40	10.27	ppb	6.52	2000.00	
65 Cu	202.40	10.12	ppb	5.17	2000.00	
66 Zn	404.60	20.23	ppb	6.10	2000.00	
75 As	38.52	1.93	ppb	0.80	200.00	
82 Se	2.91	0.15	ppb	57.49	200.00	
85 Rb	98.82	4.94	ppb	2.79	200.00	
88 Sr	540.80	27.04	ppb	2.45	600.00	
90 Zr	36.98	1.85	ppb	1.43	200.00	
95 Mo	11.82	0.59	ppb	3.70	200.00	
97 Mo	10.95	0.55	ppb	7.12	200.00	
98 Mo	11.13	0.56	ppb	2.76	200.00	

107 Ag	0.77	0.04	ppb	16.95	200.00
109 Ag	0.71	0.04	ppb	12.60	200.00
111 Cd	3.03	0.15	ppb	25.54	200.00
114 Cd	2.37	0.12	ppb	14.98	200.00
118 Sn	3.81	0.19	ppb	3.27	200.00
120 Sn	3.58	0.18	ppb	8.02	200.00
121 Sb	1.95	0.10	ppb	11.27	200.00
123 Sb	1.66	0.08	ppb	13.75	200.00
125 Te	-0.23	-0.01	ppb	142.48	200.00
126 Te	-0.03	0.00	ppb	384.78	200.00
133 Cs	13.42	0.67	ppb	3.57	200.00
137 Ba	518.80	25.94	ppb	4.48	400.00
203 Tl	0.88	0.04	ppb	3.09	200.00
205 Tl	0.94	0.05	ppb	7.16	200.00
208 Pb	178.16	8.91	ppb	6.92	200.00
209 Bi	2.70	0.13	ppb	5.95	200.00
232 Th	44.68	2.23	ppb	6.11	200.00
238 U	16.18	0.81	ppb	9.70	200.00

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	342884.50	6.49	348070.81	98.5	70 - 130	
72 Ge	53569.71	5.40	64011.38	83.7	70 - 130	
89 Y	558152.81	5.90	610073.63	91.5	70 - 130	
115 In	460624.41	1.40	578951.50	79.6	70 - 130	
159 Tb	866820.19	2.83	1206407.00	71.9	70 - 130	

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2916a.B\003CALB.D\003CALB.D#

2 :Element Failures 0 :Max. Number of Failures Allowed
0 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: Fail
ISTD Pass

Sample QC Report

Data File:	D:\ICPCHEM\1\DATA\02A2916a.B\153SMPL.D\153SMPL.D#
Date Acquired:	Jan 30 2002 12:06 pm
Acq. Method:	WATER10.M
Operator:	ASW
Sample Name:	201280079 SAMPLE
Misc Info:	29360
Vial Number:	4202
Current Method:	D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File:	D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal. Update:	Jan 29 2002 05:03 pm
Sample Type:	Sample
Dilution Factor:	20.00
Autodil Factor:	Undiluted
Final Dil Factor:	20.00

QC Elements

Element		Corr Conc	Raw Conc	Units	RSD(%)	High Limit	Flag
7	Li	210.40	10.52	ppb	1.08	200.00	
9	Be	6.11	0.31	ppb	7.47	200.00	
11	B	-0.94	-0.05	ppb	495.32	400.00	
23	Na	1,396.20	69.81	ppb	1.76	30000.00	
24	Mg	72,300.00	3615.00	ppb	0.24	20000.00	
27	Al	111,800.00	5590.00	ppb	1.91	1000.00	>LRS
29	SiO2	7,036.00	351.80	ppb	25.56	20000.00	
31	PO4	43,620.00	2181.00	ppb	1.65	4000.00	
39	K	19,626.00	981.30	ppb	1.65	15000.00	
43	Ca	22,960.00	1148.00	ppb	1.08	50000.00	
47	Ti	7,144.00	357.20	ppb	2.05	200.00	>LRS
51	V	545.80	27.29	ppb	3.23	200.00	
52	Cr	254.00	12.70	ppb	3.06	200.00	
53	Cr	278.80	13.94	ppb	4.01	200.00	
55	Mn	2,488.00	124.40	ppb	4.36	1000.00	
57	Fe	215,000.00	10750.00	ppb	4.71	10000.00	>LRS
59	Co	95.04	4.75	ppb	6.52	200.00	
60	Ni	194.92	9.75	ppb	5.10	200.00	
62	Ni	200.60	10.03	ppb	3.94	200.00	
63	Cu	239.20	11.96	ppb	5.39	2000.00	
65	Cu	240.00	12.00	ppb	5.07	2000.00	
66	Zn	415.60	20.78	ppb	5.25	2000.00	
75	As	28.08	1.40	ppb	3.08	200.00	
82	Se	0.39	0.02	ppb	718.50	200.00	
85	Rb	261.00	13.05	ppb	0.96	200.00	
88	Sr	353.40	17.67	ppb	0.36	600.00	
90	Zr	83.72	4.19	ppb	0.75	200.00	
95	Mo	8.69	0.43	ppb	5.23	200.00	
97	Mo	8.81	0.44	ppb	3.10	200.00	
98	Mo	8.17	0.41	ppb	2.51	200.00	

107 Ag	1 34	0.07	ppb	4.80	200.00
109 Ag	1.26	0.06	ppb	6.47	200.00
111 Cd	3.59	0.18	ppb	7.36	200.00
114 Cd	2.90	0.14	ppb	3.66	200.00
118 Sn	4.97	0.25	ppb	4.97	200.00
120 Sn	4.76	0.24	ppb	5.11	200.00
121 Sb	4.29	0.21	ppb	4.49	200.00
123 Sb	4.08	0.20	ppb	7.66	200.00
125 Te	-0.23	-0.01	ppb	89.09	200.00
126 Te	-0.08	0.00	ppb	115.87	200.00
133 Cs	16.86	0.84	ppb	2.66	200.00
137 Ba	967.20	48.36	ppb	2.55	400.00
203 Tl	1.54	0.08	ppb	1.62	200.00
205 Tl	1 72	0.09	ppb	5.28	200.00
208 Pb	229.00	11.45	ppb	4.40	200.00
209 Bi	2.94	0.15	ppb	2.03	200.00
232 Th	40.14	2.01	ppb	4.20	200.00
238 U	11.06	0.55	ppb	11.61	200.00

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	373980.31	4.59	348070.81	107.4	70 - 130	
72 Ge	57133.28	5.83	64011.38	89.3	70 - 130	
89 Y	574211.50	5.70	610073.63	94.1	70 - 130	
115 In	499220.50	1.17	578951.50	86.2	70 - 130	
159 Tb	873430.19	1.88	1206407.00	72.4	70 - 130	

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2916a.B\003CALB.D\003CALB.D#

3 :Element Failures 0 :Max. Number of Failures Allowed
0 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: Fail
ISTD: Pass

Sample QC Report

Data File:	D:\ICPCHEM\1\DATA\02A2916a.B\154SMPL.D\154SMPL.D#
Date Acquired:	Jan 30 2002 12:14 pm
Acq. Method:	WATER10.M
Operator:	ASW
Sample Name:	201280080 SAMPLE
Misc Info.	29360
Vial Number:	4203
Current Method:	D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File.	D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal. Update:	Jan 29 2002 05:03 pm
Sample Type:	Sample
Dilution Factor:	20.00
Autodil Factor:	Undiluted
Final Dil Factor:	20.00

QC Elements

Element	Corr Conc	Raw Conc	Units	RSD(%)	High Limit	Flag
7 Li	299.60	14.98	ppb	5.67	200.00	
9 Be	7.05	0.35	ppb	12.83	200.00	
11 B	74.88	3.74	ppb	3.04	400.00	
23 Na	4,470.00	223.50	ppb	6.30	30000.00	
24 Mg	93,240.00	4662.00	ppb	4.56	20000.00	
27 Al	129,660.00	6483.00	ppb	4.52	1000.00	>LRS
29 SiO2	19,836.00	991.80	ppb	9.66	20000.00	
31 PO4	78,560.00	3928.00	ppb	5.47	4000.00	
39 K	28,620.00	1431.00	ppb	2.25	15000.00	
43 Ca	79,380.00	3969.00	ppb	4.25	50000.00	
47 Ti	12,174.00	608.70	ppb	3.98	200.00	>LRS
51 V	566.40	28.32	ppb	4.34	200.00	
52 Cr	533.60	26.68	ppb	4.85	200.00	
53 Cr	557.80	27.89	ppb	6.24	200.00	
55 Mn	8,906.00	445.30	ppb	5.48	1000.00	
57 Fe	564,200.00	28210.00	ppb	7.21	10000.00	>LRS
59 Co	223.40	11.17	ppb	8.69	200.00	
60 Ni	311.80	15.59	ppb	7.80	200.00	
62 Ni	324.60	16.23	ppb	8.56	200.00	
63 Cu	5,056.00	252.80	ppb	7.40	2000.00	
65 Cu	5,042.00	252.10	ppb	7.36	2000.00	
66 Zn	20,400.00	1020.00	ppb	6.49	2000.00	
75 As	249.20	12.46	ppb	2.38	200.00	
82 Se	7.92	0.40	ppb	65.18	200.00	
85 Rb	287.00	14.35	ppb	3.10	200.00	
88 Sr	916.20	45.81	ppb	3.33	600.00	
90 Zr	147.56	7.38	ppb	1.93	200.00	
95 Mo	38.32	1.92	ppb	2.89	200.00	
97 Mo	38.34	1.92	ppb	3.27	200.00	
98 Mo	38.04	1.90	ppb	2.87	200.00	

107 Ag	26.96	1.35	ppb	7.57	200.00
109 Ag	26.54	1.33	ppb	7.84	200.00
111 Cd	34.64	1.73	ppb	8.64	200.00
114 Cd	43.26	2.16	ppb	9.60	200.00
118 Sn	316.20	15.81	ppb	4.09	200.00
120 Sn	303.20	15.16	ppb	4.22	200.00
121 Sb	450.20	22.51	ppb	4.55	200.00
123 Sb	433.20	21.66	ppb	4.17	200.00
125 Te	0 45	0.02	ppb	110.98	200.00
126 Te	0.30	0.02	ppb	67.88	200.00
133 Cs	20.70	1.04	ppb	2.69	200.00
137 Ba	3,230.00	161.50	ppb	2.63	400.00
203 Tl	7.25	0.36	ppb	8.78	200.00
205 Tl	9.26	0.46	ppb	7.39	200.00
208 Pb	3,878.00	193.90	ppb	8.81	200.00
209 Bi	4.77	0.24	ppb	7.21	200.00
232 Th	77.22	3.86	ppb	9.67	200.00
238 U	20.42	1.02	ppb	15.17	200.00

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	356093.09	3.12	348070.81	102.3	70 - 130	
72 Ge	55597.78	2.04	64011.38	86.9	70 - 130	
89 Y	603796.31	1.69	610073.63	99.0	70 - 130	
115 In	515065.09	4.68	578951.50	89.0	70 - 130	
159 Tb	828824.13	2.78	1206407.00	68.7	70 - 130	ISFail

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2916a.B\003CALB.D\003CALB.D#

3 :Element Failures 0 :Max. Number of Failures Allowed
1 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: Fail
ISTD: Fail

