Columbia River Integrated Environmental Monitoring Program 1991 - 1993, (CRIEMP) Data Report

March, 1993

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1 INTRODUCTION

1.1 OVERVIEW

This data report covers the CRIEMP 91-93 sampling period from September 3, 1991 to October 27, 1992. The primary objective of this program was to collect and share environmental information on the lower Columbia River. This report contains all the data collected during this program on the Columbia River from Hugh Keenleyside Dam to the international boundary.

1.2 PROGRAM MANAGEMENT AND COORDINATION

This program was managed by the Columbia River Integrated Environmental Monitoring Program (CRIEMP) Coordinating Committee. The technical committee was represented by Cominco Ltd.; Celgar Pulp Co.; B.C. Hydro; BC Environment, Lands and Parks - Water Quality Branch; BC Environment, Lands and Parks - Environmental Protection Branch; Environment Canada; Department of Fisheries and Oceans; City of Trail; and City of Castlegar.

2 CRIEMP MONITORING OBJECTIVES

2.1 CRIEMP 1991-93 MONITORING OBJECTIVES

CRIEMP 1991-93 was the first monitoring program being implemented by CRIEMP. The following are the specific objectives for CRIEMP 1991-93.

* to assess the cumulative effects of Celgar, Cominco, municipalities, and other sources of pollutants.
* to provide statistically valid and quality assured data for a trend analysis on toxic organics from Celgar's pulp mill.
* to identify sentinel species for trend assessment of bioaccumulation of toxic compounds.
* to provide information on the contamination of non-migratory fish species.

The sampling program was integrated within four river reaches and included an extension of existing monitoring sites within some of the reaches (i.e. the Federal/Provincial water quality monitoring sites at Birchbank and Waneta). Monitoring of fish was incorporated to address the human health concerns through consumption. Other components of the fish study included assessment of the distribution and abundance of fish, their habitat, and a fish

health study. The bioreconnaissance study investigated biological indicators and bed sediment sampling strategies for use as monitoring tools.

3 PROGRAM DATA SUMMARY

3.1 *GENERAL INSTRUCTIONS*

In addition to a hard copy of the data in this report there are 3 diskettes attached which contain all collected data. This data is stored on the diskettes in a compressed format and you will need a software decompression program (i.e. Norton Utilities®) to uncompress and then load the data. All the files on these diskettes have been created using Lotus 123 for Windows® Version 1.1. and are in a 3D format (each file contains multiple spreadsheets).

All files can be manipulated in the same fashion so the following instructions will work for all files.

Spreadsheet "A" is the raw data and includes "less than" (<) symbols which represent data that is below a specified detection limit (i.e. < 50). It also includes all results from any field, travelling, spiked, and laboratory blanks.

Spreadsheet "B" is the manipulated data; meaning that the < symbols have been removed and the remaining number has been entered (i.e. <50 = 50). Also this "B" data has had all field, travelling, spiked, and laboratory blanks removed because it is irrelevant to any spreadsheet calculations. At the bottom of the spreadsheet under the individual column headings there are a number a calculated fields (count, max, min, mean, median etc.); these fields are protected so that the formulas can not be altered accidentally. You can still change them if you want to but you must unprotect them first.

Spreadsheet "C" is the macro (\A or [Ctrl] A) that performs the data manipulation on "B", "D", and "E". There is an explanation beside each line in the macro (it is also protected) telling you what and how the macro is handling the data. As was mentioned in "B", about the <, there is a line in the macro STEP that removes the < signs from the data. At present, by using the converted < number, this conforms to the BC Environment - Water Management Branch protocol that they use for data manipulation. This can be changed to use 1/2 of the minimum detectable concentration (MDC) or to substitute a "zero" value that could be used in the data calculations. The following lines can be substituted in STEP to change the calculations:

"1/2 MDC" - STEP	{EDIT}{HOME}{DEL}{DEL}.5*~{EDIT-COPY}{BRANCH TEST1}
"ZERO" - STEP	{EDIT}{HOME}{DEL}{DEL}0*~{EDIT-COPY}{BRANCH TEST1}

If these macro lines are changed you must recalculate the whole spreadsheet. This means copying spreadsheet "A" to "B", deleting the rows containing the field, travelling, spiked, and laboratory blanks and running the macro [Ctrl] A.

Below the macro in "C" is a lookup table. This table is used in the calculation of the 90% confidence limit (CL) on "B". This table can be changed to calculate the 95% CL or the 99% CL by substituting the proper values into this table from a list of "Student t" values found in any statistical textbook. If these values are changed you must recalculate the worksheet to update the CL value in "B". This can be done by pressing the F9 key.

Spreadsheet "D" and "E" are the worksheets where the extracted data (minus any blank cells) are placed. These are used in the calculation of the median and 90th percentile in "B".

Spreadsheet "F" is the database where an average concentration is calculated (if there is more than one number for a particular date) for the individual weeks of the sampling program. This can be used for plotting the date vs. concentration for a specific assay. It is presently setup to extract this information from "A", which would eliminate all <'s, but you can globally change the equation to extract this information from the manipulated "B". To extract from "B" change place the cursor in the upper left cell in "E" and individually press the F4 key, the Home, and the End keys to highlight the entire range; then use Edit Find/Replace and globally change $A: to $B:. The spreadsheet will automatically recalculate itself. **(NOTE: It is best not to save the file after making the $B: change because if you then make any changes to "B" later, via the macro in "C", this will have a very adverse effect on the recalculation time !!)**

3.2 *WATER QUALITY*

This baseline program was an extensive 13 month study of the ambient water quality from the Keenleyside Dam to the International Boundary. General variables, nutrients, metals/metalloids, AOX, chlorinated organics, resin and fatty acids were monitored at eight sites, above and below industrial and municipal outfalls. These initial results serve as a reference point for comparison to future gathered data (i.e. after industrial and municipal modernization projects) to determine changes in the water quality.

3.3 *BIOLOGICAL ASSESSMENT*

The object of the biological assessment portion of the program was to document the present condition of the aquatic ecosystem. This included monitoring of community structure (benthic invertebrates, periphyton, and, aquatic macrophtyes), bioaccumulation (walleye, rainbow trout, mountain whitefish, bivalves, and caddis flies), sediment contamination levels, and sediment bioassays.

3.4 *FISH ABUNDANCY AND MOVEMENT*

Studies provided CRIEMP with information on fish distribution, population sizes, habitat requirements, and basic life history information. As well, BC Hydro's programs also provided total gas pressure and dissolved oxygen data.

3.5 *FISH HEALTH*

The Celgar Expansion Review Panel recommended that the Department of Fisheries and Oceans undertake a research program to include fish and aquatic resources in the lower Columbia River. In 1991 a study was undertaken to assess dioxin and furan body burden, physiological stress response (mixed function oxidase enzyme induction), tissue histology, disease diagnostics, and general physical parameters in mountain whitefish, which serve as a good indicator species for organic contaminants due to their feeding and migratory behaviour. Green Plan funds have been allocated to support another three sampling periods in 1992, 1994, and 1996.

4 METHODS

4.1 *WATER MONITORING*

4.1.1 *Water Monitoring Sites*

Reach I -

No sites were chosen for the water sampling program in this reach as it is a lake and not a river environment and any interpretation of results would be difficult.

Reach II -

Site II-1 was chosen as a control site because a) it is above any industrial or municipal effluent outfalls and the water has been well mixed as it passes through the Keenleyside Dam and b) this is part of the river environment and not part of the Arrow Lakes environment. This site is monitored every four weeks by boat for general variables, nutrients, resin and fatty acids, chlorophenols and every 8 weeks for general variables, nutrients, resin and fatty acids, chlorophenols, metals and metalloids from September 3/91 to October 27/92. Twice per year, October 1/91 and March 17/92, this site will also be monitored for dioxins and furans.

Site II-2 was originally chosen to be on the west side of the Columbia River downstream of Celgar but due to the Celgar construction and the change in the river current because of this construction a site was chosen in the middle of the Columbia River, 400 meters downstream of the Celgar diffuser plume outfall. This site is monitored every four weeks

by boat for general variables, nutrients, resin and fatty acids, chlorophenols and every 8 weeks for general variables, nutrients, resin and fatty acids, chlorophenols, metals and metalloids from September 3/91 to October 27/92. Twice per year, October 1/91 and March 17/92, this site will also be monitored for dioxins and furans.

Site II-4 was chosen because it was downstream of the Castlegar sewage treatment plant but above the Kootenay and Columbia River confluence. This site is monitored every four weeks by boat for general variables, nutrients, resin and fatty acids, and chlorophenols and every 8 weeks for general variables, nutrients, resin and fatty acids, chlorophenols, metals and metalloids from September 3/91 to October 27/92. Twice per year, October 1/91 and March 17/92, this site will also be monitored for dioxins and furans.

Reach III -

Site III-2 at Birchbank was chosen because this is the mixing reach between the Kootenay confluence and Trail and there is an established federal/provincial monitoring station here. This station is monitored every two weeks under the existing Canada-British Columbia Water Quality Monitoring Agreement from shore and every four weeks by boat from September 3/91 to October 27/92 for general variables, nutrients, resin and fatty acids, chlorophenols. Twice per year, October 1/91 and March 17/92, this site will also be monitored for dioxins and furans.

Reach IV -

Site IV-1 was chosen to satisfy the Water Management Branch monitoring requirements for water quality objectives of 5 times in 30 days.

Site IV-1A and *Site* IV-1B are required to be monitored under Cominco's permit with BCELP. They are downstream of Cominco's effluent discharges and will be sampled by boat every four weeks from September 3/91 to October 27/92 for general variables, metals and metalloids.

Site IV-3 is sampled weekly from shore as a Federal/Provincial monitoring station. It is the last monitoring station before the Columbia River crosses the international boundary.

Individual variables and sampling parameters are shown in Table 15 through Table 22 in Appendix A.

The sampling sites chosen to meet the above criteria are shown in Appendix B: Figure 1 Water Sampling Site Map and Table 1.

Table 1: Stream Reaches and Water Sampling Stations

Reach/Station	Description	Station Number
		SEAM #
Reach II	Columbia River from Hugh Keenleyside Dam to the confluence of the Columbia and Kootenay Rivers	
II-1	100 m below Hugh Keenleyside Dam on east side of Columbia River	0200183
II-2	400 m below the Celgar diffuser outfall in the middle of the Columbia River	E216155
II-4	400 m above the confluence of the Kootenay and Columbia Rivers on the west side of the Columbia River	0200200
Reach III	Columbia River from the confluence of the Kootenay and Columbia Rivers to Stoney Creek above Trail	
III-2	West side of the Columbia River at Birchbank	0200003
Reach IV	Columbia River from Stoney Creek above Trail to the international boundary	
IV-1	1/3 of the way across (from south side) the old Trail bridge	E209100
IV-1A	West Trail side of the old Trail bridge	E216137
IV-1B	East Trail side of the old Trail bridge	E216136
IV-3	400 m above the confluence of the Pend O'reille and Columbia Rivers on the east side of the Columbia River	0200559

4.1.2 *Water Sampling Procedures*

4.1.2.1 *Field Sampling Procedures*

There are 2 different sampling procedures that are being used for this water sampling program (Appendix B). The first procedure is shore sampling and this is used every week for 3 weeks at Waneta (Site IV-3) and every other two weeks at Birchbank (Site III-2). The second procedure is boat sampling and this is used every four weeks at all the sites. For station III-2 and IV-3, the protocols for shore sampling are the procedures used by Environment Canada for the routine monitoring. For the remaining stations, the BCELP procedures are used for sampling from shore. Samples collected from the boat followed the respective Environment Canada or BCELP shore sampling with the following steps:

1) Follow the shore sampling procedures except that you must make sure the gas tanks and exhaust have been covered to reduce the chance of gas and oil contaminants and other organic contaminants from the exhaust fumes.

2) Ensure that the boat is facing upstream into the current before sampling.

4.1.2.2 *Field Sampling - Field Blanks*

Field bottles were prepared as a check on contamination from field sampling or sample transport. The bottles in the field blanks kit have been filled with de-ionized water by Zenon. The treatment and handling of these samples provides us with a check on sources of contamination and error.

1) The samplers will follow all normal CRIEMP sampling procedures with the exception of actually placing the bottles into the water.

2) Remove the bottles containing water from kit, and remove individual caps. Lower uncapped bottles to approximately 1 meter from the river's surface but do not let it come in contact with the river. Add preservatives, if required, recap bottles and shake well. Repack kit and send to the laboratory with a completed requisition form.

4.1.3 *Analytical Procedures*

4.1.3.1 *Environment Canada*

Samples for most variables collected from Birchbank and Waneta were analysed at Environment Canada Laboratories. Heavy metals are analysed at the National Water Quality Laboratory at Burlington, Ontario according to methods described in Environment Canada (1990b) Water Quality Monitoring Protocols.

4.1.3.2 *Zenon Environmental Laboratories*

4.1.3.2.1 Methods

Methods used by this laboratory are found in the Part I. 1976 Edition, and Part II. Supplement of "A LABORATORY MANUAL FOR THE CHEMICAL ANALYSIS OF WATERS, WASTEWATERS, SEDIMENTS AND BIOLOGICAL MATERIALS" (1976 Edition Including Updates).

4.1.3.2.2 Sample Bottles and Preservation

Table 2 and Table 3 describe sample bottles and preservation methods used for samples.

Table 2: Sample Bottles and Preservation used for water samples analysed at Zenon

Variable	Test	Sample Size	Sample Bottle	Preservation
General Variables (GV)	Physical, Anions	2 L	Polyethylene	4 C / 72 hrs.
	Coliform	250 mL	Poly, sterilized	4 C / 48 hrs.
	E. Coli/Enterococcus	250 mL	Poly, sterilized	4 C / 48 hrs.
	Alkalinity	From GV bottle		
	Total Organic Carbon	100 mL	Poly	4 C / 72 hrs.
	Chloroform (CH)	500 mL	Glass	4 C / 14 days
Metals/Metalloids (M)	Metals (Total) + hardness	250 mL	Poly	Field filtered, pH to <2 with HNO3 (4 mL conc. HNO3) / 6 mon.
	Metals (Dissolved)	250 mL	Poly	Field filtered, pH to <2 with HNO3 (4 mL conc. HNO3) / 6 mon.

Table 3: Sample Bottles and Preservation used for water samples analysed at Zenon

Variable	Test	Sample Size	Sample Bottle	Preservation
Metals/Metalloids (M)	Mercury	1 L	Glass	6 mL 10% $K_2Cr_2O_7$ + 6 mL H_2SO_4 /L (28 days)
AOX (A)	AOX	500 mL	Amber glass, Acid rinsed + baked	pH to <2 with HNO_3 (4 mL conc. HNO_3)
	Chlorate	From GV Bottle		
Resin Acids (R)		1 L	Amber glass (solvent cleaned)	pH to >2 with NaOH (21 days)
Fatty Acids (F)		From resin sample bottle		
Nutrients	Orthophosphorus + Total Diss. P + Total P + Total N + NH_3 + NO_2 + NO_3	From GV sample bottle		

4.1.3.3 AXYS Analytical Services Ltd.

AXYS is performing the Dioxin/Furan, Total Phenolics, Chloroform, and Chlorophenol analyses. Methods used for performing the analyses are described in Appendix D.

4.1.3.4 Analytical Services Laboratories Ltd.

ASL is doing the special low level Mercury analysis, following the methods described in Appendix E.

4.2 BIOLOGICAL AND SEDIMENT SAMPLING

Three types of monitoring were used in this program. These are:

1. Community Structure Survey - involved the identification and quantification of organisms found above and below the various waste discharges. Changes in the types and numbers of organisms at a particular location over time can give an indication of the effects of a waste discharge and, in some cases, how successful

newly installed treatment systems have been in reducing impacts. This information also can be used to describe or inventory an aquatic ecosystem and provide an understanding of how biologically productive it is.

2. Bioaccumulation Sampling - A few sentinel species were tested for a variety of contaminants to determine the extent of downstream effects and the efficacy of waste treatment over time. These species must be ubiquitous or found commonly throughout the river system and preferably spend most or all of their life cycle in one location in the river. The sentinel species monitored included fish as well as invertebrates. Fish that are consumed by the public were also monitored to address the second objective above.

3. Sediment Contaminant and Toxicity Sampling - sediment analysis was done to determine the extent of downstream accumulation of various pollutants. Because of the necessity of finding sufficient fine sediment for analysis it was not be possible to sample randomly but rather accessible zones of fine sediment deposition were sampled. Re-sampling permanent locations may permit an assessment of temporal trends following treatment upgrading of the major discharges. For a number of reasons it was not possible to integrate contaminant sampling in sediments with that in biota as recommended by Sigma (1990).

Various laboratory bioassays were also conducted on fine sediments collected along the river to determine potential toxicity. Laboratory bioassays are somewhat artificial in that the sediments are disturbed during collection, possibly releasing toxins that would remain unavailable to organisms in the river, and in that the test organisms are often not the same as those found in the river. Bioassays can, however, be useful in determining the relative toxicity between sites. It is hoped that sediment contaminant analysis can be related to the results of the toxicity testing unless detected toxic effects are the result of some contaminant for which no analysis has been performed.

Data obtained from this biological and sediment monitoring program will be reviewed upon completion of the study to determine which components should be part of a long-term monitoring strategy. The information may also be used by BC Environment and Environment Canada to develop ecosystem objectives.

4.3 COMMUNITY STRUCTURE SURVEY

This segment of the proposed program differs significantly from that recommended by Sigma (1990). The Sigma approach stressed analysis of benthic invertebrate tissue for a wide range of contaminants after taxonomic sorting into "functional groups". Contaminant levels in benthos would then be compared to sediment levels from the same station. A number of stations in each reach sampled on each bank of the river would be sampled to address the spatial variability of the contaminants analyzed. For reasons outlined in the Preamble this is not recommended as a monitoring objective. Accumulation of contaminants in sediments and aquatic life is addressed in later sections.

The objectives of this Community Structure survey were:

* to gather information on the types and abundance of benthic flora and fauna from various locations along the river to describe the aquatic ecosystem, particularly at points above and below the major discharges.

* to gather the above information in such a way so that re-sampling will show the effects of changes in waste treatment. Gross changes in the community structure will be relatively easy to detect, even with moderate sampling effort. Benthic invertebrate sampling can be conducted to also show more subtle changes. Periphyton and aquatic macrophyte growth and distribution are dramatically effected by so many natural environmental factors, which may mask the effects of waste contaminants, that extensive monitoring of these components can not be justified.

See Table 4 for details on the Summary of Community Structure Survey.

4.3.1 Benthic Invertebrate

4.3.1.1 Benthic Invertebrate Monitoring Sites

The sites used were:

i) no monitoring in Reach I on the small creeks entering Lower Arrow Lake, it would be very difficult to compare information form these stations with those on the Columbia River and separate the differences caused by waste discharges from those caused by greatly differing habitat.

Control sites were at *Site* II-1 above Celgar and on the Kootenay River near the mouth (CS-3 or *Site* II-5 (0200178) below the Brilliant Dam.

ii) Reach II - *Site* II-3 Robson West below Celgar.

iii) Reach III - *Site* III-2 at Birchbank (0200003)

iv) Reach IV - *Site* IV-2 (E216138) upstream of Bear Creek and *Site* IV-3 (0200559) at Waneta.

The sampling sites chosen to meet the above criteria are shown in Appendix B: Figure 2 Benthic Sampling Site Map.

A reconnaissance trip was needed to locate sites with similar substrate size, composition, and water velocity. Collection was done by land and by boat.

4.3.1.2 Benthic Invertebrates Sampling Procedures

Benthic invertebrate was done twice, in April and October. Samples were collected using a Waters and Knapp sampler. Sampling depth was 20-25 cm. As well an oversized sampler (a modified Surber/Hess) was used to sample those sites where the water depth was 30-40 cm.

At each site dissolved oxygen, conductivity, pH, and water temperature were measured. Norecol arranged for sorting and enumeration of the benthic invertebrate samples. Taxonomic identifications were taken to genus and portions were taken for a reference collection. QA/QC protocols included resorting in 20% of the samples and the CRIEMP reference collection was sent to the U.S. geological Survey for identification confirmation.

4.3.2 Periphyton

4.3.2.1 Periphyton Monitoring Sites

Periphyton monitoring sites were chosen and marked during the Norecol reconnaissance trip and were as close as possible to the sites used for the benthic invertebrate collection sites.

Control sites were at *Site* II-1 above Celgar and on the Kootenay River near the mouth (CS-3 or *Site* II-5 (0200178) below the Brilliant Dam.

i) Reach II - *Site* II-1 North Bank below Keenleyside dam and *Site* II-2 downstream of Celgar.

ii) Reach III - *Site* III-2 at Birchbank (0200003)

iii) Reach IV - *Site* IV-1 (E216138) Ryan Creek and *Site* IV-3 (0200559) at Waneta (across from the Cominco gravel pit)

The sampling sites chosen to meet the above criteria are shown in Appendix B: Figure 3 Periphyton Sampling Site Map.

4.3.2.2 Periphyton Sampling Procedures

The quantities of attached algae at a site were estimated by selecting five boulders at a site which visually seem to represent the growth at the site. Areas of 25cm^2 were scraped using a stainless steel razor blade from each boulder and the five replicates were composited in a single sampling jar. The sample bottle was shaken to distribute the algae and were wet filtered through a glass fibre filter. Each filter was cut into thirds and one-third was preserved with magnesium carbonate for chlorophyll *a*, another third for biomass determination and the final third was washed off the filter paper with distilled water and preserved with acid Lugol's solution.

4.3.2.3 Periphyton Analytical Procedures

One-third portion of each sample was identified and enumerated and then portions of the samples were archived for the reference collection. Sample enumeration was performed using an inverted microscope at 1000 power and the procedure followed the Standard Methods (ALPHA 1989). Counting continued until at least 100 cells of the dominant species were counted for each sample but a minimum of ten fields were counted for each sample. A second taxonomist confirmed the species identification.

4.3.3 Aquatic Macrophytes

4.3.3.1 Aquatic Macrophyte Monitoring Sites

The survey consisted of travelling by boat along each shore between Keenleyside Dam and the international boundary. A reference site on the Kootenay River was also done. The location of major aquatic weed beds were mapped at a 1:20,000 scale and were photographed for comparison of changes over time.

Control sites were at *Site* II-1 above Celgar and on the Kootenay River near the mouth (CS-3 or *Site* II-5 (0200178) below the Brilliant Dam.

i) Reach II - *Site* II-1 North Bank below Keenleyside dam, *Site* II-2 downstream of Celgar and *Site* II-3 at Robson (west bank)

ii) Reach IV - *Site* IV-3 (0200559) at Waneta

The sampling sites chosen to meet the above criteria are shown in Appendix B: Figure 4 Aquatic Macrophytes Sampling Site Map.

4.3.3.2 Aquatic Macrophyte Sampling Procedures

Representative samples were collected for taxonomic identification and placed in Ziploc bags, labelled and stored in a 4° C cooler for transportation. An alternate set were dried in a plant press.

4.3.3.3 Aquatic Macrophyte Analytical Procedures

Identifications were made using Warrington's (1980) key *Studies on Aquatic Macrophytes Part XXXIII: Aquatic Plants of British Columbia* and the dried samples were mounted on herbarium sheets to form a permanent reference collection.

Table 4: Summary of Community Structure Survey

Variable	# of Sites	# of Replicates	# of Analyses
Benthic invert. (ID and count)	6	5	60 (sampled twice)
Periphyton (ID and counts)	6	1 composite	6
Periphyton (chlorophyll a)	6	5	30
Periphyton (biomass total + ash)	6	5	30
Macrophytes Survey	N/A	N/A	N/A

Note: Collections were made for archiving.

4.4 BIOACCUMULATION MONITORING

A considerable amount of sampling of sport and coarse fish tissue for metals and dioxins and furans has already been done particularly to address human consumption concerns (see Table 5). Some of the results for metals have been reported in Smith (1987), Norecol (1989), for dioxins and furans in Crozier (1991), and Mah et al (1989). Additional required sampling is summarized in Table 6. The fish sampling was completed by BC Environment, Lands and Parks.

The sentinel species (taxa) used were:

* clams - found throughout; divers had to collect.
* emergent caddis flies - caught in light traps on shore.

Table 5: **Fish Bioaccumulation Sampling** - Completed

Site or Reach	Parameter	No. of analyses
Reach 1	D/F	4
Reach 2	D/F	5
	D/F	6
Reach 3	D/F	16
Reach 4	D/F	4
Reach 5	D/F	4
	D/F	6
Reach 6	D/F	4
Reach 3	Hg	1
Reach 4	Hg	1
Reach 5	Hg	1

Note: Reaches for D/F sampling are slightly different than Sigma Reaches, see Crozier (1991)

Table 6: **Additional Fish Bioaccumulation Sampling**

Species	Parameter	No. of Samples[1]
WS	metals	6
	Hg	6
	D/F	6
Wa[2]	metals	24
	Hg	24
RT[2]	metals	24
	Hg	24
MWF	metals	24
	Hg	24

Species: WS = white surgeon, Wa = walleye, RT = rainbow trout, MWF = mountain whitefish
Tissue: all tissue is axial muscle

1. samples for walleye, rainbow trout, and whitefish are composites of 6 fish except in two reaches where each fish will be analyzed to correlate tissue levels with body size and observed pathology.

2. dioxin/furan sampling for Wa and RT has been done in 1989 by DFO, this sampling should be repeated but is not recommended at this time.

Field parameters - no analytical cost

Taken from each fish sampled: fork length, total weight, gonad weight, liver weight, otoliths and fin rays for ageing

any observed pathological conditions should be noted (eg. lesions, emaciation, etc.).

4.4.1 Clams

4.4.1.1 Clams Monitoring Sites

Collection was done at seven sites:

Control sites were at Kootenay River at Glade and on the Kootenay River near the mouth (CS-3 or *Site* II-5 (0200178) below the Brilliant Dam.

i) Reach II - *Site* II-1 below Keenleyside dam, *Site* II-2 downstream of Celgar and *Site* II-3 at Robson (west bank)

ii) Reach III - *Site* III-2 Birchbank

ii) Reach IV - *Site* IV-3 (0200559) at Waneta

The sampling sites chosen to meet the above criteria are shown in Appendix B: Figure 4 Clams Sampling Site Map.

4.4.1.2 Clams Sampling Procedures

Clams were collected by diving or snorkelling in 0.5-5 m of water in July 1992. They were selected for a representative size range and a minimum of five were collected for a composite sample. They were collected in a net bag, washed clean of sediment, placed in clean (not solvent rinsed or baked) aluminium foil, placed inside a zip lock bag and placed on dry ice in the field.

4.4.1.3 Clams Analytical Procedures

Zenon Laboratories analyzed the tissue for metals by ICAP following the protocol listed in "Standard methods for the Examination of Water and Wastewater", 17th Edition, published by the American Public Health Association.

AXYS Analytical Services Ltd. analyzed the samples for dioxins/furans and chlorinated phenolic compounds. All D/F samples were spiked with an aliquot of ^{13}C-labelled internal standards prior to analysis. Tissue samples were ground with sodium sulfate, packed in a glass column and eluted with solvent. The extracts were subjected to a series of cleanup steps and then analyzed by gas chromatography with mass spectrometric detection (GC/MS).

4.4.2 *Emergent Caddis Flies*

4.4.2.1 *Emergent Caddis Flies Monitoring Sites*

The following sample sites were chosen:

KR-1 Kootenay River near Glade (control)
KR-2 Kootenay River near Grohman Narrows (control)
II-2 Columbia River below Celgar IDZ (>100m, <1000m)
II-3 Columbia River at Robson
III-2 Columbia River at Birchbank
IV-2 Columbia River upstream of Bear Creek
IV-3 Columbia River at Waneta

The sampling sites chosen to meet the above criteria are shown in Appendix B: Figure 5 Clams Sampling Site Map and Appendix B: Figure 6 Caddis Fly Sampling Site Map.

4.4.2.2 *Emergent Caddis Flies Sampling Procedures*

The caddis flies were collected using battery operated ultraviolet light traps. These traps were designed by Environment Canada. All equipment used to trap and handle caddis flies were of stainless steel with the exception of the baskets used to hold the caddis flies and wash bottles which were made of teflon. Non-glass exposed parts of the lights were wrapped in teflon tape.

Traps and buckets were initially scrubbed with soap and tap water to remove oily residues and scrubbed with soap and tap water prior to each use. The equipment was rinsed with distilled water and dried using cloth towels. At the sampling sites , traps, buckets and baskets were rinsed with hexane. Traps were setup at dusk.

Collection baskets were placed in aluminium foil (unbaked) pads within the stainless steel buckets to eliminate any gaps between the trap cone and the teflon basket. Dry ice was placed around the baskets to within 5-10 cm of the top and the lights were switched on. After collection the teflon baskets were covered with baked aluminium foil and polythene gloves were used to handle the foil. The covered baskets were then placed in a cooler on dry ice for transportation.

Insects were sorted twice (as a check) and then weighed into amber glass bottles with baked Al foil cap liners (organics), acid rinsed polythene jars (metals), or polythene jars (identification). Containers were labelled with date, collector, location, assays and net weight. Samples were transferred to coolers with dry ice for shipment.

4.4.2.3 Emergent Caddis Flies Analytical Procedures

Zenon Laboratories analyzed the tissue for metals by ICAP following the protocol listed in "Standard methods for the Examination of Water and Wastewater", 17th Edition, published by the American Public Health Association.

AXYS Analytical Services Ltd. analyzed the samples for dioxins/furans and chlorinated phenolic compounds. All D/F samples were spiked with an aliquot of ^{13}C-labelled internal standards prior to analysis. Tissue samples were ground with sodium sulfate, packed in a glass column and eluted with solvent. The extracts were subjected to a series of cleanup steps and then analyzed by gas chromatography with mass spectrometric detection (GC/MS).

The non-fish part of the bioaccumulation study is summarized in Table 7.

Table 7: Non-Fish Bioaccumulation Sampling

Site	Species	Tissue	No. of Samples	Parameters
Pre-testing	various	various	2	D/F
			8	M
KR-1	C	ST	1	D/F,M,Hg,CP
	ECF	WB	1	D/F,M,Hg,CP
KR-2	C	ST	1	D/F,M,Hg,CP
	ECF	WB	1	D/F,M,Hg,CP
II-2	C	ST	1	D/F,M,Hg,CP
	ECF	WB	1	D/F,M,Hg,CP
II-3	C	ST	3	D/F,M,Hg,CP
	ECF	WB	3	D/F,M,Hg,CP
III-2	C	ST	1	D/F,M,Hg,CP
	ECF	WB	1	D/F,M,Hg,CP
IV-2	C	ST	1	M,Hg
	ECF	WB	1	M,Hg
IV-3	C	ST	3	D/F,M,Hg,CP
	ECF	WB	3	D/F,M,Hg,CP

Notes:

Sites:	KR-1 = a control site on the Kootenay River (near Glade) KR-2 = another control site on the Kootenay River (near Grohman Narrows)
Species:	C = clams, ECF = emergent caddis flies (species, or at least genus, must be determined)
Tissue:	ST = soft tissue, WB = whole body
Parameters:	DF = dioxins/furans (17 cogeners), M = metals (Zenon's 19 metal ICP scan), CP = Zenon's pulp & paper chlorinated phenol GCMS scan

Number of samples: Triplicate samples analyzed separately at Robson and at Waneta for QC.

Dioxin/Furan Phased Analysis:

To avoid unnecessary costs, samples from the most contaminated areas were analyzed first (II-2 and II-3).

4.4.3 *Columbia River Fish Health Study*

4.4.3.1 *Fish Collection*

Fish were captured by angling or boat electroshocking with an amperage ranging from 2.5 to 3.5. A total of 48 fish were angled from the Slocan River and another 22 were electroshocked from the same reach so that electroshocked and angled fish could be compared for histological abnormalities. Intensive efforts to angle mountain whitefish on the Columbia River were not successful, so all fish from Reach III (Genelle site) and Reach IV (Beaver Creek site) were captured by electroshocking at night with an amperage of 2.5 - 3.5. Angled fish were placed directly into holding pens in the river, and electroshocked fish were held onboard in a live tank until delivered to holding pens in the river near the shore.

4.4.3.2 *General Sampling Protocols*

Approximately 60 fish per reach were sampled for general morphometric parameters and histopathological analyses. Fish were killed by severing the spinal column immediately anterior to the brain, and then slicing through the brain with a sharp knife. All fish were kept alive until the time of dissection. Fork lengths were measured with a fish measuring board, and wet weight was determined. Individuals were given a brief external examination and all abnormalities were recorded, and sometimes photographed. Fish were then opened for visual inspection, and again abnormalities were recorded and sometimes photographed. Sex was recorded, and gonads, livers, and stomachs were weighed for subsequent determination of hepato-somatic and gonado-somatic index. Gutted weight was also measured. All weights were determined using an electronic balance. Samples of gill, liver, kidney, pancreas, pyloric caeca/pancreas, spleen, and posterior intestine were sent

to the Fish Health and Parasitology Section at the Pacific Biological Station in Nanimo, B.C. for histopathological analyses. Stomachs were preserved in 10% formalin, and contents were analysed by Applied Technical Services in Saanichton, B.C. Otoliths were removed from each fish, placed in otolith trays, and sent to the Fish Ageing Laboratory at the Pacific Biological Station for ageing.

Additional fish (approximately 10 per site) were sacrificed and examined for parasites. Analyses were done at the Pacific Biological Station in Nanimo.

4.4.3.3 Metals and Metallothioneins

A subset of approximately 16 fish per site were analysed for muscle metal concentrations, liver metallothionein levels, and liver concentrations of metallothionein-inducing metals. These fish were sampled as above with the following additions. After excising a small portion of liver for histopathological analysis the remainder of the liver was removed from the body cavity and placed in an acid-washed polypropylene container. Samples were immediately frozen and stored on dry ice until delivered to the DFO Ocean Chemistry section at the Institute of Ocean Sciences in Sidney, B.C. Completely gutted carcasses were then sealed in contaminant-free plastic bags and frozen between two blocks of dry ice. Carcasses were shipped to Quanta Trace Laboratory in Burnaby, B.C. where they were stored at -20 °C until analyses. For each carcass a chunk of muscle which had not been previously exposed was removed using acid-washed instruments and prepared for ICAP scans.

4.4.3.4 Organic Contaminants and MFO's

A subset of approximately 13 fish per site were analysed for muscle concentrations of dioxins, furans, and PCB's (Arochlor, co-planar, and mono-orthosubstituted PCB's). These fish were sampled according to the general protocol outlined above with the following differences. A small portion of the liver was removed for histopathological analysis and the remainder was removed from the body cavity, placed in a small whirl-pack bag, and immediately frozen between two blocks of dry ice. Livers were transported on dry ice to the DFO Freshwater Institute in Winnipeg, Manitoba, where they were analysed for MFO activity. Samples were held at -60 °C or lower until used. Gutted carcasses from the same fish were sealed in contaminant-free plastic bags and frozen between two blocks of dry ice and transported to the DFO Institute for Ocean Sciences in Sidney, B.C., where they were held at -20 °C until delivery to AXYS Analytical Services Ltd. of Sidney, B.C. Not less than 10 grams of previously unexposed muscle was removed and prepared for high resolution analyses of dioxins and furans. Another chunk of unexposed muscle tissue was also removed for PCB analysis as described above. Lipids were measured in each muscle sample, as organic contaminants are lipid soluble.

4.4.3.5 Statistical Analyses

Statistical analyses were done by Aquametrix Research Ltd. in Sidney, B.C. Comparisons will be made for all parameters between the two Columbia River reaches and between the reference site and each of the Columbia River reaches. Efforts will be made to statistically manage problems such as differences in age distribution of fish between the different sampling reaches.

4.5 COLUMBIA RIVER FISH ABUNDANCY AND MOVEMENT STUDY

In the area of drainage covered by the CRIEMP program, BC Hydro environmental projects coincidentally provided aquatic information to the CRIEMP database. Included are: inventory and impact assessment studies conducted under the Resource Smart project.

BC Hydro installed total gas pressure (TGP) meters above and below the Keenleyside Dam and at the Birchbank Federal/Provincial water sampling station as part of a program to monitor and determine means of overcoming TGP production. This program will provide TGP and dissolved oxygen data to the CRIEMP database. Additional mitigation studies into spawning habitat enhancement on the Norn's Creek fan near Robson will provide further information on fish utilization of the river.

B.C. Hydro data will be provided in Appendix - F (Section 13.2) to this report summarising the TGP and dissolved oxygen data.

4.6 SEDIMENT CONTAMINANT MONITORING AND TOXICITY ASSESSMENT

4.6.1 Sediment Monitoring Sites

Sediment samples were collected for chemical analyses and toxicity testing. Sediment sampling took place September 1 and 2, 1992. This sampling time was chosen because of the low flow conditions in the Columbia River during safety inspection and maintenance of the Hugh Keenleyside Dam. Representatives from Environment Canada conducted a field audit at two sites with the Norecol personnel at this time. Additional samples were collected at three other site for splits for the U.S. Geological Survey to be used for a methods comparison test.

The sites used for the sediment collection are as follows:

- II-1 (control), II-2, II-3, Upstream of Nelson on Kootenay Lake (control)
- III-1, III-2, III-3
- IV-1, IV-2, IV-3

The sampling sites chosen to meet the above criteria are shown in Appendix B: Figure 7 Sediment Sampling Site Map.