Sample QC Report

Data File:	D:\ICPCHEM\1\DATA\02A2916a.B\155SMPL.D\155SMPL.D#
Date Acquired:	Jan 30 2002 12:22 pm
Acq. Method:	WATER10.M
Operator:	ASW
Sample Name:	201280081 SAMPLE
Misc Info:	29360
Vial Number:	4204
Current Method:	D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File:	D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal. Update:	Jan 29 2002 05:03 pm
Sample Type:	Sample
Dilution Factor:	20.00
Autodil Factor:	Undiluted
Final Dil Factor:	20.00

QC Elements

Element	Corr Conc	Raw Conc	Units	RSD(%)	High Limit	Flag
7 Li	237.40	11.87	ppb	3.64	200.00	
9 Be	6.78	0.34	ppb	8.27	200.00	
11 B	105.84	5.29	ppb	5.49	400.00	
23 Na	4,808.00	240.40	ppb	1.28	30000.00	
24 Mg	74,000.00	3700.00	ppb	2.04	20000.00	
27 Al	107,080.00	5354.00	ppb	2.76	1000.00	>LRS
29 SiO2	16,240.00	812.00	ppb	5.50	20000.00	
31 PO4	71,840.00	3592.00	ppb	2.75	4000.00	
39 K	22,340.00	1117.00	ppb	2.09	15000.00	
43 Ca	80,600.00	4030.00	ppb	1.18	50000.00	
47 Ti	9,198.00	459.90	ppb	4.60	200.00	>LRS
51 V	571.20	28.56	ppb	4.69	200.00	
52 Cr	540.80	27.04	ppb	5.19	200.00	
53 Cr	559.40	27.97	ppb	5.41	200.00	
55 Mn	8,558.00	427.90	ppb	6.23	1000.00	
57 Fe	544,000.00	27200.00	ppb	6.23	10000.00	>LRS
59 Co	220.20	11.01	ppb	5.55	200.00	
60 Ni	254.00	12.70	ppb	5.13	200.00	
62 Ni	262.40	13.12	ppb	3.39	200.00	
63 Cu	5,278.00	263.90	ppb	5.14	2000.00	
65 Cu	5,218.00	260.90	ppb	5.62	2000.00	
66 Zn	18,368.00	918.40	ppb	5.69	2000.00	
75 As	199.20	9.96	ppb	3.75	200.00	
82 Se	7.74	0.39	ppb	31.90	200.00	
85 Rb	196.90	9.85	ppb	2.96	200.00	
88 Sr	860.40	43.02	ppb	2.28	600.00	
90 Zr	130.54	6.53	ppb	4.05	200.00	
95 Mo	43.82	2.19	ppb	2.34	200.00	
97 Mo	43.10	2.16	ppb	1.18	200.00	
98 Mo	42.38	2.12	ppb	2.82	200.00	

107 Ag	63.06	3.15	ppb	5.60	200.00
109 Ag	61.82	3.09	ppb	5.83	200.00
111 Cd	23.26	1.16	ppb	10.98	200.00
114 Cd	35.82	1.79	ppb	9.62	200.00
118 Sn	419.00	20.95	ppb	3.34	200.00
120 Sn	406.20	20.31	ppb	4.34	200.00
121 Sb	630.60	31.53	ppb	4.44	200.00
123 Sb	611.40	30.57	ppb	4.79	200.00
125 Te	0.56	0.03	ppb	19.78	200.00
126 Te	0.41	0.02	ppb	30.87	200.00
133 Cs	14.81	0.74	ppb	4.52	200.00
137 Ba	3,022.00	151.10	ppb	5.68	400.00
203 Tl	3.93	0.20	ppb	5.85	200.00
205 Tl	5 22	0.26	ppb	3.05	200.00
208 Pb	2,558.00	127.90	ppb	4.73	200.00
209 Bi	6.83	0.34	ppb	5.91	200.00
232 Th	108.52	5.43	ppb	5.96	200.00
238 U	27.72	1.39	ppb	8.41	200.00

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	375901.09	5.55	348070.81	108.0	70 - 130	
72 Ge	58206.69	4.77	64011.38	90.9	70 - 130	
89 Y	631677.13	4.10	610073.63	103.5	70 - 130	
115 In	541354 38	1.18	578951.50	93.5	70 - 130	
159 Tb	847716.50	0.22	1206407.00	70.3	70 - 130	

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2916a.B\003CALB.D\003CALB.D#

3 :Element Failures 0 :Max. Number of Failures Allowed
0 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: Fail
ISTD: Pass

Sample QC Report

Data File:	D:\ICPCHEM\1\DATA\02A2916a.B\156SMPL.D\156SMPL.D#
Date Acquired.	Jan 30 2002 12:29 pm
Acq. Method:	WATER10.M
Operator:	ASW
Sample Name:	201280082 SAMPLE
Misc Info:	29360
Vial Number.	4205
Current Method:	D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File:	D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal. Update:	Jan 29 2002 05:03 pm
Sample Type:	Sample
Dilution Factor:	20.00
Autodil Factor:	Undiluted
Final Dil Factor:	20.00

QC Elements

Element	Corr Conc	Raw Conc	Units	RSD(%)	High Limit	Flag
7 Li	345.40	17.27	ppb	0.83	200.00	
9 Be	8.44	0.42	ppb	1.62	200.00	
11 B	9.95	0.50	ppb	32.44	400.00	
23 Na	4,526.00	226.30	ppb	2.41	30000.00	
24 Mg	410,000.00	20500.00	ppb	2.31	20000.00	>LRS
27 Al	215,800.00	10790.00	ppb	1.65	1000.00	>LRS
29 SiO2	1,764.40	88.22	ppb	15.64	20000.00	
31 PO4	70,080.00	3504.00	ppb	1.40	4000.00	
39 K	42,840.00	2142.00	ppb	3.46	15000.00	
43 Ca	259,400.00	12970.00	ppb	1.92	50000.00	
47 Ti	10,300.00	515.00	ppb	2.15	200.00	>LRS
51 V	1,101.60	55.08	ppb	2.51	200.00	
52 Cr	808.80	40.44	ppb	4.03	200.00	
53 Cr	807.80	40.39	ppb	3.15	200.00	
55 Mn	7,650.00	382.50	ppb	4.81	1000.00	
57 Fe	481,200.00	24060.00	ppb	4.70	10000.00	>LRS
59 Co	244.40	12.22	ppb	2.33	200.00	
60 Ni	599.60	29.98	ppb	2.90	200.00	
62 Ni	610.80	30.54	ppb	1.72	200.00	
63 Cu	533.80	26.69	ppb	2.68	2000.00	
65 Cu	529.40	26.47	ppb	1.98	2000.00	
66 Zn	4,704.00	235.20	ppb	3.38	2000.00	
75 As	137.78	6.89	ppb	0.79	200.00	
82 Se	3.68	0.18	ppb	22.32	200.00	
85 Rb	320.20	16.01	ppb	0.62	200.00	
88 Sr	850.80	42.54	ppb	2.72	600.00	
90 Zr	133.18	6.66	ppb	3.80	200.00	
95 Mo	35.38	1.77	ppb	1.81	200.00	
97 Mo	35.20	1.76	ppb	1.86	200.00	
98 Mo	35.40	1.77	ppb	1.37	200.00	

107 Ag	2.53	0.13	ppb	5.02	200.00
109 Ag	2.35	0.12	ppb	4.42	200.00
111 Cd	41 04	2.05	ppb	3.21	200.00
114 Cd	38 96	1.95	ppb	4.65	200.00
118 Sn	7.37	0.37	ppb	5.41	200.00
120 Sn	7.22	0.36	ppb	7.44	200.00
121 Sb	13.75	0.69	ppb	2.41	200.00
123 Sb	13.12	0.66	ppb	6.08	200.00
125 Te	0.04	0.00	ppb	173.85	200.00
126 Te	0.11	0.01	ppb	58.90	200.00
133 Cs	31.86	1.59	ppb	2.61	200.00
137 Ba	4,418.00	220.90	ppb	2.28	400.00
203 Tl	3.68	0.18	ppb	2.72	200.00
205 Tl	4.63	0.23	ppb	2.21	200.00
208 Pb	1,962.40	98.12	ppb	2.14	200.00
209 Bi	2.89	0.14	ppb	4.43	200.00
232 Th	48.82	2.44	ppb	1.34	200.00
238 U	28.46	1.42	ppb	3.93	200.00

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	389993.09	5.95	348070.81	112.0	70 - 130	
72 Ge	57111.66	3.75	64011.38	89.2	70 - 130	
89 Y	612756.88	5.42	610073.63	100.4	70 - 130	
115 In	500998.69	1.36	578951.50	86.5	70 - 130	
159 Tb	817405.13	1.46	1206407.00	67.8	70 - 130	ISFail

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2916a.B\003CALB.D\003CALB.D#

4 :Element Failures 0 :Max. Number of Failures Allowed
1 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: Fail
ISTD: Fail

Sample QC Report

Data File:	D:\ICPCHEM\1\DATA\02A2916a.B\157SMPL.D\157SMPL.D#
Date Acquired:	Jan 30 2002 12:37 pm
Acq. Method:	WATER10.M
Operator:	ASW
Sample Name:	201280083 SAMPLE
Misc Info:	29360
Vial Number:	4206
Current Method:	D:\ICPCHEM\1\METHODS\WATER10.M
Calibration File:	D:\ICPCHEM\1\CALIB\WATER10.C
Last Cal. Update:	Jan 29 2002 05:03 pm
Sample Type:	Sample
Dilution Factor:	20.00
Autodil Factor:	Undiluted
Final Dil Factor:	20.00

QC Elements

Element	Corr Conc	Raw Conc	Units	RSD(%)	High Limit	Flag
7 Li	317.20	15.86	ppb	6.71	200.00	
9 Be	8.08	0.40	ppb	3.48	200.00	
11 B	11.37	0.57	ppb	7.86	400.00	
23 Na	4,440.00	222.00	ppb	5.69	30000.00	
24 Mg	196,540.00	9827.00	ppb	6.45	20000.00	
27 Al	253,800.00	12690.00	ppb	5.18	1000.00	>LRS
29 SiO2	1,109.80	55.49	ppb	28.74	20000.00	
31 PO4	61,100.00	3055.00	ppb	4.05	4000.00	
39 K	36,280.00	1814.00	ppb	2.63	15000.00	
43 Ca	121,700.00	6085.00	ppb	2.48	50000.00	
47 Ti	12,302.00	615.10	ppb	4.87	200.00	>LRS
51 V	1,552.00	77.60	ppb	5.81	200.00	
52 Cr	670.80	33.54	ppb	6.81	200.00	
53 Cr	692.60	34.63	ppb	7.21	200.00	
55 Mn	10,754.00	537.70	ppb	6.75	1000.00	
57 Fe	625,400.00	31270.00	ppb	5.83	10000.00	>LRS
59 Co	335.00	16.75	ppb	6.94	200.00	
60 Ni	493.00	24.65	ppb	6.54	200.00	
62 Ni	506.60	25.33	ppb	7.99	200.00	
63 Cu	778.20	38.91	ppb	6.76	2000.00	
65 Cu	777.80	38.89	ppb	5.56	2000.00	
66 Zn	766.60	38.33	ppb	5.97	2000.00	
75 As	172.74	8.64	ppb	4.40	200.00	
82 Se	5.08	0.25	ppb	28.87	200.00	
85 Rb	248.00	12.40	ppb	4.36	200.00	
88 Sr	1,305.00	65.25	ppb	4.07	600.00	
90 Zr	148.96	7.45	ppb	1.34	200.00	
95 Mo	10.55	0.53	ppb	3.02	200.00	
97 Mo	9.86	0.49	ppb	3.44	200.00	
98 Mo	9.24	0.46	ppb	6.30	200.00	