4.6.2 *Sediment Sampling Procedures*

Prior to sampling at each site all equipment to be used for sampling or preparing composite samples was cleaned with phosphate free detergent and river water. It was then rinsed three times with acetone and three times with hexane.
Samples were collected with a stainless steel Eckman dredge, a stainless steel scoop, or a combination of dredge and scoop.

Composite samples were prepared by personnel wearing polypropylene gloves and stainless steel equipment. The samples were transferred to appropriate containers for the required analyses: glass jars for metals and organic analysis (lined with cleaned and baked aluminium foil), Whirl-Pak bags for particle analysis, and acid-washed polyethylene bags for toxicity tests. The samples for metals and organic analyses were placed on dry ice, while the others were placed on regular ice. They were shipped to the laboratories in appropriate coolers with dry and regular ice.

4.6.3 *Sediment Analytical Procedures*

Table 8 lists the sediment comtaminant sampling parameters and Table 9 lists the bioassay tests performed. These tests were done by the BC Environment Aquatic Toxicity Laboratory in North Vancouver. Dilution water for all the bioassays was taken from the Columbia River below the Keenleyside Dam and shipped to the lab.

Table 8: **Sediment Contaminant Sampling**

Parameter	Number of Samples
Particle size distribution	11
Moisture content	11
TOC	11
Metals package	11
Arsenic (low level)	11
Cadmium (low level)	11
Acid Volatile Sulphide	11
Mercury	11
EOX	11
Dioxins/furans	11
Pulp & paper chlorinated phenols	11
Resin acids	11
Total Kjeldahl nitrogen	11

Table 9: Sediment Bioassays

Test	Description	Quantity of Sample Required	Other Test Requirements
Sediment			
Solid Phase Microtox	Bioluminescent bacteria, results often correlate with other tests, easy test which can be repeated	2 grams	sediment particle size <125 *u* (test and sieve if necessary)
Hyallela azteca	Freshwater amphipod, burrows in sediment	300 mL	sediment particle size <250 *u* (test and sieve if necessary)[1]
Rainbow trout sub-gravel filter (7 days or longer)	Sediment is placed on filter in tank, water is pumped down through sediment back into tank	2 kg	fine sediment. Water chemistry analysis 3 times during test[1]
Sediment Extract[2]			
Microtox	as above	1 L of extract	50 gms of sediment needed to extract
Daphnia magna 48 hours	Zooplankton acute toxicity test. If there are mortalities in a sample this will trigger a Rainbow trout 96 hr. LC_{50} test	1 L of extract	50 gms of sediment needed to extract[1]
Rainbow trout 96 hr LC_{50}	Standard fish acute toxicity test. Do if Daphnia test shows toxicity	at least 20 L of extract	2 kg of sediment needed to extract[1]

1. Analysis for the parameters and sites listed below will be performed on the overlying water or extract once at the end of each test.
Parameters and Sites: Total and dissolved metals (Cd, Cu, Pb, Zn), total Hg, total hardness, ammonia, nitrite on sites II-1, III-2, IV-1, IV-2, IV-3: dioxins and furans, chlorophenols and resin and fatty acids on sites II-1, II-2, II-3, IV-3 (dioxins and furans, chlorophenols and resin and fatty acids need only be analyzed if they have been found in the sediment contaminant analysis). Dissolved oxygen and pH will be monitored regularly during the test.

2. Prepared using a modified SWEP procedure developed by Zenon Labs. This method normally uses DI water at pH 7.0, for these studies it was recommended that Columbia River water from above the Celgar pulp mill be used.

4.6.3.1 Zenon Environmental Laboratories Analyses

Analysed sediment samples for metals by Inductively Coupled Argon Plasma (ICAP), extractable organic halides by Dohrmann Model MC3 analyser, total Kjeldahl nitrogen by automated colourimetric analysis, acid volatile sulphides by EPA SW846 Method 9030A, and total organic carbon by the Leco method.

4.6.3.2 AXYS Laboratory Analyses

A limited subset of the samples were analysed for dioxins/furans, chlorinated phenolic compounds, and resin and fatty acids.

5 QUALITY ASSURANCE

5.1 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

A QA/QC program was in place to ensure that data collected was of acceptable quality. QA/QC measures were in place for the field collection, laboratory analysis and data input phases of the program. Monitoring results, including QA/QC results, were reviewed biannually to detect problems in the data collection program.

References consulted were: Environment Canada 1990a, Environment Canada 1990b, and Environment Canada 1991.

Sampling variables are listed in Table 10 to Table 13. Alert levels are shown in Table 14.

5.2 LABORATORY SCREENING

The following factors were considered in the laboratory screening process:

- participation in inter-laboratory comparison studies and the availability of data on the laboratory's performance in these studies;
- documentation of the analytical methods for the variables of interest.;
- documentation of the laboratory's internal QA/QC procedures;
- adequacy of facilities available for sample storage;
- some laboratories provided a QA/QC chart of the laboratory's precision and accuracy.
- Zenon, Environment Canada's Pacific and Yukon Region Conservation and Protection Laboratory and Environment Canada's National Water Quality Laboratory did conduct analyses for the two federal-provincial monitoring stations, as agreed under the

Canada-British Columbia Water Quality Monitoring Agreement. Zenon, AXYS, and ASL did conduct the analyses for the additional CRIEMP stations.

The laboratory screening guidelines was applied in selecting laboratories for analysis of split or replicate samples for QA/QC.

5.3 *WATER*

5.3.1 *Procedures*

Water samples were collected following the specific procedures recommended in Sigma Engineering (1990), with the following additions or changes.

Sampling bottles were either glass, polyethylene or Teflon, according to the variable and laboratory specifications. Sample bottles were washed following procedures defined by the laboratory.

For variables such as heavy metals, the samples were preserved according to laboratory specifications. A quality control program was in place for reporting on the purity of the preservatives and their dispensers. The results of this program was available to the project leader.

Organics samples were collected in solvent-washed bottles with solvent-cleaned Teflon or aluminium foil liners for the lids. For many organic variables, such as chlorinated phenolics, dark or amber glass bottles were used.

Procedures for filtering nutrients and metals were documented. A trial sampling of filtered samples was conducted at two sites. In this sampling, 10 to 12 replicates from each site and 10 to 12 blanks (distilled/deionized water from the laboratory) were filtered. These filtered samples and blanks were compared to an equal number of total, unfiltered samples and blanks, respectively. An analysis of the results determined that the equipment used by the laboratory for the analyses did not have low enough detection limits to detect the subtle differences between filtered and unfiltered samples. This filtering program was put on hold until further testing by Environment Canada took place.

Detailed water sampling procedures were documented and followed. These already existed for the federal-provincial monitoring sites at III-2 and IV-3 (Environment Canada 1990b).

Following is a description of QA/QC measures that were required for the water sampling and analysis components of the CRIEMP for 1991-1993.

5.3.2 *QA/QC*

5.3.2.1 Field QA/QC

5.3.2.1.1 Replication

Samples collected from sites II-1, II-2, II-3, IV-1 and IV-2 were collected according to procedures documented in Appendix B and analyzed by Zenon Laboratories. Samples collected at sites III-2 and IV-3 were collected as described in Environment Canada, 1990b and analyzed at Environment Canada laboratories.

Replicate samples served a dual function. They were used to evaluate reproducibility or precision in a laboratory's (Zenon Laboratory's) performance, as well as provide a comparison between the laboratories involved in conducting routine analyses for the CRIEMP stations.

For most variables, four replicates were collected monthly from the Waneta (IV-3) site. One of the replicates was the routine sample collected at Waneta and analyzed at Environment Canada laboratories as part of the Canada-British Columbia Water Quality Agreement. The remaining three replicates were analyzed at Zenon Laboratories.

These three replicates were submitted to Zenon Laboratories blindly, without their true station identity known.

Replicates were used for evaluating analytical precision.

For the inorganic variables three replicate samples were collected, as described above. For mercury, one replicate was analyzed at ASL Laboratories, and one was analyzed at Zenon. For the chlorinated phenolics and resin and fatty acids two replicates, including the routine sample as one replicate, were collected. For the dioxins and furans one replicate, plus the sample, was collected at each of two sites once during the program period.

5.3.2.1.2 Field Blanks

Field Blanks were required to identify sources of contamination in the sampling procedure or in the sample transport. Field blank testing was coordinated with laboratory bottle blank testing.

The blanks consisted of sample bottles filled with de-ionized water in the laboratory. The laboratory prepared laboratory bottle blanks and field blanks at the same time.

At the sampling site, the collector placed the sample bottle containing the de-ionized water into the sampling equipment usually used for sampling. The collector followed the procedures usually used for collecting a sample, short of actually collecting a sample. The collector then preserved the sample, as he/she did with an actual sample.

Single blank samples were prepared four times during the year's sampling period for site IV-3 (Waneta) and II-1 (Hugh Keenleyside). These blanks were prepared for the general variables, AOX, chlorinated phenolics (phenols, guaiacols, catechols), resin acids, fatty acids, total metals, total mercury and total nutrients.

5.3.2.1.3 Field Collection Audit

During the 1991-92 sampling period, a field audit was made by Environment Canada staff. The Environment Canada team sampled at sites II-1, II-4, IV-3 at the same time as the CRIEMP collectors. For the audit, triplicate samples of general variables, metals, mercury, arsenic/selenium and nutrients were collected by both Environment Canada and the routine collectors. Single samples for chlorinated phenols were collected. Field blanks were also be made by Environment Canada for all variables. Environment Canada samples were analyzed at Environment Canada laboratories in Burlington, Ontario or West Vancouver, B.C.

5.3.2.2 Laboratory QA/QC

5.3.2.2.1 Laboratory Blanks

Laboratory blanks were prepared from distilled/deionized water and in concert with the field blanks, as described above under Section 5.3.2.1.2. Field Blanks.

Laboratory blanks remained in the laboratory and were analyzed with the corresponding field blanks.

5.3.2.2.2 Standards

Each laboratory provided data on the laboratory's analytical precision relative to the analysis of standard or reference substances.

5.3.2.2.3 Reference Samples/Inter-laboratory Studies

Each laboratory involved in water analysis for the CRIEMP did participate in established inter-laboratory (Round Robin) studies. The laboratory's performance in these studies is available to the CRIEMP Coordinating Committee.

5.3.2.2.4 Inter-laboratory studies on analysis of replicates

The Interlaboratory comparison of replicate samples was addressed in the field collection audit (Section 5.3.2.1.3).

5.3.2.2.5 Intra-laboratory QA/QC

Sigma Engineering (1990) outlined essential elements required for intra-laboratory QA/QC. It was recommended that the procedures outlined for dioxins/furans analysis be replaced with the more recent procedures presented in Environment Canada (1990a).

5.4 SEDIMENT

5.4.1 Procedures

Sediments were collected as recommended in Sigma Engineering (1990). Stainless steel sampling equipment was used. Tools used for mixing and dispensing samples were properly cleaned (acid-cleaned for metals and solvent-cleaned for organics) and were made of either Teflon or stainless steel. Stainless steel equipment was not acid cleaned. When the Ekman or Ponar dredge are used for sampling, sediments touching the metal of the sampler were not used for the sample.

Bottles for metals analysis were either polyethylene or Teflon wide-mouth bottles which were acid-washed. Appropriate acid-washed cap liners (Teflon or polyethylene) were used. Glass jars were used for metals or organics samples.

Separate bottles were used for particle size samples; these should not be frozen.

5.4.2 QA/QC

5.4.2.1 Field QA/QC

5.4.2.1.1 Field Splits

Field splits were used to test for analytical precision and accuracy. Analytical accuracy was tested by analyzing split samples at Zenon and the Environment Canada National Water Quality Laboratory. The splits were taken from the samples being used for the Environment Canada field audit.

Further details on splitting of the sample and its relationship to the Environment Canada field audit is presented in the next section on Field Audit Collection.

In 1991-92 splits were prepared for metals; chlorinated phenols, catechols, guaiacols, dioxins and furans; total organic carbon and particle size.

5.4.2.1.2 Field Collection Audit

A field audit was conducted to observe the CRIEMP collectors' sampling techniques for potential contamination in the sampling.

Environment Canada did collect two sediment samples with CRIEMP collectors. One site was located in Reach I, upstream of industrial inputs. This site acted as a control on the cleanliness of the sampling equipment.

At this Reach 1 site two separate samples were collected. One sample was collected by the CRIEMP collectors and another sample was collected at the same time by Environment Canada. Each sample was well mixed and split into 10 portions, as follows:

2 to CRIEMP for metals analysis;
2 to Environment Canada for metals analysis;
2 to CRIEMP for organics and total organic carbon analysis;
2 to Environment Canada for organics and total organic carbon analysis;
1 to CRIEMP for particle size;
1 to Environment Canada for particle size.

The second audit sample was be collected by CRIEMP collectors at a site downstream of expected contaminants. The sample was split into six subsamples. Each of these six subsamples was analysed for metals, organics, total organic carbon and particle size. One subsample was submitted as the CRIEMP sample; two subsamples were submitted by CRIEMP as a blind splits; three subsamples were analyzed by Environment Canada as blind replicates. Splits from 3 to 5 locations were also be sent for analysis to the U. S. Geological Survey.

5.4.2.2 Laboratory QA/QC

5.4.2.2.1 Standards

Data on their analytical performance on reference and standard samples is available.

5.4.2.2.2 Reference Samples/Inter-laboratory Studies

Each laboratory involved in sediment analysis for the CRIEMP did participate in inter-laboratory studies on the analyses of reference samples. The results of these studies are available to all members of the CRIEMP Coordinating Committee for evaluation.

5.4.2.2.3 Intra-laboratory QA/QC

Refer to the water section above.

5.5 BIOTA

5.5.1 Procedures

Sigma Engineering (1990) outlined procedures for fish collection. Following are a few additions to the Sigma recommendations. All trays, buckets, etc. used for holding fish were made of stainless steel or Teflon and cleaned with solvents. In addition, when handling the fish, especially during dissection, polyethylene gloves and not latex gloves were worn. In collecting other biota, similar precautions were taken, with respect to cleanliness. Handling of the organisms was kept to a minimum.

Dissecting and homogenizing of tissues was done with stainless steel and Teflon equipment that had been cleaned with acid and solvent solutions.

5.5.2 QA/QC

The recommended QA/QC applied to only the bioaccumulation component of the biological sampling. QA/QC was be conducted on the community structure component by having a second expert identification conducted on subsamples of the biological samples.

5.5.2.1 Field QA/QC

5.5.2.1.1 Field Splits

Splits were made of the fish bioaccumulation and non-fish bioaccumulation samplings.

i) fish bioaccumulation

For fish collections conducted in 1990 by B.C. Ministry of Environment, Lands and Parks and Environment Canada, some of the samples were split for QA/QC.

For the additional recommended fish sampling, one sample from mountain whitefish - was split into subsamples. The sample should be split after the tissue has been homogenized. For two of the four species, the QA/QC sample will be split into five subsamples, as follows:

- one subsample to be submitted to the analytical laboratory as the sample;

- two subsamples to be submitted to the same analytical laboratory as above, as blind splits;
- one subsamples to be submitted to an "approved" QA laboratory for analysis and;
- one subsample to be submitted to the Fisheries and Oceans Canada Laboratory for analysis.

For the remaining two samples, each will be split into three subsamples - one to be submitted as the sample, and the other two to be submitted as blind splits.

ii) non-fish bioaccumulation

Splits will be made if sufficient tissue is collected. If not, the selected organism may not be appropriate for long-term monitoring on environmental quality.

It is recommended that for two organisms, one sample will be split into three subsamples -- sample plus two blind splits. As this is a check on analytical precision, the splits should be made on the homogenized tissue.

5.5.2.1.2 Field Collection Audit

Environment Canada did conduct an audit on sampling conducted by contractors on non-fish bioaccumulation.

An audit was conducted on 2 of the samples. For the audit, Environment Canada did collect similar samples at the same location as the contractor and analyzed the samples.

5.5.2.2 Laboratory QA/QC

5.5.2.2.1 Standards

As with the water and sediment samples, high quality standard samples were utilized by the laboratories. Data on the laboratories' analytical performance on reference and standard samples is available.

5.5.2.2.2 Reference Samples/Inter-laboratory Studies

Each laboratory involved in sediment analysis for the CRIEMP did participate in inter-laboratory studies on the analyses of reference samples. The results of these studies are available to all members of the CRIEMP Coordinating Committee for evaluation.

5.5.2.2.3 Intra-laboratory QA/QC

Refer to the water section above.

5.6 DATA MANAGEMENT PLAN

A Data Management Plan was necessary to ensure that data was entered into databases in an accurate and timely fashion, available to program managers for review and scrutinized for anomalies. The plan specified procedures for review of data, guidelines for identifying problems with the data (outliers, contamination, etc.) and follow-up procedures relating to questionable data.

5.6.1 Field Collection

At the federal-provincial sites, Birchbank (III-2) and Waneta (IV-3), station data cards were completed as instructed in the federal-provincial field sampling protocol (FS000017, Environment Canada 1990b).

At all other sites, the following information was noted on CRIEMP station data cards:

- Station
- Station Number
- Date of Sampling
- Air Temperature (°C), measured as described in Environment Canada (1990b)
- Water Temperature (°C), measured as described in Environment Canada (1990b)
- Remarks, describing the conditions at the time of sampling (such as weather, water turbidity, floating debris, presence of ice, etc.). Any deviations from the prescribed sampling procedures was noted.
- Name of Collector(s)

The CRIEMP station cards were forwarded to the CRIEMP Coordinator following the sampling.

Blind replicates were submitted to the laboratory as samples from a newly created fictitious SEAM station. The true identity of the samples was recorded by the field collectors on the appropriate field data sheet and submitted to the CRIEMP Coordinator.

QA/QC replicates were collected for analysis by "other" laboratories (laboratories not routinely analyzing the particular variables for CRIEMP) and were submitted by the CRIEMP Coordinator to the respective laboratories.

5.6.2 *Laboratory Analysis*

Following analysis of samples, the results are to be entered into a database following procedures established for provincial data at Zenon and federal or federal-provincial data at Environment Canada Laboratories.

A report on intra-laboratory QA/QC was submitted to the Program Coordinator by participating laboratories twice per year. The reports included data on the following:

- method performance test results;
- laboratory and complementary field blanks;
- results of inter-laboratory tests;
- results of duplicate samples taken as subsamples by the laboratory (one sample in every ten samples, for dioxins/furans analyses);
- method blank results;
- surrogate recoveries (where applicable);
- results of certified standard analyses.

5.6.3 *Data Analysis for QA/QC*

Monthly, the CRIEMP Coordinator reviewed the data and reported on the status and quality of the data to the Coordinating Committee. The following was included in the verbal report:

- a review of all routine water quality data, with respect to outliers and questionable values. The Alert Levels listed in Table 5.2 can be used as a guideline for data review.
- a review of laboratory and field blanks data for unacceptably high levels (all detectable levels should be considered as alert levels).
- a review of blind replicates data with respect to variability (less than or equal to 25 % variability considered acceptable).

- a review of data on replicates sent to other laboratories for analysis (a variation of greater than 15 % among laboratories should require further investigation of the results).

The CRIEMP Coordinator took action to resolve questions arising from data anomalies, as follows:

- checking on data entry at its various stages;
- checking on laboratory and field blanks for possible causes of problem;
- checking CRIEMP field station cards for comments on sampling conditions, etc.;
- comparing with other data, such as residue levels, or other related variables;
- request for a re-analysis of the sample;
- reviewing data with respect to inter-laboratory comparisons for systematic problems.

The Coordinator did report on his investigations into data problems to the Coordinating Committee which determined the need for further action or studies to resolve outstanding data problems.

Table 10: **Summary of Analyses** - required to accommodate QA/QC in CRIEMP sampling for 1991

I. WATER

APPLICATION	VARIABLE	NUMBER OF ANALYSES
Testing of filtering procedures	metals-diss	30-36 (10-12 replicates x 2 sites; 10-12 blanks total)
	metals-tot	30-36
	As-diss	30-36
	As-total	30-36
	Hg-diss	30-36
	Hg-total	30-36
	P-diss	30-36
Replicates (blind)	general variables	48 (3 replicates at Waneta x 16 times)
	metals-tot	42
	Hg-total	51
	As/Se-total	42
	N-total	48
	P-diss	48
	P-ortho	48
	P-total	48
	AOX	16
	chlorinated phenols	32
	chl. guaiacols	32
	chl. catechols	32
	resin acids	16
	fatty acids	16
	dioxins/furans	2

Table 10 cont'd: **Summary of Analyses** - required to accommodate QA/QC in CRIEMP sampling for 1991

I. WATER

APPLICATION	VARIABLE	NUMBER OF ANALYSES
Field Blanks	general variables	12 (1 x 2 sites (Wan + U/S) x 4 times + 4 sites x 1 time)
	metals-tot	10
	Hg-total	10
	As/Se-total	10
	N-total	10
	P-diss	10
	P-ortho	10
	P-total	10
	AOX	10
	chlorinated phenols	10
	chl. guaiacols	10
	chl. catechols	10
	resin acids	10
	fatty acids	10
	dioxins/furans	1 possibly
Laboratory Blanks	general variables	4 made up
	metals-tot	4 made up
	Hg-total	4 made up
	As/Se-total	4 made up
	N-total	4 made up
	P-total	4 made up

Table 10 cont'd: **Summary of Analyses** - required to accommodate QA/QC in CRIEMP sampling for 1991

I. WATER

APPLICATION	VARIABLE	NUMBER OF ANALYSES
Laboratory Blanks cont'd	AOX	4 made up
	chlorinated phenols	4 made up
	chl. guaiacols	4 made up
	chl. catechols	4 made up
	resin acids	4 made up
	fatty acids	4 made up
	dioxins/furans	1 ?
Replicates (inter-laboratory studies)	general variables	6 (2 samples x 1 times x 3 labs)
	metals-tot	6
	Hg-total	6
	As/Se-total	6
	N-total	6
	N-diss	6
	P-diss	6
	P-ortho	6
	P-total	6
	AOX	6 (2 samples x 1 times x 3 labs)
	chlorinated phenols	6
	chl. guaiacols	6
	chl. catechols	6
	resin acids	6
	fatty acids	6
	dioxins/furans	3

? may not be applicable at present time

Table 11: **Summary of Analyses** - required to accommodate QA/QC in CRIEMP sampling for 1991

II. SEDIMENT

APPLICATION	VARIABLE	NUMBER OF ANALYSES
Field splits/ Field Collection Audit	metals-tot	5
	Hg-total	5
	As/Se-total	5
	phenols-total	5
	EOX	5
	dioxins/furans	5
	chlorophenols	5
	chl. guaiacols	5
	chl. catechols	5
	resin acids	5
	fatty acids	5
	TOC	5
	particle size	5
Replicates (inter-laboratory studies)	will be addressed by field audit	

Table 12: **Summary of Analyses** - required to accommodate QA/QC in CRIEMP sampling for 1991

III. BIOTA

APPLICATION	VARIABLE	NUMBER OF ANALYSES
Field splits - fish	metals-tot	14 (8 = fish; 6 = non-fish)
	Hg-total	14
	As/Se-total	14
	phenols-total	8 (2 = fish; 6 = non-fish)
	EOX	8
	dioxins/furans	8
	chlorophenols	8
	chl. guaiacols	8
	chl. catechols	8
	resin acids	8
	fatty acids	8
	lipid/ moisture	8
Field Collection Audit	metals-tot	2 (add. to splits)
	Hg-total	2
	As/Se-total	2
	phenols-total	2
	dioxins/furans	2
	chlorophenols	2
	chl. guaiacols	2
	chl. catechols	2
	resin acids	2
	fatty acids	2
	lipid/ moisture	2
Replicates (inter-laboratory studies)	will be addressed by field audit	

Table 13: QA/QC - conducted by Environment Canada

I. WATER

APPLICATION	VARIABLE	NUMBER OF ANALYSES
Field Collection Audit	general variables	20 (collected at 3 sites + blanks)
	metals-tot	20
	metals-diss	20
	Hg-total	20
	Hg-diss	20
	As/Se-total	20
	As/Se-diss	20
	N-total	20
	N-diss	20
	P-diss	20
	P-ortho	20
	P-total	20
	chlorinated phenols	5

II. SEDIMENT

APPLICATION	VARIABLE	NUMBER OF ANALYSES
Field splits/ Field Collection Audit	metals-tot	6
	Hg-total	6
	As/Se-total	6
	phenols-total	6
	dioxins/furans	6
	chlorophenols	6
	chl. guaiacols*	6
	chl. catechols*	6
	resin acids*	6
	fatty acids*	6
	TOC	6
	particle size	6

* may not be possible

Table 13 cont'd: QA/QC - conducted by Environment Canada

III. BIOTA

APPLICATION	VARIABLE	NUMBER OF ANALYSES
Field Collection Audit	metals-tot	4
	Hg-total	4
	As/Se-total	4
	phenols-total	4
	dioxins/furans	4
	chlorophenols	4
	chl. guaiacols*	4
	chl. catechols*	4
	resin acids*	4
	fatty acids*	4
	lipid/ moisture	4

* may not be possible

Table 14: Alert Levels of Water Quality Variables

Alert levels of water quality variables (mg/L) - used as guidelines in data review

1. GENERAL VARIABLES

Sampling stations	Birchbank		Waneta	
VARIABLE	Low	High	Low	High
Temperature-air	-10	35	-10	35
Temperature-water	+ 2.0	20	+ 2.0	20
pH-field	6.8	8.2	6.8	8.2
pH-lab.	6.8	8.2	6.8	8.2
Conductivity-field				
Conduct.-lab. (Conduct.-field should be within 10% of Conduct.-lab.)				
Sodium-diss.	0.7	2.0	0.7	2.0
Chloride-diss.	0.3	1.6	0.3	1.8
Tot. diss. solids (not monitored before)				
Colour (app.)	--	15	--	15
NFR (fixed total)	--	10	--	10
Turbidity	0.10	2.00	0.20	2.00
Coliform-fecal (should be under detection limit)				
Calcium-diss.	15.000	22.000	15.000	27.000
Magnesium-diss.	3.000	5.000	3.000	5.000
Hardness	50	75	50	85
Alkalinity-total	40	65	40	65
Alkal. -phenolph. (null by definition if pH < 8.3)				
Potassium-diss.	0.4	0.8	0.4	0.8
Sulphate	7.0	11.5	7.5	20.0
Fluoride	--	0.100	--	0.200
Silica (reactive)	3.00	5.00	3.00	5.00
Silicon (ICP)	1.40	2.30	1.40	2.30

Table 14 cont'd: Alert Levels of Water Quality Variables

2. NUTRIENTS

Sampling stations	Birchbank		Waneta	
VARIABLE	Low	High	Low	High
Total phosphorus	--	0.025	--	0.100
Total diss. P	--	0.025	--	0.100
Ortho-P	--	0.025	--	0.100
Total diss. N	--	0.200	--	0.200
Nitrate+Nitrite	--	0.150	--	0.150
Diss. Ammonia	--	0.030	--	0.030

The high alert level for ammonia is the limit set by IJC for the Great Lakes (IJC 1986); ammonia in the Columbia River was not monitored in the past. The high alert levels for the other general variables and nutrients, except ortho-P, are greater than most values measured in the past. Ortho-P was not measured in the past; its levels should never be greater than those measured for the other phosphorus variables. The low alert levels for the general variables are less than those measured in the past.

3a. TOTAL HEAVY METALS

Sampling stations	Birchbank		Waneta	
METAL	Low	High	Low	High
Aluminium	--	0.1	--	0.1
Cadmium	--	0.0008	--	0.0008
Chromium	--	0.0020	--	0.0020
Copper	--	0.0020	--	0.0020
Iron	0.0100	0.3000	0.0100	0.3000
Lead	--	0.0020	--	0.0020

The high values are levels that should not be exceeded for the protection of freshwater aquatic life, as specified by the Canadian Water Quality Guidelines (CCREM 1987). The low value for iron, if observed, may indicate a clerical error.

Table 14 cont'd: Alert Levels of Water Quality Variables

3b. TOTAL HEAVY METALS

Sampling stations	Birchbank		Waneta	
METAL	Low	High	Low	High
Arsenic	--	0.0006	--	0.0012
Manganese	--	0.0100	--	0.0200
Nickel	--	0.0010	--	0.0010
Selenium	--	0.0003	--	0.0005
Zinc	--	0.0050	--	0.0300

The high values are greater than most values measured in the past for these stations. The high value for zinc at Waneta is the CCREM (1987) recommendation for the protection of freshwater aquatic life.

3c. TOTAL HEAVY METALS

Sampling stations	Birchbank		Waneta	
METAL	Low	High	Low	High
Mercury	--	0.0001	--	0.0001
Thallium	--	0.005	--	0.005

The high alert levels are the analytical detection limits. As Thallium has not been monitored in the past, a record of background levels does not exist. Therefore, the analytical detection limit is recommended as the alert level for the present.

6 SUMMARY

An enormous amount of data was collected and only a small part has been printed out. The data printed is a summary of the water data only. This data has been adjusted for MDC's (i.e. All "less thans" are reported as the MDC number) and the raw and adjusted data can be found on the diskettes at the end of the report. Hopefully this will allow all participants to manipulate the data to meet their individual requirements.

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8 APPENDIX - A: Sampling Locations and Frequency

Table 15: General Variables - Sampling Locations and Frequency

Sampling Station	Station	Station	Station	Station	Station
	II-1	II-1	II-2	II-2	II-4
	Below K Dam	Below K Dam	400 m D/S	400 m D/S	D/S STP
SEAM No.	'0200183	'0200183	E216155	E216155	'0200200
Analytical Responsibility	Celgar	Prov. (WQ)	Celgar	Prov. (WQ)	Celgar
Sampling Freq	1/mon	(5x)/30 days	1/mon	(5x)/30 days	1/mon
.....start date	Sep-91	Mar-92	Sep-91	Mar-92	Sep-91
.....end date	Oct-92		Oct-92		Oct-92
Analytical Lab.	Zenon	Zenon	Zenon	Zenon	Zenon
General Variables					
pH	16	3	16	3	16
Temperature	16	3	16	3	16
TDS	16		16		16
Conductivity	16		16		16
Color x 3	16	3	16	3	16
TSS	16	3	16	3	16
Turbidity	16	3	16	3	16
Hardness	16		16		16
Coliform (fecal)	16	3	16	3	16
E.Coli/Entero.	13	3	13	3	13
Alkalinity x 2	16		16		16
DO	16	3	16	3	16
Cl	16		16		16
SO4	16		16		16
Fluoride	16		16		16
Si	16		16		16
Ca	16		16		16
Na	16	3	16	3	16
K	16		16		16
Total Organic C	16		16		16

Table 15 cont'd: General Variables - Sampling Locations and Frequency

Sampling Station	Station	Station	Station	Station	Station
	II-4	III-2	III-2	III-2	III-2
	D/S STP	Birchbank	Birchbank	Birchbank	Birchbank
SEAM No.	'0200200	'0200003	'0200003	'0200003	'0200003
Analytical Responsibility	Prov. (WQ)	Celgar	Prov. (WQ)	Prov. (EP)	Federal
Sampling Freq	(5x)/30 days	1/mon	(5x)/30 days	2/mon	2/mon
.....start date	Mar-92	Sep-91	Mar-92	Sep-91	Sep-91
.....end date		Oct-92		Oct-92	Oct-92
Analytical Lab.	Zenon	Zenon	Zenon	Zenon	Fed. Lab
General Variables					
pH	3		4	32	32
Temperature	3		4		32
TDS		16			
Conductivity				32	32
Color x 3	3		4	32	32
TSS	3		4	32	
Turbidity	3		4		32
Hardness			4		32
Coliform (fecal)	3		4	32	
E.Coli/Entero.	3		4	13	
Alkalinity x 2			4		32
DO	3	16	4		
Cl					32
SO4			4		32
Fluoride			4		32
Si					32
Ca					32
Na	3		4		32
K					32
Total Organic C		16			

Table 15 cont'd: General Variables - Sampling Locations and Frequency

Sampling Station	Station	Station	Station	Station	Station
	IV-1B	IV-1	IV-1A	IV-3	IV-3
	East Tr.	Mid Stream	West Tr.	Waneta	Waneta
SEAM No.	E216136	E209100	E216137	'0200559	'0200559
Analytical Responsibility	Cominco	Prov. (WQ)	Cominco	Celgar	Prov. (EP)
Sampling Freq	1/mon	(5x)/30 days	1/mon	1/mon	1/wk
.....start date	Sep-91	Mar-92	Sep-91	Sep-91	Sep-91
.....end date	Oct-92		Oct-92	Oct-92	Oct-92
Analytical Lab.	Zenon	Zenon	Zenon	Zenon	Zenon
General Variables					
pH	16	3	16		64
Temperature	16	3	16		
TDS	16		16	16	
Conductivity	16		16		64
Color x 3	16	3	16		64
TSS	16	3	16		64
Turbidity	16	3	16		
Hardness	16		16		
Coliform (fecal)	16	3	16		64
E.Coli/Entero.	13	3	13		13
Alkalinity x 2	16		16		
DO	16	3	16	16	
Cl	16		16		
SO4	16		16		
Fluoride	16		16		
Si	16		16		
Ca	16		16		
Na	16	3	16		
K	16		16		
Total Organic C				16	

Table 15 cont'd: General Variables - Sampling Locations and Frequency

Sampling Station	Station	Number of QA samples
	IV-3	
	Waneta	
SEAM No.	0200559	
Analytical Responsibility	Federal	
Sampling Freq	1/wk	
.....start date	Sep-91	
.....end date	Oct-92	
Analytical Lab.	Fed. Lab	
General Variables		
pH	64	
Temperature	64	
TDS		
Conductivity	64	58
Color x 3	64	58
TSS		58
Turbidity	64	58
Hardness	64	58
Coliform (fecal)		7
E.Coli/Entero.		5
Alkalinity x 2	64	46
DO		
Cl diss.	64	58
SO4	64	58
Fluoride	64	58
Si	64	58
Ca	64	58
Na diss.	64	58
K diss.	64	58
Total Organic C		21

Table 16: Metals/Metalloids - Sampling Locations and Frequency

Sampling Station	Station	Station	Station	Station	Station
	II-1	II-2	II-4	III-2	III-2
	Below K Dam	400 m D/S	D/S STP	Birchbank	Birchbank
SEAM No.	'0200183	E216155	'0200200	'0200200	'0200200
Analytical Responsibility	Cominco	Cominco	Cominco	Prov. (WQ)	Prov. (EP)
Sampling Freq.	Bi-monthly	Bi-monthly	Bi-monthly	(5x)/30 days	2/mon
.....start date	Sep-91	Sep-91	Sep-91	Sep-91	Sep-91
.....end date	Oct-92	Oct-92	Oct-92	Oct-92	Oct-92
Analytical Lab.	Zenon	Zenon	Zenon	Zenon	Zenon
Metal and Metalloids (total)					
Al	8	8	8	4	32
As (low level)	8	8	8	4	
Cd (ultra low level)	8	8	8	4	
Cr (low level)	8	8	8	4	
Cu	8	8	8	4	
Fe	8	8	8	4	
Pb (low level)	8	8	8	4	
Mn	8	8	8	4	
Mo	8	8	8	4	32
Ni	8	8	8	4	32
Se	8	8	8	4	32
Tl	8	8	8	4	32
Zn	8	8	8	4	
Hg (low level)	8	8	8	10	

Table 16 cont'd: Metals/Metalloids - Sampling Locations and Frequency

Sampling Station	Station	Station	Station	Station	Station	# of QA
	III-2	IV-1B	IV-1A	IV-3	IV-3	
	Birchbank	East Tr.	West Tr.	Waneta	Waneta	
SEAM No.	'0200200	E216136	E216137	'0200559	'0200559	
Analytical Responsibility	Federal	Cominco	Cominco	Prov. (EP)	Federal	
Sampling Freq.	2/mon	1/mon	1/mon	1/wk	1/wk	
.....start date	Sep-91	Sep-91	Sep-91	Sep-91	Sep-91	
.....end date	Oct-92	Oct-92	Oct-92	Oct-92	Oct-92	
Analytical Lab.	Fed. Lab	Zenon	Zenon	Zenon	Fed. Lab	
Metal and Metalloids (total)						
Al		16	16	64		52
As (low level)	32	16	16		64	52
Cd (ultra low level)	32	16	16		64	52
Cr (low level)	32	16	16		64	52
Cu	32	16	16		64	52
Fe	32	16	16		64	52
Pb (low level)	32	16	16		64	52
Mn	32	16	16		64	52
Mo		16	16	64		52
Ni		16	16	64		52
Se		16	16	64		52
Tl		16	16	64		52
Zn	32	16	16		64	52
Hg (low level)	32	16	16		64	61

Table 17: AOX and Chlorate - Sampling Locations and Frequency

Sampling Station	Station	Station	Station	Station	Station	# of QA/QC
	II-1	II-2	II-4	III-2	IV-3	
	Below K Dam	400 m D/S	D/S STP	Birchbank	Waneta	
SEAM No.	'0200183	E216155	'0200200	'0200003	'0200559	
Analytical Responsibility	Celgar	Celgar	Celgar	Celgar	Celgar	
Sampling Frequency	1/mon	1/mon	1/mon	1/mon	1/mon	
.....start date	Sep-91	Sep-91	Sep-91	Sep-91	Sep-91	
.....end date	Oct-92	Oct-92	Oct-92	Oct-92	Oct-92	
Analytical Laboratory	Zenon	Zenon	Zenon	Zenon	Zenon	
Adsorbable Organic Halides						
AOX	16	16	16	16	16	26
Chlorate	16	16	16	16	16	26

Table 18: Dioxins/Furans - Sampling Locations and Frequency

Sampling Station	Station	Station	Station	Station	Station	# of QA/QC
	II-1	II-2	II-4	III-2	IV-3	
	Below K Dam	400 m D/S	D/S STP	Birchbank	Waneta	
SEAM Station No.	'0200183	E216155	'0200200	'0200003	'0200559	
Analytical Responsibility	Celgar	Celgar	Celgar	Celgar	Celgar	
Sampling Frequency	2/yr	2/yr	2/yr	2/yr	2/yr	
.....start date	Sep-91	Sep-91	Sep-91	Sep-91	Sep-91	
.....end date	Oct-92	Oct-92	Oct-92	Oct-92	Oct-92	
Analytical Laboratory	AXYS	AXYS	AXYS	AXYS	AXYS	
Dioxins and Furans						
T4CDD	2	2	2	2	2	2
2378T4CDD	2	2	2	2	2	2
P5CDD	2	2	2	2	2	2
12378P5CDD	2	2	2	2	2	2
H6CDD	2	2	2	2	2	2
123478H6CDD	2	2	2	2	2	2
123678H6CDD	2	2	2	2	2	2
123789H6CDD	2	2	2	2	2	2
H7CDD	2	2	2	2	2	2
1234678H7CDD	2	2	2	2	2	2
O8CDD	2	2	2	2	2	2
T4CDF	2	2	2	2	2	2
2378T4CDF	2	2	2	2	2	2
P5CDF	2	2	2	2	2	2
12378P5CDF	2	2	2	2	2	2
23478P5CDF	2	2	2	2	2	2
H6CDF	2	2	2	2	2	2
123478H6CDF	2	2	2	2	2	2
123678H6CDF	2	2	2	2	2	2
234678H6CDF	2	2	2	2	2	2
123789H6CDF	2	2	2	2	2	2
H7CDF	2	2	2	2	2	2
1234678H7CDF	2	2	2	2	2	2
1234789H7CDF	2	2	2	2	2	2
O8CDF	2	2	2	2	2	2

Table 19: Chlorophenols, Phenolics, and Chloroform - Sampling Locations and Frequency

Sampling Station	Station	Station	Station	Station	Station	# of QA
	II-1	II-2	II-4	III-2	IV-3	
	Below K Dam	400 m D/S	D/S STP	Birchbank	Waneta	
SEAM No.	'0200183	E216155	'0200200	'0200003	'0200559	
Analytical Responsibility	Celgar	Celgar	Celgar	Celgar	Celgar	
Sampling Frequency	1/mon	1/mon	1/mon	1/mon	1/mon	
.....start date	Sep-91	Sep-91	Sep-91	Sep-91		
.....end date	Oct-92	Oct-92	Oct-92	Oct-92		
Analytical Laboratory	AXYS	AXYS	AXYS	AXYS	AXYS	
Chlorophenols						
Phenols	16	16	16	16	16	26
Chloroform	2	2	2	2	2	2
4-Chlorophenol	16	16	16	16	16	21
2,6-DCP	16	16	16	16	16	21
2,4/2,5-DCP	16	16	16	16	16	21
3,5-DCP	16	16	16	16	16	21
2,3-DCP	16	16	16	16	16	21
3,4-DCP	16	16	16	16	16	21
2,4,6-TCP	16	16	16	16	16	21
2,3,6-TCP	16	16	16	16	16	21
2,3,5-TCP	16	16	16	16	16	21
2,4,5-TCP	16	16	16	16	16	21
2,3,4-TCP	16	16	16	16	16	21
3,4,5-TCP	16	16	16	16	16	21
2,3,5,6-TetraCP	16	16	16	16	16	21
2,3,4,6-TetraCP	16	16	16	16	16	21
2,3,4,5-TetraCP	16	16	16	16	16	21
Pentachlorophenol	16	16	16	16	16	21
6-chloroguaiacol	16	16	16	16	16	21
4-chloroguaiacol	16	16	16	16	16	21
5-chloroguaiacol	16	16	16	16	16	21
3,4-DCguaiacol	16	16	16	16	16	21
4,6-DCguaiacol	16	16	16	16	16	21
4,5-DCguaiacol	16	16	16	16	16	21
3,4,5-TCguaiacol	16	16	16	16	16	21

Table 19 cont'd: Chlorophenols, Phenolics, and Chloroform - Sampling Locations and Frequency

Sampling Station	Station	Station	Station	Station	Station	# of QA
	II-1	II-2	II-4	III-2	IV-3	
	Below K Dam	400 m D/S	D/S STP	Birchbank	Waneta	
SEAM No.	'0200183	E216155	'0200200	'0200003	'0200559	
Analytical Responsibility	Celgar	Celgar	Celgar	Celgar	Celgar	
Sampling Frequency	1/mon	1/mon	1/mon	1/mon	1/mon	
.....start date	Sep-91	Sep-91	Sep-91	Sep-91		
.....end date	Oct-92	Oct-92	Oct-92	Oct-92		
Analytical Laboratory	AXYS	AXYS	AXYS	AXYS	AXYS	
Chlorophenols						
4,5,6-TCguaiacol	16	16	16	16	16	21
3,4,5,6-TCguaiacol	16	16	16	16	16	21
3-chlorocatechol	16	16	16	16	16	21
4-chlorocatechol	16	16	16	16	16	21
3,4-DCcatechol	16	16	16	16	16	21
3,6-DCcatechol	16	16	16	16	16	21
3,5-DCcatechol	16	16	16	16	16	21
4,5-DCcatechol	16	16	16	16	16	21
3,4,5-TCcatechol	16	16	16	16	16	21
3,4,5,6-TCcatechol	16	16	16	16	16	21
4,5-DCveratrole	16	16	16	16	16	21
3,4,6-TCveratrole	16	16	16	16	16	21
3,4,5-TCveratrole	16	16	16	16	16	21
3,4,5,6-TCveratrole	16	16	16	16	16	21
5-chlorovanillin	16	16	16	16	16	21
6-chlorovanillin	16	16	16	16	16	21
5,6-DCvanillin	16	16	16	16	16	21
3-chlorosyringol	16	16	16	16	16	21
3,5-DCsyringol	16	16	16	16	16	21
3,4,5-TCsyringol	16	16	16	16	16	21

Table 20: Resin Acids - Sampling Locations and Frequency

Sampling Station	Station	Station	Station	Station	Station	# of QA/QC
	II-1	II-2	II-4	III-2	IV-3	
	Below K Dam	400 m D/S	D/S STP	Birchbank	Waneta	
SEAM Station No.	'0200183	E216155	'0200200	'0200003	'0200559	
Analytical Responsibility	Celgar	Celgar	Celgar	Celgar	Celgar	
Sampling Frequency	1/mon	1/mon	1/mon	1/mon	1/mon	
.....start date	Sep-91	Sep-91	Sep-91	Sep-91	Sep-91	
.....end date	Oct-92	Oct-92	Oct-92	Oct-92	Oct-92	
Analytical Laboratory	Zenon	Zenon	Zenon	Zenon	Zenon	
Resin Acids						
Abietic Acid	16	16	16	16	16	26
Chlorodehydroabietic Acid	16	16	16	16	16	26
Dehydroabietic Acid	16	16	16	16	16	26
Dichlorodehydroabietic Acid	16	16	16	16	16	26
Isopimaric Acid	16	16	16	16	16	26
Levo Pimaric Acid	16	16	16	16	16	26
Neoabietic Acid	16	16	16	16	16	26
Pimaric Acid	16	16	16	16	16	26
Palustric Acid	16	16	16	16	16	26
Sandaraco Pim. Acid	16	16	16	16	16	26

Table 21: Fatty Acids - Sampling Locations and Frequency

Sampling Station	Station	Station	Station	Station	Station	# of QA/QC
	II-1	II-2	II-4	III-2	IV-3	
	Below K Dam	400 m D/S	D/S STP	Birchbank	Waneta	
SEAM Station No.	'0200183	E216155	'0200200	'0200003	'0200559	
Analytical Responsibility	Celgar	Celgar	Celgar	Celgar	Celgar	
Sampling Frequency	1/mon	1/mon	1/mon	1/mon	1/mon	
.....start date	Sep-91	Sep-91	Sep-91	Sep-91	Sep-91	
.....end date	Oct-92	Oct-92	Oct-92	Oct-92	Oct-92	
Analytical Laboratory	Zenon	Zenon	Zenon	Zenon	Zenon	
Fatty Acids						
Arachidic Acid	16	16	16	16	16	26
Behenic Acid	16	16	16	16	16	26
Lauric Acid	16	16	16	16	16	26
Lignoceric Acid	16	16	16	16	16	26
Linolenic Acid	16	16	16	16	16	26
Linoleic Acid	16	16	16	16	16	26
Myristic Acid	16	16	16	16	16	26
Oleic Acid	16	16	16	16	16	26
Palmitric Acid	16	16	16	16	16	26
Stearic Acid	16	16	16	16	16	26

Table 22: Nutrients - Sampling Locations and Frequency

Sampling Station	Station	Station	Station	Station	Station	Station
	II-1	II-1	II-2	II-2	II-4	II-4
	Below K Dam	Below K Dam	400 m D/S	400 m D/S	D/S STP	D/S STP
SEAM Station No.	'0200183	'0200183	E216155	E216155	'0200200	'0200200
Analytical Responsibility	Celgar	Prov. (WQ)	Celgar	Prov. (WQ)	Celgar	Prov. (WQ)
Sampling Frequency	1/mon	(5x)/30 days	1/mon	(5x)/30 days	1/mon	(5x)/30 days
.....start date	Sep-91	Mar-92	Sep-91	Mar-92	Sep-91	Mar-92
.....end date	Oct-92		Oct-92		Oct-92	
Analytical Laboratory	Zenon	Zenon	Zenon	Zenon	Zenon	Zenon
Nutrients						
N Org Total	16	3	16	3	16	3
N Kjel Total	16	3	16	3	16	3
N Total	16	3	16	3	16	3
N Amm Diss.	16	3	16	3	16	3
N NO3+NO2 Diss.	16	3	16	3	16	3
P Ortho Diss.	16	3	16	3	16	3
P Total	16	3	16	3	16	3
P Total Diss.	16	3	16	3	16	3

Table 22 cont'd: Nutrients - Sampling Locations and Frequency

Sampling Station	Station	Station	Station	Station	Station	Station
	III-2	III-2	III-2	IV-1B	IV-1	IV-1A
	Birchbank	Birchbank	Birchbank	East Tr.	Mid Stream	West Tr.
SEAM Station No.	'0200003	'0200003	'0200003	E216136	E209100	E216137
Analytical Responsibility	Prov. (EP)	Prov. (WQ)	Federal	Cominco	Prov. (WQ)	Cominco
Sampling Frequency	2/mon	(5x)/30 days	2/mon	1/mon	(5x)/30 days	1/mon
.....start date	Sep-91	Mar-92	Sep-91	Sep-91	Mar-92	Sep-91
.....end date	Oct-92		Oct-92	Oct-92		Oct-92
Analytical Laboratory	Zenon	Zenon	Fed. Lab	Zenon	Zenon	Zenon
Nutrients						
N Org Total		4		16	3	16
N Kjel Total		4		16	3	16
N Total		4	32	16	3	16
N Amm Diss.	32	4		16	3	16
N NO3+NO2 Diss.		4	32	16	3	16
P Ortho Diss.	32	4		16	3	16
P Total		4	32	16	3	16
P Total Diss.	32	4		16	3	16

Table 22 cont'd: Nutrients - Sampling Locations and Frequency

Sampling Station	Station	Station	# of QA/QC
	IV-3	IV-3	
	Waneta	Waneta	
SEAM Station No.	'0200559	'0200559	
Analytical Responsibility	Prov. (EP)	Federal	
Sampling Frequency	1/wk	1/wk	
.....start date	Sep-91	Sep-91	
.....end date	Oct-92	Oct-92	
Analytical Laboratory	Zenon	Fed. Lab	
Nutrients			
N Org Total			58
N Kjel Total			58
N Total		64	58
N Amm Diss.	64		58
N NO3+NO2 Diss.		64	58
P Ortho Diss.	64		58
P Total		64	58
P Total Diss.	64		58

9 APPENDIX - B: Site Maps

9.1 CRIEMP SAMPLING SITE MAPS

Figure 1: Water Sampling Site Map

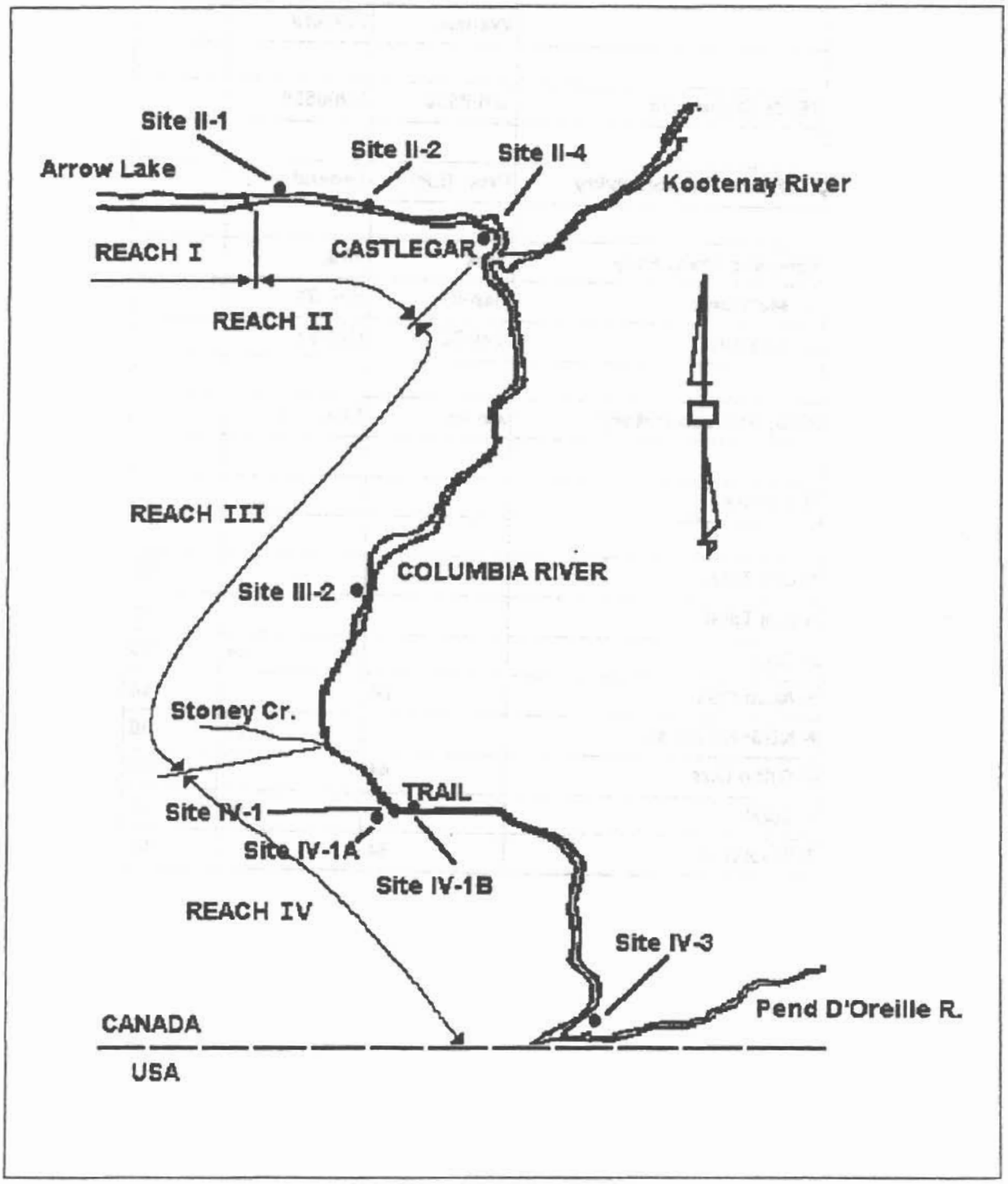


Figure 2: Benthic Sampling Site Map

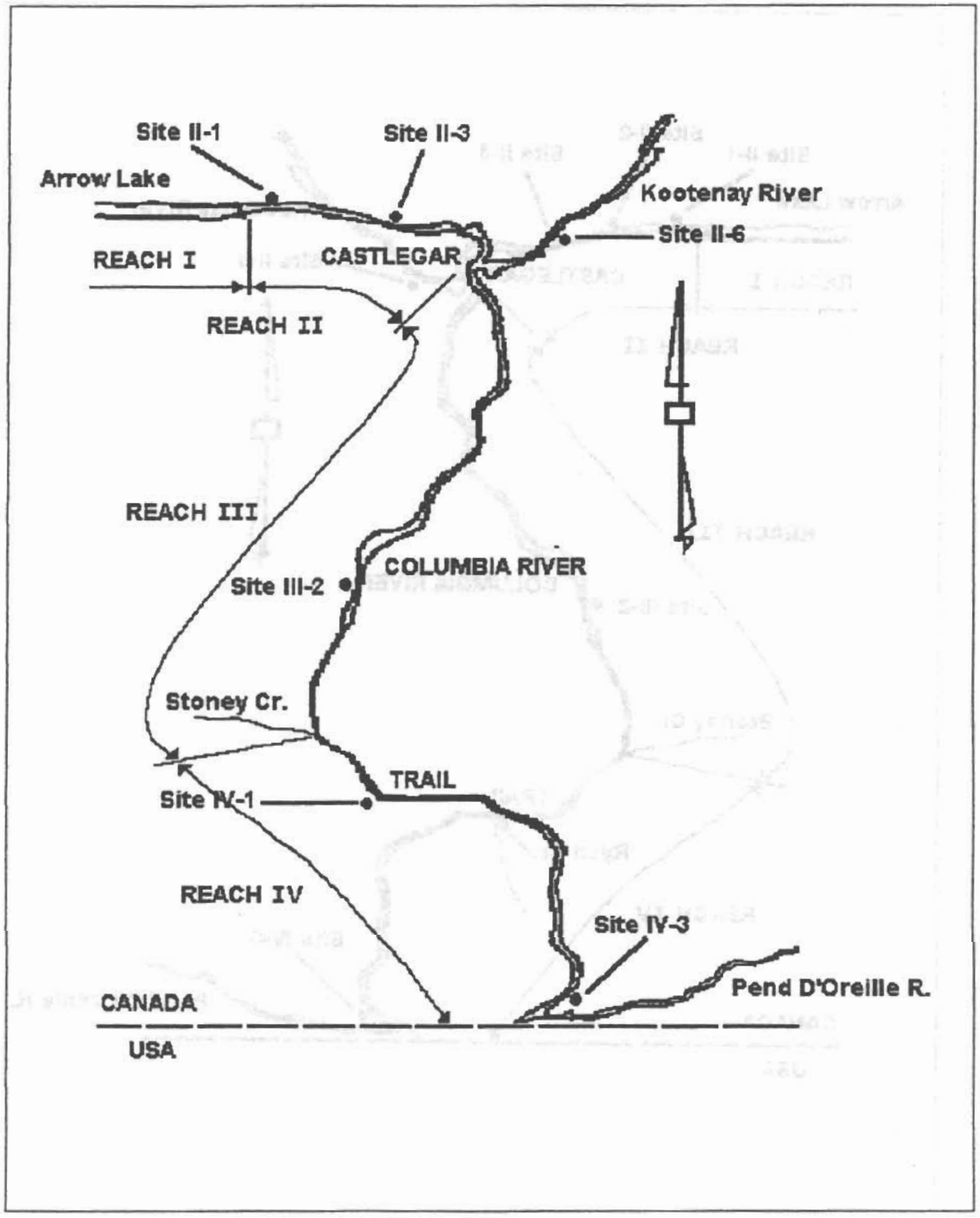


Figure 3: Periphyton Sampling Site Map

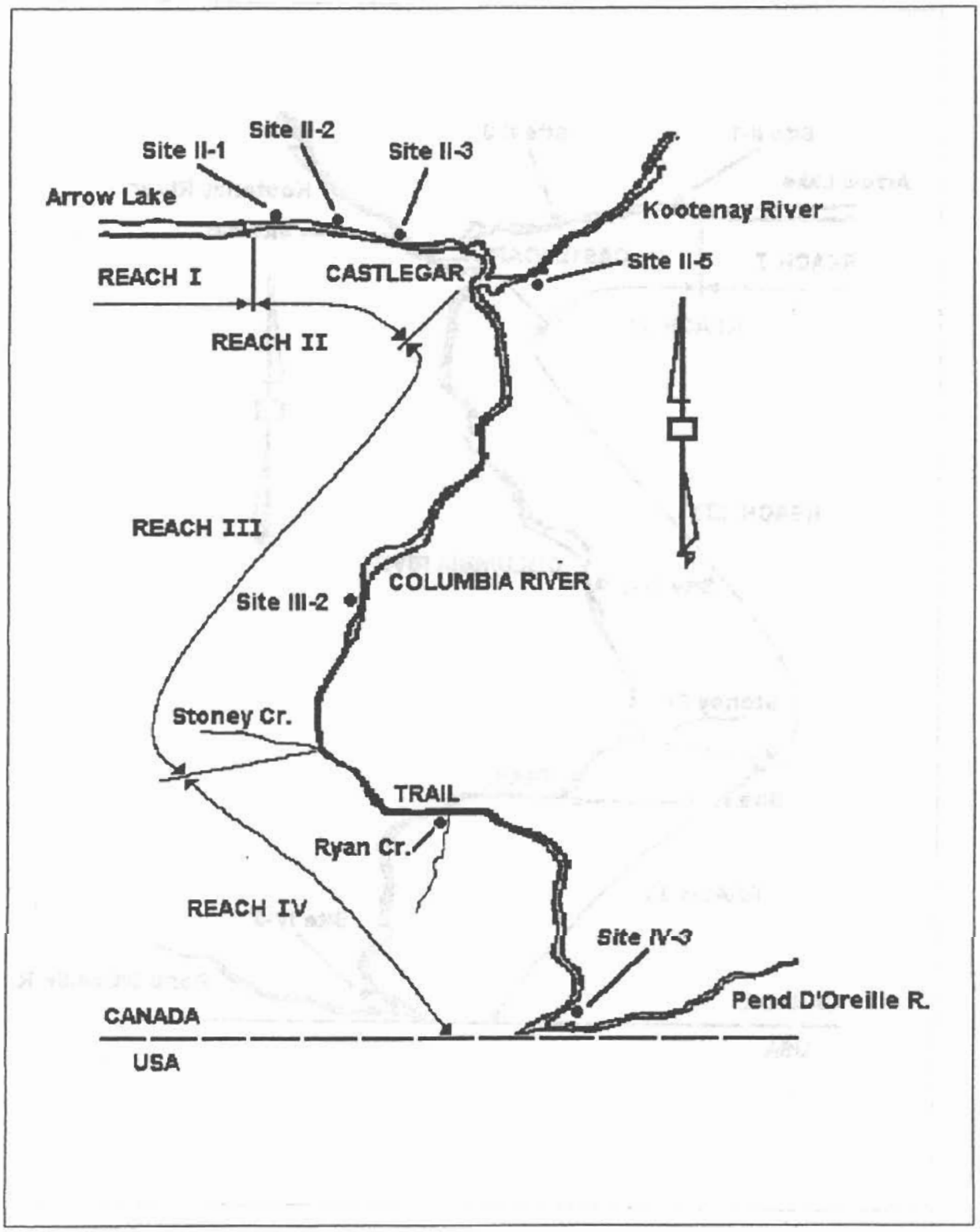


Figure 4: Macrophyte Sampling Site Map

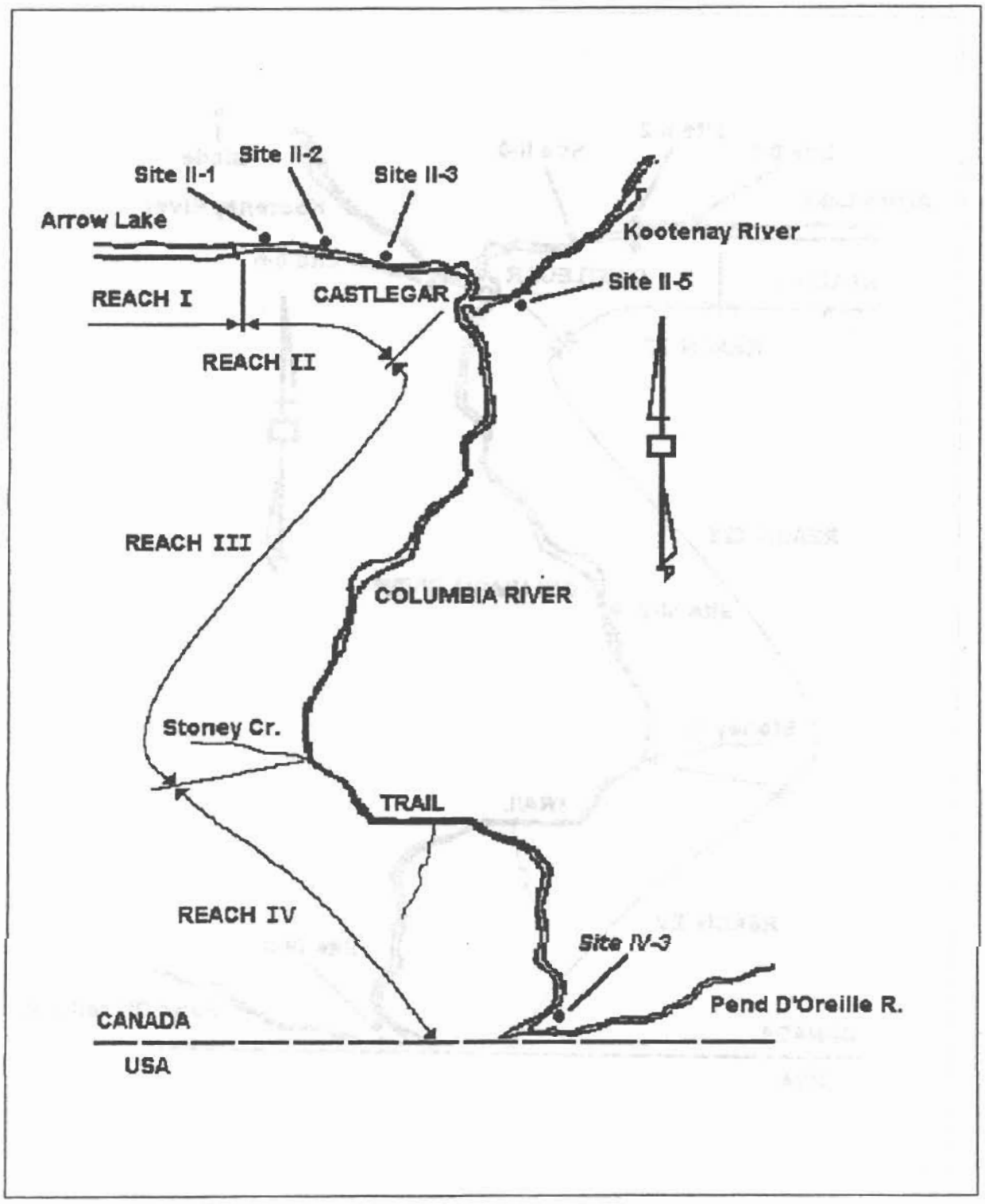


Figure 5: Clams Sampling Site Map

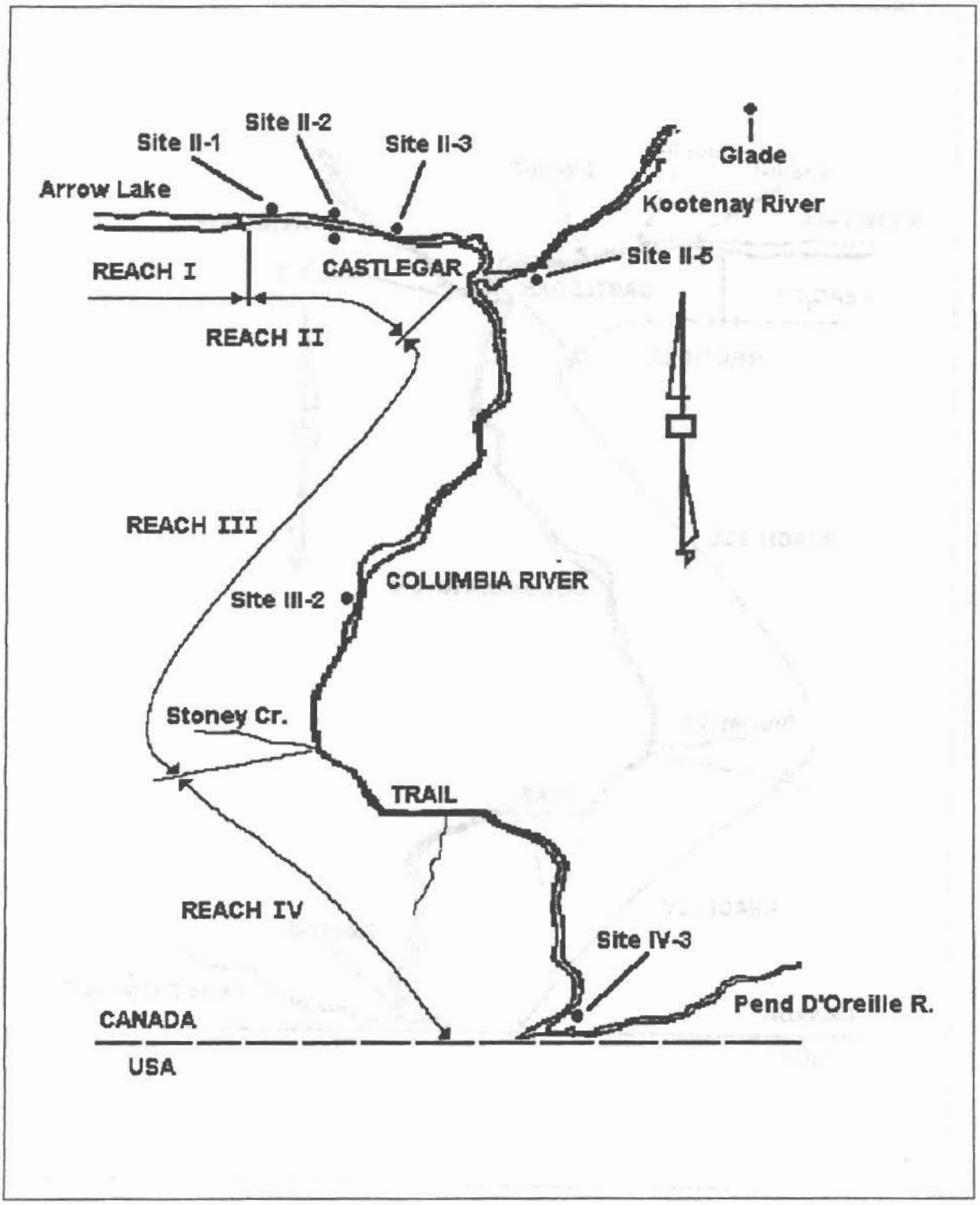


Figure 6: Caddis Fly Sampling Site Map

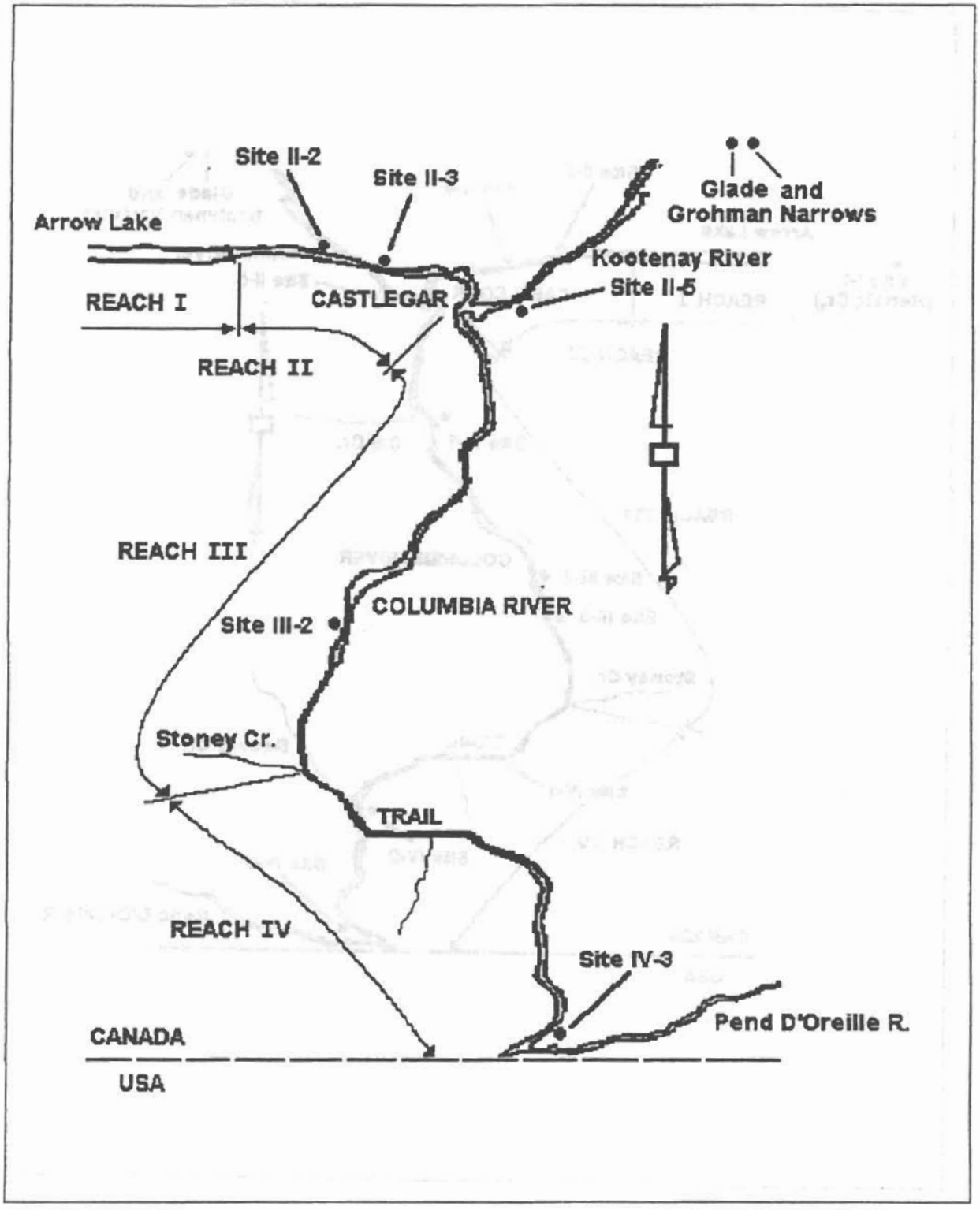
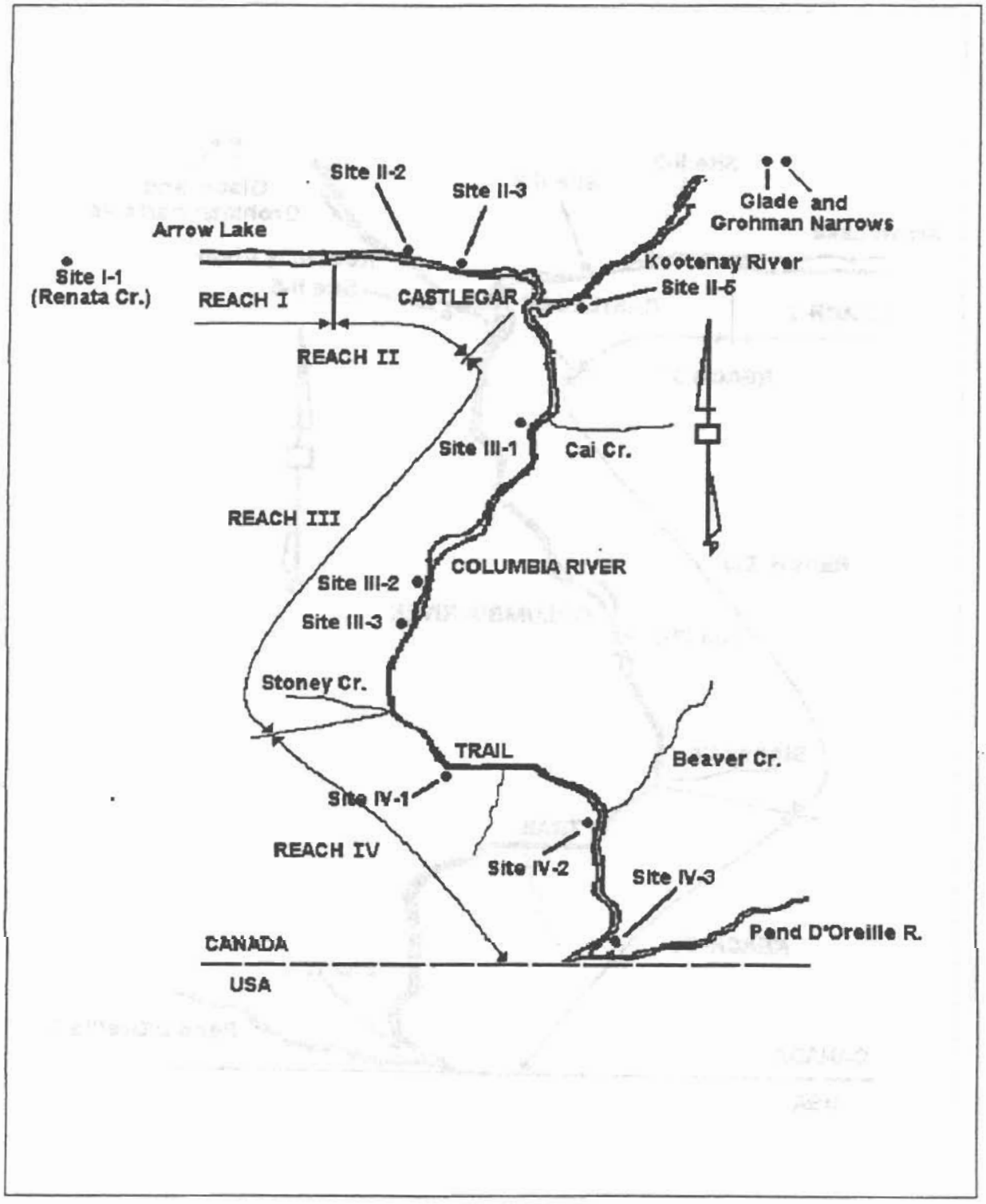


Figure 7: Sediment Sampling Site Map



10 APPENDIX - C: Field Sampling Procedures

10.1 SAMPLING FROM SHORE (FEDERAL PROCEDURE)

1) If wading is necessary to collect samples, 2 people must be present, and a floatation jacket or life preserver must be worn. If the river appears to be too high and/or swift for wading, then sample should be collected from shore. If sampling from shore, ensure a safe footing, and make sure you are well balanced, keeping in mind that the current may pull the sampler sharply downstream. Never take unnecessary risks.