107 Ag	1.60	0.08	ppb	7.47	200.00
109 Ag	1.46	0.07	ppb	16.24	200.00
111 Cd	6.47	0.32	ppb	9.00	200.00
114 Cd	5.52	0.28	ppb	11.25	200.00
118 Sn	5.82	0.29	ppb	3.62	200.00
120 Sn	5.75	0.29	ppb	4.26	200.00
121 Sb	13.01	0.65	ppb	4.01	200.00
123 Sb	12.51	0.63	ppb	4.07	200.00
125 Te	0.15	0.01	ppb	134.02	200.00
126 Te	0.28	0.01	ppb	46.84	200.00
133 Cs	29.68	1.48	ppb	2.66	200.00
137 Ba	2,808.00	140.40	ppb	3.25	400.00
203 Tl	2.58	0.13	ppb	16.92	200.00
205 Tl	2.70	0.14	ppb	10.06	200.00
208 Pb	238.80	11.94	ppb	8.12	200.00
209 Bi	2.76	0.14	ppb	7.11	200.00
232 Th	77.64	3.88	ppb	6.96	200.00
238 U	10.02	0.50	ppb	8.54	200.00

ISTD Elements

Element	CPS Mean	RSD(%)	Ref Value	Rec(%)	QC Range(%)	Flag
45 Sc	347067.09	5.72	348070.81	99.7	70 - 130	
72 Ge	53181.84	4.84	64011.38	83.1	70 - 130	
89 Y	588401.81	4.46	610073.63	96.4	70 - 130	
115 In	456881.00	5.24	578951.50	78.9	70 - 130	
159 Tb	845624.31	2.94	1206407.00	70.1	70 - 130	

ISTD Ref File : D:\ICPCHEM\1\DATA\02A2916a.B\003CALB.D\003CALB.D#

3 :Element Failures 0 :Max. Number of Failures Allowed
0 :ISTD Failures 0 :Max. Number of ISTD Failures Allowed

Data Results:

Analytes: Fail
ISTD: Pass

Leco Carbon Analysis

Ken Vidal

18 May 2001

Contents

- Contents
- 1. Summary
  - 1.1 Applications
  - 1.2 Method Principles
- 2. Apparatus
- 3. Reagents
- 4. Procedure
  - 4.1 Alloy Samples
  - 4.2 Graphitic Carbon in Cast Iron
  - 4.3 Geological Samples
  - 4.4 Total Organic Carbon in Soils and Sediments
  - 4.5 Suggested sample weights
  - 4.6 Quality Control
  - 4.7 Addition of Accelerators
  - 4.8 Furnace setup
  - 4.9 Furnace calibration
  - 4.10 Furnace Operation
- 5. Calculations
- Bibliography

1. Summary

1.1 Applications

Analysis of carbon in steel cast iron stainless steel and other ferrous or non-ferrous alloys, geological materials, and other materials.

After suitable sample pre-treatment, analysis of graphitic carbon in ferrous alloys or analysis of total organic carbon in geological samples.

1.2 Method Principles

Fine sample materials (drillings or cuttings of alloys, powdered geological samples)

are burned using accelerators in an oxygen atmosphere using a Leco Induction Furnace. The combustion gases pass through scrubbers to remove water vapour and sulphur combustion products, and are absorbed by a dilute potassium hydroxide solution contained in a Dietert Volumetric Carbon Determinator.

The carbon dioxide generated from the combustion of the carbon in the sample produces a change in the volume in the Carbon Determinator.

The percent carbon is read directly from a scale as the apparatus is calibrated volumetrically.

2. Apparatus

1. Leco Induction Furnace
2. Dietert Model 3003 Two Minute Carbon Determinator

3. Reagents

1. Reagent Grade Hydrochloric Acid
2. Copper Ring Accelerator
3. Iron Chip Accelerator
4. Tin Chip Accelerator
5. Reagent Grade Magnesium Oxide, ashed 1 hr@950 degrees C and stored in dessicator
6. Reagent Grade Sulphuric Acid
7. Ten Percent Hydrochloric Acid Solution containing Methyl Red Indicator
8. Fifteen Percent Potassium Hydroxide Solution

4. Procedure

4.1 Alloy Samples

Alloy samples must be in the form of fine cuttings or drillings.

Using a drill press, drill solid samples using a clean drill bit. Several grams of drillings are required. Collect the drillings in a suitable manner, eg. with a sheet of paper.

If client-supplied drillings are not known to be free of oil contamination,

rinse the drillings several times with hexane and dry carefully before analysis.

4.2 Graphitic Carbon in Cast Iron

Weigh sample drillings into a 150 ml beaker. Since graphitic carbon in cast iron will be less than 1%, a suggested sample weight would be 1g. Add 15 ml hydrochloric acid in a fumehood.

Heat the solution and boil for ten minutes, remove from heat and cool.

Using a vacuum apparatus, filter solution through special Leco filtering crucibles.

Wash residue in filtering crucible at least five times with hot water.

Dry the filtering crucibles containing the sample residue for four hours at a maximum temperature of 60 degrees C.

Combust with one scoop of iron chip accelerator and subtract blank reading.

4.3 Geological Samples

Dry samples overnight at 60 degrees C.

Sample material for TOC analysis must be finely powdered, eg. minus 80 mesh, and homogeneous. Grind samples using mortar and pestle or Siebtek grinder, as required.

Some losses of petroleum fractions or other volatile materials may occur during drying and sample preparation steps.

4.4 Total Organic Carbon in Soils and Sediments

To optimize the analysis a preliminary total carbon analysis is performed on the finely-ground sample.

Weigh an appropriate sized sample into a 100 or 150 ml beaker. A weight of up to 0.5g is used for TOC analysis, however 0.1g is usually used to

minimize sulphur interference and speed combustion.

In a fumehood, add 15 mls concentrated HCl, heat for 10 minutes, remove from heat and cool.

Using a vacuum apparatus, filter solution through special Leco filtering crucibles.

Wash residue in filtering crucible at least three times with hot water, and dry crucibles overnight at a maximum temperature of 60 deg. C.

4.5 Suggested sample weights

Sample Type	Suggested Sample Size
Cast Iron	0.25g
Other Ferrous Alloys	1.00g
Non-ferrous Alloys	1.00g
Geological	0.01-0.5g

4.6 Quality Control

Where sample size permits, steel and alloy samples are analyzed in duplicate.

Geological samples are normally analyzed with ten percent duplicates.

TOC samples have one blank per set.

Certified reference materials are available as Certified Ring Standards (available from Delta Scientific) and as Certified Alloy Chip materials from the U.S. National Bureau of Standards, British Chemical

Standards and other sources.

Delta Certified rings are to be run with each batch of samples; NBS or BCS Certified Standards are to be run as project requirements dictate.

A certified ring should be run every ten samples for calibration verification.

4.7 Addition of Accelerators

To each cucible, add one scoop of Iron Chip Accelerator and one Copper Ring Accelerator.

For non-ferrous alloys or geological samples a further addition of one scoop of Tin Chip Accelerator is made.

When analyzing high sulphur soils for TC/TOC a further addition of one scoop of ashed MgO is made to blanks, samples and standards to speed evolution of SO.

4.8 Furnace setup

1. Clean furnace thoroughly.
2. Set induction coil spacing to approx. 0.100" , as per operating manual.
3. Check that bottom of pedestal is in. from floor of pedestal tray.
4. When the tray is locked in position, the inside bottom of the crucible should be near the geometric centre of the induction coil.
5. Oxygen line into top of furnace.
6. Combustion products gas exit line passes out the bottom of the furnace, then through lower cloth filter.
7. Combustion product gas flows out top of filter device, through catalyst, to absorbing solution in Dietert Volumetric Determinator.
8. Use glass furnace tube with small hole (``restricted tube").
9. Set oxygen at 8 psi.

4.9 Furnace calibration

For each sample batch, calibrate the Carbon Determinator using one or more Standard Carbon Rings. The calibration standards chosen should be in the

same range as that expected for the samples; for example, for a stainless steel, use a low level ring.

4.10 Furnace Operation

1. Switch on Leco ``Filament Voltage" then ``High Voltage"; Furnace will not operate for 45 seconds. Turn gas coil cooling fan on.
2. Turn three-way valve to atmosphere (4:00). Check meniscus level on carbon readout scale, if low add water; mark zero point.
3. Do leak check:
    1. raise crucible and main switch, put bottle up.
    2. Turn valve to system (6:00)
    3. Lower bottle: no leaks if readout scale has stable reading.
4. Turn Grid Control to ``High"; as analysis continues, turn control down if Grid nears ``500".
5. Open valve to atmosphere (4:00). Place levelling bottle up and note zero point on scale.
6. Lower main crucible switch to turn furnace on.
7. Close valve for collecting (6:00)
8. Lower levelling bottle.
9. Turn oxygen on to 1 litre per minute.
10. When solution level nears bottom of readout scale, turn crucible switch off and turn off oxygen flow.
11. Turn valve to atmosphere (4:00).
12. Turn valve to measurement system (right-2:00).
13. Move levelling bottle up and down twice.
14. Line up bottom of meniscus on right side of apparatus, then wait 10 seconds and read percent carbon result directly from the appropriate scale. The scales are a ``1 gram scale" and a ``[illegible] gram scale".
15. Open valve to atmosphere (4:00). Continue with analysis of next sample.

5. Calculations

The results from the daily calibration standard rings are used to correct for temperature and atmospheric pressure variations. Exercise judgement in applying the correction factors.

Bibliography

1 Instruction Manual for Operation of Leco Induction Furnaces Models 521, 522, and 523 Laboratory Equipment Corporation June 1956

2 Chemical Analysis of Iron and Steel, Lundell, Hoffman, Bright, John Wiley, New York (1931) pp 154-187

3 ASTM E350-89c Standard Methods for Chemical Analysis of Carbon Steel, Low Alloy Steel,

Silicon Electrical Steel, Ingot Iron, and Wrought Iron
4 ASTM E351-89 Standard Methods for Chemical Analysis of Cast Iron-All Types
5 ASTM E352-89 Tool and Medium to High Alloy Steels

About this document ...

Leco Carbon Analysis

This document was generated using the **LaTeX**2HTML translator Version 99.1 release (March 30, 1999)

Copyright © 1993, 1994, 1995, 1996, Nikos Drakos, Computer Based Learning Unit, University of Leeds.
Copyright © 1997, 1998, 1999, Ross Moore, Mathematics Department, Macquarie University, Sydney.