2) In preparation for measuring the air temperature, remove cover from field thermometer and place in the shade, preferably about 1 metre above the ground and away from any vehicle, to minimize the heat influence from anything other than ambient air temperature. Leave the thermometer for 5-10 minutes or for the time it takes to collect the water samples. Measure the air temperature to the nearest 0.5 degrees (°C), and record the value in its designated location on the Federal data card.

3) Check sampler to ensure all fittings are tight.

4) Leave sample bottles in the sampling kit until ready to load sampler on shore, to prevent any potential contamination. If it is necessary to load sample bottles at vehicle, then leave caps on until ready to collect sample.

5) Take water samples from location indicated on site map, unless special circumstances exist. If it is necessary to take sample from somewhere other than designated spot, then this should be recorded in the "Remarks" section of the data card.

6) Always collect samples while facing upstream, to prevent increased suspended sediment caused by wading from entering the sample.

7) Rinse sampler once in river water.

8) Loosen bottle caps prior to loading sampler. Once bottles have been loaded, replace sampler top, and screw handle on to tighten.

9) Remove bottle caps and place in plastic bag provided. Avoid touching the insides of the caps with your fingers.

10) Collect the samples by submerging the sampler to the length of the handle below the surface. When collecting sample, avoid foam and floating debris.

11) Note time of sampling. If in-situ pH and conductivity are to be measured, refer to Protocols FS-12 and FS-13.

12) Cap bottles loosely, and return to vehicle to carry out sample preservation.

13) Back at vehicle, record air temperature and place thermometer in sample bottle labelled "FIELD" to equilibrate for at least 3 minutes.

14) Remove sampler top. Pour a small amount of water out of each sample bottle, shaking each before doing so, to ensure that the sample remains well-mixed.

15) Using the plastic gloves provided, add preservatives to those samples which need preservation, being sure to match each preservative with its similarly labelled bottle. Re-cap bottles tightly, and shake those to which preservatives have been added.

NOTE: Vehicle exhaust and cigarette smoke will contaminate water samples - these should be avoided when bottles are open.

16) Measure the water temperature within 5 minutes of sampling. Read water temperature by holding the bottle and the thermometer at eye level, and keeping the bulb of the thermometer submerged in the sample. Record water temperature in appropriate spot on data card.

17) Re-pack sampling kit, ensuring that glass bottles are separated from one another by plastic gloves to prevent breakage. Pack sponges in as tightly as possible to avoid bottle movement.

18) Complete data card as per Protocol FS-17. Put it back in its plastic bag, and pack it into sampling kit, along with the empty preservative vials.

19) Send sampling kit back to the Conservation and Protection (C&P) Laboratories on the same day that the samples are collected.

NOTE: Any deviations from this protocol must be noted in the "Remarks" section of the data card.

Sampling Techniques:

- If a bottle or cap is suspected of having been contaminated, rinse it thoroughly with river water, and make a note on the data card.

- If sampling kit can not be sent to the lab on day of sampling, bottles should be refrigerated overnight, and sent off the next day.

10.2 SAMPLING FROM SHORE (CRIEMP PROCEDURE)

1) If sampling from shore, ensure a safe footing, and make sure you are well balanced, keeping in mind that the current may pull the sampler sharply downstream. Never take unnecessary risks.

2) In preparation for measuring the air temperature, remove cover from field thermometer and place in the shade, preferably about 1 metre above the ground and away from any vehicle, to minimize the heat influence from anything other than ambient air temperature. Leave the thermometer for 5-10 minutes or for the time it takes to collect the water samples. Measure the air temperature to the nearest 0.5 degrees (°C), and record the value in its designated location on the Federal data card.

3) Leave sample bottles in the sampling kit until ready to sample, to prevent any potential contamination.

4) Take water samples from location indicated on site map, unless special circumstances exist. If it is necessary to take sample from somewhere other than designated spot, then this should be recorded in the "Comments" section of the laboratory requisition form.

5) Always collect samples while facing upstream, to prevent increased suspended sediment from entering the sample.

6) Put on plastic gloves. Remove bottle caps one at a time and place in plastic bag provided. Avoid touching the insides of the caps with your fingers.

7) Collect the individual samples by submerging the bottle below the surface. When collecting sample, avoid foam and floating debris. After sample is collected carry out sample preservation if necessary, tightly cap bottle, and shake well to mix preservatives.

8) Note time of sampling. Measure pH, water temperature, and conductivity and record in the "Comments" section of the requisition form.

9) Return capped bottles to the kit.

NOTE: Vehicle exhaust and cigarette smoke will contaminate water samples - these should be avoided when bottles are open.

10) Re-pack sampling kit, ensuring that glass bottles are separated from one another by plastic gloves etc. to prevent breakage. Pack sponges in as tightly as possible to avoid bottle movement.

11) Complete requisition form. Put it back in its plastic bag, and pack it into sampling kit, along with the empty preservative vials.

12) Send sampling kit back to Zenon Environmental Laboratories on the same day that the samples are collected.

NOTE: Any deviations from this protocol must be noted in the "Comments" section of the requisition form.

Sampling Techniques:

- If a bottle or cap is suspected of having been contaminated, rinse it thoroughly with river water, and make a note on the data card.

- If sampling kit can not be sent to the lab on day of sampling, bottles should be refrigerated overnight, and sent off the next day.

10.3 SAMPLING FROM BOAT (CRIEMP PROCEDURE)

1) Follow the shore sampling procedures except that you must make sure the gas tanks and exhaust have been covered to reduce the chance of gas and oil contaminants and other organic contaminants from the exhaust fumes.

2) Ensure that the boat is facing upstream into the current before sampling.

1 INTRODUCTION

1.1 OVERVIEW

This data report covers the CRIEMP 91-93 sampling period from September 3, 1991 to October 27, 1992. The primary objective of this program was to collect and share environmental information on the lower Columbia River. This report contains all the data collected during this program on the Columbia River from Hugh Keenleyside Dam to the international boundary.

1.2 PROGRAM MANAGEMENT AND COORDINATION

This program was managed by the Columbia River Integrated Environmental Monitoring Program (CRIEMP) Coordinating Committee. The technical committee was represented by Cominco Ltd.; Celgar Pulp Co.; B.C. Hydro; BC Environment, Lands and Parks - Water Quality Branch; BC Environment, Lands and Parks - Environmental Protection Branch; Environment Canada; Department of Fisheries and Oceans; City of Trail; and City of Castlegar.

2 CRIEMP MONITORING OBJECTIVES

2.1 CRIEMP 1991-93 MONITORING OBJECTIVES

CRIEMP 1991-93 was the first monitoring program being implemented by CRIEMP. The following are the specific objectives for CRIEMP 1991-93.

* to assess the cumulative effects of Celgar, Cominco, municipalities, and other sources of pollutants.
* to provide statistically valid and quality assured data for a trend analysis on toxic organics from Celgar's pulp mill.
* to identify sentinel species for trend assessment of bioaccumulation of toxic compounds.
* to provide information on the contamination of non-migratory fish species.

The sampling program was integrated within four river reaches and included an extension of existing monitoring sites within some of the reaches (i.e. the Federal/Provincial water quality monitoring sites at Birchbank and Waneta). Monitoring of fish was incorporated to address the human health concerns through consumption. Other components of the fish study included assessment of the distribution and abundance of fish, their habitat, and a fish

health study. The bioreconnaissance study investigated biological indicators and bed sediment sampling strategies for use as monitoring tools.

3 PROGRAM DATA SUMMARY

3.1 GENERAL INSTRUCTIONS

In addition to a hard copy of the data in this report there are 3 diskettes attached which contain all collected data. This data is stored on the diskettes in a compressed format and you will need a software decompression program (i.e. Norton Utilities®) to uncompress and then load the data. All the files on these diskettes have been created using Lotus 123 for Windows® Version 1.1. and are in a 3D format (each file contains multiple spreadsheets).

All files can be manipulated in the same fashion so the following instructions will work for all files.

Spreadsheet "A" is the raw data and includes "less than" (<) symbols which represent data that is below a specified detection limit (i.e. < 50). It also includes all results from any field, travelling, spiked, and laboratory blanks.

Spreadsheet "B" is the manipulated data; meaning that the < symbols have been removed and the remaining number has been entered (i.e. <50 = 50). Also this "B" data has had all field, travelling, spiked, and laboratory blanks removed because it is irrelevant to any spreadsheet calculations. At the bottom of the spreadsheet under the individual column headings there are a number a calculated fields (count, max, min, mean, median etc.); these fields are protected so that the formulas can not be altered accidentally. You can still change them if you want to but you must unprotect them first.

Spreadsheet "C" is the macro (\A or [Ctrl] A) that performs the data manipulation on "B", "D", and "E". There is an explanation beside each line in the macro (it is also protected) telling you what and how the macro is handling the data. As was mentioned in "B", about the <, there is a line in the macro STEP that removes the < signs from the data. At present, by using the converted < number, this conforms to the BC Environment - Water Management Branch protocol that they use for data manipulation. This can be changed to use 1/2 of the minimum detectable concentration (MDC) or to substitute a "zero" value that could be used in the data calculations. The following lines can be substituted in STEP to change the calculations:

"1/2 MDC" - STEP	{EDIT}{HOME}{DEL}{DEL}.5*~{EDIT-COPY}{BRANCH TEST1}
"ZERO" - STEP	{EDIT}{HOME}{DEL}{DEL}0*~{EDIT-COPY}{BRANCH TEST1}

11 APPENDIX D: AXYS Analytical Services Methods

11.1 ANALYSIS OF POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS

Samples are spiked with ^{13}C-labelled internal standards (tetra-chlorodibenzodioxin, tetra-chlorodibenzofuran, penta-chlorodibenzodioxin, hexa-chlorodibenzodioxin, hepta-chlorodibenzodioxin, and octa-chlorodibenzodioxin) prior to analysis. The sample is filtered, the filtrate and filter paper independently extracted and the extracts combined. After a series of washings and chromatographic cleanup steps, the extract is analyzed by GC/MS. The method detection limit is 60-240 ng/L (T4CDD/F - O8CDD/F).

Sample Storage

Samples are stored in a cool, dry place prior to analysis. They can be stored indefinitely and no preservation is required.

Extraction

A one litre sample is placed in a glass jug. An aliquot of internal standard is added and the sample filtered through a Millipore system.

The dried filter paper with particulate is soxhlet extracted with 80/20 toluene/acetone. The filtrate is stirred and extracted with dichloromethane. The extracts from the filtrate and particulate are combined and are ready for the washing and cleanup procedures.

Cleanup

The extract is subject to a series of cleanup steps including:

- washing with KOH

- washing with water

- washing with H_2SO_4

- washing with water

- column chromatography on silica gel

- column chromatography on alumina

- column chromatography on carbon/celite

- column chromatography on alumina

The final extract is evaporated to a small volume, transferred to a microvial and an aliquot of recovery standard added (^{13}C labelled 1,2,3,4-tetra-chlorodibenzodioxin, 1,2,3,6,7,8-hexa-chlorodibenzodioxin, and 1,2,3,4,6,7,8-hepta-chlorodibenzofuran). The extract is ready for analysis by GC/MS.

GC/MS

The extracts are analyzed by gas chromatography with mass spectrometric detection (GC/MS) operated in the multiple ion detection mode. The quadrapole GC/MS spectrometer is a Varian 3400 GC with a Finnigan Incos 50 mass spectrometer and a DG 10 data system. The high resolution GC/MS system is a VG 70 SE mass spectrometer with a Hewlett Packard 5890 gas chromatograph and a VAX work station.

QA/QC

A procedural blank is analyzed with each batch of samples. Matrix spikes and analysis duplicates are performed on a regular basis.

11.2 *ANALYSIS OF CHLOROPHENOLS, CHLOROGUAIACOLS, AND CHLOROCATECHOLS*

Extraction Methods

All samples are spiked with an aliquot of surrogate standard solution (containing ^{13}C-labelled 4-monochlorophenol, 2,4,6-trichlorophenol, 2,4,5-trichlorophenol, 2,3,4,5-tetrachlorophenol, and pentachlorophenol) prior to analysis.

Water

A one litre sample is spiked with an aliquot of surrogate standard solution. The pH of the sample is adjusted to pH 2 with concentrated sulphuric acid. The sample is then extracted three times with dichloromethane. The combined extracts are dried over anhydrous sodium sulfate, concentrated by rotary evaporation to 1 mL and transferred to a 250 mL separatory funnel.

Potassium carbonate solution is added to the separatory funnel, followed by acetic anhydride. The solution is shaken vigorously with venting. Hexane is added to the top, the mixture shaken and allowed to react for 30 minutes.

The acetylated sample is extracted with hexane, dried over anhydrous sodium sulfate and concentrated by rotary evaporation to 1 mL. The sample is ready for cleanup on silica gel.

Column Cleanup

The derivatized sample extract is loaded onto a silica gel column and eluted with isopropanol/toluene (30:70). The eluate is concentrated by rotary evaporation. The extract is then transferred to a centrifuge tube and an aliquot of recovery standard (2,6-dibromophenol) is added. The sample is then concentrated to 100 μL. The sample is ready for analysis by GC/MS.

Instrumental Analysis

Sample extracts are analyzed by gas chromatography (GC) with detection by mass spectrometer (MS). Analysis of the extract is carried out using a Finnigan Incos 50 mass spectrometer equipped with a Varian 3400 gas chromatograph with a CTC autosampler and a DG 10 Data system. The chromatographic separation is carried out using a Restek$_x$- 5 column (30 m, 0.25 mm i.d. x 0.25 μm film thickness). The mass spectrometer was operated in the EI mode (70 Ev) using Multiple Ion Detection (MID) to enhance the sensitivity, acquiring two characteristic ions for each target analyte and surrogate standard. A split/splitless injection sequence is used.

11.3 ANALYSIS OF CHLOROVERATROLES AND CHLOROANISOLES

Extraction Method

All samples are spiked with an aliquot of surrogate standard solution containing perdeuterated dibenzodioxin and dibenzofuran.

Water

A one litre sample is spiked with an aliquot of surrogate standard solution. The pH of the sample is adjusted to pH 2 with concentrated sulphuric acid. The sample is then extracted three times with hexane. The combined extracts are dried over anhydrous sodium sulfate, concentrated by rotary evaporation to 1 mL and transferred to a 250 mL separatory funnel.

The extract is loaded onto a silica gel column and eluted with dichloromethane. An aliquot of recovery standard (perdeuterated fluoranthene) is added and the extract is reduced in volume, placed in a microvial, and analyzed by GC/MS.

Instrumental Analysis

Sample extracts are analyzed by gas chromatography (GC) with detection by mass spectrometer (MS). Analysis of the extract is carried out using a Finnigan Incos 50 mass spectrometer equipped with a Varian 3400 gas chromatograph with a CTC autosampler and a DG 10 Data system. The chromatographic separation is carried out using a Restek$_x$- 5 column (30 m, 0.25 mm i.d. x 0.25 μm film thickness). The mass spectrometer was operated in the EI mode (70 Ev) using Multiple Ion Detection (MID) to enhance the

sensitivity, acquiring two characteristic ions for each target analyte and surrogate standard. A split/splitless injection sequence is used.

11.4 PREPARATION OF PRE-CLEANED BOTTLES

Sample bottles are obtained from two sources; they are either recycled empty bottles that the reagent solvent came in or they are purchased new from a supplier.

Sample bottles are washed with water and laboratory detergent. They are then rinsed with distilled water and baked at 350°C for at least six hours in a forced air oven. Randomly selected bottles are "proofed" to ensure that they are clean. A cleaned bottle is selected and thoroughly rinsed with three 100 mL portions of dichloromethane. The three rinses are combined and analyzed for the target compounds of interest. To do this, the combined solvent is spiked with a aliquot of the labelled surrogate standard used for each particular analysis, concentrated to a volume of 50 μL and analyzed by GC/MS in the same manner as a sample analysis. The proofed bottle is rebaked before use to ensure no residual solvent is present.

12 APPENDIX E: ASL Mercury Determination

12.1 LOW LEVEL DETERMINATION OF MERCURY IN WATER (0.005 PPB)

12.2 REFERENCE

U.S. EPA, 1986 Test Methods for Evaluating Solid Waste - Physical/Chemical Methods, SW #846, 3rd ed. Washington, DC 20460.

12.3 GENERAL SUMMARY

Low level mercury is determined in a water sample by digesting it in a hot oven, using potassium permanganate and sulphuric acid. Hydroxylamine hydrochloride is added to the sample, to reduce the excess potassium permanganate and a stannous chloride solution is added to reduce the mercury.

12.4 PRECAUTIONS

1. Refer to Material Safety Data Sheets (MSDS) for information on potassium permanganate, sulphuric acid, potassium persulphate, hydroxylamine hydrochloride, stannous chloride, and nitric acid.

2. Care should be taken when handling sulphuric acid. If the concentrated acid must be diluted with water, always add acid to water and never water to acid.

3. Proper clothing, labcoats, eye protection, and gloves must be worn when handling these reagents.

12.5 DIGESTION PROCEDURE

1. Obtain the appropriate number of new 125 mL plastic bottles and fill all the bottles with a fresh 5-10% nitric acid solution, cap, and lay flat. Allow the bottles to soak for a minimum of one hour or overnight. Each bottle must be rolled over at least once during this time period to ensure that all sides of the bottles are washed with the nitric acid solution. *Note: use only Baker Instra-analysed grade nitric acid, for all requirements in this procedure.*

2. Empty each bottle and rinse 3-5 times with deionized/distilled water, including the lids. Shake out excess water and allow bottles and lids to dry in a Class 100 laminar flow clean work space.

3. Prepare a 100 ppb mercury standard by acid washing a 500 mL volumetric flask. Rinse flask well with deionized/ distilled water. Pipet 5.00 mL of 10 ppm mercury

standard into the flask and dilute with deionized/ distilled water. Acidify with 2 mL of nitric acid and bulk to the mark with deionized/ distilled water.

4. Make a set of calibrating standards by pipetting the appropriate amount of freshly prepared 100 ppb mercury standard into a clean bottle and dilute to 100 mL using a calibrated 100 mL bottle. The following set of calibrating standards can be used as a guide:

   i) Three reagent blanks
   ii) Two 0.005 ppb standards
   iii) Two 0.010 ppb standards
   iv) Two 0.030 ppb standards
   v) Two 0.050 ppb standards
   vi) Two 0.075 ppb standards
   vii) One 0.100 ppb standard
   viii) Two certified reference samples (ORMS & APG)

5. Shake out any excess rinse water in the bottle and then pour 100 mL of shaken water sample into it using a calibrated 100 mL bottle as a guide.

6. Into each bottle containing the 100 mL water sample, add the following reagents:

   i) 5.0 mL H_2SO_4 (high grade only)
   ii) 2.0 mL of 5% $KMnO_4$ solution

7. Cover each bottle with a lid and shake well in order to mix the reagents properly.

8. Loosen caps slightly and allow bottles to digest in a warm oven for 1 1/2 to 2 hours.

9. Cool digested samples for about 30 minutes before analysis.

10. Add about 1 mL of hydroxylamine HCl solution to each bottle just prior to analysis and swirl the bottle until all the purple and brown colour disappears and a clear colourless solution remains.

11. Add about 1 mL of $SnCl_2$ solution before analysis by cold vapour atomic absorption spectrophotometry.

12.6 QUALITY CONTROL

A certified reference sample is always included with each batch of analysis. Two duplicate samples per 10 samples are also included for analysis.

12.7 REPORTING

After determining the numbers from a linear calibration plot, enter the data onto the appropriate station sheet and hand into the data entry clerk.

13 APPENDIX - F: Columbia River Data

13.1 WATER DATA

13.1.1 Water Data Summaries

SITE II-1

Parameter													
	MDC				5		5		1			0.5	
	(deg C)		(pH units)	Arrow Flow	(Col. Unit)	(TAC)	(SWU)	(uS/cm)	(mg/L)	(mg/L)	(NTU)	(mg/L)	(mg/L)
Reqn_No	Temp	Diss_O	pH	Flow	Color_True	Color_TAC	Color_SW_Diss	Spec_Cond	Res_Nonfilt	Res_Filt_1_Ou	Turbidity	Alk_Phen_8_3	Alk_Total_4_5
COUNT	19	19	19	24	19	19	19	19	19	19	19	19	19
MEAN	9.9	11.6	7.8	51497.59	5.0	1.8	5.2	119.1	1.4	74.3	0.3	0.5	51.5
MEDIAN	10.4	11.8	8.0	46820.83	5.0	2.0	5.0	123.0	1.0	74.0	0.3	0.5	52.0
MAX	17.0	15.4	8.3	93487.79	5.0	4.0	7.0	129.0	4.0	86.0	0.6	0.5	56.1
MIN	4.5	9.4	7.1	26897.65	5.0	1.0	5.0	99.0	1.0	60.0	0.2	0.5	42.8
RANGE	12.5	6.0	1.2	66590.14	0.0	3.0	2.0	30.0	3.0	26.0	0.4	0.0	13.3
90th PERCENTILE	15.8	12.8	8.3	79790.36	5.0	3.0	5.0	128.0	2.0	82.0	0.5	0.5	55.3
STD	4.4332	1.4922	0.4045	18007.13	0.0000	0.8983	0.5015	9.7152	0.9551	6.8723	0.1344	0.0000	3.9637
90% CL	1.7636	0.5936	0.1609	6300.13	0.0000	0.3574	0.1995	3.8648	0.3800	2.7338	0.0535	0.0000	1.5768

Reqn_No	Hard_Total	Coliform_Fecal	E_Coli	Enterococcus	Chlorate	Fluoride_Diss	Silica_React_Diss	Sulfate_Diss	AOX	Abietic_Acid	Chlorodehydroabietic_Acid
	(mg/L)	2 (CFU)	2	2	0.1 (mg/L)	0.1 (mg/L)	(mg/L)	(mg/L)	0.01 (mg/L)	0.001 (mg/L)	0.001 (mg/L)
COUNT	10	19	17	17	16	19	19	19	16	16	15
MEAN	57.5	1.9	2.0	1.8	0.02	0.1	3.0	8.8	0.01	0.0010	0.0008
MEDIAN	58.7	2.0	2.0	2.0	0.01	0.1	3.5	8.8	0.01	0.0010	0.0010
MAX	65.7	2.0	2.0	2.0	0.10	0.1	4.3	9.2	0.04	0.0040	0.0010
MIN	48.3	1.0	2.0	1.0	0.01	0.1	0.5	6.9	0.01	0.0005	0.0005
RANGE	17.4	1.0	0.0	1.0	0.09	0.0	3.8	2.3	0.03	0.0035	0.0005
90th PERCENTILE	64.7	2.0	2.0	2.0	0.01	0.1	3.7	9.1	0.01	0.0010	0.0010
STD	5.8270	0.2294	0.0000	0.3930	0.0225	0.0000	1.1733	0.6836	0.0075	0.0008	0.0003
90% CL	3.3776	0.0913	0.0000	0.1664	0.0098	0.0000	0.4668	0.2719	0.0033	0.0004	0.0001

Reqn_No	Dehydroabietic_Acid	Dichlorodehydroabietic_Acid	Isopimaric_Acid	Levo_Pimaric_Acid	Neoabietic_Acid	Pimaric_Acid	Palustric_Acid	Sandaraco_Pim_Acid
	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)
COUNT	16	15	16	16	16	16	15	16
MEAN	0.0008	0.0008	0.0008	0.0008	0.0020	0.0008	0.0008	0.0008
MEDIAN	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
MAX	0.0010	0.0010	0.0010	0.0010	0.0150	0.0010	0.0010	0.0010
MIN	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
RANGE	0.0005	0.0005	0.0005	0.0005	0.0145	0.0005	0.0005	0.0005
90th PERCENTILE	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
STD	0.0003	0.0003	0.0003	0.0003	0.0037	0.0003	0.0003	0.0003
90% CL	0.0001	0.0001	0.0001	0.0001	0.0016	0.0001	0.0001	0.0001

Reqn_No	Arachidic_Acid	Behenic_Acid	Lauric_Acid	Lignoceric_Acid	Linolenic_Acid	Linoleic_Acid	Myristic_Acid	Oleic_Acid	Palmitric_Acid	Stearic_Acid	Al_Total	As_Total
	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.02 (mg/L)	0.001 (mg/L)
COUNT	15	15	16	15	15	15	15	15	16	15	10	10
MEAN	0.0012	0.0008	0.0103	0.0013	0.0008	0.0008	0.0050	0.0037	0.0036	0.0016	0.03	0.001
MEDIAN	0.0010	0.0010	0.0020	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.04	0.001
MAX	0.0070	0.0010	0.0430	0.0060	0.0010	0.0010	0.0190	0.0310	0.0190	0.0090	0.05	0.001
MIN	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.02	0.001
RANGE	0.0065	0.0005	0.0425	0.0055	0.0005	0.0005	0.0185	0.0305	0.0185	0.0085	0.03	0.000
90th PERCENTILE	0.0010	0.0010	0.0230	0.0030	0.0010	0.0010	0.0180	0.0080	0.0070	0.0030	0.05	0.001
STD	0.0016	0.0003	0.0142	0.0014	0.0003	0.0003	0.0065	0.0079	0.0054	0.0022	0.0119	0.0000
90% CL	0.0007	0.0001	0.0062	0.0007	0.0001	0.0001	0.0029	0.0036	0.0024	0.0010	0.0069	0.0000

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	0.001 (mg/L)	0.01 (mg/L)	0.0005 (mg/L)	0.003 (mg/L)	0.002 (mg/L)	0.001 (mg/L)	0.003 (mg/L)	0.02 (mg/L)	0.002 (mg/L)	0.00005 (mg/L)	0.004 (mg/L)	0.008 (mg/L)	0.001 (mg/L)	0.003 (mg/L)	0.003 (mg/L)	0.002 (mg/L)	0.1 (mg/L)
Reqn_No	Ba_Total	Ca_Total	Cd_Total	Co_Total	Cr_Total	Cu_Total	Fe_Total	Mg_Total	Mn_Total	Hg_Total	Mo_Total	Ni_Total	Pb_Total	Ti_Total	V_Total	Zn_Total	K_Diss
COUNT	10	10	10	10	10	10	10	10	10	7	10	10	10	10	10	10	19
MEAN	0.014	17.0	0.0005	0.003	0.003	0.001	0.028	3.64	0.002	0.00005	0.004	0.008	0.001	0.006	0.003	0.008	0.6
MEDIAN	0.015	17.2	0.0005	0.003	0.002	0.001	0.028	3.75	0.002	0.00005	0.004	0.008	0.001	0.003	0.003	0.005	0.6
MAX	0.016	19.2	0.0005	0.003	0.005	0.002	0.042	4.32	0.005	0.00008	0.004	0.008	0.003	0.020	0.003	0.030	0.8
MIN	0.010	14.7	0.0005	0.003	0.002	0.001	0.009	2.81	0.002	0.00005	0.004	0.008	0.001	0.003	0.003	0.002	0.5
RANGE	0.006	4.5	0.0000	0.000	0.003	0.001	0.033	1.51	0.003	0.00003	0.000	0.000	0.002	0.017	0.000	0.028	0.3
90th PERCENTILE	0.016	18.9	0.0005	0.003	0.004	0.002	0.039	4.25	0.002	0.00005	0.004	0.008	0.001	0.014	0.003	0.014	0.7
STD	0.0018	1.5565	0.0000	0.0000	0.0011	0.0004	0.0113	0.4876	0.0009	0.00001	0.0000	0.0000	0.0006	0.0060	0.0000	0.0085	0.0692
90% CL	0.0011	0.9022	0.0000	0.0000	0.0006	0.0002	0.0065	0.2826	0.0005	0.00001	0.0000	0.0000	0.0004	0.0035	0.0000	0.0049	0.0275

Reqn_No	N_Org_Total	N_Kjel_Total	N_Total	N_Amm_Diss	N_NO3_NO2_Diss	P_Ortho_Diss	P_Total	P_Total_Diss	Total_Org_C	Total_Inorg_C	C_Total	Na_Diss	Cl_Diss
	0.04 (mg/L)	0.04 (mg/L)	0.02 (mg/L)	0.005 (mg/L)	0.005 (mg/L)	0.002 (mg/L)	0.003 (mg/L)	0.003 (mg/L)	1 (mg/L)	(mg/L)	(mg/L)	0.5 (mg/L)	0.5 (mg/L)
COUNT	19	19	19	19	19	19	19	19	16	16	16	19	19
MEAN	0.05	0.06	0.18	0.006	0.12	0.003	0.004	0.003	2.3	12.0	13.1	0.8	0.5
MEDIAN	0.05	0.05	0.17	0.005	0.12	0.003	0.003	0.003	3.0	12.0	13.0	0.8	0.5
MAX	0.11	0.11	0.26	0.011	0.15	0.003	0.020	0.003	3.0	15.0	15.0	1.0	0.6
MIN	0.04	0.04	0.13	0.005	0.08	0.003	0.003	0.003	1.0	9.0	11.0	0.6	0.5
RANGE	0.07	0.07	0.13	0.006	0.07	0.000	0.017	0.000	2.0	6.0	4.0	0.4	0.1
90th PERCENTILE	0.09	0.09	0.20	0.007	0.14	0.003	0.003	0.003	3.0	14.0	14.0	1.0	0.5
STD	0.0214	0.0227	0.0324	0.0018	0.0184	0.0000	0.0039	0.0000	0.9309	1.5055	1.1815	0.1108	0.0229
90% CL	0.0085	0.0090	0.0129	0.0007	0.0073	0.0000	0.0015	0.0000	0.4080	0.6598	0.5178	0.0441	0.0091

	0.001 (mg/L)	0.002 (mg/L)	0.0005 (mg/L)	0.3-2.8 (ng/L)	0.1-1.8 (ng/L)	0.2-1.5 (ng/L)	0.1-1.4 (ng/L)	0.2-1.6 (ng/L)	0.1-1.1 (ng/L)	0.1-1.4 (ng/L)	0.1-2 (ng/L)	0.2-1.3 (ng/L)	0.1-1 (ng/L)
Reqn_No	Resin_Acid	Phenols	Chloroform	4_Chlorophenol	26_DCP	24_26_DCP	35_DCP	23_DCP	34_DCP	246_TCP	236_TCP	235_TCP	245_TCP
COUNT	3	15	2	17	17	17	17	17	17	17	17	17	17
MEAN	0.0067	0.003	0.001	1.01	0.68	0.62	0.45	0.51	0.37	0.47	0.56	0.43	0.34
MEDIAN	0.0005	0.002	0.001	0.80	0.60	0.60	0.30	0.40	0.30	0.30	0.40	0.30	0.20
MAX	0.0190	0.007	0.001	2.80	1.80	1.50	1.40	1.60	1.10	1.40	2.00	1.30	1.00
MIN	0.0005	0.002	0.001	0.30	0.10	0.20	0.10	0.20	0.10	0.10	0.20	0.20	0.10
RANGE	0.0185	0.005	0.001	2.50	1.70	1.30	1.30	1.40	1.00	1.30	1.80	1.10	0.90
90th PERCENTILE	0.0190	0.006	0.001	2.40	1.10	1.00	0.80	0.80	0.60	0.90	0.80	0.60	0.60
STD	0.0107	0.0016	0.0004	0.7782	0.4978	0.3678	0.3319	0.3533	0.2664	0.3754	0.4387	0.2845	0.2265
90% CL	0.0180	0.0007	0.0016	0.3295	0.2108	0.1558	0.1405	0.1496	0.1128	0.1590	0.1858	0.1205	0.0959

	0.2-1.3 (ng/L)	0.1-1.1 (ng/L)	0.2-1 (ng/L)	0.2-1.6 (ng/L)	0.1-0.8 (ng/L)	0.2-1.5 (ng/L)	0.4-7 (ng/L)	0.7-11 (ng/L)	0.6-10 (ng/L)
Reqn_No	234_TCP	345_TCP	2356_TetraCP	2346_TetraCP	2345_TetraCP	Pentachlorophenol	6_chloroguaiacol	4_chloroguaiacol	5_chloroguaiacol
COUNT	17	17	17	17	17	17	17	17	17
MEAN	0.45	0.36	0.50	0.68	0.33	0.55	2.35	3.39	3.22
MEDIAN	0.40	0.30	0.40	0.50	0.20	0.50	1.20	2.00	1.60
MAX	1.30	1.10	1.00	1.60	0.80	1.50	7.00	11.00	10.00
MIN	0.20	0.10	0.20	0.20	0.10	0.20	0.40	0.70	0.60
RANGE	1.10	1.00	0.80	1.40	0.70	1.30	6.60	10.30	9.40
90th PERCENTILE	0.70	0.70	0.80	1.00	0.70	1.00	4.80	5.50	6.10
STD	0.2939	0.2671	0.2291	0.3945	0.2229	0.3538	1.9638	2.7878	3.0036
90% CL	0.1245	0.1131	0.0970	0.1671	0.0944	0.1498	0.8316	1.1805	1.2719

Reqn_No	34_DCgualacol	46_DCgualacol	45_DCgualacol	345_TCgualacol	456_TCgualacol	3456_TCgualacol	3_chlorocatechol	4_chlorocatechol	34_DCcatechol
	0.3-1.8 (ng/L)	0.3-2.4 (ng/L)	0.3-1.6 (ng/L)	0.09-0.9 (ng/L)	0.07-0.8 (ng/L)	0.06-0.8 (ng/L)	0.3-20 (ng/L)	0.4-20 (ng/L)	0.2-15 (ng/L)
COUNT	17	17	17	17	17	17	17	15	17
MEAN	0.85	0.81	0.66	0.38	0.32	0.27	6.05	8.63	3.21
MEDIAN	0.60	0.70	0.50	0.20	0.20	0.20	5.00	5.00	1.00
MAX	1.80	2.40	1.60	0.90	0.80	0.80	20.00	20.00	15.00
MIN	0.30	0.30	0.30	0.09	0.07	0.06	0.30	0.40	0.20
RANGE	1.50	2.10	1.30	0.81	0.73	0.74	19.70	19.60	14.80
90th PERCENTILE	1.60	1.10	0.90	0.80	0.70	0.40	10.00	20.00	10.00
STD	0.5293	0.5285	0.3776	0.2862	0.2604	0.2278	5.9594	7.0354	5.0223
90% CL	0.2241	0.2238	0.1599	0.1212	0.1103	0.0965	2.5236	3.1989	2.1268

Reqn_No	36_DCcatechol	35_DCcatechol	45_DCcatechol	345_TCcatechol	3456_TCcatechol	45_DCveratrole	346_TCveratrole	345_TCveratrole
	0.2-15 (ng/L)	0.3-15 (ng/L)	0.2-15 (ng/L)	0.05-10 (ng/L)	0.04-10 (ng/L)	0.3-16 (ng/L)	0.1-9.3 (ng/L)	0.1-9.3 (ng/L)
COUNT	17	17	17	17	17	18	18	18
MEAN	3.78	4.84	4.41	2.21	3.91	3.78	1.06	1.06
MEDIAN	1.20	5.00	5.00	0.70	5.00	1.70	0.40	0.40
MAX	15.00	15.00	15.00	10.00	10.00	16.00	9.30	9.30
MIN	0.20	0.30	0.20	0.05	0.04	0.30	0.10	0.10
RANGE	14.80	14.70	14.80	9.95	9.96	15.70	9.20	9.20
90th PERCENTILE	10.00	10.00	8.00	5.00	8.50	6.70	1.40	1.40
STD	5.2370	4.9050	4.0586	2.7991	3.4077	4.9170	2.0996	2.0996
90% CL	2.2177	2.0771	1.7187	1.1853	1.4431	2.0166	0.8611	0.8611

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Reqn_No	3456_TCveratrole	5_chlorovanillin	6_chlorovanillin	56_DCvanillin	3_chlorosyringol	35_DCsyringol	345_TCsyringol	T4CDD	2378T4CDD	P5CDD
	0.06-12 (ng/L)	0.2-3.8 (ng/L)	0.2-4.7 (ng/L)	0.07-2.8 (ng/L)	0.4-15 (ng/L)	0.4-2.9 (ng/L)	0.1-1.4 (ng/L)	0.4-1.5 (pg/L)	0.4-1.5 (pg/L)	0.5-1.8 (pg/L)
COUNT	18	17	17	17	17	17	17	2	2	2
MEAN	1.05	1.47	1.51	0.71	2.45	1.47	0.48	0.95	0.95	1.15
MEDIAN	0.30	1.20	1.30	0.60	1.10	1.20	0.50	0.95	0.95	1.15
MAX	12.00	3.80	4.70	2.80	15.00	2.90	1.40	1.50	1.50	1.80
MIN	0.06	0.20	0.20	0.07	0.40	0.40	0.10	0.40	0.40	0.50
RANGE	11.94	3.60	4.50	2.73	14.60	2.50	1.30	1.10	1.10	1.30
90th PERCENTILE	1.00	2.50	2.40	1.00	4.00	2.30	1.00	1.50	1.50	1.80
STD	2.7547	1.0582	1.1861	0.6650	3.4846	0.8145	0.3746	0.7778	0.7778	0.9192
90% CL	1.1298	0.4481	0.5023	0.2816	1.4756	0.3449	0.1586	3.4727	3.4727	4.1041

	0.5-1.8 (pg/L)	1.2-2.2 (pg/L)	1.2-2.2 (pg/L)	1.2-2.2 (pg/L)	1.2-2.2 (pg/L)	2-5.6 (pg/L)	2-5.6 (pg/L)	3.6-39 (pg/L)	0.4-1.5 (pg/L)	0.4-1.5 (pg/L)	0.5-1.6 (pg/L)	0.5-1.6 (pg/L)
Reqn_No	**12378P5CDD**	**H6CDD**	**123478H6CDD**	**123678H6CDD**	**123789H6CDD**	**H7CDD**	**1234678H7CDD**	**O8CDD**	**T4CDF**	**2378T4CDF**	**P5CDF**	**12378P5CDF**
COUNT	2	2	2	2	2	2	2	2	2	2	2	2
MEAN	1.15	1.70	1.70	1.70	1.70	3.80	3.80	21.30	0.95	0.95	1.05	1.05
MEDIAN	1.15	1.70	1.70	1.70	1.70	3.80	3.80	21.30	0.95	0.95	1.05	1.05
MAX	1.80	2.20	2.20	2.20	2.20	5.60	5.60	39.00	1.50	1.50	1.60	1.60
MIN	0.50	1.20	1.20	1.20	1.20	2.00	2.00	3.60	0.40	0.40	0.50	0.50
RANGE	1.30	1.00	1.00	1.00	1.00	3.60	3.60	35.40	1.10	1.10	1.10	1.10
90th PERCENTILE	1.80	2.20	2.20	2.20	2.20	5.60	5.60	39.00	1.50	1.50	1.60	1.60
STD	0.9192	0.7071	0.7071	0.7071	0.7071	2.5456	2.5456	25.0316	0.7778	0.7778	0.7778	0.7778
90% CL	4.1041	3.1570	3.1570	3.1570	3.1570	11.3652	11.3652	111.7578	3.4727	3.4727	3.4727	3.4727

	0.5-1.6 (pg/L)	0.8-2 (pg/L)	0.8-2 (pg/L)	0.8-2 (pg/L)	0.8-2 (pg/L)	0.8-2 (pg/L)	1.1-2.1 (pg/L)	1.1-2.1 (pg/L)	1.1-2.1 (pg/L)	2-2.8 (pg/L)
Reqn_No	23478P5CDF	H6CDF	123478H6CDF	123678H6CDF	234678H6CDF	123789H6CDF	H7CDF	1234678H7CDF	1234789H7CDF	O8CDF
COUNT	2	2	2	2	2	2	2	2	2	2
MEAN	1.05	1.40	1.40	1.40	1.40	1.40	1.60	1.60	1.60	2.40
MEDIAN	1.05	1.40	1.40	1.40	1.40	1.40	1.60	1.60	1.60	2.40
MAX	1.60	2.00	2.00	2.00	2.00	2.00	2.10	2.10	2.10	2.80
MIN	0.50	0.80	0.80	0.80	0.80	0.80	1.10	1.10	1.10	2.00
RANGE	1.10	1.20	1.20	1.20	1.20	1.20	1.00	1.00	1.00	0.80
90th PERCENTILE	1.60	2.00	2.00	2.00	2.00	2.00	2.10	2.10	2.10	2.80
STD	0.7778	0.8485	0.8485	0.8485	0.8485	0.8485	0.7071	0.7071	0.7071	0.5657
90% CL	3.4727	3.7884	3.7884	3.7884	3.7884	3.7884	3.1570	3.1570	3.1570	2.5256

ier outfall

Parameter	Temp	Diss_O	pH	Color_True	Color_TAC	Color_SW_Diss	Spec_Cond	Res_Nonfilt	Res_Filt_1_Ou	Turbidity	Alk_Phen_8_3	Alk_Total_4_5
MDC				5		5		1			0.5	
	(deg C)		(pH units)	(Col. Unit)	(TAC)	(SWU)	(uS/cm)	(mg/L)	(mg/L)	(NTU)	(mg/L)	(mg/L)
Regn_No												
COUNT	17	16	19	19	19	19	19	19	18	19	19	19
MEAN	9.1	11.5	7.7	5.0	3.4	5.8	121.0	1.6	76.1	0.5	0.5	51.4
MEDIAN	7.0	11.8	7.7	5.0	3.0	5.0	124.0	1.0	75.0	0.5	0.5	52.1
MAX	16.1	13.5	8.4	5.0	7.0	10.0	135.0	4.0	102.0	1.8	0.5	56.3
MIN	4.5	9.4	6.1	5.0	2.0	4.0	100.0	1.0	64.0	0.2	0.5	42.9
RANGE	11.6	4.1	2.3	0.0	5.0	6.0	35.0	3.0	38.0	1.4	0.0	13.4
90th PERCENTILE	14.6	12.6	8.2	5.0	6.0	9.0	131.0	4.0	84.0	1.1	0.5	55.5
STD	4.0	1.2	0.5	0.0000	1.6095	1.6754	10.1708	1.1161	9.1682	0.3762	0.0000	4.0330
90% CL	1.7	0.5	0.2	0.0000	0.6403	0.6635	4.0460	0.4440	3.7601	0.1497	0.0000	1.6043

er outfall

Reqn_No	Hard_Total	Coliform_Fecal	E_Coli	Enterococcus	Chlorate	Fluoride_Diss	Silica_React_Diss	Sulfate_Diss	AOX	Abietic_Acid	Chlorodehydroabietic_Acid
	(mg/L)	2 (CFU)	2	2	0.1 (mg/L)	0.1 (mg/L)	(mg/L)	(mg/L)	0.01 (mg/L)	0.001 (mg/L)	0.001 (mg/L)
COUNT	10	19	17	17	16	19	19	19	16	15	14
MEAN	57.9	2.0	2.1	1.8	0.06	0.10	3.01	8.92	0.03	0.0008	0.0008
MEDIAN	58.9	2.0	2.0	2.0	0.05	0.10	3.50	9.00	0.02	0.0010	0.0010
MAX	66.4	5.0	10.0	3.0	0.21	0.10	4.30	13.30	0.18	0.0010	0.0010
MIN	47.7	1.0	1.0	1.0	0.01	0.10	0.50	7.40	0.01	0.0005	0.0005
RANGE	18.7	4.0	9.0	2.0	0.20	0.00	3.80	5.90	0.17	0.0005	0.0005
90th PERCENTILE	65.9	4.0	2.0	2.0	0.10	0.10	3.70	9.40	0.04	0.0010	0.0010
STD	6.5549	1.1547	2.0881	0.5623	0.0531	0.0000	1.1737	1.2947	0.0423	0.0003	0.0003
90% CL	3.7995	0.4593	0.8843	0.2381	0.0233	0.0000	0.4669	0.5150	0.0185	0.0001	0.0001

:er outfall

Reqn_No	Dehydroabietic_Acid	Dichlorodehydroabietic_Acid	Isopimaric_Acid	Levo_Pimaric_Acid	Neoabietic_Acid	Pimaric_Acid	Palustric_Acid	Sandaraco_Pim_Acid
	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)
COUNT	15	14	15	15	15	15	14	15
MEAN	0.0009	0.0008	0.0012	0.0009	0.0020	0.0008	0.0009	0.0008
MEDIAN	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
MAX	0.0030	0.0010	0.0050	0.0010	0.0140	0.0010	0.0030	0.0010
MIN	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
RANGE	0.0025	0.0005	0.0045	0.0005	0.0135	0.0005	0.0025	0.0005
90th PERCENTILE	0.0010	0.0010	0.0030	0.0010	0.0050	0.0010	0.0010	0.0010
STD	0.0006	0.0003	0.0012	0.0003	0.0035	0.0003	0.0006	0.0003
90% CL	0.0003	0.0001	0.0006	0.0001	0.0016	0.0001	0.0003	0.0001

er outfall

Reqn_No	Arachidic_Acid	Behenic_Acid	Lauric_Acid	Lignoceric_Acid	Linolenic_Acid	Linoleic_Acid	Myristic_Acid	Oleic_Acid	Palmitric_Acid	Stearic_Acid	Al_Total	As_Total
	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.02 (mg/L)	0.001 (mg/L)
COUNT	14	14	14	14	14	14	14	14	15	15	10	10
MEAN	0.0033	0.0008	0.0155	0.0010	0.0010	0.0010	0.0110	0.0056	0.0087	0.0075	0.04	0.001
MEDIAN	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0020	0.0010	0.0030	0.0010	0.04	0.001
MAX	0.0260	0.0010	0.1400	0.0040	0.0040	0.0040	0.0880	0.0360	0.0570	0.0430	0.06	0.001
MIN	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.02	0.001
RANGE	0.0255	0.0005	0.1395	0.0035	0.0035	0.0035	0.0875	0.0355	0.0565	0.0425	0.04	0.000
90th PERCENTILE	0.0110	0.0010	0.0450	0.0010	0.0010	0.0010	0.0250	0.0200	0.0160	0.0220	0.05	0.001
STD	0.0071	0.0003	0.0377	0.0009	0.0009	0.0009	0.0232	0.0108	0.0145	0.0122	0.0134	0.0000
90% CL	0.0034	0.0001	0.0179	0.0004	0.0004	0.0004	0.0110	0.0050	0.0066	0.0056	0.0078	0.0000

ıer outfall

	0.001 (mg/L)	0.01 (mg/L)	0.0005 (mg/L)	0.003 (mg/L)	0.002 (mg/L)	0.001 (mg/L)	0.003 (mg/L)	0.02 (mg/L)	0.002 (mg/L)	0.00005 (mg/L)	0.004 (mg/L)	0.008 (mg/L)	0.001 (mg/L)	0.003 (mg/L)	0.003 (mg/L)	0.002 (mg/L)	0.1 (mg/L)
Reqn_No	Ba_Total	Ca_Total	Cd_Total	Co_Total	Cr_Total	Cu_Total	Fe_Total	Mg_Total	Mn_Total	Hg_Total	Mo_Total	Ni_Total	Pb_Total	Tl_Total	V_Total	Zn_Total	K_Diss
COUNT	10	10	10	10	10	10	10	10	10	8	10	10	10	10	10	10	19
MEAN	0.021	17.15	0.0005	0.0030	0.0025	0.0013	0.0290	3.6460	0.0031	0.00006	0.0040	0.0080	0.0015	0.0030	0.0030	0.0085	0.6684
MEDIAN	0.016	17.36	0.0005	0.0030	0.0020	0.0010	0.0255	3.7450	0.0020	0.00005	0.0040	0.0080	0.0010	0.0030	0.0030	0.0045	0.7000
MAX	0.083	19.40	0.0005	0.0030	0.0050	0.0030	0.0700	4.3600	0.0100	0.00009	0.0040	0.0080	0.0030	0.0030	0.0030	0.0380	1.0000
MIN	0.010	14.59	0.0005	0.0030	0.0020	0.0010	0.0040	2.7200	0.0020	0.00005	0.0040	0.0080	0.0010	0.0030	0.0030	0.0020	0.5000
RANGE	0.073	4.81	0.0000	0.0000	0.0030	0.0020	0.0660	1.6400	0.0080	0.00004	0.0000	0.0000	0.0020	0.0000	0.0000	0.0360	0.5000
90th PERCENTILE	0.017	19.20	0.0005	0.0030	0.0040	0.0020	0.0440	4.3500	0.0030	0.00005	0.0040	0.0080	0.0030	0.0030	0.0030	0.0120	0.7000
STD	0.0217	1.7527	0.0000	0.0000	0.0011	0.0007	0.0183	0.5439	0.0025	0.00001	0.0000	0.0000	0.0008	0.0000	0.0000	0.0109	0.1057
90% CL	0.0126	1.0159	0.0000	0.0000	0.0006	0.0004	0.0106	0.3152	0.0014	0.00001	0.0000	0.0000	0.0005	0.0000	0.0000	0.0063	0.0420

:er outfall

Reqn_No	N_Org_Total	N_Kjel_Total	N_Total	N_Amm_Diss	N_NO3_NO2_Diss	P_Ortho_Diss	P_Total	P_Total_Diss	Total_Org_C	Total_Inorg_C	C_Total	Na_Diss	Cl_Diss
	0.04 (mg/L)	0.04 (mg/L)	0.02 (mg/L)	0.005 (mg/L)	0.005 (mg/L)	0.002 (mg/L)	0.003 (mg/L)	0.003 (mg/L)	1 (mg/L)	(mg/L)	(mg/L)	0.5 (mg/L)	0.5 (mg/L)
COUNT	18	18	18	19	19	19	19	19	16	16	16	19	19
MEAN	0.077	0.084	0.204	0.0085	0.1189	0.0030	0.0045	0.0038	2.1250	11.9375	13.0625	1.5421	0.7895
MEDIAN	0.080	0.085	0.195	0.0050	0.1200	0.0030	0.0030	0.0030	2.5000	12.0000	13.0000	1.1000	0.7000
MAX	0.220	0.280	0.460	0.0570	0.1800	0.0030	0.0240	0.0180	3.0000	15.0000	15.0000	8.1000	1.6000
MIN	0.040	0.040	0.140	0.0050	0.0800	0.0030	0.0030	0.0030	1.0000	9.0000	11.0000	0.7000	0.5000
RANGE	0.180	0.240	0.320	0.0520	0.1000	0.0000	0.0210	0.0150	2.0000	6.0000	4.0000	7.4000	1.1000
90th PERCENTILE	0.090	0.100	0.230	0.0080	0.1400	0.0030	0.0050	0.0030	3.0000	13.0000	14.0000	2.0000	1.2000
STD	0.0435	0.0556	0.0752	0.0118	0.0247	0.0000	0.0048	0.0034	0.9574	1.4361	1.1236	1.6368	0.3195
90% CL	0.0178	0.0228	0.0308	0.0047	0.0098	0.0000	0.0019	0.0014	0.4196	0.6294	0.4924	0.6511	0.1271

ıer outfall

Reqn_No	Resin_Acid	Phenols	Chloroform	4_Chlorophenol	26_DCP	24_25_DCP	35_DCP	23_DCP	34_DCP	246_TCP	236_TCP	235_TCP	245_TCP
	0.001 (mg/L)	0.002 (mg/L)	0.0005 (mg/L)	0.2-6 (ng/L)	0.2-4 (ng/L)	0.05-12 (ng/L)	0.1-2 (ng/L)	0.1-2 (ng/L)	0.1-1 (ng/L)	0.1-28 (ng/L)	0.2-3 (ng/L)	0.2-1.3 (ng/L)	0.1-1.1 (ng/L)
COUNT	4	29	4	34	34	34	34	34	34	34	34	34	34
MEAN	0.0040	0.0021	0.0008	1.0882	0.7882	3.0926	0.5235	0.6059	0.3971	6.7500	0.7265	0.4882	0.3706
MEDIAN	0.0008	0.0020	0.0008	0.7500	0.6000	1.0500	0.4000	0.5000	0.3000	5.5000	0.5000	0.4000	0.3000
MAX	0.0140	0.0050	0.0010	6.0000	4.0000	12.0000	2.0000	2.0000	1.0000	28.0000	3.0000	1.3000	1.1000
MIN	0.0005	0.0020	0.0005	0.2000	0.2000	0.0500	0.1000	0.1000	0.1000	0.1000	0.2000	0.2000	0.1000
RANGE	0.0135	0.0030	0.0005	5.8000	3.8000	11.9500	1.9000	1.9000	0.9000	27.9000	2.8000	1.1000	1.0000
90th PERCENTILE	0.0140	0.0020	0.0010	2.4000	1.5000	9.0000	1.0000	1.1000	0.8000	14.0000	1.3000	1.0000	0.7000
STD	0.0067	0.0006	0.0003	1.0957	0.7327	3.6448	0.3947	0.4022	0.2443	6.7373	0.6077	0.3043	0.2316
90% CL	0.0078	0.0002	0.0003	0.3189	0.2132	1.0608	0.1149	0.1171	0.0711	1.9608	0.1769	0.0886	0.0674

er outfall

	0.2-1.5 (ng/L)	0.1-1.2 (ng/L)	0.2-1 (ng/L)	0.2-3.4 (ng/L)	0.1-0.8 (ng/L)	0.2-4.8 (ng/L)	0.4-9.2 (ng/L)	0.6-16 (ng/L)	0.5-14 (ng/L)
Reqn_No	234_TCP	345_TCP	2356_TetraCP	2346_TetraCP	2345_TetraCP	Pentachlorophenol	6_chloroguaiacol	4_chloroguaiacol	5_chloroguaiacol
COUNT	34	34	34	34	34	34	34	34	34
MEAN	0.5235	0.4147	0.5500	0.8912	0.3441	0.8824	3.1118	4.7059	4.3588
MEDIAN	0.4500	0.4000	0.5000	0.8000	0.3500	0.4000	2.5000	4.0000	3.3000
MAX	1.5000	1.2000	1.0000	3.4000	0.8000	4.8000	9.2000	16.0000	14.0000
MIN	0.2000	0.1000	0.2000	0.2000	0.1000	0.2000	0.4000	0.6000	0.5000
RANGE	1.3000	1.1000	0.8000	3.2000	0.7000	4.6000	8.8000	15.4000	13.5000
90th PERCENTILE	1.0000	0.8000	1.0000	1.2000	0.5000	2.0000	5.1000	8.9000	10.0000
STD	0.3144	0.2476	0.2326	0.6917	0.1709	1.0729	2.4153	3.8258	3.6023
90% CL	0.0915	0.0721	0.0677	0.2013	0.0497	0.3123	0.7029	1.1134	1.0484

:er outfall

	0.2-4.5 (ng/L)	0.2-15 (ng/L)	0.3-34 (ng/L)	0.1-40 (ng/L)	0.1-8.9 (ng/L)	0.1-22 (ng/L)	0.2-30 (ng/L)	0.6-30 (ng/L)	0.2-10 (ng/L)
Reqn_No	34_DCguaiacol	46_DCguaiacol	45_DCguaiacol	345_TCguaiacol	456_TCguaiacol	3456_TCguaiacol	3_chlorocatechol	4_chlorocatechol	34_DCcatechol
COUNT	34	34	34	34	34	34	32	30	34
MEAN	1.0176	2.6147	3.5853	10.3794	2.1029	3.7618	6.4813	8.5200	1.9294
MEDIAN	0.9500	1.0500	0.8500	7.0000	1.5000	2.2000	5.0000	6.5000	0.7000
MAX	4.5000	15.0000	34.0000	40.0000	8.9000	22.0000	30.0000	30.0000	10.0000
MIN	0.2000	0.2000	0.3000	0.1000	0.1000	0.1000	0.2000	0.6000	0.2000
RANGE	4.3000	14.8000	33.7000	39.9000	8.8000	21.9000	29.8000	29.4000	9.8000
90th PERCENTILE	1.7000	9.1000	13.0000	31.0000	5.0000	7.4000	10.0000	15.0000	6.0000
STD	0.7983	3.6536	7.3612	10.5479	2.2064	4.9633	5.6767	6.3645	2.9078
90% CL	0.2323	1.0633	2.1423	3.0698	0.6421	1.4445	1.7030	1.9742	0.8463

er outfall

	0.2-10 (ng/L)	0.2-30 (ng/L)	0.3-30 (ng/L)	0.06-15 (ng/L)	0.06-30 (ng/L)	0.6-16 (ng/L)	0.1-21 (ng/L)	0.1-21 (ng/L)
Reqn_No	36_DCcatechol	35_DCcatechol	45_DCcatechol	345_TCcatechol	3456_TCcatechol	45_DCveratrole	346_TCveratrole	345_TCveratrole
COUNT	34	34	34	34	34	28	28	28
MEAN	2.5294	5.2324	5.3000	2.8868	5.6332	3.9607	2.3536	2.7071
MEDIAN	0.8000	5.0000	5.0000	0.4500	5.0000	2.1500	0.5500	0.9500
MAX	10.0000	30.0000	30.0000	15.0000	30.0000	16.0000	21.0000	21.0000
MIN	0.2000	0.2000	0.3000	0.0600	0.0600	0.6000	0.1000	0.1000
RANGE	9.8000	29.8000	29.7000	14.9400	29.9400	15.4000	20.9000	20.9000
90th PERCENTILE	10.0000	10.0000	10.0000	10.0000	10.0000	7.0000	2.0000	4.0000
STD	3.4473	5.9701	5.7395	3.9158	5.9789	4.2002	5.3149	5.2407
90% CL	1.0033	1.7375	1.6704	1.1396	1.7401	1.3518	1.7105	1.6867

ier outfall

	0.07-26 (ng/L)	0.3-2.4 (ng/L)	0.2-5 (ng/L)	0.08-1.2 (ng/L)	0.4-5 (ng/L)	0.4-3.1 (ng/L)	0.1-1 (ng/L)	0.4-2.9 (pg/L)	0.4-2.9 (pg/L)	0.5-3.3 (pg/L)
Reqn_No	3456_TCveratrole	5_chlorovanillin	6_chlorovanillin	56_DCvanillin	3_chlorosyringol	35_DCsyringol	345_TCsyringol	T4CDD	2378T4CDD	P5CDD
COUNT	28	34	34	34	34	34	34	8	8	8
MEAN	2.6943	1.2294	1.3441	0.5759	1.9029	1.6118	0.4618	1.2625	1.2625	1.4500
MEDIAN	0.3500	1.2000	1.2500	0.6000	1.8500	1.6000	0.4000	1.1000	1.1000	1.3000
MAX	26.0000	2.4000	5.0000	1.2000	5.0000	3.1000	1.0000	2.9000	2.9000	3.3000
MIN	0.0700	0.3000	0.2000	0.0800	0.4000	0.4000	0.1000	0.4000	0.4000	0.5000
RANGE	25.9300	2.1000	4.8000	1.1200	4.6000	2.7000	0.9000	2.5000	2.5000	2.8000
90th PERCENTILE	1.2000	2.1000	2.1000	1.0000	4.0000	2.8000	0.8000	2.0000	2.0000	2.3000
STD	7.0713	0.6177	0.8645	0.2807	1.2963	0.7559	0.2617	0.9149	0.9149	1.0420
90% CL	2.2758	0.1798	0.2516	0.0817	0.3773	0.2200	0.0762	0.6129	0.6129	0.6981

ier outfall

	0.5-3.3 (pg/L)	0.8-3.3 (pg/L)	0.9-3.6 (pg/L)	0.8-3.3 (pg/L)	0.8-3.3 (pg/L)	0.9-3.9 (pg/L)	0.9-3.9 (pg/L)	2-6.6 (pg/L)	0.3-2.4 (pg/L)	0.3-2.4 (pg/L)	0.5-3.6 (pg/L)	0.5-3.6 (pg/L)
Reqn_No	12378P5CDD	H6CDD	123478H6CDD	123678H6CDD	123789H6CDD	H7CDD	1234678H7CDD	O8CDD	T4CDF	2378T4CDF	P5CDF	12378P5CDF
COUNT	8	8	8	8	8	8	8	8	8	8	8	8
MEAN	1.4500	1.8375	2.0000	1.7125	1.8750	2.2375	2.2375	3.4500	1.1000	1.1000	1.5625	1.5875
MEDIAN	1.3000	1.4000	1.4000	1.4000	1.4000	2.1500	2.1500	2.9000	1.1000	1.1000	1.2500	1.3000
MAX	3.3000	3.3000	3.6000	3.3000	3.3000	3.9000	3.9000	6.6000	2.4000	2.4000	3.6000	3.6000
MIN	0.5000	0.8000	0.9000	0.8000	0.8000	0.9000	0.9000	2.0000	0.3000	0.3000	0.5000	0.5000
RANGE	2.8000	2.5000	2.7000	2.5000	2.5000	3.0000	3.0000	4.6000	2.1000	2.1000	3.1000	3.1000
90th PERCENTILE	2.3000	3.0000	3.6000	2.5000	3.2000	3.4000	3.4000	5.0000	1.6000	1.6000	3.1000	3.1000
STD	1.0420	1.0783	1.2672	0.9403	1.1548	1.0609	1.0609	1.5483	0.7597	0.7597	1.2188	1.1993
90% CL	0.6981	0.7224	0.8490	0.6300	0.7737	0.7108	0.7108	1.0373	0.5090	0.5090	0.8166	0.8035

ier outfall

	0.5-3.5 (pg/L)	0.6-2.6 (pg/L)	0.5-2.6 (pg/L)	0.5-2.6 (pg/L)	0.6-2.6 (pg/L)	0.6-3.2 (pg/L)	0.5-3 (pg/L)	0.5-2.5 (pg/L)	0.5-3.7 (pg/L)	0.6-5.1 (pg/L)
Reqn_No	23478P5CDF	H6CDF	123478H6CDF	123678H6CDF	234678H6CDF	123789H6CDF	H7CDF	1234678H7CDF	1234789H7CDF	O8CDF
COUNT	8	8	8	8	8	8	8	8	8	8
MEAN	1.5500	1.5250	1.4375	1.3250	1.6375	1.8125	1.7250	1.5250	1.9625	2.8500
MEDIAN	1.2500	1.5000	1.3500	1.3000	1.6500	1.6000	1.8000	1.5500	2.0000	2.5000
MAX	3.5000	2.6000	2.6000	2.6000	2.6000	3.2000	3.0000	2.5000	3.7000	5.1000
MIN	0.5000	0.6000	0.5000	0.5000	0.6000	0.6000	0.5000	0.5000	0.5000	0.6000
RANGE	3.0000	2.0000	2.1000	2.1000	2.0000	2.6000	2.5000	2.0000	3.2000	4.5000
90th PERCENTILE	3.1000	2.3000	2.1000	1.7000	2.5000	3.2000	2.4000	2.2000	3.0000	5.0000
STD	1.1952	0.7869	0.7782	0.7046	0.8383	1.0616	0.8328	0.7086	1.0433	1.6449
90% CL	0.8008	0.5272	0.5214	0.4721	0.5616	0.7112	0.5580	0.4748	0.6990	1.1021

:gar	Parameter											
	MDC			5		5		1			0.5	
	(deg C)		(pH units)	(Col. Unit)	(TAC)	(SWU)	(uS/cm)	(mg/L)	(mg/L)	(NTU)	(mg/L)	(mg/L)
Reqn_No	Temp	Diss_O	pH	Color_True	Color_TAC	Color_SW_Diss	Spec_Cond	Res_Nonfilt	Res_Filt_1_Ou	Turbidity	Alk_Phen_8_3	Alk_Total_4_5
COUNT	19	19	19	19	19	19	19	19	19	19	19	19
MEAN	10.0	11.4	7.8	5.0	3.0000	5.6842	122.8421	1.6842	78.1053	0.4684	0.5000	51.7211
MEDIAN	10.3	11.7	7.9	5.0	3.0000	5.0000	124.0000	1.0000	78.0000	0.4000	0.5000	52.2000
MAX	17.5	13.3	8.3	5.0	5.0000	8.0000	141.0000	4.0000	100.0000	1.2000	0.5000	58.3000
MIN	4.5	9.4	7.3	5.0	1.0000	5.0000	100.0000	1.0000	62.0000	0.2000	0.5000	42.8000
RANGE	13.0	3.9	1.0	0.0	4.0000	3.0000	41.0000	3.0000	38.0000	1.0000	0.0000	15.5000
90th PERCENTILE	16.0	13.0	8.2	5.0	4.0000	8.0000	134.0000	3.0000	88.0000	0.8000	0.5000	55.9000
STD	4.4511	1.2713	0.3630	0.0000	1.0541	1.1572	11.2510	1.0569	9.0547	0.2964	0.0000	4.3159
90% CL	1.7707	0.5057	0.1444	0.0000	0.4193	0.4604	4.4757	0.4204	3.6020	0.1179	0.0000	1.7169

:gar		2	2	2	0.1	0.1			0.01	0.001	0.001
	(mg/L)	(CFU)			(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Reqn_No	Hard_Total	Coliform_Fecal	E_Coli	Enterococcus	Chlorate	Fluoride_Diss	Silica_React_Diss	Sulfate_Diss	AOX	Abietic_Acid	Chlorodehydroabietic_Acid
COUNT	11	19	17	17	16	19	19	19	16	15	15
MEAN	56.3545	2.4737	2.2353	1.8235	0.0575	0.1000	3.0000	9.0316	0.0308	0.0010	0.0227
MEDIAN	58.8000	2.0000	2.0000	2.0000	0.0600	0.1000	3.5000	9.1000	0.0300	0.0010	0.0010
MAX	64.9000	13.0000	9.0000	2.0000	0.1100	0.1000	4.2000	10.7000	0.0700	0.0040	0.3300
MIN	46.9000	1.0000	1.0000	1.0000	0.0100	0.1000	0.5000	7.2000	0.0100	0.0005	0.0005
RANGE	18.0000	12.0000	8.0000	1.0000	0.1000	0.0000	3.7000	3.5000	0.0600	0.0035	0.3295
90th PERCENTILE	64.4000	3.0000	2.0000	2.0000	0.1000	0.1000	3.7000	10.3000	0.0500	0.0010	0.0010
STD	6.9574	2.6535	1.8210	0.3930	0.0353	0.0000	1.1648	0.9939	0.0181	0.0009	0.0850
90% CL	3.8011	1.0556	0.7711	0.1664	0.0155	0.0000	0.4633	0.3954	0.0079	0.0004	0.0386

›gar	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)
Reqn_No	Dehydroabietic_Acid	Dichlorodehydroabietic_Acid	Isopimaric_Acid	Levo_Pimaric_Acid	Neoabietic_Acid	Pimaric_Acid	Palustric_Acid	Sandaraco_Pim_Acid
COUNT	15	15	15	15	15	15	15	15
MEAN	0.0012	0.0008	0.0015	0.0019	0.0008	0.0011	0.0014	0.0008
MEDIAN	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
MAX	0.0060	0.0010	0.0100	0.0100	0.0010	0.0030	0.0100	0.0010
MIN	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
RANGE	0.0055	0.0005	0.0095	0.0095	0.0005	0.0025	0.0095	0.0005
90th PERCENTILE	0.0030	0.0010	0.0030	0.0080	0.0010	0.0020	0.0010	0.0010
STD	0.0015	0.0003	0.0024	0.0029	0.0003	0.0007	0.0024	0.0003
90% CL	0.0007	0.0001	0.0011	0.0013	0.0001	0.0003	0.0011	0.0001

›gar	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.02 (mg/L)	0.001 (mg/L)
Reqn_No	Arachidic_Acid	Behenic_Acid	Lauric_Acid	Lignoceric_Acid	Linolenic_Acid	Linoleic_Acid	Myristic_Acid	Oleic_Acid	Palmitric_Acid	Stearic_Acid	Al_Total	As_Total
COUNT	15	15	15	15	15	15	14	15	15	15	11	11
MEAN	0.0008	0.0008	0.0127	0.0053	0.0008	0.0008	0.0095	0.0009	0.0071	0.0022	0.0343	0.0010
MEDIAN	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0020	0.0010	0.0020	0.0010	0.0360	0.0010
MAX	0.0010	0.0010	0.0710	0.0660	0.0010	0.0010	0.0480	0.0020	0.0380	0.0190	0.0600	0.0010
MIN	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0010	0.0005	0.0200	0.0010
RANGE	0.0005	0.0005	0.0705	0.0655	0.0005	0.0005	0.0475	0.0015	0.0370	0.0185	0.0400	0.0000
90th PERCENTILE	0.0010	0.0010	0.0610	0.0020	0.0010	0.0010	0.0440	0.0010	0.0260	0.0021	0.0410	0.0010
STD	0.0003	0.0003	0.0230	0.0168	0.0003	0.0003	0.0163	0.0004	0.0107	0.0047	0.0121	0.0000
90% CL	0.0001	0.0001	0.0104	0.0076	0.0001	0.0001	0.0077	0.0002	0.0049	0.0021	0.0066	0.0000

›gar	0.001 (mg/L)	0.01 (mg/L)	0.0005 (mg/L)	0.003 (mg/L)	0.002 (mg/L)	0.001 (mg/L)	0.003 (mg/L)	0.02 (mg/L)	0.002 (mg/L)	0.00005 (mg/L)	0.004 (mg/L)	0.008 (mg/L)	0.001 (mg/L)	0.003 (mg/L)	0.003 (mg/L)	0.002 (mg/L)	0.1 (mg/L)
Reqn_No	Ba_Total	Ca_Total	Cd_Total	Co_Total	Cr_Total	Cu_Total	Fe_Total	Mg_Total	Mn_Total	Hg_Total	Mo_Total	Ni_Total	Pb_Total	Tl_Total	V_Total	Zn_Total	K_Diss
COUNT	11	11	11	11	11	11	11	11	11	8	11	11	11	11	11	11	19
MEAN	0.0146	16.7291	0.0005	0.0030	0.0025	0.0015	0.0282	3.5400	0.0027	0.00005	0.0040	0.0082	0.0013	0.0032	0.0030	0.0088	0.6368
MEDIAN	0.0150	17.3500	0.0005	0.0030	0.0020	0.0010	0.0260	3.7400	0.0030	0.00005	0.00400	0.0080	0.0010	0.0030	0.0030	0.0040	0.6000
MAX	0.0160	19.0000	0.0005	0.0030	0.0050	0.0030	0.0420	4.2500	0.0060	0.00008	0.0040	0.0100	0.0020	0.0050	0.0030	0.0360	0.7000
MIN	0.0100	14.2000	0.0005	0.0030	0.0020	0.0010	0.0140	2.7300	0.0010	0.00005	0.0040	0.0080	0.0010	0.0030	0.0030	0.0020	0.5000
RANGE	0.0060	4.8000	0.0000	0.0000	0.0030	0.0020	0.0280	1.5200	0.0050	0.00003	0.0000	0.0020	0.0010	0.0020	0.0000	0.0340	0.2000
90th PERCENTILE	0.0160	18.9000	0.0005	0.0030	0.0030	0.0020	0.0410	4.2500	0.0030	0.00005	0.00400	0.0080	0.0020	0.0030	0.0030	0.0160	0.7000
STD	0.0019	1.8712	0.0000	0.0000	0.0009	0.0007	0.0097	0.5687	0.0013	0.00001	0.0000	0.0006	0.0005	0.0006	0.0000	0.0105	0.0597
90% CL	0.0010	1.0223	0.0000	0.0000	0.0005	0.0004	0.0053	0.3107	0.0007	0.00001	0.0000	0.0003	0.0003	0.0003	0.0000	0.0057	0.0238

›gar	0.04 (mg/L)	0.04 (mg/L)	0.02 (mg/L)	0.005 (mg/L)	0.005 (mg/L)	0.002 (mg/L)	0.003 (mg/L)	0.003 (mg/L)	1 (mg/L)	(mg/L)	(mg/L)	0.5 (mg/L)	0.5 (mg/L)
Reqn_No	N_Org_Total	N_Kjel_Total	N_Total	N_Amm_Diss	N_NO3_NO2_Diss	P_Ortho_Diss	P_Total	P_Total_Diss	Total_Org_C	Total_Inorg_C	C_Total	Na_Diss	Cl_Diss
COUNT	18	18	18	19	19	19	19	19	16	16	16	19	19
MEAN	0.0711	0.0739	0.1894	0.0054	0.1168	0.0030	0.0042	0.0030	2.2500	12.1875	13.3750	1.3158	0.8842
MEDIAN	0.0550	0.0600	0.1700	0.0050	0.1200	0.0030	0.0030	0.0030	3.0000	12.0000	13.0000	1.3000	0.8000
MAX	0.2300	0.2300	0.3700	0.0100	0.1500	0.0030	0.0100	0.0030	3.0000	15.0000	16.0000	2.2000	1.8000
MIN	0.0400	0,0400	0.1300	0.0050	0.0800	0.0030	0.0030	0.0030	1.0000	9.0000	11.0000	0.7000	0.5000
RANGE	0.1900	0.1900	0.2400	0.0050	0.0700	0.0000	0.0070	0.0000	2.0000	6.0000	5.0000	1.5000	1.3000
90th PERCENTILE	0.1000	0.1000	0.2300	0.0060	0.1400	0.0030	0.0070	0.0030	3.0000	14.0000	14.0000	1.7000	1.2000
STD	0.0465	0.0463	0.0595	0.0012	0.0183	0.0000	0.0019	0.0000	0.9309	1.4705	1.4083	0.3891	0.3420
90% CL	0.0191	0.0190	0.0244	0.0005	0.0073	0.0000	0.0008	0.0000	0.4080	0.6445	0.6172	0.1548	0.1360