The command line arguments were:
latex2html `-no_subdir -split 0 -show_section_numbers /usr/local/httpd/htdocs/methods/carbon.tex`

The translation was initiated by root on 2002-01-22

---

root

2002-01-22

Instrument: LECO Created by: krv on Jan 30/02 12:22 pm

Sample#	A Type	Client Sample ID	Batch#	IV	FV
	BLANK		**29415**		
TOC-SOIL 0					
201280112	**SAMPLE**	**SEA106 SS1S**	**29415**		
TOC-SOIL 3.69					
201280116	**SAMPLE**	**SEA106 SS2S**	**29415**		
TOC-SOIL 2.05					
201280118	**SAMPLE**	**SEA106 SS2D**	**29415**		
TOC-SOIL 0.73					
201280119	**SAMPLE**	**SEA106 SS3S**	**29415**		
TOC-SOIL 3.05					
201280121	**SAMPLE**	**SEA106 SS4**	**29415**		
TOC-SOIL 1.48					
201280123	**SAMPLE**	**SEA106 SS6**	**29415**		
TOC-SOIL 1.66					
201280124	**SAMPLE**	**SEA106 SS7**	**29415**		
TOC-SOIL 1.26					
201280125	**DUP**	**SEA106 SS4 Duplicate**	**29415**		
TOC-SOIL 1.24					
201280125	**SAMPLE**	**SEA106 SS4 Duplicate**	**29415**		
TOC-SOIL 1.33					
201260011	**SAMPLE**	**KEY004 MW02-17- 5.5**	**29415**		
TOC-SOIL 0.13					
201260012	**SAMPLE**	**KEY004 MW02-17- 8'**	**29415**		
TOC-SOIL 0.07					
201260013	**SAMPLE**	**KEY004 MW02-17- 12'**	**29415**		
TOC-SOIL 0.03					
201260014	**SAMPLE**	**KEY004 MW02-17- 17'**	**29415**		
TOC-SOIL 0.09					
201260015	**SAMPLE**	**KEY004 MW02-19- 13'**	**29415**		
TOC-SOIL 0.06					
201260016	**SAMPLE**	**KEY004 MW02-19- 7'**	**29415**		
TOC-SOIL 0.08					

Instrument: LECO Created by: krv on Jan 30/02 12:22 pm

Sample#	A Type	Client Sample ID	Batch#	IV	FV
201280066	**SAMPLE**	**COL117 1A**	**29415**		
TOC-SOIL 0.22					
201280068	**SAMPLE**	**COL117 2A**	**29415**		
TOC-SOIL 0.09					
201280069	**SAMPLE**	**COL117 1B**	**29415**		
TOC-SOIL 0.72					
201280070	**SAMPLE**	**COL117 2B**	**29415**		
TOC-SOIL 0.57					
201280071	**SAMPLE**	**COL117 3A**	**29415**		
TOC-SOIL 0.12					
201280072	**SAMPLE**	**COL117 3B**	**29415**		
TOC-SOIL 0.63					
201280073	**SAMPLE**	**COL117 41**	**29415**		
TOC-SOIL 0.18					
201280074	**SAMPLE**	**COL117 42**	**29415**		
TOC-SOIL 0.07					
201280075	**SAMPLE**	**COL117 51**	**29415**		
TOC-SOIL 0.05					
201280076	**DUP**	**COL117 52**	**29415**		
TOC-SOIL 0.16					
201280076	**SAMPLE**	**COL117 52**	**29415**		
TOC-SOIL 0.15					
201280078	**SAMPLE**	**COL117 61**	**29415**		
TOC-SOIL 0.07					
201280079	**SAMPLE**	**COL117 62**	**29415**		
TOC-SOIL 0.14					
201280080	**SAMPLE**	**COL117 71**	**29415**		
TOC-SOIL 0.14					
201280081	**SAMPLE**	**COL117 81**	**29415**		
TOC-SOIL 0.07					
201280082	**SAMPLE**	**COL117 91**	**29415**		
TOC-SOIL 0.16					

Instrument: LECO Created by: krv on Jan 30/02 12:22 pm

Sample#	A Type	Client Sample ID	Batch#	IV	FV
201280083	**SAMPLE**	**COL117 101**	**29415**		
TOC-SOIL 0.06					

****** End of worklist# 62347 ******

[redacted]

Columbia Environmental 28 Jan 02
30128011

Soils: TOC

TOC

30 Jan 02

SAMPLE	Weight	lgScale	%TOC
CRing	(0.050%C) t=1.00 See 30128006		(0.028%C) t=0.75 See 30126002
Blk-1	See 30126002		
80066	0.1133	0.035	0.22
68	0.1175	0.015	0.09
69	0.1115	0.080	0.72
70	0.1324	0.075	0.57
71	0.1395	0.025	0.12
72	0.1185	0.075	0.63
73	0.1346	0.035	0.18
74	0.1065	0.010	0.07
75	0.1331	0.010	0.05
76	0.1220	0.025	0.14
76'	0.1065	0.025	0.16 / 0.15
cal Ver	(0.182%C) 0.185		
78	0.1024	0.010	0.07
79	0.1236	0.025	0.14
80	0.1480	0.030	0.14
81	0.1584	0.015	0.07
82	0.1321	0.030	0.16
83	0.1487	0.020	0.09
83'	0.1064	0.005	0.03 / 0.06
cal Ver	(0.182%C) 0.175		

SAMPLE	Wt
CRing	(0.8
20201 0079	0.110
97	0.105
98	0.102
99	0.110
100	0.106
101	0.119
101'	0.142
CalVer	(0.18
CRing	(0.18

SAMPLE	Wt
CRing	(0.050
Blk-1	—
20201 0079	0.011
97	0.011
98	0.012
99	0.010
100	0.0116
101	0.0113

The State of Washington Department of Ecology

This is to certify that

Cantest Ltd.

Burnaby, BC

has complied with provisions set forth in Chapter 173-50 WAC and is hereby recognized by the Department of Ecology as an ACCREDITED LABORATORY for the analytical parameters listed on the accompanying Scope of Accreditation. This certificate is effective August 1, 2001, and shall expire July 31, 2002.

Witnessed under my hand on July 19, 2001.

Perry F. Brake, Chemist
Lab Accreditation Unit Supervisor

Lab Accreditation Number
C250

Scope of Accreditation

Cantest Ltd.

Burnaby, BC

is accredited by the State of Washington Department of Ecology to perform analyses for the parameters listed below using the analytical methods indicated. This Scope of Accreditation applies to non-potable water analyses only. Accreditation for all parameters is final unless indicated otherwise in a note. Accreditation is for the latest version of a method unless otherwise specified in a note. EPA refers to the U.S. Environmental Protection Agency. SM refers to American Public Health Association's publication, Standard Methods for the Examination of Water and Wastewater, 19th edition, unless otherwise noted. ASTM stands for the American Society of Testing and Materials. PSEP stands for Puget Sound Estuary Program. Other references are detailed in the notes section.

Parameter Name	Reference	Method Number	Notes
Alkalinity, Total	SM	403(4a)	1
Biochemical Oxygen Demand, BOD/CBOD	SM	507	1
Calcium	EPA	200.15	1
Chloride	SM	4110 B	1
Cyanide, Total	SM	4500-CN C+E	1
Fluoride	SM	4110 B	1
Magnesium	EPA	200.15	1
Nitrate	SM	4110 B	1
Nitrate + Nitrite	SM	4500-NO3-F	1
Nitrogen, Total Kjeldahl	SM	4500-Norg C	1
pH	SM	4500-H	1
Phosphorus, Total	SM	424 C(III)+F	1
Phosphorus, Total	SM	424 E	1
Potassium	SM	322 B	1
Silica	EPA	200.7	1
Sodium	EPA	200.15	1
Solids, Total Suspended	SM	209 C	1
Specific Conductance	SM	2510	1
Sulfate	SM	4110 B	1
Antimony	EPA	200.8/6020	1
Arsenic	EPA	200.8/6020	1
Arsenic	SM	3113 B	1
Cadmium	EPA	200.8/6020	1
Cadmium	SM	3113 B	1
Chromium	EPA	200.8/6020	1
Chromium	SM	3113 B	1

Parameter Name	Reference	Method Number	Notes
Cobalt	EPA	200.8/6020	1
Copper	EPA	200.8/6020	1
Copper	SM	3113 B	1
Iron	EPA	200.7/6010	1
Lead	EPA	200.8/6020	1
Lead	SM	3113 B	1
Manganese	EPA	200.8/6020	1
Mercury	SM	3112	1
Nickel	EPA	200.8/6020	1
Selenium	EPA	200.8/6020	1
Selenium	SM	3113 B	1
Vanadium	EPA	200.8/6020	1
Zinc	EPA	200.8/6020	1
Fecal Coliforms	SM	9221 E	1
Total Coliforms	SM	9221 B	1
BTEX	EPA	602	1,3
Organochlorine Pesticides	EPA	8081	1
Polychlorinated Biphenyls	EPA	8082	1
BNA Extr (Semivolatile) Organics	EPA	625	1,2
Volatile Organic Compounds	EPA	624	1

Accredited Parameter Note Detail

(1) Accreditation based in part on recognition of accreditation of the lab by the Canadian Association for Environmental Analytical Laboratories (CAEAL), Inc. (2) EPA method modified to quantify polynuclear aromatic hydrocarbons only. (3) EPA Method modified to quantify only benzene, ethylbenzene, toluene, and xylenes.

7/19/01

Authentication Signature

Perry Brake -- Unit Supervisor, Washington State Department of Ecology -- Lab Accreditation Unit

(b) (4) copyright

This certificate is the property of the Standards Council of Canada (SCC) and must be returned on request; reproduction is prohibited except on written approval of the SCC.
Ce certificat est la propriété du Conseil canadien des normes (CCN) et doit lui être remis sur demande; toute reproduction est interdite sans autorisation écrite du CCN

Canada

(b) (4) copyright

This certificate is the property of the Standards Council of Canada (SCC) and must be returned on request; reproduction is prohibited except on written approval of the SCC.
Ce certificat est la propriété du Conseil canadien des normes (CCN) et doit lui être remis sur demande; toute reproduction est interdite sans l'autorisation écrite du CCN.

Canada

SCOPE OF ACCREDITATION

CANTEST LTD.
4606 Canada Way
BURNABY BC V5G 1K5

Accredited Laboratory No. 117

CONTACT:	Mr. Bob Hunter	TEL.: (604) 734-7276 FAX: (604) 731-2386 E-MAIL: rhunter@cantest.com

CLIENTS SERVED:	All interested parties.	
FIELD(S) OF TESTING:	Biological, Chemical/Physical.	
PROGRAM SPECIALTY AREAS:	Environmental	
ISSUED ON:	2001-06-25	VALID TO: 2004-06-08

ANIMAL AND PLANTS (AGRICULTURE)

Please see the details in the non-environmental scope issued separately.