·gar	0.001 (mg/L)	0.002 (mg/L)	0.0005 (mg/L)	0.3-3.2 (ng/L)	0.3-2.8 (ng/L)	0.3-18 (ng/L)	0-2.2 (ng/L)	0.3-2.3 (ng/L)	0.2-1.6 (ng/L)	0.1-28 (ng/L)	0.3-1.8 (ng/L)	0.2-1.2 (ng/L)	0.2-1.3 (ng/L)
Reqn_No	Resin_Acid	Phenols	Chloroform	4_Chlorophenol	26_DCP	24_25_DCP	35_DCP	23_DCP	34_DCP	246_TCP	236_TCP	235_TCP	245_TCP
COUNT	3	14	1	18	18	18	18	18	18	18	18	18	18
MEAN	0.0068	0.0033	0.0005	1.2500	0.7833	5.8333	0.5722	0.6722	0.5056	12.0889	0.7278	0.5111	0.4444
MEDIAN	0.0080	0.0020	ERR	1.0500	0.4500	5.8000	0.4000	0.4500	0.3000	10.0000	0.6000	0.4000	0.3500
MAX	0.0120	0.0140	0.0005	3.2000	2.8000	18.0000	2.2000	2.3000	1.6000	38.0000	1.8000	1.2000	1.3000
MIN	0.0005	0.0020	0.0005	0.3000	0.3000	0.3000	0.0000	0.3000	0.2000	0.1000	0.3000	0.2000	0.2000
RANGE	0.0115	0.0120	0.0000	2.9000	2.5000	17.7000	2.2000	2.0000	1.4000	37.9000	1.5000	1.0000	1.1000
90th PERCENTILE	0.0120	0.0050	ERR	2.0000	1.5000	12.0000	1.0000	1.0000	0.9000	18.0000	1.2000	0.8000	0.7000
STD	0.0058	0.0032	ERR	0.8284	0.7733	5.4287	0.6105	0.6163	0.4425	9.4250	0.4599	0.3046	0.3091
90% CL	0.0098	0.0015	ERR	0.3397	0.3171	2.2264	0.2504	0.2527	0.1815	3.8654	0.1886	0.1249	0.1268

ıgar	0.2-1.6 (ng/L)	0.1-1.3 (ng/L)	0.2-1.8 (ng/L)	0.2-7 (ng/L)	0.1-1.2 (ng/L)	0.2-4 (ng/L)	0.6-5 (ng/L)	1-8 (ng/L)	1-7 (ng/L)
Reqn_No	234_TCP	345_TCP	2356_TetraCP	2346_TetraCP	2345_TetraCP	Pentachlorophenol	6_chlorogualacol	4_chlorogualacol	5_chlorogualacol
COUNT	18	18	18	18	18	18	18	18	18
MEAN	0.5889	0.4611	0.6667	1.9500	0.4167	1.0611	2.8667	4.3667	3.8333
MEDIAN	0.4500	0.3500	0.8000	1.1500	0.3000	0.6000	2.0000	4.7000	4.1000
MAX	1.6000	1.3000	1.8000	7.0000	1.2000	4.0000	5.0000	8.0000	7.0000
MIN	0.2000	0.1000	0.2000	0.2000	0.1000	0.2000	0.6000	1.0000	1.0000
RANGE	1.4000	1.2000	1.6000	6.8000	1.1000	3.8000	4.4000	7.0000	6.0000
90th PERCENTILE	1.0000	0.8000	1.0000	4.0000	0.7000	2.1000	4.9000	7.0000	5.6000
STD	0.3848	0.3346	0.4379	1.8542	0.3167	1.0112	1.5316	2.1135	1.8075
90% CL	0.1578	0.1372	0.1796	0.7604	0.1299	0.4147	0.6282	0.8668	0.7413

›gar	0.2-5.2 (ng/L)	0.2-18 (ng/L)	0.2-43 (ng/L)	0.1-61 (ng/L)	0.1-15 (ng/L)	0.1-29 (ng/L)	0.5-10 (ng/L)	0.9-20 (ng/L)
Reqn_No	34_DCgualacol	46_DCgualacol	45_DCgualacol	345_TCgualacol	456_TCgualacol	3456_TCgualacol	3_chlorocatechol	4_chlorocatechol
COUNT	18	18	18	18	18	18	17	16
MEAN	1.6500	4.8722	5.8722	23.4556	4.3389	8.5889	5.4471	7.2875
MEDIAN	1.4000	2.0500	1.1500	15.5000	3.3000	4.2000	5.0000	6.0000
MAX	5.2000	18.0000	43.0000	61.0000	15.0000	29.0000	10.0000	20.0000
MIN	0.2000	0.2000	0.2000	0.1000	0.1000	0.1000	0.5000	0.9000
RANGE	5.0000	17.8000	42.8000	60.9000	14.9000	28.9000	9.5000	19.1000
90th PERCENTILE	2.8000	9.4000	5.5000	52.0000	7.4000	26.0000	10.0000	10.0000
STD	1.2935	5.3497	12.6945	21.4346	3.8549	10.1528	3.1343	4.4300
90% CL	0.5305	2.1940	5.2063	8.7908	1.5810	4.1639	1.3273	1.9415

›gar	0.2-6 (ng/L)	0.3-6 (ng/L)	0.3-10 (ng/L)	0.4-10 (ng/L)	0.06-5.9 (ng/L)	0.08-10 (ng/L)	0.6-16 (ng/L)	0.1-9.9 (ng/L)	0.4-9.9 (ng/L)
Reqn_No	34_DCcatechol	36_DCcatechol	35_DCcatechol	45_DCcatechol	345_TCcatechol	3456_TCcatechol	45_DCveratrole	346_TCveratrole	345_TCveratrole
COUNT	18	18	18	18	18	18	14	14	14
MEAN	1.2833	1.3000	3.1611	4.1889	1.9978	4.1044	3.7857	1.6214	2.5286
MEDIAN	0.6500	0.7000	2.5000	4.9000	0.9000	5.0000	2.6000	0.6000	1.7500
MAX	6.0000	6.0000	10.0000	10.0000	5.9000	10.0000	16.0000	9.9000	9.9000
MIN	0.2000	0.3000	0.3000	0.4000	0.0600	0.0800	0.6000	0.1000	0.4000
RANGE	5.8000	5.7000	9.7000	9.6000	5.8400	9.9200	15.4000	9.8000	9.5000
90th PERCENTILE	2.8000	2.8000	5.0000	6.0000	5.0000	8.9000	8.3000	3.9000	5.2000
STD	1.6500	1.6421	2.6993	2.7613	2.1692	3.3698	4.2201	2.6438	2.5903
90% CL	0.6767	0.6735	1.1070	1.1325	0.8896	1.3820	1.9974	1.2513	1.2261

›gar	0.1-15 (ng/L)	0.3-4 (ng/L)	0.3-6.3 (ng/L)	0.1-3.2 (ng/L)	0.3-12 (ng/L)	0.5-5.8 (ng/L)	0.1-2.2 (ng/L)	0.4-1.8 (pg/L)	0.4-1.8 (pg/L)	0.5-2.6 (pg/L)
Reqn_No	3456_TCveratrole	5_chlorovanillin	6_chlorovanillin	56_DCvanillin	3_chlorosyringol	35_DCsyringol	345_TCsyringol	T4CDD	2378T4CDD	P5CDD
COUNT	14	18	18	18	18	18	18	2	2	2
MEAN	1.8571	1.4500	1.7444	0.9111	3.3056	1.8000	0.6778	1.1000	1.1000	1.5500
MEDIAN	0.4500	1.0500	1.1500	0.7000	1.4500	1.5500	0.4500	1.1000	1.1000	1.5500
MAX	15.0000	4.0000	6.3000	3.2000	12.0000	5.8000	2.2000	1.8000	1.8000	2.6000
MIN	0.1000	0.3000	0.3000	0.1000	0.3000	0.5000	0.1000	0.4000	0.4000	0.5000
RANGE	14.9000	3.7000	6.0000	3.1000	11.7000	5.3000	2.1000	1.4000	1.4000	2.1000
90th PERCENTILE	3.7000	2.1000	3.6000	1.6000	10.0000	2.2000	1.3000	1.8000	1.8000	2.6000
STD	3.9543	1.0331	1.4774	0.7669	4.0112	1.2993	0.5786	0.9899	0.9899	1.4849
90% CL	1.8716	0.4237	0.6059	0.3145	1.6451	0.5329	0.2373	4.4198	4.4198	6.6297

›gar	0.5-2.6 (pg/L)	1.8-3.8 (pg/L)	1.8-3.8 (pg/L)	1.8-3.8 (pg/L)	1.8-3.8 (pg/L)	1.8-3.7 (pg/L)	1.8-3.7 (pg/L)	3.6-6.8 (pg/L)	0.5-1.5 (pg/L)	0.5-1.5 (pg/L)	0.6-2.2 (pg/L)	0.6-2.2 (pg/L)
Reqn_No	12378P5CDD	H6CDD	123478H6CDD	123678H6CDD	123789H6CDD	H7CDD	1234678H7CDD	O8CDD	T4CDF	2378T4CDF	P5CDF	12378P5CDF
COUNT	2	2	2	2	2	2	2	2	2	2	2	2
MEAN	1.5500	2.8000	2.8000	2.8000	2.8000	2.7500	2.7500	5.2000	1.0000	1.0000	1.4000	1.4000
MEDIAN	1.5500	2.8000	2.8000	2.8000	2.8000	2.7500	2.7500	5.2000	1.0000	1.0000	1.4000	1.4000
MAX	2.6000	3.8000	3.8000	3.8000	3.8000	3.7000	3.7000	6.8000	1.5000	1.5000	2.2000	2.2000
MIN	0.5000	1.8000	1.8000	1.8000	1.8000	1.8000	1.8000	3.6000	0.5000	0.5000	0.6000	0.6000
RANGE	2.1000	2.0000	2.0000	2.0000	2.0000	1.9000	1.9000	3.2000	1.0000	1.0000	1.6000	1.6000
90th PERCENTILE	2.6000	3.8000	3.8000	3.8000	3.8000	3.7000	3.7000	6.8000	1.5000	1.5000	2.2000	2.2000
STD	1.4849	1.4142	1.4142	1.4142	1.4142	1.3435	1.3435	2.2627	0.7071	0.7071	1.1314	1.1314
90% CL	6.6297	6.3140	6.3140	6.3140	6.3140	5.9983	5.9983	10.1024	3.1570	3.1570	5.0512	5.0512

ngar	0.6-2.2 (pg/L)	1-3.7 (pg/L)	1-3.7 (pg/L)	1-3.7 (pg/L)	1-3.7 (pg/L)	1-3.7 (pg/L)	1.3-4.9 (pg/L)	1.3-4.9 (pg/L)	1.3-4.9 (pg/L)	2.6-5.7 (pg/L)
Reqn_No	23478P5CDF	H6CDF	123478H6CDF	123678H6CDF	234678H6CDF	123789H6CDF	H7CDF	1234678H7CDF	1234789H7CDF	O8CDF
COUNT	2	2	2	2	2	2	2	2	2	2
MEAN	1.4000	2.3500	2.3500	2.3500	2.3500	2.3500	3.1000	3.1000	3.1000	4.1500
MEDIAN	1.4000	2.3500	2.3500	2.3500	2.3500	2.3500	3.1000	3.1000	3.1000	4.1500
MAX	2.2000	3.7000	3.7000	3.7000	3.7000	3.7000	4.9000	4.9000	4.9000	5.7000
MIN	0.6000	1.0000	1.0000	1.0000	1.0000	1.0000	1.3000	1.3000	1.3000	2.6000
RANGE	1.6000	2.7000	2.7000	2.7000	2.7000	2.7000	3.6000	3.6000	3.6000	3.1000
90th PERCENTILE	2.2000	3.7000	3.7000	3.7000	3.7000	3.7000	4.9000	4.9000	4.9000	5.7000
STD	1.1314	1.9092	1.9092	1.9092	1.9092	1.9092	2.5456	2.5456	2.5456	2.1920
90% CL	5.0512	8.5239	8.5239	8.5239	8.5239	8.5239	11.3652	11.3652	11.3652	9.7867

Parameter												
	MDC					5	1	5		1		
	(deg C)	(deg C)	(ppm)	(pH units)	Arrow+Cor.	(Col. Unit)	(TAC)	(SWU)	(uS/cm)	(mg/L)	(mg/L)	(NTU)
Reqn_No	Temp_W	Temp_A	Diss_O	pH	Flow	Color_True	Color_TAC	Color_SW_Diss	Spec_Cond	Res_Nonfilt	Res_Filt_1_Ou	Turbidity
COUNT	56	29	28	70	24	9	55	44	56	41	9	29
MEAN	10.7	11.1	11.2	7.9	74926.53	5.0000	3.1636	5.1591	128.6607	1.4634	77.1111	0.7897
MEDIAN	10.3	11.0	11.6	8.0	74305.31	5.0000	3.0000	5.0000	132.5000	1.0000	80.0000	0.6000
MAX	18.5	24.0	13.1	8.4	110643.87	5.0000	10.0000	7.0000	148.0000	4.0000	96.0000	2.0000
MIN	4.4	0.0	9.3	6.0	53806.40	5.0000	1.0000	1.0000	110.0000	1.0000	62.0000	0.0000
RANGE	14.1	24.0	3.8	2.4	56837.47	0.0000	9.0000	6.0000	38.0000	3.0000	34.0000	2.0000
90th PERCENTILE	16.7	20.0	12.6	8.2	97252.41	5.0000	5.0000	6.0000	141.0000	3.0000	88.0000	1.5000
STD	4.4401	7.5254	1.2301	0.3456	15683.26	0.0000	1.6189	0.8611	10.8264	0.9513	11.6667	0.5544
90% CL	0.9992	2.3770	0.3959	0.0690	5487.08	0.0000	0.3676	0.2186	2.4363	0.2502	7.2333	0.1751

Reqn_No	Alk_Phen_8_3	Alk_Total_4_5	Hard_Total	Coliform_Fecal	E_Coli	Enterococcus	Chlorate	Fluoride_Diss	Silica_React_Diss	Sulfate_Diss	AOX
	0.5 (mg/L)	(mg/L)	(mg/L)	2 (CFU)	2	2	0.1 (mg/L)	0.1 (mg/L)	(mg/L)	(mg/L)	0.1 (mg/L)
COUNT	11	40	37	40	17	17	17	35	9	38	17
MEAN	0.5000	52.4025	58.0676	2.3000	2.5294	2.0588	0.0282	0.0815	3.4556	9.0684	0.0282
MEDIAN	0.5000	52.0000	58.4000	2.0000	2.0000	2.0000	0.0200	0.0800	3.7000	9.0000	0.0200
MAX	0.5000	59.1000	66.9000	7.0000	8.0000	7.0000	0.1000	0.1000	4.6000	10.9000	0.1000
MIN	0.5000	45.0000	49.6000	1.0000	1.0000	1.0000	0.0100	0.0600	0.5000	7.2000	0.0100
RANGE	0.0000	14.1000	17.3000	6.0000	7.0000	6.0000	0.0900	0.0400	4.1000	3.7000	0.0900
90th PERCENTILE	0.5000	57.3000	64.3000	4.0000	4.0000	2.0000	0.0400	0.1000	4.2000	10.5000	0.0400
STD	0.0000	4.0075	4.4947	1.3625	1.8748	1.3449	0.0283	0.0139	1.1770	1.0206	0.0290
90% CL	0.0000	1.0753	1.2540	0.3656	0.7939	0.5695	0.0120	0.0040	0.7297	0.2810	0.0123

Reqn_No	Abietic_Acid	Chlorodehydroabietic_Acid	Dehydroabietic_Acid	Dichlorodehydroabietic_Acid	Isopimaric_Acid	Levo_Pimaric_Acid	Neoabietic_Acid	Pimaric_Acid
	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)
COUNT	17	15	17	15	17	17	17	17
MEAN	0.0009	0.0008	0.0010	0.0008	0.0011	0.0008	0.0011	0.0008
MEDIAN	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
MAX	0.0020	0.0010	0.0040	0.0010	0.0060	0.0010	0.0060	0.0010
MIN	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
RANGE	0.0015	0.0005	0.0035	0.0005	0.0055	0.0005	0.0055	0.0005
90th PERCENTILE	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
STD	0.0004	0.0003	0.0008	0.0003	0.0013	0.0003	0.0013	0.0003
90% CL	0.0002	0.0001	0.0003	0.0001	0.0005	0.0001	0.0005	0.0001

	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)
Reqn_No	Palustric_Acid	Sandaraco_Pim_Acid	Arachidic_Acid	Behenic_Acid	Lauric_Acid	Lignoceric_Acid	Linolenic_Acid	Linoleic_Acid	Myristic_Acid	Oleic_Acid
COUNT	15	17	15	15	17	15	15	15	16	15
MEAN	0.0011	0.0008	0.0008	0.0014	0.0047	0.0013	0.0008	0.0008	0.0030	0.0047
MEDIAN	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
MAX	0.0060	0.0010	0.0020	0.0100	0.0210	0.0080	0.0010	0.0010	0.0090	0.0400
MIN	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
RANGE	0.0055	0.0005	0.0015	0.0095	0.0205	0.0075	0.0005	0.0005	0.0085	0.0395
90th PERCENTILE	0.0010	0.0010	0.0010	0.0010	0.0120	0.0010	0.0010	0.0010	0.0068	0.0130
STD	0.0014	0.0003	0.0004	0.0024	0.0060	0.0019	0.0003	0.0003	0.0031	0.0104
90% CL	0.0006	0.0001	0.0002	0.0011	0.0026	0.0009	0.0001	0.0001	0.0014	0.0047

	0.001 (mg/L)	0.001 (mg/L)	0.02 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.05 (ug/L)	0.01 (mg/L)	0.0005 (mg/L)	0.003 (mg/L)	0.002 (mg/L)	0.0002 (ug/L)	0.001 (mg/L)	0.003 (mg/L)	(mg/L)	0.02 (mg/L)
Reqn_No	Palmitric_Acid	Stearic_Acid	Al_Total	As_Total	Ba_Total	Be_Total	Ca_Total	Cd_Total	Co_Total	Cr_Total	Cr_Total_1	Cu_Total	Fe_Total	Li_Total	Mg_Total
COUNT	17	17	36	36	36	31	36	36	36	7	29	36	36	29	36
MEAN	0.0047	0.0043	0.0378	0.0003	0.0249	0.0468	17.1333	0.0002	0.0007	0.0031	0.0003	0.0011	0.0326	0.0012	3.7192
MEDIAN	0.0020	0.0010	0.0275	0.0002	0.0200	0.0500	17.2000	0.0001	0.0001	0.0020	0.0002	0.0005	0.0272	0.0013	3.8000
MAX	0.0140	0.0280	0.2500	0.0010	0.2290	0.0500	19.7000	0.0005	0.0030	0.0070	0.0016	0.0100	0.1490	0.0017	4.4000
MIN	0.0005	0.0005	0.0042	0.0001	0.0090	0.0010	14.9000	0.0001	0.0001	0.0020	0.0002	0.0003	0.0112	0.0009	2.9000
RANGE	0.0135	0.0275	0.2458	0.0009	0.2200	0.0490	4.8000	0.0004	0.0029	0.0050	0.0014	0.0097	0.1378	0.0008	1.5000
90th PERCENTILE	0.0120	0.0060	0.0490	0.0010	0.0207	0.0500	18.7000	0.0005	0.0030	0.0050	0.0005	0.0011	0.0502	0.0014	4.2000
STD	0.0050	0.0080	0.0404	0.0003	0.0351	0.0122	1.3478	0.0002	0.0012	0.0020	0.0003	0.0022	0.0241	0.0002	0.4219
90% CL	0.0021	0.0034	0.0114	0.0001	0.0099	0.0037	0.3812	0.0000	0.0003	0.0015	0.0001	0.0006	0.0068	0.0001	0.1193

	0.002		0.00005	0.004	0.008	0.001				0.003	0.003	0.002	0.1		
	(mg/L)	(ug/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(ug/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Reqn_No	Mn_Total	Mn_Total_1	Hg_Total	Mo_Total	Ni_Total	Pb_Total	Se_Total	Si_Total	Sr_Total	Ti_Total	V_Total	Zn_Total	K_Diss	N_Org_Total	N_Kjel_Total
COUNT	7	29	49	36	36	36	31	31	31	7	36	36	38	9	9
MEAN	0.0036	0.0021	0.000014	0.0012	0.0018	0.0005	0.0020	1.8413	0.0919	0.0136	0.0007	0.0048	0.5471	0.0633	0.0667
MEDIAN	0.0020	0.0019	0.000010	0.0005	0.0003	0.0002	0.0001	1.8400	0.1060	0.0200	0.0001	0.0014	0.5200	0.0700	0.0700
MAX	0.0100	0.0039	0.000050	0.0040	0.0080	0.0011	0.0300	2.5300	0.1180	0.0200	0.0030	0.0570	0.7000	0.1000	0.1000
MIN	0.0020	0.0012	0.000005	0.0004	0.0002	0.0002	0.0001	1.3700	0.0001	0.0030	0.0001	0.0005	0.4700	0.0200	0.0300
RANGE	0.0080	0.0027	0.000045	0.0036	0.0078	0.0009	0.0299	1.1600	0.1179	0.0170	0.0029	0.0565	0.2300	0.0800	0.0700
90th PERCENTILE	0.0040	0.0030	0.000024	0.0040	0.0080	0.0010	0.0002	2.2700	0.1150	0.0200	0.0030	0.0100	0.6000	0.0800	0.0900
STD	0.0029	0.0007	0.000011	0.0014	0.0031	0.0004	0.0075	0.3108	0.0371	0.0083	0.0012	0.0103	0.0569	0.0240	0.0235
90% CL	0.0022	0.0002	0.000003	0.0004	0.0009	0.0001	0.0023	0.0947	0.0113	0.0061	0.0003	0.0029	0.0157	0.0149	0.0145

Reqn_No	N_Total	N_Amm_Diss	N_NO3_NO2_Diss	P_Ortho_Diss	P_Total	P_Total_Diss	Total_Org_C	Total_Inorg_C	C_Total	Na_Diss	Cl_Diss	Resin_Acid	Phenols
	0.02 (mg/L)	0.005 (mg/L)	0.005 (mg/L)	0.003 (mg/L)	0.003 (mg/L)	0.003 (mg/L)	1 (mg/L)	(mg/L)	(mg/L)	0.5 (mg/L)	(mg/L)	0.001 (mg/L)	0.002 (mg/L)
COUNT	84	44	96	43	95	43	17	17	17	38	39	5	15
MEAN	0.1723	0.0063	0.1207	0.0030	0.0059	0.0031	2.2941	12.5294	13.8235	1.1542	0.6892	0.0007	0.0028
MEDIAN	0.1600	0.0050	0.1030	0.0030	0.0040	0.0030	3.0000	12.0000	14.0000	1.2000	0.7000	0.0005	0.0020
MAX	1.8000	0.0170	1.7300	0.0030	0.0570	0.0050	4.0000	15.0000	17.0000	2.0000	1.4000	0.0010	0.0110
MIN	0.0800	0.0050	0.0600	0.0030	0.0020	0.0030	1.0000	9.0000	11.0000	0.0900	0.0800	0.0005	0.0020
RANGE	1.7200	0.0120	1.6700	0.0000	0.0550	0.0020	3.0000	6.0000	6.0000	1.9100	1.3200	0.0005	0.0090
90th PERCENTILE	0.1900	0.0090	0.1430	0.0030	0.0080	0.0030	3.0000	14.0000	15.0000	1.6000	0.9000	0.0010	0.0040
STD	0.1823	0.0026	0.1684	0.0000	0.0069	0.0003	1.0467	1.5049	1.4678	0.4667	0.2406	0.0003	0.0023
90% CL	0.0332	0.0007	0.0287	0.0000	0.0012	0.0001	0.4432	0.6373	0.6216	0.1285	0.0654	0.0003	0.0011

	0.0005 (mg/L)	0.3-4.9 (ng/L)	0.2-2.9 (ng/L)	0.3-8.4 (ng/L)	0.1-2.7 (ng/L)	0.1-2.5 (ng/L)	0.1-2.1 (ng/L)	0.2-18 (ng/L)	0.2-1.5 (ng/L)	0.1-1 (ng/L)	0.1-0.9 (ng/L)	0.02-1.2 (ng/L)	0.1-2.5 (ng/L)
Reqn_No	**Chloroform**	**4_Chlorophenol**	**26_DCP**	**24_25_DCP**	**35_DCP**	**23_DCP**	**34_DCP**	**246_TCP**	**236_TCP**	**235_TCP**	**245_TCP**	**234_TCP**	**345_TCP**
COUNT	3	18	18	18	18	18	18	18	18	18	18	18	18
MEAN	0.0008	1.6444	0.8778	2.2611	0.6333	0.7111	0.5167	5.4944	0.6333	0.4556	0.3667	0.4622	0.5611
MEDIAN	0.0010	1.1500	0.7000	1.8000	0.4000	0.6000	0.3500	5.0000	0.5500	0.4500	0.3000	0.4000	0.3500
MAX	0.0010	4.9000	2.9000	8.4000	2.7000	2.5000	2.1000	18.0000	1.5000	1.0000	0.9000	1.2000	2.5000
MIN	0.0005	0.3000	0.2000	0.3000	0.1000	0.1000	0.1000	0.2000	0.2000	0.1000	0.1000	0.0200	0.1000
RANGE	0.0005	4.6000	2.7000	8.1000	2.6000	2.4000	2.0000	17.8000	1.3000	0.9000	0.8000	1.1800	2.4000
90th PERCENTILE	0.0010	3.5000	1.3000	5.0000	1.0000	1.2000	0.8000	8.8000	1.2000	0.8000	0.7000	0.9000	1.0000
STD	0.0003	1.3631	0.6735	2.1696	0.6624	0.6192	0.5102	4.2853	0.3865	0.2706	0.2249	0.3204	0.6409
90% CL	0.0005	0.5590	0.2762	0.8898	0.2717	0.2539	0.2092	1.7575	0.1585	0.1110	0.0922	0.1314	0.2628

	0.2-1.4 (ng/L)	0.2-3 (ng/L)	0.1-0.9 (ng/L)	0.2-1.5 (ng/L)	0.6-7.1 (ng/L)	0.7-12 (ng/L)	1-10 (ng/L)	0.2-4.1 (ng/L)
Reqn_No	2356_TetraCP	2346_TetraCP	2345_TetraCP	Pentachlorophenol	6_chlorogualacol	4_chlorogualacol	5_chlorogualacol	34_DCgualacol
COUNT	18	18	18	18	18	18	18	18
MEAN	0.5833	1.0556	0.3611	0.6778	2.6222	3.8667	3.7167	1.2222
MEDIAN	0.4000	0.9000	0.2500	0.5500	2.0500	3.0000	2.4000	1.0000
MAX	1.4000	3.0000	0.9000	1.5000	7.1000	12.0000	10.0000	4.1000
MIN	0.2000	0.2000	0.1000	0.2000	0.6000	0.7000	1.0000	0.2000
RANGE	1.2000	2.8000	0.8000	1.3000	6.5000	11.3000	9.0000	3.9000
90th PERCENTILE	1.0000	2.0000	0.8000	1.1000	5.0000	6.2000	10.0000	2.0000
STD	0.3569	0.7617	0.2570	0.3719	1.8361	3.0262	3.1149	1.0247
90% CL	0.1464	0.3124	0.1054	0.1525	0.7530	1.2411	1.2775	0.4203

	0.3-16 (ng/L)	0.3-27 (ng/L)	0.2-44 (ng/L)	0.1-15 (ng/L)	0.1-19 (ng/L)	0.4-10 (ng/L)	1-20 (ng/L)	0.2-10 (ng/L)
Reqn_No	46_DCgualacol	45_DCgualacol	345_TCgualacol	456_TCgualacol	3456_TCgualacol	3_chlorocatechol	4_chlorocatechol	34_DCcatechol
COUNT	18	18	18	18	18	16	15	18
MEAN	2.6722	3.3611	9.8500	2.1333	3.8389	4.9875	8.5200	1.6444
MEDIAN	1.2500	1.0000	6.0500	1.0000	0.9500	5.0000	9.0000	0.7000
MAX	16.0000	27.0000	44.0000	15.0000	19.0000	10.0000	20.0000	10.0000
MIN	0.3000	0.3000	0.2000	0.1000	0.1000	0.4000	1.0000	0.2000
RANGE	15.7000	26.7000	43.8000	14.9000	18.9000	9.6000	19.0000	9.8000
90th PERCENTILE	5.8000	3.9000	24.0000	4.0000	12.0000	10.0000	20.0000	2.0000
STD	3.8877	6.9104	11.9754	3.4443	5.5701	3.8552	5.5161	2.4879
90% CL	1.5944	2.8341	4.9114	1.4126	2.2844	1.6895	2.5081	1.0203

	0.3-10 (ng/L)	0.2-10 (ng/L)	0.3-10 (ng/L)	0.1-10 (ng/L)	0.1-10 (ng/L)	0.4-16 (ng/L)	0.1-22 (ng/L)	0.2-22 (ng/L)
Reqn_No	36_DCcatechol	35_DCcatechol	45_DCcatechol	345_TCcatechol	3456_TCcatechol	45_DCveratrole	346_TCveratrole	345_TCveratrole
COUNT	18	18	18	18	18	16	16	16
MEAN	1.7833	3.8611	4.5333	2.9833	4.8000	3.9313	1.8438	2.0188
MEDIAN	0.7500	2.0000	4.6000	1.7500	5.0000	1.5000	0.4000	0.7500
MAX	10.0000	10.0000	10.0000	10.0000	10.0000	16.0000	22.0000	22.0000
MIN	0.3000	0.2000	0.3000	0.1000	0.1000	0.4000	0.1000	0.2000
RANGE	9.7000	9.8000	9.7000	9.9000	9.9000	15.6000	21.9000	21.8000
90th PERCENTILE	2.8000	10.0000	10.0000	10.0000	10.0000	7.3000	0.8000	1.0000
STD	2.4758	3.8691	3.5440	3.5637	3.5612	4.7682	5.3883	5.3392
90% CL	1.0154	1.5868	1.4535	1.4616	1.4605	2.0897	2.3614	2.3399

	0.08-37 (ng/L)	0.3-4 (ng/L)	0.3-4 (ng/L)	0.1-1.7 (ng/L)	0.5-5 (ng/L)	0.6-5.3 (ng/L)	0.1-1.3 (ng/L)	0.4-1.5 (pg/L)	0.4-1.5 (pg/L)	0.7-1.6 (pg/L)
Reqn_No	3456_TCveratrole	5_chlorovanillin	6_chlorovanillin	56_DCvanillin	3_chlorosyringol	35_DCsyringol	345_TCsyringol	T4CDD	2378T4CDD	P5CDD
COUNT	16	18	18	18	18	18	18	2	2	2
MEAN	2.6113	1.5056	1.4944	0.8000	1.9389	1.9000	0.5556	0.9500	0.9500	1.1500
MEDIAN	0.3000	1.4500	1.3500	0.7000	1.3500	1.4000	0.4500	0.9500	0.9500	1.1500
MAX	37.0000	4.0000	4.0000	1.7000	5.0000	5.3000	1.3000	1.5000	1.5000	1.6000
MIN	0.0800	0.3000	0.3000	0.1000	0.5000	0.6000	0.1000	0.4000	0.4000	0.7000
RANGE	36.9200	3.7000	3.7000	1.6000	4.5000	4.7000	1.2000	1.1000	1.1000	0.9000
90th PERCENTILE	0.6000	2.0000	2.0000	1.6000	3.8000	3.0000	0.9000	1.5000	1.5000	1.6000
STD	9.1734	0.9777	0.9527	0.5509	1.4865	1.3298	0.3634	0.7778	0.7778	0.6364
90% CL	4.0202	0.4010	0.3907	0.2260	0.6096	0.5454	0.1490	3.4727	3.4727	2.8413

	0.7-1.6 (pg/L)	1.5-2.2 (pg/L)	1.5-2.2 (pg/L)	1.5-2.2 (pg/L)	1.5-2.2 (pg/L)	2.1-2.7 (pg/L)	2.1-2.7 (pg/L)	2.9-6.3 (pg/L)	0.4-1.5 (pg/L)	0.4-1.5 (pg/L)	0.5-1.8 (pg/L)	0.5-1.8 (pg/L)
Reqn_No	12378P5CDD	H6CDD	123478H6CDD	123678H6CDD	123789H6CDD	H7CDD	1234678H7CDD	O8CDD	T4CDF	2378T4CDF	P5CDF	12378P5CDF
COUNT	2	2	2	2	2	2	2	2	2	2	2	2
MEAN	1.1500	1.8500	1.8500	1.8500	1.8500	2.4000	2.4000	4.6000	0.9500	0.9500	1.1500	1.1500
MEDIAN	1.1500	1.8500	1.8500	1.8500	1.8500	2.4000	2.4000	4.6000	0.9500	0.9500	1.1500	1.1500
MAX	1.6000	2.2000	2.2000	2.2000	2.2000	2.7000	2.7000	6.3000	1.5000	1.5000	1.8000	1.8000
MIN	0.7000	1.5000	1.5000	1.5000	1.5000	2.1000	2.1000	2.9000	0.4000	0.4000	0.5000	0.5000
RANGE	0.9000	0.7000	0.7000	0.7000	0.7000	0.6000	0.6000	3.4000	1.1000	1.1000	1.3000	1.3000
90th PERCENTILE	1.6000	2.2000	2.2000	2.2000	2.2000	2.7000	2.7000	6.3000	1.5000	1.5000	1.8000	1.8000
STD	0.6364	0.4950	0.4950	0.4950	0.4950	0.4243	0.4243	2.4042	0.7778	0.7778	0.9192	0.9192
90% CL	2.8413	2.2099	2.2099	2.2099	2.2099	1.8942	1.8942	10.7338	3.4727	3.4727	4.1041	4.1041