ENVIRONMENTAL AND OCCUPATIONAL HEALTH AND SAFETY

Environmental:

Air

(Organic Vapours - Air Charcoal Tube)

67-S-003; based on WCB 3301	GC/FID - EXTRACTION 1,1,1-Trichloroethane Benzene Carbon Tetrachloride Chloroform Ethylbenzene Isopropanol

Methylene Chloride
Styrene
Tetrachlorethylene
Toluene
Trichloroethylene
Xylene

Air Filter

(Major Ions - Air)

64-P-038, 64-A-037; based on NIOSH 7903

IC - EXTRACTION
Bromide
Chloride
Fluoride
Nitrate
Sulfate

(Metals - Air)

65-P-014, 65-S-060; based on B.C. WCB METHOD 1051

ICP - DIGESTION
Cadmium
Copper
Lead
Zinc

Oil

(Total PCB - Oil)

62-C-020; based on ASTM D4059

GC/ECD - EXTRACTION
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
Total PCB

Soil/Sediment

(Chlorinated Phenols - Soil)

Accredited Laboratory No. 117

62-C-019; based on EPA 8040, BC MOE (1994)	GC/EC - EXTRACTION 2,3,4,5-Tetrachlorophenol 2,3,4,6-Tetrachlorophenol 2,3,4-Trichlorophenol 2,3,5,6-Tetrachlorophenol 2,3,5-Trichlorophenol 2,3,6-Trichlorophenol 2,4,5-TCP 2,4,6-Trichlorophenol 3,4,5-TCP Pentachlorophenol

(Extractable HC - Soil)

62-C-012; based on EPA 8015, BC MOE (1997)	GC/FID - EXTRACTION Heavy Extractable Petroleum Hydrocarbons Light Extractable Petroleum Hydrocarbons Total Extractable Hydrocarbons

(Extractable HC - Soil)

62-C-055; BCMOE CSR Analytical Method 3, Analytical Method 6	GC/FID - EXTRACTION Extractable Petroleum Hydrocarbons (EPHs10-19) Extractable Petroleum Hydrocarbons (EPHs19-32) Heavy Extractable Petroleum Hydrocarbons (HEPHs) Light Extractable Petroleum Hydrocarbons (LEPHs)

(Extractable HC - Soil (Mobile))

62-C-038; based on EPA 8015, BC MOE (1997)	GC/FID - EXTRACTION Heavy Extractable Petroleum Hydrocarbons Light Extractable Petroleum Hydrocarbons

Accredited Laboratory No. 117

	Total Extractable Hydrocarbons
(Herbicides – Soil)	
62-C-029; based on JAOAC, Vol. 74	GC/MS - EXTRACTION 2,4 D 2,4 DB 2,4,5 T 2,4,5 TP Dicamba MCPA MCPP Picloram
(LEP Leach - Soils)	
65-S-011; BCWMA LEP	LEACH LEP Leach
(Light Hydrocarbons - Soil)	
62-C-021; based on BCMOE 1995	GC/FID - EXTRACTION Light Hydrocarbons Volatile Petroleum Hydrocarbons
(Mercury - Soil)	
65-A-002, 65-P-004; based on SM 3112, EPA 3050	COLD VAPOUR AA - DIGESTION Mercury
(Metals - Soil/AA)	
65-A-008, 65-P-004; based on EPA 200.2; EPA 3050	AA - DIGESTION Cadmium Lead
(Metals - Soil/GFAA)	
65-A-003, 65-P-004; based on EPA 200.9, EPA 3050	GRAPHITE FURNACE AA - DIGESTION Arsenic

	Selenium
(Metals - Soil/ICP)	
65-P-004, 65-S-013, 65-S-060; based on EPA 200.7, EPA 3050	ICP - DIGESTION Antimony Barium Beryllium Chromium Cobalt Copper Lead Molybdenum Nickel Silver Tin Vanadium Zinc
(Oil and Grease/Hydrocarbons - Soil)	
64-C-036; based on BCMOE 1994, 1995/SM 5520B, E, F	GRAVIMETRIC - EXTRACTION Hydrocarbons Oil and Grease
(PAH - Soil)	
62-C-018; based on EPA 8270	GC/MS - EXTRACTION Acenaphthene Acenaphthylene Anthracene Benzo (a) anthracene Benzo (a) pyrene Benzo (b) fluoranthene Benzo (g,h,i) perylene Benzo (k) fluoranthene Chrysene Dibenz (a,h) anthracene Fluoranthene

	Fluorene Indeno (1,2,3 - cd) pyrene Naphthalene Phenanthrene Pyrene
(TCLP Leach - Soils)	
65-S-012; EPA 1311	LEACH TCLP Leach
(Total PCB - Soil)	
62-C-025; based on EPA 8080	GC/ECD - EXTRACTION Aroclor 1242 Aroclor 1248 Aroclor 1254 Aroclor 1260 Total PCB
(Volatile Hydrocarbons - Soil)	
62-C-050; BCMOE CSR, Analytical Method 1, Analytical Method 5	GC/FID-EXTRACTION - PURGE & TRAP Volatile Hydrocarbons (VHs6-10) Volatile Petroleum Hydrocarbons (VPHs)
(Volatiles - Soil/GCMS)	
62-C-016; based on EPA 8240, EPA 624, EPA 8260A	GC/MS - PURGE AND TRAP 1,1,1-Trichloroethane 1,1,2,2,-Tetrachloroethane 1,1,2-Trichloroethane 1,1-Dichloroethane 1,1-Dichloroethene 1,2-Dibromoethane 1,2-Dichlorobenzene 1,2-Dichloroethane 1,2-Dichloropropane

1,3-Dichlorobenzene
1,4-Dichlorobenzene
2-Butanone
2-Hexanone
4-Methyl-2-pentanone
Benzene
Bromodichloromethane
Bromoform
Bromomethane
Carbon Tetrachloride
Chlorobenzene
Chloroethane
Chloroform
Chloromethane
cis-1,2-Dichloroethene
cis-1,3-Dichloropropene
Dibromochloromethane
Dibromomethane
Dichlorodifluoromethane
Ethylbenzene
Methylene Chloride
Styrene
Tetrachloroethene
Toluene
trans-1,2-Dichloroethene
trans-1,3-Dichloropropene
Trichloroethene
Trichlorofluoromethane
Vinyl Chloride
Xylenes

(Volatiles - Soil/GCMS/Headspace)

62-C-046; based on EPA 5021

GC/MS - HEADSPACE
1,1,1-Trichloroethane
1,1,2,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
1,2-Dibromoethane
1,2-Dichlorobenzene

1,2-Dichloroethane
1,2-Dichloropropane
1,3-Dichlorobenzene
1,4-Dichlorobenzene
2-Hexanone
4-Methyl-2-pentanone
Benzene
Bromodichloromethane
Bromoform
Bromomethane
Carbon Tetrachloride
Chlorobenzene
Chloroethane
Chloroform
Chloromethane
cis-1,2-Dichloroethene
cis-1,3-Dichloropropene
Dibromochloromethane
Dibromomethane
Dichlorodifluoromethane
Ethylbenzene
Methylene Chloride
Styrene
Tetrachloroethene
Toluene
trans-1,2-Dichloroethene
trans-1,3-Dichloropropene
Trichloroethene
Trichlorofluoromethane
Vinyl Chloride
Xylenes

(Volatiles - Soil/GCPID (Mobile))

62-C-036; based on EPA 8020, EPA 602

GC-PID - PURGE AND TRAP
Benzene
Ethyl Benzene
Toluene
Xylenes

Accredited Laboratory No. 117

Solids

(Asbestos - Solids)

67-C-002; based on WCB0205	POL. LIGHT MICROSCOPY Asbestos (Bulk)

Water (Inorganic)

(Alkalinity (pH 4.5) - Water)

64-C-005; based on SM 2320	TITRIMETRIC Alkalinity (pH 4.5) Bicarbonate Alkalinity Carbonate Alkalinity Hydroxide Alkalinity pH

(Ammonia - Water)

64-C-020; based on SM 4500-NH3	COLORIMETRIC Ammonia

(BOD - Water)

64-C-016; based on SM 5210 B	D.O. METER BOD (5 day) Carbonaceous BOD

(COD - Water)

64-C-017; based on SM 5220 A, C	TITRIMETRIC - REFLUX Chemical Oxygen Demand

(Color - Water)

64-C-004; based on SM 2120 B	COLOR COMPARATOR Color

Accredited Laboratory No. 117

(Conductivity (25 °C) - Water)

64-C-005; based on SM 2510	CONDUCTIVITY METER Conductivity (25 °C)

(Cyanide - Water)

64-C-024, 64-C-025; based on SM 4500 CN - A - E, I, EPA 335.4	COLOR - DISTILLATION CN (SAD) CN (WAD)

(Major Ions - Water)

64-A-037; based on SM 4110	ION CHROMATOGRAPHY Bromide Chloride Fluoride Nitrate Sulfate

(Mercury - Water)

65-P-005, 65-C-015; based on EPA 245.7	COLD VAPOUR AF - DIGESTION Dissolved Mercury Mercury Total Mercury

(Metals - Water/GFAA)

65-A-003, 65-P-005; based on SM 3113 B, SM 3030 B	AA - GRAPHITE Dissolved Antimony Dissolved Arsenic Dissolved Cadmium Dissolved Chromium Dissolved Cobalt Dissolved Copper Dissolved Lead Dissolved Nickel Dissolved Selenium

	Dissolved Silver
	Dissolved Thallium

(Metals - Water/ICP)

65-P-005, 65-S-060; based on EPA 200.7, SM 3030B	ICP
	Dissolved Aluminum
	Dissolved Antimony
	Dissolved Arsenic
	Dissolved Barium
	Dissolved Beryllium
	Dissolved Boron
	Dissolved Cadmium
	Dissolved Calcium
	Dissolved Chromium
	Dissolved Cobalt
	Dissolved Copper
	Dissolved Hardness
	Dissolved Iron
	Dissolved Lead
	Dissolved Magnesium
	Dissolved Manganese
	Dissolved Molybdenum
	Dissolved Nickel
	Dissolved Phosphorus
	Dissolved Silver
	Dissolved Strontium
	Dissolved Tin
	Dissolved Titanium
	Dissolved Vanadium
	Dissolved Zinc
	Sodium

(Metals - Water/ICPMS)

65-P-005, 65-S-050; based on SM 3030 B, EPA 200.8	ICP/MS
	Dissolved Aluminum
	Dissolved Antimony
	Dissolved Arsenic
	Dissolved Barium
	Dissolved Beryllium

	Dissolved Boron Dissolved Cadmium Dissolved Calcium Dissolved Chromium Dissolved Cobalt Dissolved Copper Dissolved Iron Dissolved Lead Dissolved Magnesium Dissolved Manganese Dissolved Molybdenum Dissolved Nickel Dissolved Phosphorus Dissolved Potassium Dissolved Selenium Dissolved Silicon Dissolved Silver Dissolved Sodium Dissolved Thallium Dissolved Thorium Dissolved Tin Dissolved Uranium Dissolved Vanadium Dissolved Zinc
(Nitrate + Nitrite - Water)	
64-C-009; based on SM 4500-NO3 F	AUTO COLOR Nitrate plus Nitrite
(Nitrite - Water)	
64-C-011; based on SM 4500-NO2 B	COLORIMETRIC Nitrite
(Oil and Grease/Hydrocarbons - Water)	
64-C-018; based on SM 5520 B, F, BC MOE (1994)	GRAVIMETRIC - EXTRACTION Hydrocarbons Oil and Grease

Accredited Laboratory No. 117

(Organic Carbon - Water)

64-C-019; based on SM 5310 B	IR - COMBUSTION Total Carbon Total Inorganic Carbon Total Organic Carbon

(pH - Water)

64-C-001; based on SM 4500 H +	pH METER pH

(Phenols - Water)

64-C-022; based on SM 5530 B, C	COLOR - DISTILLATION Phenols

(Phosphorus - Total - Water)

64-C-012; based on SM 4500P	COLOR - DIGESTION Soluble Reactive Phosphorus Total Dissolved Phosphorus Total Orthophosphate Total Phosphorus

(Potassium - Water)

65-A-010, 65-P-005, 65-P-006, 65-P-007; based on SM 3500-K D, EPA 3015, EPA 3005	FLAME PHOTOMETRIC Potassium Total Potassium

(Silica - Reactive - Water)

65-P-007, 65-P-006, 65-S-060; based on SM 4500 D/EPA 200.7	ICP - DIGESTION Reactive Silica Total Silica

Accredited Laboratory No. 117

(Sulphides - Water)

64-C-027; based on SM (1995) 4500-S-2 D	Total Sulphide

(TKN - Water)

64-C-021; based on SM 4500 N ORG B	COLOR - DIGESTION Total Kjeldahl Nitrogen

(Total Metals - Water/GFAA)

65-A-003, 65-P-007, 65-P-006; based on SM 3113 B, EPA 3015, EPA 3005	AA GRAPHITE - DIGESTION Antimony Arsenic Selenium Total Antimony Total Arsenic Total Cadmium Total Chromium Total Cobalt Total Copper Total Lead Total Nickel Total Selenium Total Silver Total Thallium

(Total Metals - Water/ICP)

65-P-007, 65-P-006, 65-S-060; based on EPA 200.7, EPA 3015, EPA 3005	ICP - DIGESTION Total Aluminum Total Antimony Total Arsenic Total Barium Total Beryllium Total Boron Total Cadmium Total Calcium

Total Chromium
Total Cobalt
Total Copper
Total Iron
Total Lead
Total Magnesium
Total Manganese
Total Molybdenum
Total Nickel
Total Phosphorus
Total Silver
Total Sodium
Total Strontium
Total Tin
Total Titanium
Total Vanadium
Total Zinc

(Total Metals - Water/ICPMS)

65-P-007, 65-P-006, 65-S-050;
based on EPA 3015, EPA 3005, EPA 200.8

ICP/MS - DIGESTION
Antimony
Arsenic
Selenium
Total Aluminum
Total Barium
Total Beryllium
Total Boron
Total Cadmium
Total Calcium
Total Chromium
Total Cobalt
Total Copper
Total Iron
Total Lead
Total Magnesium
Total Manganese
Total Molybdenum
Total Nickel
Total Phosphorus

	Total Potassium Total Silicon Total Silver Total Sodium Total Thalium Total Thorium Total Tin Total Uranium Total Vanadium Total Zinc
(Total Suspended Solids - Water)	
64-C-006; based on SM 2540D	GRAVIMETRIC Total Suspended Solids
(Turbidity- Water)	
64-C-034; based on SM 2130	TURBIDIMETRIC Turbidity
Water (Microbiology)	
(Coliforms - Water/MF)	
63-C-002; based on SM 9222	MEMBRANE FILTRATION Fecal Coliforms Total Coliforms
(Coliforms - Water/MPN)	
63-C-001; based on SM 9221	MULTIPLE TUBE FERMENTATION Fecal Coliforms Total Coliforms
(Enterococci/Fecal Streptococci - Water)	
63-C-005, 63-C-006; based on SM 9230 C	FILTRATION AND PLATING Enterococci Fecal Streptococci

Accredited Laboratory No. 117

(Heterotrophic Plate Count - Water)

63-C-003; based on SM 9215 B	PLATING ON MEDIA Heterotrophic Plate Count

(Pseudomonas aeruginosa - Water)

63-C-004; based on SM 9213 E	FILTRATION; PLATING Pseudomonas aeruginosa

Water (Organic)

(Carbamate Pesticides - Water)

62-C-030; based on EPA 8318	LIQ. - LIQ. - EXTRACTION - HPLC 3-Hydroxy Carbofuran Aldicarb Aldicarb Sulfone Aldicarb Sulfoxide Carbaryl Carbofuran Dioxacarb Methiocarb Methomyl Oxamyl Promecarb Propoxur

(Chlorinated Herbicides - Water)

62-C-026; based on EPA 515.1	GC/ECD - DERIVATIZATION 2,4,5-T 2,4,5-TP 2,4-D 2,4-DB DICAMBA MCPA MCPP PICLORAM

Accredited Laboratory No. 117

(Chlorophenols - Water)

62-C-013; based on EPA 604/8040, BC MOE (1994)	GC/ECD - DERIVATIZATION 2,3,4,5-Tetrachlorophenol 2,3,4,6-Tetrachlorophenol 2,3,4-Trichlorophenol 2,3,5,6-Tetrachlorophenol 2,3,5-Trichlorophenol 2,3,6-Trichlorophenol 2,4,5-Trichlorophenol 3,4,5-Trichlorophenol Pentachlorophenol

(Extractable HC - Water)

62-C-011; based on EPA 8015, BC MOE (1997)	GC/FID - EXTRACTION Heavy Extractable Petroleum Hydrocarbons Light Extractable Petroleum Hydrocarbons Total Extractable Hydrocarbons

(Extractable HC - Water)

62-C-056; BCMOE CSR Analytical Method 4, Analytical Method 6	GC/FID - EXTRACTION Extractable Petroleum Hydrocarbons (EPHw10-19) Extractable Petroleum Hydrocarbons (EPHw19-32) Heavy Extractable Petroleum Hydrocarbons (HEPHw) Light Extractable Petroleum Hydrocarbons (LEPHw)

(Glycols - Water)

67-C-017; based on Envir. Canada, PESC, Glycols V 1.1 Jan. 97	GC/FID - DIRECT INJECTION Diethylene Glycol Ethylene Glycol

	Propylene Glycol Triethylene Glycol
(Glyphosate/AMPA - Water(FPD))	
62-C-022; based on J. OF CHROM (1996)	GC-FPD - EXTRACTION AMPA Glyphosate
(Light Hydrocarbons - Water)	
62-C-021; based on BCMOE 1995	GC/FID - EXTRACTION Light Hydrocarbons Volatile Petroleum Hydrocarbons
(OCP/PCB - Water)	
62-C-040, 62-C-044; based on EPA 8080, EPA 608	GC/ECD - EXTRACTION 4,4'-DDD 4,4'-DDE 4,4'-DDT A -BHC Aldrin alpha-Chlordane beta-BHC delta-BHC Dieldrin Endosulfan I Endosulfan II Endosulfan Sulfate Endrin Endrin Aldehyde gamma -BHC (Lindane) gamma-Chlordane Heptachlor Heptachlor Epoxide Hexachlorobenzene (HCB) Lindane Methoxychlor Mirex o,p' - DDT

p,p' - DDD
p,p' - DDE
p,p' - DDT
p,p' Methoxychlor
Total PCB
Toxaphene

(Organo P Pesticides - Water)

62-C-033; based on EPA 507

GC/FPD/NPD - EXTRACTION
Azinphosmethyl
Chlorfenvinphos
Chlorpyrifos
Demeton
Diazinon
Dimethoate
Disulfoton
Ethion
Fenithion
Fenitrothion
Fonofos
Isofenphos
Malathion
Methidiathion
Methyl Parathion
Mevinphos
Monocrotophos
Parathion
Phorate
Phosalone
Phosmet
Terbufos
Tetrachlorvinphos

(PAH - Water)

62-C-101; based on EPA 625

GC/MS - EXTRACTION
Acenaphthene
Acenaphthylene
Acridine
Anthracene

Benzo (a) anthracene
Benzo (a) pyrene
Benzo (b) fluoranthene
Benzo (g,h,i) perylene
Benzo (k) fluoranthene
Chrysene
Dibenz(a,h)anthracene
Fluoranthene
Fluorene
Indeno (1,2,3 - cd) pyrene
Naphalene
Phenanthrene
Pyrene

(Resin and Fatty Acids - Water)

62-C-028; based on ALTA ENVIR. CTR. AE129.0

GC/MS - EXTRACTION
12,14-Dichlorodehydroabietic Acid
12-Chlorodehydroabietic Acid
8(14)-Abietenic Acid
9,10-Dichlorostearic Acid
Abietic Acid
Arachidic Acid
Behenic Acid
Dehydroabietic Acid
Dihydroisopimaric Acid
Isopimaric Acid
Lauric Acid
Linoleic Acid
Linolenic Acid
Myristic Acid
Neoabietic Acid
Oleic Acid
Palmitic Acid
Palustric Acid
Pimaric Acid
Sandaracopimaric Acid
Stearic Acid

Accredited Laboratory No. 117

(Volatile Hydrocarbons - Water)

62-C-051; BCMOE CSR Analytical Method 2, Analytical Method 5	GC/FID - PURGE & TRAP Volatile Hydrocarbons (VHw6-10) Volatile Petroleum Hydrocarbons (VPHw)

(Volatiles - Water/GCMS)

62-C-017; based on EPA 624	GC/MS - PURGE AND TRAP 1,1,1-Trichloroethane 1,1,2,2,-Tetrachloroethane 1,1,2-Trichloroethane 1,1-Dichloroethane 1,1-Dichloroethene 1,2-Dibromoethane 1,2-Dichlorobenzene 1,2-Dichloroethane 1,2-Dichloropropane 1,3-Dichlorobenzene 1,4-Dichlorobenzene 2-Butanone 2-Hexanone 4-Methyl-2-pentanone Benzene Bromodichloromethane Bromoform Bromomethane Carbon Tetrachloride Chlorobenzene Chlorodibromomethane Chloroethane Chloroform Chloromethane cis-1,2-Dichloroethene cis-1,3-Dichloropropene Dibromochloromethane Dibromomethane Dichlorodifluoromethane Ethylbenzene

Methylene Chloride
o-xylene
p-xylene
Styrene
Tetrachloroethene
Toluene
trans-1,2-Dichloroethene
trans-1,3-Dichloropropene
Trichloroethene
Trichlorofluoromethane
Vinyl Chloride
Xylenes

(Volatiles - Water/GCPID (Mobile))

62-C-036; based on EPA 602, EPA 8020

GC/PID - PURGE AND TRAP
Benzene
Ethylbenzene
o-xylene
p-xylene
Toluene

D.W. Wilson, Director, Conformity Assessment

CAEAL 2168, SCC 1003-15/188
Partner: CAEAL-SCC

Sequence Name: D:\ICPCHEM\1\SEQUENCE\JAN29_02.B

WORKLIST 62320

Comment:
Operator: ASW
Data Path: D:\ICPCHEM\1\DATA\02A2916a.B\
Pre-Seq Cmd:
Post-Seq Cmd:

Method Sections To Run
(X) Full Method
( ) Reprocessing Only

	Type	Vial	DataFile	Method	Sample Name
1)	CALBEG	- Start of CALIB			
2)	CalBlk	4501	--------	WATER10	CALIB BLANK1
3)	CalBlk	4502	--------	WATER10	CALIB BLANK2
4)	CalBlk	4503	--------	WATER10	CALIB BLANK3
5)	CalStd	4504	--------	WATER10	CALIB BLANK4
6)	CALEND	- End of CALIB			
7)	SMPLBEG	- Start of SMPL			
8)	CCB	5	--------	WATER10	1%HNO3
9)	CCB	5	--------	WATER10	1%HNO3
10)	CCB	2101	--------	WATER10	26087 BLK-1
11)	CCB	2102	--------	WATER10	26087 BLK-2
12)	Sample	2103	--------	WATER10	26087 SP LEAVES
13)	CCB	3	--------	WATER10	4%HNO3
14)	Sample	2104	--------	WATER10	26087 TO LEAVES
15)	CCB	3	--------	WATER10	4%HNO3
16)	Sample	2105	--------	WATER10	108020009 SAMPLE
17)	Sample	2106	--------	WATER10	108020009 DUP
18)	Sample	2107	--------	WATER10	108130242 SAMPLE
19)	Sample	2108	--------	WATER10	108130243 SAMPLE
20)	Sample	2109	--------	WATER10	108230270 SAMPLE
21)	Sample	2110	--------	WATER10	108230272 SAMPLE
22)	Sample	2111	--------	WATER10	108230274 SAMPLE
23)	Sample	2112	--------	WATER10	108230276 SAMPLE
24)	Sample	2201	--------	WATER10	108230278 SAMPLE
25)	Sample	2202	--------	WATER10	108230281 SAMPLE
26)	Sample	2203	--------	WATER10	108230283 SAMPLE
27)	Sample	2204	--------	WATER10	108230283 DUP
28)	Sample	2205	--------	WATER10	108230290 SAMPLE
29)	Sample	2206	--------	WATER10	108230291 SAMPLE
30)	Sample	2207	--------	WATER10	108230292 SAMPLE
31)	Sample	2208	--------	WATER10	108230294 SAMPLE
32)	Sample	2209	--------	WATER10	108230299 SAMPLE
33)	Sample	2210	--------	WATER10	108230300 SAMPLE
34)	Sample	2211	--------	WATER10	108230301 SAMPLE
35)	Sample	2212	--------	WATER10	108230303 SAMPLE
36)	Sample	2301	--------	WATER10	108230305 SAMPLE
37)	Sample	2302	--------	WATER10	108270060 SAMPLE
38)	Sample	2303	--------	WATER10	108270060 DUP
39)	Sample	2304	--------	WATER10	108270064 SAMPLE
40)	Sample	2305	--------	WATER10	108270077 SAMPLE
41)	Sample	2306	--------	WATER10	108270078 SAMPLE
42)	Sample	2307	--------	WATER10	108270080 SAMPLE
43)	Sample	2308	--------	WATER10	108270081 SAMPLE

Sequence Name: D:\ICPCHEM\1\SEQUENCE\JAN29_02.S

Line	Type	Vial	DataFile	Method	Sample Name	
44)	Sample	2309	--------	WATER10	108270086	SAMPLE
45)	Sample	2310	--------	WATER10	108270088	SAMPLE
46)	Sample	2311	--------	WATER10	108270089	SAMPLE
47)	Sample	2312	--------	WATER10	108270090	SAMPLE
48)	Sample	2401	--------	WATER10	108270090	DUP
49)	Sample	2402	--------	WATER10	108270091	SAMPLE
50)	Sample	2403	--------	WATER10	108270092	SAMPLE
51)	Sample	2404	--------	WATER10	108270094	SAMPLE
52)	Sample	2405	--------	WATER10	108270099	SAMPLE
53)	Sample	2406	--------	WATER10	108270100	SAMPLE
54)	Sample	2407	--------	WATER10	108270101	SAMPLE
55)	Sample	2408	--------	WATER10	108270102	SAMPLE
56)	Sample	2409	--------	WATER10	108270103	SAMPLE
57)	Sample	2410	--------	WATER10	108270104	SAMPLE
58)	Sample	2411	--------	WATER10	108270106	SAMPLE
59)	Sample	2412	--------	WATER10	108270106	DUP
60)	Sample	2501	--------	WATER10	108270111	SAMPLE
61)	Sample	2502	--------	WATER10	108270115	SAMPLE
62)	Sample	2503	--------	WATER10	108270116	SAMPLE
63)	Sample	2504	--------	WATER10	108270118	SAMPLE
64)	Sample	2505	--------	WATER10	108270119	SAMPLE
65)	Sample	2506	--------	WATER10	108270120	SAMPLE
66)	Sample	2507	--------	WATER10	108270122	SAMPLE
67)	Sample	2508	--------	WATER10	108270124	SAMPLE
68)	Sample	2509	--------	WATER10	108270125	SAMPLE
69)	CCB	3	--------	WATER10	4%HNO3	
70)	CCB	5	--------	WATER10	1%HNO3	
71)	CCB	5	--------	WATER10	1%HNO3	
72)	Sample	3201	--------	WATER10	29360 BLK-1	
73)	Sample	3202	--------	WATER10	29360 BLK-2	
74)	Sample	3203	--------	WATER10	29360 BLK-3	
75)	Sample	3204	--------	WATER10	SALM-2711 29360	
76)	CCB	3	--------	WATER10	4%HNO3	
77)	Sample	3205	--------	WATER10	201280005	SAMPLE
78)	Sample	3206	--------	WATER10	201280005	DUP
79)	Sample	3207	--------	WATER10	201280006	SAMPLE
80)	Sample	3208	--------	WATER10	201280007	SAMPLE
81)	Sample	3209	--------	WATER10	201280014	SAMPLE
82)	Sample	3210	--------	WATER10	201280015	SAMPLE
83)	Sample	3211	--------	WATER10	201280016	SAMPLE
84)	Sample	3212	--------	WATER10	201280017	SAMPLE
85)	Sample	3301	--------	WATER10	201280018	SAMPLE
86)	Sample	3302	--------	WATER10	201280019	SAMPLE
87)	Sample	3303	--------	WATER10	201280020	SAMPLE
88)	Sample	3304	--------	WATER10	201280021	SAMPLE
89)	Sample	3305	--------	WATER10	201280021	DUP
90)	Sample	3306	--------	WATER10	201280023	SAMPLE
91)	Sample	3307	--------	WATER10	201280024	SAMPLE
92)	Sample	3308	--------	WATER10	201280025	SAMPLE
93)	Sample	3309	--------	WATER10	201280026	SAMPLE
94)	Sample	3310	--------	WATER10	201280027	SAMPLE
95)	Sample	3311	--------	WATER10	201280028	SAMPLE
96)	Sample	3312	--------	WATER10	201280029	SAMPLE

Sequence Name: D:\ICPCHEM\1\SEQUENCE\[illegible]

Line	Type	Vial	DataFile	Method	Sample Name	
97)	Sample	3412	--------	WATER10	201280112	SAMPLE
98)	Sample	3401	--------	WATER10	201280115	SAMPLE
99)	Sample	3402	--------	WATER10	201280116	SAMPLE
100)	Sample	3403	--------	WATER10	201280116	DUP
101)	Sample	3404	--------	WATER10	201280118	SAMPLE
102)	Sample	3405	--------	WATER10	201280119	SAMPLE
103)	Sample	3406	--------	WATER10	201280120	SAMPLE
104)	Sample	3407	--------	WATER10	201280121	SAMPLE
105)	Sample	3408	--------	WATER10	201280122	SAMPLE
106)	Sample	3409	--------	WATER10	201280123	SAMPLE
107)	Sample	3410	--------	WATER10	201280124	SAMPLE
108)	Sample	3411	--------	WATER10	201280127	SAMPLE
109)	SMPLEND	- End of SMPL				
110)	USRBEG	- Start of USER				
111)	Sample	4101	--------	WATER10	201280066	SAMPLE
112)	Sample	4102	--------	WATER10	201280066	DUP
113)	Sample	4103	--------	WATER10	201280068	SAMPLE
114)	Sample	4104	--------	WATER10	201280069	SAMPLE
115)	Sample	4105	--------	WATER10	201280070	SAMPLE
116)	Sample	4106	--------	WATER10	201280071	SAMPLE
117)	Sample	4107	--------	WATER10	201280072	SAMPLE
118)	Sample	4108	--------	WATER10	201280073	SAMPLE
119)	Sample	4207	--------	WATER10	SALM-2711	29360
120)	Sample	4208	--------	WATER10	SALM-2711	29316
121)	Sample	4109	--------	WATER10	201280074	SAMPLE
122)	Sample	4110	--------	WATER10	201280075	SAMPLE
123)	Sample	4111	--------	WATER10	201280075	DUP
124)	Sample	4112	--------	WATER10	201280076	SAMPLE
125)	Sample	4201	--------	WATER10	201280078	SAMPLE
126)	Sample	4202	--------	WATER10	201280079	SAMPLE
127)	Sample	4203	--------	WATER10	201280080	SAMPLE
128)	Sample	4204	--------	WATER10	201280081	SAMPLE
129)	Sample	4205	--------	WATER10	201280082	SAMPLE
130)	Sample	4206	--------	WATER10	201280083	SAMPLE
131)	USREND	- End of USER				
132)	CCVBEG	- Start of CCV				
133)	CCB	3	--------	WATER10	4% HNO3	
134)	CCV1	1302	--------	WATER10	STD3 OLD	
135)	CCB	3	--------	WATER10	4% HNO3	
136)	CCV1	4501	--------	WATER10	STD3 NEW	
137)	CCB	3	--------	WATER10	4% HNO3	
138)	CCB	1307	--------	WATER10	1% HNO3	
139)	CCVEND	- End of CCV				
140)	ERRBEG	- Start of ERRTERM				
141)	CCB	3	--------	WATER10	4% HNO3	
142)	CCB	5	--------	WATER10	1% HNO3	
143)	Sample	4502	--------	WATER10	1ppm	
144)	Sample	4503	--------	WATER10	5ppm	
145)	Sample	4504	--------	WATER10	10ppm	
146)	CCB	4	--------	WATER10	30% H2O2	
147)	StandBy					
148)	CCB	4	--------	WATER10	30% H2O2	
149)	CCB	4	--------	WATER10	30% H2O2	

Line	Type	Vial	DataFile	Method	Sample Name
150)	CCB	4	--------	WATER10	30% H2O2
151)	CCB	4	--------	WATER10	30% H2O2
152)	CCB	4	--------	WATER10	30% H2O2
153)	CCB	4	--------	WATER10	30% H2O2
154)	CCB	3	--------	WATER10	4% HNO3
155)	CCB	5	--------	WATER10	1% HNO3
156)	CCB	4	--------	WATER10	30% H2O2
157)	CCB	4	--------	WATER10	30% H2O2
158)	CCB	4	--------	WATER10	30% H2O2
159)	CCB	4	--------	WATER10	30% H2O2
160)	CCB	4	--------	WATER10	30% H2O2
161)	CCB	4	--------	WATER10	30% H2O2
162)	CCB	4	--------	WATER10	30% H2O2
163)	CCB	4	--------	WATER10	30% H2O2
164)	CCB	3	--------	WATER10	4% HNO3
165)	CCB	5	--------	WATER10	1% HNO3
166)	CCB	4	--------	WATER10	30% H2O2
167)	CCB	4	--------	WATER10	30% H2O2
168)	CCB	4	--------	WATER10	30% H2O2
169)	CCB	4	--------	WATER10	30% H2O2
170)	CCB	4	--------	WATER10	30% H2O2
171)	CCB	4	--------	WATER10	30% H2O2
172)	CCB	4	--------	WATER10	30% H2O2
173)	CCB	4	--------	WATER10	30% H2O2
174)	CCB	4	--------	WATER10	30% H2O2
175)	CCB	3	--------	WATER10	4% HNO3
176)	CCB	5	--------	WATER10	1% HNO3
177)	CCB	4	--------	WATER10	30% H2O2
178)	CCB	4	--------	WATER10	30% H2O2
179)	CCB	4	--------	WATER10	30% H2O2
180)	CCB	4	--------	WATER10	30% H2O2
181)	CCB	4	--------	WATER10	30% H2O2
182)	CCB	4	--------	WATER10	30% H2O2
183)	CCB	4	--------	WATER10	30% H2O2
184)	CCB	4	--------	WATER10	30% H2O2
185)	CCB	4	--------	WATER10	30% H2O2
186)	CCB	3	--------	WATER10	4% HNO3
187)	CCB	5	--------	WATER10	1% HNO3
188)	CCB	4	--------	WATER10	30% H2O2
189)	CCB	4	--------	WATER10	30% H2O2
190)	CCB	4	--------	WATER10	30% H2O2
191)	CCB	4	--------	WATER10	30% H2O2
192)	CCB	4	--------	WATER10	30% H2O2
193)	CCB	4	--------	WATER10	30% H2O2
194)	CCB	4	--------	WATER10	30% H2O2
195)	CCB	4	--------	WATER10	30% H2O2
196)	CCB	4	--------	WATER10	30% H2O2
197)	CCB	3	--------	WATER10	4% HNO3
198)	CCB	5	--------	WATER10	1% HNO3
199)	CCB	4	--------	WATER10	30% H2O2
200)	CCB	4	--------	WATER10	30% H2O2
201)	CCB	4	--------	WATER10	30% H2O2
202)	CCB	4	--------	WATER10	30% H2O2