	0.5-1.8 (pg/L)	1.3-2 (pg/L)	1.3-2 (pg/L)	1.3-2 (pg/L)	1.3-2 (pg/L)	1.3-2 (pg/L)	2-2.6 (pg/L)	2-2.6 (pg/L)	2-2.6 (pg/L)	3-3.1 (pg/L)
Reqn_No	23478P5CDF	H6CDF	123478H6CDF	123678H6CDF	234678H6CDF	123789H6CDF	H7CDF	1234678H7CDF	1234789H7CDF	O8CDF
COUNT	2	2	2	2	2	2	2	2	2	2
MEAN	1.1500	1.6500	1.6500	1.6500	1.6500	1.6500	2.3000	2.3000	2.3000	3.0500
MEDIAN	1.1500	1.6500	1.6500	1.6500	1.6500	1.6500	2.3000	2.3000	2.3000	3.0500
MAX	1.8000	2.0000	2.0000	2.0000	2.0000	2.0000	2.6000	2.6000	2.6000	3.1000
MIN	0.5000	1.3000	1.3000	1.3000	1.3000	1.3000	2.0000	2.0000	2.0000	3.0000
RANGE	1.3000	0.7000	0.7000	0.7000	0.7000	0.7000	0.6000	0.6000	0.6000	0.1000
90th PERCENTILE	1.8000	2.0000	2.0000	2.0000	2.0000	2.0000	2.6000	2.6000	2.6000	3.1000
STD	0.9192	0.4950	0.4950	0.4950	0.4950	0.4950	0.4243	0.4243	0.4243	0.0707
90% CL	4.1041	2.2099	2.2099	2.2099	2.2099	2.2099	1.8942	1.8942	1.8942	0.3157

ross

Parameter	MDC (deg C)	(ppm)	(pH units)	(Col. Unit)	(TAC)	(SWU)	(uS/cm)	(mg/L)	(mg/L)	(NTU)	(mg/L)	(mg/L)	(mg/L)
Reqn_No	Temp	Diss_O	pH	Color_True	Color_TAC	Color_SW_Diss	Spec_Cond	Res_Nonfilt	Res_Filt_1_Ou	Turbidity	Alk_Phen_8_3	Alk_Total_4_5	Hard_Total
COUNT	3	3	3	3	3	3	2	2	2	2	3	3	0
MEAN	6.4	11.9	7.8	5.0000	3.3333	5.3333	134.5000	1.0000	96.0000	0.3000	0.5000	57.3000	ERR
MEDIAN	6.3	11.9	7.6	5.00	3.0000	5.0000	134.5000	1.0000	96.0000	0.3000	0.5000	57.7000	ERR
MAX	7.0	12.0	8.2	5.0000	5.0000	6.0000	137.0000	1.0000	102.0000	0.3000	0.5000	58.7000	ERR
MIN	6.0	11.8	7.5	5.0000	2.0000	5.0000	132.0000	1.0000	90.0000	0.3000	0.5000	55.5000	ERR
RANGE	1.0	0.2	0.7	0.0000	3.0000	1.0000	5.0000	0.0000	12.0000	0.0000	0.0000	3.2000	ERR
90th PERCENTILE	7.0	12.0	8.2	5.00	5.0000	6.0000	137.0000	1.0000	102.0000	0.3000	0.5000	58.7000	ERR
STD	0.5132	0.1000	0.3786	0.0000	1.5275	0.5774	3.5355	0.0000	8.4853	0.0000	0.0000	1.6371	ERR
90% CL	0.8651	0.1686	0.6383	0.0000	2.5752	0.9733	15.7850	0.0000	37.8840	0.0000	0.0000	2.7599	ERR

ross

Reqn_No	Coliform_Fecal (CFU)	E_Coli	Enterococcus	Chlorate (mg/L)	Fluoride_Diss (mg/L)	Silica_React_Diss (mg/L)	Sulfate_Diss (mg/L)	K_Diss (mg/L)	N_Org_Total (mg/L)	N_Kjel_Total (mg/L)	N_Total 0.02 (mg/L)	N_Amm_Diss 0.005 (mg/L)
COUNT	3	3	3	0	3	2	2	2	3	3	3	3
MEAN	8.3333	9.0000	1.6667	ERR	0.1333	4.6000	10.2500	0.6000	0.1167	0.1833	0.2900	0.0683
MEDIAN	8.0000	9.0000	2.0000	ERR	0.1000	4.6000	10.2500	0.6000	0.0600	0.2200	0.3300	0.0210
MAX	14.0000	17.0000	2.0000	ERR	0.2000	4.7000	10.3000	0.6000	0.2500	0.2700	0.3700	0.1630
MIN	3.0000	1.0000	1.0000	ERR	0.1000	4.5000	10.2000	0.6000	0.0400	0.0600	0.1700	0.0210
RANGE	11.0000	16.0000	1.0000	ERR	0.1000	0.2000	0.1000	0.0000	0.2100	0.2100	0.2000	0.1420
90th PERCENTILE	14.0000	17.0000	2.0000	ERR	0.2000	4.7000	10.3000	0.6000	0.2500	0.2700	0.3700	0.1630
STD	5.5076	8.0000	0.5774	ERR	0.0577	0.1414	0.0707	0.0000	0.1159	0.1097	0.1058	0.0820
90% CL	9.2850	13.4869	0.9733	ERR	0.0973	0.6314	0.3157	0.0000	0.1954	0.1849	0.1784	0.1382

ross

Reqn_No	N_NO3_NO2_Diss	P_Ortho_Diss	P_Total	P_Total_Diss	Total_Org_C	Total_Inorg_C	C_Total	Na_Diss	Cl_Diss
	0.005 (mg/L)	0.002 (mg/L)	0.002 (mg/L)	0.002 (mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
COUNT	3	2	2	2	0	0	0	2	3
MEAN	0.1067	0.0155	0.0210	0.0160	ERR	ERR	ERR	1.7000	1.1667
MEDIAN	0.1100	0.0155	0.0210	0.0160	ERR	ERR	ERR	1.7000	1.1000
MAX	0.1100	0.0280	0.0350	0.0290	ERR	ERR	ERR	1.7000	1.4000
MIN	0.1000	0.0030	0.0070	0.0030	ERR	ERR	ERR	1.7000	1.0000
RANGE	0.0100	0.0250	0.0280	0.0260	ERR	ERR	ERR	0.0000	0.4000
90th PERCENTILE	0.1100	0.0280	0.0350	0.0290	ERR	ERR	ERR	1.7000	1.4000
STD	0.0058	0.0177	0.0198	0.0184	ERR	ERR	ERR	0.0000	0.2082
90% CL	0.0097	0.0789	0.0884	0.0821	ERR	ERR	ERR	0.0000	0.3509

/est Trail)

Parameter													
	MDC			5		5		1			0.5		
	(deg C)	(ppm)	(pH units)	(Col. Unit)	(TAC)	(SWU)	(uS/cm)	(mg/L)	(mg/L)	(NTU)	(mg/L)	(mg/L)	(mg/L)
Reqn_No	Temp	Diss_O	pH	Color_True	Color_TAC	Color_SW_Diss	Spec_Cond	Res_Nonfilt	Res_Filt_1_Ou	Turbidity	Alk_Phen_8_3	Alk_Total_4_5	Hard_Total
COUNT	16	15	16	16	16	16	16	16	16	16	16	16	15
MEAN	11.0	11.0	7.8	5.0000	3.0000	5.4375	132.0000	2.1250	84.8750	0.5500	0.5000	54.1875	63.3667
MEDIAN	10.9	11.4	7.8	5.0000	3.0000	5.0000	131.5000	2.0000	82.0000	0.5000	0.5000	54.9500	64.7000
MAX	18.5	12.4	8.7	5.0000	5.0000	8.0000	147.0000	4.0000	100.0000	1.1000	0.5000	62.5000	76.2000
MIN	4.1	9.4	7.3	5.0000	1.0000	5.0000	116.0000	1.0000	72.0000	0.3000	0.5000	46.3000	53.9000
RANGE	14.4	3.0	1.4	0.0000	4.0000	3.0000	31.0000	3.0000	28.0000	0.8000	0.0000	16.2000	22.3000
90th PERCENTILE	16.9	12.4	8.3	5.0000	4.0000	6.0000	142.0000	4.0000	92.0000	0.8000	0.5000	58.1000	74.6000
STD	4.8941	1.0999	0.3987	0.0000	0.9661	0.8921	8.5557	1.1475	7.2284	0.2394	0.0000	4.0558	7.1344
90% CL	2.1448	0.5001	0.1747	0.0000	0.4234	0.3910	3.7495	0.5029	3.1679	0.1049	0.0000	1.7774	3.2439

West Trail)

Reqn_No	Coliform_Fecal	E_Coli	Enterococcus	Chlorate	Fluoride_Diss	Silica_React_Diss	Sulfate_Diss	Al_Total	As_Total	Ba_Total	Ca_Total	Cd_Total	Co_Total	Cr_Total
	2 (CFU)	2	2	0.1 (mg/L)	0.1 (mg/L)	(mg/L)	(mg/L)	0.02 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.01 (mg/L)	0.0005 (mg/L)	0.003 (mg/L)	0.002 (mg/L)
COUNT	16	14	14	0	16	16	16	16	16	16	16	16	16	16
MEAN	16.3125	15.2857	4.8571	ERR	0.1488	3.6250	11.8750	0.0440	0.0010	0.0209	18.7894	0.0007	0.0030	0.0031
MEDIAN	14.5000	15.5000	3.5000	ERR	0.1300	3.7500	10.8000	0.0500	0.0010	0.0205	18.6500	0.0005	0.0030	0.0025
MAX	33.0000	30.0000	21.0000	ERR	0.2600	5.1000	23.0000	0.0650	0.0010	0.0290	23.6000	0.0017	0.0030	0.0110
MIN	1.0000	1.0000	1.0000	ERR	0.1000	0.5000	8.9000	0.0200	0.0010	0.0160	16.0000	0.0005	0.0030	0.0020
RANGE	32.0000	29.0000	20.0000	ERR	0.1600	4.6000	14.1000	0.0450	0.0000	0.0130	7.6000	0.0012	0.0000	0.0090
90th PERCENTILE	26.0000	30.0000	7.0000	ERR	0.2000	4.6000	14.6000	0.0600	0.0010	0.0250	20.5000	0.0008	0.0030	0.0040
STD	10.5117	10.2689	5.0208	ERR	0.0539	1.0586	3.4457	0.0155	0.0000	0.0036	2.1514	0.0003	0.0000	0.0022
90% CL	4.6068	4.8605	2.3765	ERR	0.0236	0.4639	1.5101	0.0068	0.0000	0.0016	0.9429	0.0001	0.0000	0.0010

/est Trail)

Reqn_No	Cu_Total	Fe_Total	Mg_Total	Mn_Total	Hg_Total	Mo_Total	Ni_Total	Pb_Total	Tl_Total	V_Total	Zn_Total	K_Diss	N_Org_Total	N_Kjel_Total	N_Total	N_Amm_Diss
	0.001 (mg/L)	0.003 (mg/L)	0.02 (mg/L)	0.002 (mg/L)	0.00005 (mg/L)	0.004 (mg/L)	0.008 (mg/L)	0.001 (mg/L)	0.003 (mg/L)	0.003 (mg/L)	0.002 (mg/L)	0.1 (mg/L)	0.04 (mg/L)	0.04 (mg/L)	0.02 (mg/L)	0.005 (mg/L)
COUNT	16	16	16	16	11	16	16	16	15	16	16	16	15	16	16	16
MEAN	0.0028	0.0814	3.9706	0.0055	0.00006	0.0040	0.0081	0.0108	0.0034	0.0030	0.0295	0.6250	0.0907	0.1669	0.2650	0.0819
MEDIAN	0.0025	0.0585	4.0600	0.0050	0.00005	0.0040	0.0080	0.0100	0.0030	0.0030	0.0270	0.6000	0.0900	0.1500	0.2400	0.0605
MAX	0.0070	0.2370	4.9600	0.0110	0.00012	0.0040	0.0090	0.0310	0.0060	0.0030	0.0830	0.7000	0.1700	0.4000	0.5300	0.2270
MIN	0.0010	0.0320	3.2200	0.0020	0.00005	0.0040	0.0080	0.0010	0.0030	0.0030	0.0050	0.6000	0.0300	0.0600	0.1600	0.0070
RANGE	0.0060	0.2050	1.7400	0.0090	0.00007	0.0000	0.0010	0.0300	0.0030	0.0000	0.0780	0.1000	0.1400	0.3400	0.3700	0.2200
90th PERCENTILE	0.0030	0.1310	4.3700	0.0080	0.00008	0.0040	0.0080	0.0170	0.0050	0.0030	0.0430	0.7000	0.1500	0.2400	0.3400	0.1440
STD	0.0017	0.0574	0.4777	0.0025	0.00002	0.0000	0.0003	0.0073	0.0009	0.0000	0.0187	0.0447	0.0415	0.0858	0.1014	0.0697
90% CL	0.0007	0.0252	0.2094	0.0011	0.00001	0.0000	0.0001	0.0032	0.0004	0.0000	0.0082	0.0196	0.0189	0.0376	0.0444	0.0305

st Trail)

Reqn_No	N_NO3_NO2_Diss	P_Ortho_Diss	P_Total	P_Total_Diss	Total_Org_C	Total_Inorg_C	C_Total	Na_Diss	Cl_Diss
	0.005 (mg/L)	0.002 (mg/L)	0.003 (mg/L)	0.003 (mg/L)	1 (mg/L)	(mg/L)	(mg/L)	0.5 (mg/L)	0.5 (mg/L)
COUNT	16	16	15	16	0	0	0	16	16
MEAN	0.0981	0.0519	0.0654	0.0541	ERR	ERR	ERR	1.4750	0.8563
MEDIAN	0.0900	0.0150	0.0270	0.0150	ERR	ERR	ERR	1.4000	0.9000
MAX	0.1400	0.3110	0.3430	0.3240	ERR	ERR	ERR	2.0000	1.3000
MIN	0.0600	0.0030	0.0050	0.0030	ERR	ERR	ERR	1.0000	0.5000
RANGE	0.0800	0.3080	0.3380	0.3210	ERR	ERR	ERR	1.0000	0.8000
90th PERCENTILE	0.1300	0.0800	0.1900	0.0870	ERR	ERR	ERR	1.9000	1.1000
STD	0.0256	0.0815	0.0908	0.0850	ERR	ERR	ERR	0.2978	0.2366
90% CL	0.0112	0.0357	0.0413	0.0373	ERR	ERR	ERR	0.1305	0.1037

East Trail)

Parameter	Temp	Diss_O	pH	Color_True	Color_TAC	Color_SW_Diss	Spec_Cond	Res_Nonfilt	Res_Filt_1_Ou	Turbidity	Alk_Phen_8_3	Alk_Total_4_5
MDC	(deg C)	(ppm)	(pH units)	5 (Col. Unit)	(TAC)	5 (SWU)	(uS/cm)	1 (mg/L)	(mg/L)	(NTU)	0.5 (mg/L)	(mg/L)
Reqn_No												
COUNT	16	15	16	16	16	16	16	16	16	16	16	16
MEAN	11.1	11.0	7.9	5.0000	2.7500	5.1875	128.5000	1.6875	83.4375	0.4750	0.5000	54.9813
MEDIAN	11.3	11.3	8.1	5.0000	2.5000	5.0000	130.0000	1.0000	84.0000	0.5000	0.5000	55.1000
MAX	18.5	12.8	8.7	5.0000	4.0000	7.0000	147.0000	4.0000	120.0000	0.8000	0.5000	63.0000
MIN	4.3	9.3	7.1	5.0000	2.0000	5.0000	110.0000	1.0000	70.0000	0.2000	0.5000	47.9000
RANGE	14.2	3.5	1.6	0.0000	2.0000	2.0000	37.0000	3.0000	50.0000	0.6000	0.0000	15.1000
90th PERCENTILE	16.8	12.2	8.3	5.0000	4.0000	5.0000	139.0000	2.0000	84.0000	0.6000	0.5000	58.7000
STD	4.8857	1.1745	0.4573	0.0000	0.8563	0.5439	10.5956	1.0145	10.7453	0.1528	0.0000	3.9022
90% CL	2.1412	0.5340	0.2004	0.0000	0.3753	0.2384	4.6435	0.4446	4.7091	0.0669	0.0000	1.7101

East Trail)

Reqn_No	Hard_Total	Coliform_Fecal	E_Coli	Enterococcus	Chlorate	Fluoride_Diss	Silica_React_Diss	Sulfate_Diss	Al_Total	As_Total	Ba_Total	Ca_Total	Cd_Total
	(mg/L)	2 (CFU)	2	2	0.1 (mg/L)	0.1 (mg/L)	(mg/L)	(mg/L)	0.02 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.01 (mg/L)	0.0005 (mg/L)
COUNT	15	16	14	14	0	16	16	16	16	16	16	16	16
MEAN	61.3400	4.8125	5.0000	2.4286	ERR	0.1019	3.5625	9.5000	0.0393	0.0010	0.0181	17.8725	0.0005
MEDIAN	63.6000	2.0000	2.0000	2.0000	ERR	0.1000	3.7000	9.3000	0.0405	0.0010	0.0180	18.0000	0.0005
MAX	73.7000	22.0000	16.0000	8.0000	ERR	0.1300	5.1000	11.6000	0.0640	0.0010	0.0220	21.4000	0.0005
MIN	48.8000	1.0000	1.0000	1.0000	ERR	0.1000	0.5000	7.7000	0.0200	0.0010	0.0150	14.2000	0.0005
RANGE	24.9000	21.0000	15.0000	7.0000	ERR	0.0300	4.6000	3.9000	0.0440	0.0000	0.0070	7.2000	0.0000
90th PERCENTILE	69.3000	11.0000	14.0000	5.0000	ERR	0.1000	4.5000	10.7000	0.0500	0.0010	0.0200	20.3000	0.0005
STD	7.4441	5.7413	5.1739	1.8694	ERR	0.0075	1.0844	1.0777	0.0131	0.0000	0.0021	2.1370	0.0000
90% CL	3.3847	2.5161	2.4489	0.8848	ERR	0.0033	0.4752	0.4723	0.0058	0.0000	0.0009	0.9366	0.0000

East Trail)

Reqn_No	Co_Total	Cr_Total	Cu_Total	Fe_Total	Mg_Total	Mn_Total	Hg_Total	Mo_Total	Ni_Total	Pb_Total	Tl_Total	V_Total	Zn_Total	K_Diss	N_Org_Total	N_Kjel_Total
	0.003 (mg/L)	0.002 (mg/L)	0.001 (mg/L)	0.003 (mg/L)	0.02 (mg/L)	0.002 (mg/L)	0.00005 (mg/L)	0.004 (mg/L)	0.008 (mg/L)	0.001 (mg/L)	0.003 (mg/L)	0.003 (mg/L)	0.002 (mg/L)	0.1 (mg/L)	0.04 (mg/L)	0.04 (mg/L)
COUNT	16	16	16	16	16	16	11	16	16	16	15	16	16	16	16	16
MEAN	0.0030	0.0029	0.0014	0.0299	3.9219	0.0026	0.00006	0.0040	0.0080	0.0018	0.0035	0.0030	0.0093	0.6063	0.0719	0.0800
MEDIAN	0.0030	0.0020	0.0010	0.0345	4.0750	0.0020	0.00005	0.0040	0.0080	0.0010	0.0030	0.0030	0.0070	0.6000	0.0550	0.0600
MAX	0.0030	0.0100	0.0030	0.0450	4.9300	0.0050	0.00009	0.0040	0.0080	0.0050	0.0090	0.0030	0.0260	0.7000	0.1400	0.1900
MIN	0.0030	0.0020	0.0010	0.0100	3.2000	0.0020	0.00005	0.0040	0.0080	0.0010	0.0030	0.0030	0.0020	0.5000	0.0400	0.0400
RANGE	0.0000	0.0080	0.0020	0.0350	1.7300	0.0030	0.00004	0.0000	0.0000	0.0040	0.0060	0.0000	0.0240	0.2000	0.1000	0.1500
90th PERCENTILE	0.0030	0.0030	0.0020	0.0410	4.3900	0.0030	0.00008	0.0040	0.0080	0.0030	0.0050	0.0030	0.0130	0.6000	0.1300	0.1400
STD	0.0000	0.0020	0.0006	0.0109	0.5228	0.0009	0.00001	0.0000	0.0000	0.0012	0.0016	0.0000	0.0072	0.0443	0.0382	0.0450
90% CL	0.0000	0.0009	0.0003	0.0048	0.2291	0.0004	0.00001	0.0000	0.0000	0.0005	0.0007	0.0000	0.0031	0.0194	0.0167	0.0197

East Trail)

Reqn_No	N_Total	N_Amm_Diss	N_NO3_NO2_Diss	P_Ortho_Diss	P_Total	P_Total_Diss	Total_Org_C	Total_Inorg_C	C_Total	Na_Diss	Cl_Diss
	0.02 (mg/L)	0.005 (mg/L)	0.005 (mg/L)	0.002 (mg/L)	0.003 (mg/L)	0.003 (mg/L)	1 (mg/L)	(mg/L)	(mg/L)	0.5 (mg/L)	0.5 (mg/L)
COUNT	16	16	16	16	15	16	0	0	0	15	15
MEAN	0.1756	0.0103	0.0956	0.0030	0.0050	0.0034	ERR	ERR	ERR	1.3067	0.7933
MEDIAN	0.1600	0.0065	0.0900	0.0030	0.0040	0.0030	ERR	ERR	ERR	1.3000	0.8000
MAX	0.3200	0.0510	0.1400	0.0030	0.0150	0.0100	ERR	ERR	ERR	1.7000	1.2000
MIN	0.1100	0.0050	0.0600	0.0030	0.0030	0.0030	ERR	ERR	ERR	0.9000	0.5000
RANGE	0.2100	0.0460	0.0800	0.0000	0.0120	0.0070	ERR	ERR	ERR	0.8000	0.7000
90th PERCENTILE	0.2300	0.0110	0.1300	0.0030	0.0100	0.0030	ERR	ERR	ERR	1.6000	1.0000
STD	0.0549	0.0117	0.0256	0.0000	0.0033	0.0018	ERR	ERR	ERR	0.2120	0.1907
90% CL	0.0241	0.0051	0.0112	0.0000	0.0015	0.0008	ERR	ERR	ERR	0.0964	0.0867

Reqn_No	Temp_W	Temp_A	Diss_O	pH	Color_True	Color_TAC	Color_SW_Diss	Spec_Cond	Res_Nonfilt	Res_Filt_1_Ou	Turbidity	Alk_Phen_8_3
Parameter												
MDC					5	1	5		1			0.5
	(deg C)		(ppm)	(pH units)	(Col. Unit)	(TAC)	(SWU)	(uS/cm)	(mg/L)	(mg/L)	(NTU)	(mg/L)
COUNT	94	54	40	131	45	140	112	133	107	45	84	49
MEAN	10.6	11.9	11.1	7.9	5.0000	3.4786	5.4643	130.1729	1.7196	79.5333	0.8512	0.5000
MEDIAN	10.3	11.8	11.5	7.9	5.0000	3.0000	5.0000	131.0000	1.0000	80.0000	0.5000	0.5000
MAX	18.4	28.0	12.9	8.5	5.0000	10.0000	9.0000	149.0000	6.0000	96.0000	5.0000	0.5000
MIN	4.3	0.0	9.1	7.1	5.0000	1.0000	5.0000	109.0000	1.0000	62.0000	0.0000	0.5000
RANGE	14.1	28.0	3.8	1.4	0.0000	9.0000	4.0000	40.0000	5.0000	34.0000	5.0000	0.0000
90th PERCENTILE	16.8	22.0	12.4	8.2	5.0000	5.0000	7.0000	143.0000	4.0000	86.0000	1.5000	0.5000
STD	4.3044	7.6035	1.1100	0.2780	0.0000	1.2834	0.8997	10.1880	1.0532	6.6661	1.0639	0.0000
90% CL	0.7419	1.7424	0.2978	0.0412	0.0000	0.1841	0.1421	1.4992	0.1701	1.6734	0.1940	0.0000

Reqn_No	Alk_Total_4_5	Hard_Total	Coliform_Fecal	E_Coli	Enterococcus	Chlorate	Fluoride_Diss	Silica_React_Diss	Sulfate_Diss	AOX	Abietic_Acid
	(mg/L)	(mg/L)	2 (CFU)	2	2	0.1 (mg/L)	0.1 (mg/L)	(mg/L)	(mg/L)	0.1 (mg/L)	0.001 (mg/L)
COUNT	103	99	71	24	24	30	93	45	99	29	29
MEAN	53.1893	60.6717	9.9859	9.6250	4.3333	0.0217	0.1143	3.5422	9.7101	0.0148	0.0008
MEDIAN	53.7000	60.4000	5.0000	3.0000	2.0000	0.0100	0.1000	3.9000	9.9000	0.0100	0.0010
MAX	62.7000	75.0000	48.0000	47.0000	22.0000	0.1000	0.6000	5.1000	12.7000	0.0300	0.0010
MIN	43.0000	48.8000	1.0000	1.0000	1.0000	0.0100	0.0600	0.5000	6.1000	0.0100	0.0005
RANGE	19.7000	26.2000	47.0000	46.0000	21.0000	0.0900	0.5400	4.6000	6.6000	0.0200	0.0005
90th PERCENTILE	58.2000	67.0000	28.0000	31.0000	11.0000	0.0300	0.1500	4.6000	11.1000	0.0300	0.0010
STD	4.0228	5.6069	11.6146	13.3769	4.9490	0.0180	0.0577	1.1600	1.2871	0.0074	0.0003
90% CL	0.6623	0.9416	2.3033	4.6801	1.7315	0.0056	0.0100	0.2912	0.2182	0.0023	0.0001

Reqn_No	Chlorodehydroabietic_Acid	Dehydroabietic_Acid	Dichlorodehydroabietic_Acid	Isopimaric_Acid	Levo_Pimaric_Acid	Neoabietic_Acid	Pimaric_Acid	Palustric_Acid
	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)
COUNT	28	29	28	29	29	29	29	28
MEAN	0.0008	0.0008	0.0008	0.0009	0.0008	0.0008	0.0008	0.0008
MEDIAN	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
MAX	0.0010	0.0010	0.0010	0.0030	0.0010	0.0010	0.0010	0.0030
MIN	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
RANGE	0.0005	0.0005	0.0005	0.0025	0.0005	0.0005	0.0005	0.0025
90th PERCENTILE	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
STD	0.0003	0.0003	0.0003	0.0005	0.0003	0.0003	0.0003	0.0005
90% CL	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001	0.0001	0.0002

Reqn_No	Sandaraco_Pim_Acid	Arachidic_Acid	Behenic_Acid	Lauric_Acid	Lignoceric_Acid	Linolenic_Acid	Linoleic_Acid	Myristic_Acid	Oleic_Acid	Palmitric_Acid
	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)	0.001 (mg/L)
COUNT	29	28	28	28	28	28	28	27	28	29
MEAN	0.0008	0.0008	0.0008	0.0089	0.0026	0.0008	0.0008	0.0056	0.0026	0.0075
MEDIAN	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
MAX	0.0010	0.0010	0.0010	0.1100	0.0400	0.0010	0.0010	0.0880	0.0280	0.0800
MIN	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
RANGE	0.0005	0.0005	0.0005	0.1095	0.0395	0.0005	0.0005	0.0875	0.0275	0.0795
90th PERCENTILE	0.0010	0.0010	0.0010	0.0270	0.0010	0.0010	0.0010	0.0060	0.0010	0.0150
STD	0.0003	0.0003	0.0003	0.0220	0.0076	0.0003	0.0003	0.0167	0.0059	0.0171
90% CL	0.0001	0.0001	0.0001	0.0071	0.0024	0.0001	0.0001	0.0055	0.0019	0.0054

	0.001	0.02	0.001	0.001	0.05	0.01	0.0005	0.003	0.002	0.0002	0.001	0.003		0.02	0.002	
	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(ug/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(ug/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(ug/L)
Reqn_No	Stearic_Acid	Al_Total	As_Total	Ba_Total	Be_Total	Ca_Total	Cd_Total	Co_Total	Cr_Total	Cr_Total_1	Cu_Total	Fe_Total	Li_Total	Mg_Total	Mn_Total	Mn_Total_
COUNT	28	95	93	95	80	97	95	95	45	50	95	95	50	98	45	50
MEAN	0.0030	0.0411	0.0007	0.0197	0.0319	18.0061	0.0003	0.0015	0.0023	0.0005	0.0025	0.0470	0.0013	3.8594	0.0032	0.0030
MEDIAN	0.0010	0.0400	0.0006	0.0200	0.0500	17.8000	0.0003	0.0002	0.0020	0.0002	0.0020	0.0383	0.00120	3.8650	0.0030	0.0028
MAX	0.0500	0.1650	0.0044	0.0370	0.0700	21.9000	0.0020	0.0040	0.0040	0.0042	0.0205	0.2220	0.0018	4.9300	0.0100	0.0060
MIN	0.0005	0.0160	0.0001	0.0160	0.0010	14.8000	0.0001	0.0001	0.0020	0.0002	0.0010	0.0160	0.0010	2.8000	0.0020	0.0019
RANGE	0.0495	0.1490	0.0043	0.0210	0.0690	7.1000	0.0019	0.0039	0.0020	0.0040	0.0195	0.2060	0.0008	2.1300	0.0080	0.0041
90th PERCENTILE	0.0020	0.0670	0.0010	0.0214	0.0500	20.0000	0.0005	0.0030	0.0040	0.0011	0.0030	0.0730	0.00150	4.4000	0.0040	0.0041
STD	0.0095	0.0242	0.0005	0.0026	0.0242	1.5925	0.0003	0.0015	0.0007	0.0009	0.0022	0.0304	0.0002	0.4585	0.0013	0.0009
90% CL	0.0030	0.0042	0.0001	0.0005	0.0045	0.2702	0.0000	0.0003	0.0002	0.0002	0.0004	0.0052	0.0000	0.0774	0.0003	0.0002

	0.00005	0.004	0.008	0.001				0.003	0.003	0.002	0.1			0.02	0.005
	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(ug/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Reqn_No	Hg_Total	Mo_Total	Ni_Total	Pb_Total	Se_Total	Si_Total	Sr_Total	Tl_Total	V_Total	Zn_Total	K_Diss	N_Org_Total	N_Kjel_Total	N_Total	N_Amm_Diss
COUNT	95	95	95	95	79	83	80	45	95	95	99	43	43	188	112
MEAN	0.000027	0.0022	0.0040	0.0027	0.0115	1.9304	0.1070	0.0042	0.0015	0.0095	0.5774	0.0753	0.0928	0.1859	0.0215
MEDIAN	0.000011	0.0006	0.0008	0.0020	0.0001	1.9400	0.1080	0.0030	0.0003	0.0079	0.6000	0.0600	0.0800	0.1700	0.0155
MAX	0.000139	0.0040	0.0090	0.0200	0.0300	3.8200	0.1180	0.0160	0.0050	0.0460	0.8000	0.2900	0.3400	0.7100	0.1010
MIN	0.000005	0.0004	0.0002	0.0003	0.0001	1.2900	0.0860	0.0030	0.0001	0.0020	0.4700	0.0300	0.0400	0.0800	0.0050
RANGE	0.000134	0.0036	0.0088	0.0197	0.0299	2.5300	0.0320	0.0130	0.0049	0.0440	0.3300	0.2600	0.3000	0.6300	0.0960
90th PERCENTILE	0.000050	0.0040	0.0080	0.0050	0.0300	2.3700	0.1160	0.0070	0.0030	0.0160	0.7000	0.1300	0.1500	0.2600	0.0460
STD	0.000029	0.0018	0.0039	0.0024	0.0146	0.3649	0.0071	0.0027	0.0015	0.0062	0.0690	0.0480	0.0575	0.0693	0.0176
90% CL	0.000005	0.0003	0.0007	0.0004	0.0027	0.0669	0.0013	0.0007	0.0002	0.0011	0.0116	0.0123	0.0148	0.0086	0.0028

Reqn_No	N_NO3_NO2_Diss	P_Ortho_Diss	P_Total	P_Total_Diss	Total_Org_C	Total_Inorg_C	C_Total	Na_Diss	Cl_Diss	Resin_Acid	Phenols	Chloroform
	0.005 (mg/L)	0.003 (mg/L)	0.003 (mg/L)	0.003 (mg/L)	1 (mg/L)	(mg/L)	(mg/L)	0.5 (mg/L)	(mg/L)	0.001 (mg/L)	0.002 (mg/L)	0.0005 (mg/L)
COUNT	206	113	203	113	31	31	31	96	98	7	17	3
MEAN	0.1230	0.0087	0.0181	0.0099	2.4194	12.6774	13.9355	1.3042	0.7541	0.0006	0.0028	0.0008
MEDIAN	0.1115	0.0030	0.0130	0.0040	3.0000	12.0000	14.0000	1.3000	0.8000	0.0005	0.0020	0.0010
MAX	0.6680	0.0770	0.0890	0.0810	4.0000	15.0000	17.0000	2.0000	1.3000	0.0010	0.0090	0.0010
MIN	0.0360	0.0030	0.0040	0.0030	1.0000	9.0000	11.0000	0.9000	0.3000	0.0005	0.0020	0.0005
RANGE	0.6320	0.0740	0.0850	0.0780	3.0000	6.0000	6.0000	1.1000	1.0000	0.0005	0.0070	0.0005
90th PERCENTILE	0.1800	0.0180	0.0330	0.0190	3.0000	15.0000	15.0000	1.6000	1.0000	0.0005	0.0030	0.0010
STD	0.0636	0.0105	0.0150	0.0127	0.9228	1.5575	1.3647	0.2348	0.2052	0.0002	0.0020	0.0003
90% CL	0.0075	0.0016	0.0018	0.0020	0.2813	0.4747	0.4159	0.0400	0.0346	0.0001	0.0009	0.0005

Reqn_No	4_Chlorophenol	26_DCP	24_25_DCP	35_DCP	23_DCP	34_DCP	246_TCP	236_TCP	235_TCP	245_TCP	234_TCP	345_TCP
	0.2-2.4 (ng/L)	0.2-1.8 (ng/L)	0.2-4 (ng/L)	0.2-1.4 (ng/L)	0.2-1.5 (ng/L)	0.1-1 (ng/L)	0.2-13 (ng/L)	0.2-1.4 (ng/L)	0.1-0.9 (ng/L)	0.1-0.8 (ng/L)	0.1-1.1 (ng/L)	0.1-0.9 (ng/L)
COUNT	16	16	16	16	16	16	16	16	16	16	16	16
MEAN	0.8625	0.6438	1.3250	0.4438	0.5125	0.3688	4.8500	0.4938	0.3562	0.2813	0.3938	0.3063
MEDIAN	0.5500	0.6000	0.7500	0.3500	0.5000	0.3000	5.0500	0.4500	0.3000	0.2500	0.3500	0.2000
MAX	2.4000	1.8000	4.0000	1.4000	1.5000	1.0000	13.0000	1.4000	0.9000	0.8000	1.1000	0.9000
MIN	0.2000	0.2000	0.2000	0.2000	0.2000	0.1000	0.2000	0.2000	0.1000	0.1000	0.1000	0.1000
RANGE	2.2000	1.6000	3.8000	1.2000	1.3000	0.9000	12.8000	1.2000	0.8000	0.7000	1.0000	0.8000
90th PERCENTILE	1.7000	0.8000	2.4000	0.8000	0.8000	0.6000	7.0000	0.7000	0.6000	0.4000	0.5000	0.5000
STD	0.6632	0.4546	1.1060	0.3306	0.3481	0.2600	3.1843	0.3276	0.2159	0.2040	0.2620	0.2351
90% CL	0.2906	0.1992	0.4847	0.1449	0.1526	0.1140	1.3955	0.1436	0.0946	0.0894	0.1148	0.1031

	0.1-1 (ng/L)	0.2-1.1 (ng/L)	0.08-0.6 (ng/L)	0.2-0.6 (ng/L)	0.6-5 (ng/L)	1-6.8 (ng/L)	0.8-10 (ng/L)	0.2-1.8 (ng/L)
Reqn_No	2356_TetraCP	2346_TetraCP	2345_TetraCP	Pentachlorophenol	6_chloroguaiacol	4_chloroguaiacol	5_chloroguaiacol	34_DCguaiacol
COUNT	16	16	16	16	16	16	16	16
MEAN	0.4375	0.5750	0.2613	0.4563	2.3563	3.3000	3.2250	0.7688
MEDIAN	0.4000	0.5000	0.2500	0.5000	2.2000	3.2500	3.0000	0.6000
MAX	1.0000	1.1000	0.6000	1.2000	5.0000	6.8000	10.0000	1.8000
MIN	0.1000	0.2000	0.0800	0.2000	0.6000	1.0000	0.8000	0.2000
RANGE	0.9000	0.9000	0.5200	1.0000	4.4000	5.8000	9.2000	1.6000
90th PERCENTILE	0.6000	0.9000	0.4000	0.6000	4.1000	5.0000	5.0000	1.4000
STD	0.2277	0.2569	0.1559	0.2529	1.4269	1.7713	2.3445	0.4936
90% CL	0.0998	0.1126	0.0683	0.1108	0.6253	0.7763	1.0275	0.2163

	0.3-8 (ng/L)	0.2-3.3 (ng/L)	0.1-24 (ng/L)	0.09-4.4 (ng/L)	0.1-9 (ng/L)	0.2-10 (ng/L)	1-20 (ng/L)	0.2-10 (ng/L)
Reqn_No	46_DCgualacol	45_DCgualacol	345_TCgualacol	456_TCgualacol	3456_TCgualacol	3_chlorocatechol	4_chlorocatechol	34_DCcatechol
COUNT	16	16	16	16	16	15	14	16
MEAN	2.4125	1.1313	5.6687	1.2556	1.7313	5.2267	7.7714	1.5875
MEDIAN	1.4000	0.8500	4.2000	1.0000	1.0000	5.0000	7.5000	0.7000
MAX	8.0000	3.3000	24.0000	4.4000	9.0000	10.0000	20.0000	10.0000
MIN	0.3000	0.2000	0.1000	0.0900	0.1000	0.2000	1.0000	0.2000
RANGE	7.7000	3.1000	23.9000	4.3100	8.9000	9.8000	19.0000	9.8000
90th PERCENTILE	4.8000	2.0000	10.0000	2.5000	2.7000	10.0000	10.0000	2.0000
STD	2.3860	0.9221	6.1762	1.1951	2.1639	3.8670	4.7093	2.6533
90% CL	1.0457	0.4041	2.7067	0.5237	0.9483	1.7583	2.2290	1.1628

	0.2-10 (ng/L)	0.2-10 (ng/L)	0.2-10 (ng/L)	0.08-10 (ng/L)	0.06-10 (ng/L)	0.5-4.8 (ng/L)	0.1-5.5 (ng/L)	0.3-5.5 (ng/L)
Reqn_No	36_DCcatechol	35_DCcatechol	45_DCcatechol	345_TCcatechol	3456_TCcatechol	45_DCveratrole	346_TCveratrole	345_TCveratrole
COUNT	16	16	16	16	16	16	16	16
MEAN	1.5812	4.2000	4.6250	2.1550	4.5225	2.0375	0.7875	1.1563
MEDIAN	0.7000	3.3000	5.0000	0.6000	5.0000	1.2500	0.4000	0.8500
MAX	10.0000	10.0000	10.0000	10.0000	10.0000	5.4000	5.5000	5.5000
MIN	0.2000	0.2000	0.2000	0.0800	0.0600	0.5000	0.1000	0.3000
RANGE	9.8000	9.8000	9.8000	9.9200	9.9400	4.9000	5.4000	5.2000
90th PERCENTILE	2.0000	10.0000	10.0000	5.0000	10.0000	4.0000	1.0000	1.7000
STD	2.6539	3.9623	3.7174	2.8650	3.8296	1.5401	1.2956	1.2659
90% CL	1.1631	1.7365	1.6292	1.2556	1.6783	0.6749	0.5678	0.5548

	0.09-7.5 (ng/L)	0.3-2 (ng/L)	0.3-2 (ng/L)	0.1-1.4 (ng/L)	0.3-5.2 (ng/L)	0.4-3 (ng/L)	0.07-1.4 (ng/L)	0.4-1.7 (pg/L)	0.4-1.7 (pg/L)	0.7-3.2 (pg/L)
Reqn_No	3456_TCveratrole	5_chlorovanillin	6_chlorovanillin	56_DCvanillin	3_chlorosyringol	35_DCsyringol	345_TCsyringol	T4CDD	2378T4CDD	P5CDD
COUNT	16	16	16	16	16	16	16	3	3	3
MEAN	0.7369	0.9250	1.0063	0.5000	1.5000	1.2375	0.3981	1.1667	1.1667	2.3333
MEDIAN	0.2000	0.8000	0.9000	0.4000	1.0000	1.0000	0.3000	1.4000	1.4000	3.1000
MAX	7.5000	2.0000	2.0000	1.4000	5.2000	3.0000	1.4000	1.7000	1.7000	3.2000
MIN	0.0900	0.3000	0.3000	0.1000	0.3000	0.4000	0.0700	0.4000	0.4000	0.7000
RANGE	7.4100	1.7000	1.7000	1.3000	4.9000	2.6000	1.3300	1.3000	1.3000	2.5000
90th PERCENTILE	0.5000	1.5000	1.7000	1.0000	1.8000	2.0000	0.6000	1.7000	1.7000	3.2000
STD	1.8142	0.5106	0.5335	0.3864	1.4792	0.6888	0.3285	0.6807	0.6807	1.4154
90% CL	0.7951	0.2238	0.2338	0.1694	0.6483	0.3019	0.1440	1.1475	1.1475	2.3862

Reqn_No	12378P5CDD	H6CDD	123478H6CDD	123678H6CDD	123789H6CDD	H7CDD	1234678H7CDD	O8CDD	T4CDF	2378T4CDF	P5CDF	12378P5CDF
	0.7-3.2 (pg/L)	1.7-6.4 (pg/L)	1.7-6.4 (pg/L)	1.7-6.4 (pg/L)	1.7-6.4 (pg/L)	3.2-9 (pg/L)	3.2-9 (pg/L)	4.7-13 (pg/L)	0.4-1.8 (pg/L)	0.4-1.8 (pg/L)	0.5-2 (pg/L)	0.5-2 (pg/L)
COUNT	3	3	3	3	3	3	3	3	3	3	3	3
MEAN	2.3333	4.7333	4.7333	4.7333	4.7333	6.6667	6.6667	10.2333	1.2667	1.2667	1.4667	1.4667
MEDIAN	3.1000	6.1000	6.1000	6.1000	6.1000	7.8000	7.8000	13.0000	1.6000	1.6000	1.9000	1.9000
MAX	3.2000	6.4000	6.4000	6.4000	6.4000	9.0000	9.0000	13.0000	1.8000	1.8000	2.0000	2.0000
MIN	0.7000	1.7000	1.7000	1.7000	1.7000	3.2000	3.2000	4.7000	0.4000	0.4000	0.5000	0.5000
RANGE	2.5000	4.7000	4.7000	4.7000	4.7000	5.8000	5.8000	8.3000	1.4000	1.4000	1.5000	1.5000
90th PERCENTILE	3.2000	6.4000	6.4000	6.4000	6.4000	9.0000	9.0000	13.0000	1.8000	1.8000	2.0000	2.0000
STD	1.4154	2.6312	2.6312	2.6312	2.6312	3.0616	3.0616	4.7920	0.7572	0.7572	0.8386	0.8386
90% CL	2.3862	4.4359	4.4359	4.4359	4.4359	5.1614	5.1614	8.0787	1.2765	1.2765	1.4138	1.4138

	0.5-2 (pg/L)	1.2-5.4 (pg/L)	1.2-5.4 (pg/L)	1.2-5.4 (pg/L)	1.2-5.4 (pg/L)	1.2-5.4 (pg/L)	1.9-7.6 (pg/L)	1.9-7.6 (pg/L)	1.9-7.6 (pg/L)	3.3-13 (pg/L)
Reqn_No	23478P5CDF	H6CDF	123478H6CDF	123678H6CDF	234678H6CDF	123789H6CDF	H7CDF	1234678H7CDF	1234789H7CDF	O8CDF
COUNT	3	3	3	3	3	3	3	3	3	3
MEAN	1.4667	3.8000	3.8000	3.8000	3.8000	3.8000	5.1333	5.1333	5.1333	8.6333
MEDIAN	1.9000	4.8000	4.8000	4.8000	4.8000	4.8000	5.9000	5.9000	5.9000	9.6000
MAX	2.0000	5.4000	5.4000	5.4000	5.4000	5.4000	7.6000	7.6000	7.6000	13.0000
MIN	0.5000	1.2000	1.2000	1.2000	1.2000	1.2000	1.9000	1.9000	1.9000	3.3000
RANGE	1.5000	4.2000	4.2000	4.2000	4.2000	4.2000	5.7000	5.7000	5.7000	9.7000
90th PERCENTILE	2.0000	5.4000	5.4000	5.4000	5.4000	5.4000	7.6000	7.6000	7.6000	13.0000
STD	0.8386	2.2716	2.2716	2.2716	2.2716	2.2716	2.9263	2.9263	2.9263	4.9217
90% CL	1.4138	3.8295	3.8295	3.8295	3.8295	3.8295	4.9334	4.9334	4.9334	8.2973

13.2 B C HYDRO TGP DATA

KEENLEYSIDE DAM
TOTAL GAS PRESSURE REDUCTION STUDY
DISSOLVED GAS MONITORING METHODOLOGY

Monitoring Equipment

During the period October 1991 to June 1992, three dissolved gas monitoring stations were established on the Columbia River system. The initial station became operational on 1 October 1991, and is located at Robson (just upstream of the boat launch ramp) approximately 5.4 km downstream of the Keenleyside dam. A second station was established on 16 April 1992 in association with the Water Survey of Canada gauging station at Birchbank, located approximately 29 km downstream of the Keenleyside Dam. The third station is located on the face of the Keenleyside dam, and was installed to monitor background dissolved gas levels in the water prior to discharge at the dam. It became operational on 4 June 1992.

The monitoring equipment utilized was purchased from Common Sensing Inc. of Clark Fork, Idaho, and consisted of the Model TBO-F dissolved gas and oxygen monitor at the Birchbank site, and the Model TBO-F(DL) monitors (which include an Omnidata Easy Logger Model 824 data logger) at the Keenleyside forebay and Robson sites. These monitors measure the following parameters:

- barometric pressure (mm Hg);
- water temperature (°C);
- total gas pressure (mm Hg); and,
- dissolve oxygen partial pressure (mm Hg)

The dissolved oxygen sensor consists of an Oxyguard Handy Probe, which uses a galvanic cell that is self polarizing. As such, a minimum flow rate past the probe of 10 - 15 cm/s is required.

The monitor at Birchbank is connected to the Water Survey of Canada/ B.C. Hydro Data Collection Platform (DCP) system which transfers the measurements via satellite to the B.C. Hydro computer at Burnaby Mountain. The Keenleyside forebay and the Robson meters record the measurements, using the data logger onto 128K EPROMs (Erasable Programable Read Only Memory) data packs. These EPROMs can record the data for a period of about two months before they need to be changed. The data are then downloaded using an Omnidata Logger Reader onto a microcomputer prior to analyses.

Due to the limited number of channels available at the Birchbank DCP, only the four parameters mentioned above are transmitted from the dissolved gas monitor. Measurements are recorded hourly, and transmitted via satellite every three hours. At the Robson and Keenleyside sites, under normal operation the parameters are measured every five minutes, and then the average, maximum, minimum, and standard deviation recorded for the hour. During gate tests conducted at the Keenleyside dam during the period 20-22 July and 1-5 September 1992, the instruments were set up to take measurements every minute, and to record the average, maximum, minimum, and standard deviation every five minutes.

At the Robson and Birchbank sites, the sensor assembly is deployed in the river using a 10.2 cm PVC pipe which has a series of holes cut in the last section to allow flow through of water past the sensor. The pipe was deployed from a junction box located above the normal high water mark, out into the river, and weighted with sand bags and boulders to anchor it to the bottom. The last section was elevated about 0.4 m above the bottom, using a support structure, to ensure better water flow through, and to minimize siltation of the probe in the end section of the pipe. A "clothes line" type arrangement consisting of a continuous loop rope on two stainless steel pulleys is utilized to deploy and retrieve the dissolved gas probe from within the pipe arrangement. The dissolved gas meter at Birchbank is housed in the Water Survey of Canada tower, and is connected to the 110 V line power supply. At Robson, the

meter and data logger is housed in a Hoffman weatherproof box, and uses a rechargeable 12 V storage battery for the power supply.

At the Keenleyside forebay site, the initial plans were to connect the meter to the B.C. Hydro data collection system, and to transmit the data via satellite as is done at Birchbank; however, after delays due to technical difficulties in updating the DCP, it was decided to use a data logger setup similar to that used at Robson to get the monitoring station operational. The meter and data logger were installed in the control room at the dam, and attached to the 110 V line power supply. The cable to the sensor was run through conduits in the dam to an exit point near the ladder down the face of the dam to the floating guidewall. A 10.2 cm PVC pipe, approximately 4 m in length with a series of holes cut in the lower section was mounted off the edge of the floating guidewall near the face of the dam. The dissolved gas probe is lowered down the pipe to a point just before the end of the pipe.

Calibration

Equipment servicing and calibration has been conducted at two to four week intervals, depending on the temperature and weather conditions (i.e., less frequent servicing required at cooler water temperatures). In addition, Dr. B. D'Aoust of Common Sensing Inc. conducted periodic repair, maintenance, and calibration of the instruments as part of the service contract. The routine maintenance and calibration was conducted by a locally hired employee of R.L. & L. Environmental Services Ltd.

The routine maintenance and calibration consisted of removing the sensor from the water, replacing the silastic tubing membrane assembly, ensuring that the total gas pressure reading was equal to barometric pressure in air (i.e., 100% saturation), and calibration of the oxygen sensor in air. When proper calibration of the oxygen sensor was not possible or when the oxygen readings were obviously erroneous, the oxygen membrane was replaced following the manufacturers instructions. Barometric pressure and temperature calibrations were conducted by Dr. D'Aoust using a portable meter which had been previously calibrated to accurate standards.

Data Checking/Processing

Once downloaded, the data were checked to identify any suspicious or obviously erroneous data. During the course of the program, numerous difficulties arose which produced erroneous results (e.g., instrument/sensor failures, battery problems, effects of high flows, calibration problems, readings that were recorded by the data logger during calibration procedures, etc.). Tools used to assist in identifying suspicious data include graphical presentation, review of the statistical parameters recorded at the Robson and Keenleyside sites (e.g., max., min., standard deviation), and various modelling relationships provided by L. Fiddler of Aspen Applied Sciences Ltd. Wherever suspicious data were identified, these data were removed from the official data set.

Data Results

The dissolved gas data available at the time of preparation of this report are in two computer files in ASCII format. The file labelled HKDCRIEM.ASC contains the barometric pressure, water temperature, total gas pressure, % saturation, delta P, compensation depth (i.e., the depth below which gas bubbles would not form), and battery voltages for the period 4 June to 10 November 1993. The second file labelled ROBCRIEM.ASC contains the same information from the Robson site for the period 17 March to 10 November period. Dissolved oxygen data have not been included due to the technical problems encountered during the study which may have rendered some of the data unreliable. The data from the Birchbank site were not available at the time of preparation of this report.

14 APPENDIX - G: QA/QC Reports

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ZENON

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Regional
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FIRST HALF CRIEMP QC REPORT

prepared by Dorothy A. Jeffery QA/QC Officer

March 31, 1992

March 31, 1992

ZENON ENVIRONMENTAL LABORATORIES QUALITY CONTROL REPORT FOR CRIEMP PROJECT

This report covers the period September 1991 - February 1992 and includes or refers to some data from September - December 1991 "Preliminary QC Report" presented January 27, 1992 .

The items as specified in "PROPOSED QA/QC PROGRAM FROM COLUMBIA RIVER WATER QUALITY STUDY" of September 1991 presumably written by Terry Baturin, will be used as an outline. More information on specific questions may be available.

1. Comparison of blind replicates submitted by the client as samples.

In searching for this data the assumption was made that all samples were submitted under client codes CB, VR and XA. This located replicates for the Columbia River at Waneta Si (#0200559) for September, November, December, January, a February.

Table I gives data for parameters measured for the routine site, and sites A, B, and C. Relative Standard Deviation (RSD) has been calculated. The normal laboratory duplicate limit of <25% difference has been adjusted to <18% for RSD. These samples are field replicates, so limits for acceptance should be somewhat larger to reflect this additional source of variation. These limits should be set by the client.

Values determined near (within 5x) the Minimum detection concentration (MDC) are subject to more relative variation, therefore the <18% limit does not apply.

Variation among replicates is generally within limits with RSD's greater than 18% only for samples near the MDC. This reflects well on the sampling program and the analysis. Variation was somewhat high in September and November for turbidity, however these were very low turbidity samples. Zinc in September and Iron in December and January gave somewhat high variation, again at fairly low levels.

Some parameters have been reported in this table which were not requested. They are part of packages and in some cases are not the analytical route of choice (eg. Boron total, Sodium ICP).

2. Field blanks (identified as travelling blanks) were received for Columbia River at Waneta (form 10003332) and Columbia River above PE1272 sampled on November 27, 1991 and February 18, 1992.

Table II summaries these blanks. There were no important values greater than MDC. In a few cases (turbidity, alkalinity, and mercury) values at or slightly above the MDC were detected. Considering the number of parameters analyzed this would be expected on a statistical basis.

3. Assessment of laboratory blanks for all analyzed parameters.

Instrument blanks (usually DI water, or background solvent) are analyzed throughout the run for all parameters and in many cases the instrument is zeroed against this blank. Because of this blank values are not compiled in these cases.

Method blanks (extraction blanks, digestion blanks) are run when sample preparation is required. This data is presented in Table III and Figures 1-9 referenced against the MDC or the lowest calibration standard. Data is presented for total metals (by inductively coupled plasma spectrometry,ICP, or graphite furnace atomic absorption spectrometry, GFAA), total mercury, total alkalinity, total phosphorus, total kjeldahl nitrogen, and resin and fatty acids. Figure 9, extraction blanks for various resin acids has not been included, because all values are 0.

4. Evaluation of surrogate recoveries for major organic groups analyzed by GC.

The surrogate, 5-alpha-androstane (referred to as C19), is used for Resin acid/fatty acid analysis. Figure 10 shows surrogate recovery.

5. Recoveries of analytes from spiked samples

Chloroform spikes are used in this analytical procedure (Figure 11).

In order to monitor the recovery of various metals from water by the digestion process, a mixed metal standard is digested with each batch. Figures 12-15 show recoveries. Concentration (in mg/L) of metals used are calcium 18, cadmium 0.1, chromium 0.3, copper 0.24, iron 0.8, magnesium 14, manganese 0.36, molybdenum 1, nickel 1.2, lead 1, zinc 0.3.

Moderately clean water samples, which the Columbia River samples are, behave much like de-ionized water when spiked; therefore at Zenon we do not make a practice of spiking this type of sample. We run calibration check solutions (usually one high 70% of full scale, QCA, and one low 20% of full scale, QCB) with each batch of most analyses. These are essentially the same as spiked samples for clean water dissolved samples.

These calibration checks are presented graphically for several of the parameters in the CRIEMP project:

Sulfate	Nov & Dec 1991	Figure 16
Fluoride	Oct 1991	Figure 17
pH	Oct & Nov 1991	Figure 18
Ca by ICP	Aug to Oct 1991	Figure 19
Cd by ICP	Aug to Sep 1991	Figure 20
Fe by ICP	Aug to Oct 1991	Figure 21
Colour TAC	Sep 1991 to Feb 1992	Figure 22
Colour SW	Sep 1991 to Feb 1992	Figure 23
Ammonia	Oct 1991 to Feb 1992	Figures 24-28
Nitrate	Oct 1991 to Feb 1992	Figures 29-30
Nitrite	Dec 1991 to Feb 1991	Figures 31-33
Phos, total & dissolved	Sep 1991 to Feb 1992	Figures 34-39
Phos, digested mid-point std	Sep 1991 to Feb 1992	Figures 40-42
Sodium	Sep 1991 to Mar 1992	Figure 43
Potassium	Sep 1991 to Mar 1992	Figure 44
Chloride	Sep 1991 to Mar 1992	Figure 45

Control limits are generally set as ±3 x Standard deviation of the mean value determined over a period of time when the analytical system is known to be in control. If a check value falls outside the limits, it is repeated and if it still falls outside the limits the batch is repeated. Some plots show interim limits because we have not been accumulating data long enough to set control limits.

The Nitrogen parameters are very stable, so control limits are set as mean ± 2 standard deviations.

Total and dissolved phosphate control charts are presented as QCA/QCB sum and difference, a method suggested to enhance chart interpretation. We have not found there to be an enhancement, so this presentation is being used less in the laboratory. The computer program used to generate these plots also has the draw back that dates are not printed on plots; only sequential order numbers are printed on the plot X axis. In September 1991 at point 15, a point lies outside the control limits for both A+B and A-B. Review of the data indicated that this point was a QCA/QCB missed from the tray on the day of analysis. It was re-run a week later, and not surprisingly had concentrated. All but one sample from that tray were run on the correct day. Several trays were run on the original day and all were in control as indicated by the preceding points in the plots. At most one sample would have been affected.

Digested phosphate mid-point calibration checks are also presented (Figure 40-42).

6. An evaluation of standard reference materials analyzed during the study:

Few standard reference waters are available so they are not run routinely. In addition for the reasons discussed above, those that are available, serve more as a calibration check than as a matrix effect check. Environment Canada, CCIW, has some reference waters, one of which is CM-Ion-91 (Lake Superior Water). This has been run on several occasions.

See Table IV.

7. Summary of FPQA and other relevant QC studies for period Sept 1991 - Feb 1992.

FPQA study 55 submitted Oct 30, 1991
In the final report Zenon had one flag only in 66 results reported. This was a low value on one of the TKN analyses, a sample very close to our 0.04 mg/L MDC for TKN.

Overall the lab was rated excellent, in the top 3 of 21 participating laboratories.

FPQA study 56 submitted Dec 31, 1991
The final report rated Zenon as Excellent to Very Good. Again Zenon was in the top 3 of 18 laboratories reporting. Two flags out of 66 parameters were high on two of the ammonia samples analyzed (study mean 0.047, Zenon 0.063, and study mean 0.0020, Zenon 0.011, units mg/L). The latter sample was close to the Zenon MDC.

These studies cover a wide range of inorganic parameters. The following parameters are included in CRIEMP:

specific conductance	hardness
nitrate + nitrite	silica
ammonia	
fluoride	potassium
sodium	chloride
pH	total alkalinity
calcium	magnesium
phosphorus total	sulfate
aluminum	lead
manganese	iron
copper	zinc
cadmium.	

-Clinical Microbiology Proficiency Testing Program-October samples

Eight seeded samples were cultured (4 for Total Coliforms, and 4 for Faecal Coliforms) and processed by Membrane filtration and Most probable number method. Zenon results for all Faecal Coliform and all total coliform were within 95% Confidence Limits. Nineteen labs participated in this study.

Canadian Association of Environmental Analytical Laboratories, Performance Evaluation Study #2 for Certification of Additional Parameters - Total Kjeldahl Nitrogen, Conductivity, Fluoride, and Phosphorus Total plus 19 previous parameters. These analyses were done in September and October of 1991.

Zenon was one of two labs in Canada who completed all 23 parameters successfully and had no flagged parameters. Sixty labs participated in this CAEAL series.

The other parameters previously included in CAEAL are listed below.

chloride	calcium- dissolved
cadmium- dissolved	cobalt- dissolved
chromium- dissolved	copper- dissolved
iron- dissolved	magnesium- dissolved
manganese- dissolved	nickel- dissolved
lead- dissolved	vanadium- dissolved
zinc- dissolved	potassium
sodium	nitrate
nitrate+nitrite	silica reactive
sulphate.	

B.C. Ministry of Environment Lab Registration study 2- general parameters, ions and total metals. Analysis for this study was done in December 1991.

Seventy seven laboratories participated in this study. Zenon received acceptable performance evaluation in 11 parameters (Chloride, sodium ,Nitrate, Nitrate+nitrite, sulfate, total cadmium, total copper, total iron, total phosphorus, total lead, total zinc). Total Kjeldahl nitrogen (TKN) recoveries were low and pH data was excluded. Three acceptable conductance values were submitted but this is insufficient for performance evaluation. TKN continues to be a difficult parameter for Zenon and others (64% of performance evaluation scores were unacceptable).

Zenon was in the top 10% of laboratories in this study based on less than 10% unacceptable performance evaluation score when participating in 12 or more parameters.

U.S. Environmental Protection Agency Water Pollution Study 27, was performed in October, 1991.

Twenty trace metals (concentration range 0.7 ug/L to 1 mg/L) were reported. Results were acceptable for 18 metals (Al, As, Be, Cd, Co, Cu, Fe, Hg, Mn, Ni, Pb, Se, V, Zn, Sb, Ag, Mo, and Sr). Two metals (Cr, Ti) were outside acceptance limits for 1 of samples analyzed. This resulted from a transcription error in preparing the QC report and would not routinely be a problem since data is transferred directly from the ICP instrument to SAMAN for reporting to clients.

General parameters, nutrients, and minerals represented 20 parameters. Fifteen of 16 included in CRIEMP were done acceptably (pH, conductance, Ca, Mg, Na, K, alkalinity, Cl, F, sulfate, ammonia, ortho-phosphate, total Kjeldahl nitrogen, nitrate, non-filterable residue, total organic carbon). Total phosphorous was high on one sample due to an error in recording the dilution.

The overall Zenon laboratory performance in EPA WP27 was 6.7% flags. Overall flagging rate for this study which involved ~2000 laboratories, was 13%. Zenon was much better than this.

8. SPARCODE changes - impact on reporting

During the period of this study metals package SPARCODES have been changed, resulting in the direct reporting down to the new metals MDC's. Four parameters previously available only from the autoanalysis unit of the laboratory are now also available from the metals section as part of the metals package. The initial change of SPARCODES resulted in some analyses normally done in autoanalysis being done only in metals. These samples have been traced and the samples re-run by the requested autoanalysis route.

Arsenic hydride (low level) requests were also effected by the SPARCODE change. Again, all samples where arsenic low level had been run as arsenic ICP no hydride, were re-run by the low level route.

On reports and in SEAM it is necessary to refer to the SPARCODE to determine the analytical route that has been used.

These routes are summarized below.

Descriptor	(previous) SPARCODE autoanalysis	(new) SPARCODE metals
Sodium dissolved	Na-D1331	Na_D0031
Sodium Total		Na_T0041
Potassium dissolved	K--D1331	K__D0031
Potassium Total		K__T0041
Phosphorus dissolved	P--D139A	P__D0031
Phosphorus Total	P--T139A	P__T0041

9. Methods

"A Laboratory Manual for the Chemical Analysis of Waters, Wastewaters, Sediments and Biological Materials", 1976 and Part II Supplement, 1989 has been provided to Mr. Baturin and Mr. T Tremblay of Environment Canada. Methods which have been revised since publication of these manuals are being provided.

10. Sample bottle and Preservation preparation

a. GV - general variables - 2 litre polyethylene bottles and caps are de-ionized water (DI) rinsed, drained and capped, prior to packing in coolers for shipping to the field .

GV bottles are unpreserved.

b. AO RF - AOX and resin and fatty acids - 500 mL and 1 litre amber glass bottles with teflon lined polypropylene caps are purchased pre-cleaned from Eagle Picher. Wash 'A' procedure is as follows:

1. Bottles, liners, and caps washed in laboratory grade non-phosphate detergent.
2. Rinsed three times with distilled water.
3. Rinsed with 1:1 nitric acid.
4. Rinsed three times with ASTM-Type 1 organic free water.
5. Oven dried for one hour.
6. Rinsed with hexane.
7. Oven dried for one hour.

Preservative in acid washed 5 mL plastic vials is 10N sodium hydroxide made from pellets (BDH assured grade).

c. TOC - total organic carbon - 250 mL polyethylene bottles prepared as for GV bottles.

d. CO - coliform - 250 mL bottles are capped and autoclaved then shipped to the field.

e. HG - mercury - bottles are 1 litre clear glass bottles purchased pre-cleaned from Eagle Picher. Cleaning procedure is as described for AO RF.

Preservative, shipped in 8 mL acid washed glass vials, is 4 mL of 10% potassium dichromat (analytical grade) and 4 mL of concentrated sulfuric acid (reagent grade).

f. M - metals - 250 mL high density polyethylene bottles purchased pre-cleaned from Environmental Sampling Supply (ESS) Cleaning procedure is as follows:

1. Bottles and caps washed in laboratory grade non-phosphate detergent.
2. Rinsed three times with hot tap water.
3. Rinsed with 1:1 nitric acid.
4. Rinsed three times with ASTM-Type 1 deionized water.
5. Invert and air dry in contamination free environment.
6. Cap bottle.

Preservative, shipped in 5 mL acid washed polyethylene vials, is nitric acid (analytical grade).

g. *NFR - non-filterable residue* - bottles are 500 mL bottles prepared as for GV.

h. CH - chlorate - are 500 mL amber glass bottles purchased from Eagle Picher and cleaned by the procedure described for AO RF.

Acid testing - nitric acid is tested for metals content by graphite furnace atomic absorption by random sampling of bottles from batches of bottles of acid received.

TABLE I

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

Field Replicates Report for CRIEMP Sept 1991 to Feb 1992.

		Site	Date/Time	Form #
		Columbia @ Birchbank	91/09/03	10003316
		200003	12:35	10003312
		Result mg/L	Result mg/L	%
Parameter	Sparcode	1	2	Difference
Color true	213000	5	5	0%
pH	41220	7.8	7.7	n/a
NFR=TSS	81070	1	2	67%
Sp. Cond	111160	111	111	0%
Turbidity	151140	0.9	0.6	40%
Color TAC	241310	2	<1	n/a
FR=TDS	7H1032	70	68	3%
Phenol. Alk	1011211	<0.5	<0.5	n/a
Total Alk.	1021210	50.4	49.9	1%
TKN	01131360	0.08	0.03	91%
TKN	0113136A			
Color SW	10521320	<5	<5	n/a
Chloride	11041330			
Fluoride	11061341	<0.10	<0.10	n/a
Ammonia	11081351			
NO3+NO2	11091350			
Phosphorus Ortl	11181380			
Silica Reactive	11201381	3.4	3.4	0%
Sulfate	11211400	7.9	7.8	1%
All resin acids	xxxxP030	<0.001	<0.001	n/a
Fatty acids except following				
Lauric acid	LAURP030			
Lignoceric acid	LIGNP030			
Myristic Acid	MYRIP030			
Palmitric acid	PALMP030			
Palustric acid	PALUP030			
Stearic acid	STEAP030			
AOX	AOX-DM01	<0.01	<0.01	n/a
Mercury	Hg-T0310	<0.00005	<0.00005	n/a
Al	Al-T0041			
Al	Al-T0040	<0.10	<0.10	n/a
Al dissolved	Al-D0030			
As hydride	As-T0181	<0.001	<0.001	n/a
As hydride disso	As-D0181			
Arsenic	As-T0041			
Ba	Ba-T0041			
Ba	Ba-T0040	0.02	0.02	0%
Ba dissolved	Ba-D0030			
B	B--T0041			
B dissolved	B--D0030			
Ca	Ca-T0041			
Ca	Ca-T0040	15.9	15.8	1%
Ca dissolved	Ca-D0030			
Cd	Cd-T0060	<0.0005	<0.0005	n/a
Cd dissolved	Cd-D0050			
Co	Co-T0041			
Co	Co-T0040	<0.1	<0.1	n/a
Co dissolved	Co-D0030			
Cr	Cr-T0060	<0.005	<0.005	n/a

2 - 1 = 1 Avg

1/1.5 = 67%

Cr dissolved	Cr-D0050			
Cu	Cu-T0040	<0.01	<0.01	n/a
Cu gfaa	Cu-T0060			
Cu dissolved	Cu-D0050			
Fe	Fe-T0041			
Fe	Fe-T0040	0.03	0.03	0%
Fe dissolved	Fe-D0030			
K	K--D1331	0.5	0.5	0%
K ICP	K--T0041			
Mg	Mg-T0041			
Mg	Mg-T0040	3.25	3.28	1%
Mg dissolved	Mg-D0030			
Mn	Mn-T0040	<0.01	<0.01	n/a
Mn	Mn-T0060			
Mn dissolved	Mn-D0050			
Mo	Mo-T0041			
Mo	Mo-T0040	<0.01	<0.01	n/a
Mo dissolved	Mo-D0030			
Sodium	Na-T0041			
Sodium	Na-D1331			
Ni	Ni-T0041			
Ni	Ni-T0040	<0.05	<0.05	n/a
Ni dissolved	Ni-D0030			
Pb	Pb-T0060	<0.001	<0.001	n/a
Pb dissolved	Pb-D0050			
Phos T diss	P--D1390			
Phos total	P--T1390			
Phos total	P--T139A			
Tl	mtspmtsp			
Tl dissolved	mtspmtsp			
Sr	Sr-T0041			
V	V--T0040	<0.01	<0.01	n/a
V dissolved	V--D0030			
Zn	Zn-T0040	0.06	0.02	100%
Zn	Zn-T0060			
TOC	0103calc			
TIC	01240930			
Carbon total	C--T0910			
E. coli	01476013			
Enterococcus	01486014			
Coliform fecal	04502480			
Chlorate	pscppscp			
Chloroform				

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

1991 to Feb 1992.

		Site	Date/Time	Form #
		Columbiaa @ Waneta	91/09/03	10003315
		200559	14:15	10003317
		Result mg/L	Result mg/L	%
Parameter	Sparcode	1	2	Difference
Color true	213000	5	<5	
pH	41220	7.7	7.6	
NFR=TSS	81070	2	2	0%
Sp. Cond	111160	110	109	1%
Turbidity	151140	0.7	0.7	0%
Color TAC	241310	2	1	67%
FR=TDS	7H1032	64	62	3%
Phenol. Alk	1011211	<0.5	<0.5	
Total Alk.	1021210	48.6	51.10	5%
TKN	01131360	0.06	0.06	0%
TKN	0113136A			
Color SW	10521320	<5	<5	
Chloride	11041330	0.6	0.6	0%
Fluoride	11061341	<0.10	<0.10	
Ammonia	11081351	0.005	<0.005	
NO3+NO2	11091350	0.09	0.08	12%
Phosphorus Ortl	11181380	0.010	0.010	0%
Silica Reactive	11201381	3.4	3.4	0%
Sulfate	11211400	8.1	8.1	0%
All resin acids	xxxxP030	<0.001		
Fatty acids except following				
Lauric acid	LAURP030			
Lignoceric acid	LIGNP030			
Myristic Acid	MYRIP030	0.003		
Palmitric acid	PALMP030	0.004		
Palustric acid	PALUP030			
Stearic acid	STEAP030			
AOX	AOX-DM01	<0.01		
Mercury	Hg-T0310	<0.00005	<0.00005	
Al	Al-T0041			
Al	Al-T0040	<0.10	<0.10	
Al dissolved	Al-D0030			
As hydride	As-T0181	<0.001	<0.001	
As hydride disso	As-D0181			
Arsenic	As-T0041			
Ba	Ba-T0041			
Ba	Ba-T0040	0.02	0.02	0%
Ba dissolved	Ba-D0030			
B	B--T0041			
B dissolved	B--D0030			
Ca	Ca-T0041			
Ca	Ca-T0040	15.8	15.5	2%
Ca dissolved	Ca-D0030			
Cd	Cd-T0060	<0.0005	<0.0005	
Cd dissolved	Cd-D0050			
Co	Co-T0041			
Co	Co-T0040	<0.1	<0.1	
Co dissolved	Co-D0030			
Cr	Cr-T0060	<0.005	<0.005	

Cr dissolved	Cr-D0050			
Cu	Cu-T0040	<0.01	<0.01	
Cu gfaa	Cu-T0060			
Cu dissolved	Cu-D0050			
Fe	Fe-T0041			
Fe	Fe-T0040	0.12	0.05	**82%**
Fe dissolved	Fe-D0030			
K	K--D1331	0.5	0.5	**0%**
K ICP	K--T0041			
Mg	Mg-T0041			
Mg	Mg-T0040	3.17	3.15	**1%**
Mg dissolved	Mg-D0030			
Mn	Mn-T0040	<0.01	<0.01	
Mn	Mn-T0060			
Mn dissolved	Mn-D0050			
Mo	Mo-T0041			
Mo	Mo-T0040	<0.01	<0.01	
Mo dissolved	Mo-D0030			
Sodium	Na-T0041			
Sodium	Na-D1331	0.9	0.9	**0%**
Ni	Ni-T0041			
Ni	Ni-T0040	<0.05	<0.05	
Ni dissolved	Ni-D0030			
Pb	Pb-T0060			
Pb dissolved	Pb-D0050	0.002	0.001	**67%**
Phos T diss	P--D1390	0.010	0.010	**0%**
Phos total	P--T1390	0.017	0.016	**6%**
Phos total	P--T139A			
Tl	mtspmtsp	<0.1	<0.1	
Tl dissolved	mtspmtsp			
Sr	Sr-T0041			
V	V--T0040	<0.01	<0.01	
V dissolved	V--D0030			
Zn	Zn-T0040	0.05	0.02	**86%**
Zn	Zn-T0060			
TOC	0103calc			
TIC	01240930	12	12	**0%**
Carbon total	C--T0910	12	12	**0%**
E. coli	01476013			
Enterococcus	01486014			
Coliform fecal	04502480	<2		
Chlorate	pscppscp	<0.1	<0.1	
Chloroform				

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

		Site	Date/Time	Form #
		Columbia@ Birchbank	91/10/01	10003175
		200003	10:30	10003324
		Result mg/L	Result mg/L	%
Parameter	Sparcode	1	2	Difference
Color true	213000			
pH	41220	7.8	7.8	
NFR=TSS	81070			
Sp. Cond	111160		112	
Turbidity	151140			
Color TAC	241310		4	
FR=TDS	7H1032			
Phenol. Alk	1011211	<0.5	<0.5	
Total Alk.	1021210	48.0	47.9	0%
TKN	01131360			
TKN	0113136A			
Color SW	10521320		<5	
Chloride	11041330			
Fluoride	11061341			
Ammonia	11081351		<0.005	
NO3+NO2	11091350			
Phosphorus Ortl	11181380		<0.003	
Silica Reactive	11201381			
Sulfate	11211400			
All resin acids	xxxxP030	<0.001		
Fatty acids except following		<0.001		
Lauric acid	LAURP030			
Lignoceric acid	LIGNP030			
Myristic Acid	MYRIP030			
Palmitric acid	PALMP030			
Palustric acid	PALUP030			
Stearic acid	STEAP030			
AOX	AOX-DM01	0.04		
Mercury	Hg-T0310		<0.00005	
Al	Al-T0041			
Al	Al-T0040			
Al dissolved	Al-D0030			
As hydride	As-T0181			
As hydride disso	As-D0181			
Arsenic	As-T0041			
Ba	Ba-T0041			
Ba	Ba-T0040			
Ba dissolved	Ba-D0030			
B	B--T0041			
B dissolved	B--D0030			
Ca	Ca-T0041			
Ca	Ca-T0040			
Ca dissolved	Ca-D0030			
Cd	Cd-T0060			
Cd dissolved	Cd-D0050			
Co	Co-T0041			
Co	Co-T0040			
Co dissolved	Co-D0030			
Cr	Cr-T0060	5		

Cr dissolved	Cr-D0050		
Cu	Cu-T0040		
Cu gfaa	Cu-T0060		
Cu dissolved	Cu-D0050		
Fe	Fe-T0041		
Fe	Fe-T0040		
Fe dissolved	Fe-D0030		
K	K--D1331		
K ICP	K--T0041		
Mg	Mg-T0041		
Mg	Mg-T0040		
Mg dissolved	Mg-D0030		
Mn	Mn-T0040		
Mn	Mn-T0060		
Mn dissolved	Mn-D0050		
Mo	Mo-T0041		
Mo	Mo-T0040		
Mo dissolved	Mo-D0030		
Sodium	Na-T0041		
Sodium	Na-D1331		
Ni	Ni-T0041		
Ni	Ni-T0040		
Ni dissolved	Ni-D0030		
Pb	Pb-T0060		
Pb dissolved	Pb-D0050		
Phos T diss	P--D1390		<0.003
Phos total	P--T1390		
Phos total	P--T139A		
Tl	mtspmtsp		
Tl dissolved	mtspmtsp		
Sr	Sr-T0041		
V	V--T0040		
V dissolved	V--D0030		
Zn	Zn-T0040		
Zn	Zn-T0060		
TOC	0103calc		
TIC	01240930	12	
Carbon total	C--T0910	13	
E. coli	01476013		
Enterococcus	01486014		
Coliform fecal	04502480		
Chlorate	pscppscp	0.04	
Chloroform		<0.001	

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

		Site	Date/Time	Form #
		Columbiaia @ Waneta	91/10/01	10003280
		200559	12:10	10003323
		Result mg/L	Result mg/L	%
Parameter	Sparcode	1	2	Difference
Color true	213000			
pH	41220	7.8	7.8	
NFR=TSS	81070			
Sp. Cond	111160		113	
Turbidity	151140			
Color TAC	241310		3	
FR=TDS	7H1032			
Phenol. Alk	1011211	<0.5	<0.5	
Total Alk.	1021210	47.4	47.4	0%
TKN	01131360			
TKN	0113136A			
Color SW	10521320		5	
Chloride	11041330			
Fluoride	11061341			
Ammonia	11081351			
NO3+NO2	11091350			
Phosphorus Ortl	11181380			
Silica Reactive	11201381