Line	Type	Vial	DataFile	Method	Sample Name
203)	CCB	4	--------	WATER10	30% H2O2
204)	CCB	4	--------	WATER10	30% H2O2
205)	CCB	4	--------	WATER10	30% H2O2
206)	CCB	4	--------	WATER10	30% H2O2
207)	CCB	4	--------	WATER10	30% H2O2
208)	CCB	3	--------	WATER10	4% HNO3
209)	CCB	5	--------	WATER10	1% HNO3
210)	ERREND	- End of ERRTERM			
211)	End	- End of Sequence			
212)	BLKBEG	- Start of BLANK			
213)	BLKEND	- End of BLANK			

JUN 07 2002 13:39 FR CANTEST LTD 604 7312386 TO 12065250869 P.10/11

CHAIN OF CUSTODY RECORD

CANTEST

72550 SEBC

4606 Canada Way
Burnaby, B.C.
V5G 1K5
COL117
Tel 604 734 7276
Fax 604 731 2386
Toll Free 800 665 8566
www.cantest.com
cantest@cantest.com

Client Name: Columbia Environmental Consulting Ltd.
Postal Code: V2A 6J7
Street Address (including suite number): Lot 47-1 Green Mtn Rd.
City: Penticton
Telephone: 250-487-1222
Fax: 487-1223
E Mail Address (Required for "AutoEmail" Reports): columbia@img.net
Contact Name: Dwight Shanner
Sampler's Name: Dave Hollatz
Project Name: 0081 Columbia Metals
Project Number: 0081
Quotation Number:
P.O. Number:

RESULTS REQUESTED BY: Day Month Year
(Surcharges May Apply)

Special Instructions: ☐ AutoFax ☐ AutoEmail ☑ Return Cooler ☐ Ship Sampling Containers (please specify below)

16 misc bags ~~16 on hold~~ ~~Sublet~~ "Agricultural"

Please circle options as appropriate

FOR LABORATORY USE ONLY

Group Number	Laboratory Number	Sample Identification*	Date Sampled (M/D/Y)	Sample Type	Metals AW ICP-IT	Metals SCLL	PH	Conductivity	TSS	TDS	Alkalinity (total / spec.)	BOD	COD	Coliform Bacteria Fecal/Total	F Cl SO4 No2	Nitrite (No2)	Nitrate and Nitrite	Oil & Grease (Total / HC)	PCP (Tri, Tetra and Penta)	PCP (Mono and DI)	BETX	VPH	VOC	PAH	EPH (not PAH corrected)	LEPH/HEPH (PAH corrected)	PCB	ICPM Lead	Particle size analysis	Total organic carbon	HOLD - DO NOT ANALYZE	Number of Containers
33128011	20128 0066	1A	01/22/02	Sediment	X																							X	X	X		1
		1 A duplicate	01/22/02	Sediment																												1
	068	2A	01/22/02	Sediment	X																							X	X	X		1
		2 A duplicate	01/22/02	Sediment																												1
	069	1B	01/22/02	Sediment	X																							X	X	X		1
		1 B duplicate	01/22/02	Sediment																												1
	070	2B	01/22/02	Sediment	X																							X	X	X		1
		2 B duplicate	01/22/02	Sediment																												1
	071	3A	01/22/02	Sediment	X																							X	X	X		1
		3 A duplicate	01/22/02	Sediment																												1

Relinquished by: Dwight Shanner
Date: Jan 25
Time: 08:45
Received by:

★ = Required Field

Total Number of Containers: 10

Method of Shipment: BUS
Waybill No.: 13327195976
Received for Lab by: BJ
Date: Jan 28/02
Time: 1640

You will be paid directly by our client ☐

Shipped by: Greyhound
Shipment Condition:
Cooler opened by:
Date: —
Time: —

Company Name:
Address:
Contact:
Postal Code:
Phone:
Fax:

FOR LABORATORY USE ONLY
Sample State at Receipt: ☐ Ambient ☐ Cold ☐ Frozen ☐ N/A
Comments:
Temperature: 9.3 °C
Shelf Number:

WHITE FOLLOWS REPORT YELLOW LAB COPY PINK CLIENT COPY/GENERAL INFORMATION

JUN 07 2002 13:38 FR CANTEST LTD 604 7312386 TO 12065250869 P.09/11

CHAIN OF CUSTODY RECORD

CANTEST

72551 SEBC

4606 Canada Way
Burnaby, B.C
V5G 1K5

Tel 604 734 7276
Fax 604 731 2386
Toll Free 800 665 8566

www.cantest.com
cantest@cantest.com

Client Name: Columbia Env. Con Ltd.

Street Address (including suite number): | City:

Telephone: 250-487-1222 | Fax: | E-Mail Address (Required for "AutoEmail" Reports):

Contact Name: Dwight Shanner | Sampler's Name:

Project Name: | Project Number: 0081 | Quotation Number: | P.O. Number:

RESULTS REQUESTED BY: Day Month Year (Surcharges May Apply)

Special Instructions: ☐ AutoFax ☐ AutoEmail ☑ Return Cooler ☐ Ship Sampling Containers (please specify below)

"Agricultural" →

Please circle options as appropriate →

FOR LABORATORY USE ONLY

Group Number	Laboratory Number	Sample Identification*	Date Sampled (M/D/Y)	Sample Type	AW (CCME)	PH	Conductivity	TSS	TDS	Alkalinity (total / spec.)	BOD	COD	Coliform Bacteria Fecal/Total	F Cl SO4 No3	Nitrite (No2)	Nitrate and Nitrite	Oil & Grease (Total / HC)	PCP (Tri, Tetra and Penta)	PCP (Mono and Di)	BETX	VPH	VOC	PAH	EPH (not PAH corrected)	LEPH/HEPH (PAH corrected)	PCB	ICPM Lead	Particle Size Analysis	Total Organic Carbon		HOLD - DO NOT ANALYZE	Number of Containers
30128011	201280072	3B	01/22/02	Sediment	*																						X	X	X			1
		3B duplicate	01/22/02	Sediment																												1
073		41	01/21/02	Sediment	X																						X	X	X			1
		41 duplicate	01/21/02	Sediment																												1
074		42	01/24/02	Sediment	X																						X	X	X			1
		42 duplicate	01/24/02	Sediment																												1
075		51	01/21/02	Sediment	X																						X	X	X			1
		51 duplicate	01/21/02	Sediment																												1
076		52	01/24/02	Sediment	X																						X	X	X			1
		52 duplicate	01/24/02	Sediment																												1

Relinquished by: [signature] | Date: Jan 25 | Time: 08:45 | Received by:

Method of Shipment: | Waybill No: 13327195976 | Received for Lab by: [signature] | Date: Jan 28/02 | Time: 1040

Shipped by: | Shipment Condition: | Cooler opened by: | Date: | Time:

* = Required Field | Total Number of Containers: 10

You will be paid directly by our client ☐

Company Name:

Address:

Contact: | Postal Code:

Phone: | Fax:

FOR LABORATORY USE ONLY

Sample State at Receipt: ☐ Ambient ☐ Cold ☐ Frozen ☐ N/A | Comments:

Temperature: 9.3°C | Shelf Number:

CHAIN OF CUSTODY RECORD

CANTEST

72552 SEBC

4606 Canada Way
Burnaby, B.C.
V5G 1K5
Tel 604 734 7276
Fax 604 731 2386
Toll Free 800 665 8566
www.cantest.com
cantest@cantest.com

Client Name: Columbia ENV Con. Ltd.
Street Address (including suite number): City:
Telephone: 250-487-1222 Fax:
Contact Name: Dwight Shanner
E-Mail Address (Required for "AutoEmail" Reports):
Sampler's Name:
Project Name:
Project Number: 0081
Quotation Number:
PO Number:

RESULTS REQUESTED BY: Day Month Year (Surcharges May Apply)

Special Instructions: [ ] AutoFax [ ] AutoEmail [✓] Return Cooler [ ] Ship Sampling Containers (please specify below)

"Agricultural" →

Please circle options as appropriate →

FOR LABORATORY USE ONLY

Group Number	Laboratory Number	Sample Identification*	Date Sampled (M/D/Y)	Sample Type	PH	Conductivity	TSS	TDS	Alkalinity (total / spec)	BOD	COD	Coliform Bacteria Fecal/Total	F Cl SO_4 No.	Nitrite (NO_2)	Nitrate and Nitrite	Oil & Grease (Total / HC)	PCP (Tri, Tetra and Penta)	PCP (Mono and Di)	BETX	VPH	VOC	PAH	EPH (not PAH corrected)	LEPH/HEPH (PAH corrected)	PCB	ICPM Lead	Particle Size Analysis	Total Organic Carbon	HOLD - DO NOT ANALYZE	Number of Containers
30129	001																													
20126	0078	61	01/24/02	Sediment	X																					X	X	X		1
		61 duplicate	01/24/02	Sediment																										1
	079	62	01/24/02	Sediment	X																					X	X	X		1
		62 duplicate	01/24/02	Sediment																										1
	080	71	01/23/02	Sediment	X																					X	X	X		1
		71 duplicate	01/23/02	Sediment																										1
	081	81	01/23/02	Sediment	X																					X	X	X		1
		81 duplicate	01/23/02	Sediment																										1
	082	91	01/23/02	Sediment	X																					X	X	X		1
	083	91 duplicate	01/23/02	Sediment																										1

Relinquished by: Dwight Shanner	Date: Jan 25	Time: 08:45	Received by:
Method of Shipment	Waybill No: 1332719597 6	Received for Laboratory:	Date: Jan 28/02 Time: 1040
Shipped by:	Shipment Condition:	Cooler opened by:	Date: Time:

* = Required Field

Total Number of Containers: 12

You will be paid directly by our client [ ]

Company Name:
Address:
Contact: Postal Code:
Phone: Fax:

FOR LABORATORY USE ONLY
Sample State at Receipt: [ ] Ambient [ ] Cold [ ] Frozen [ ] N/A
Temperature: 9.2°C Shelf Number:
Comments: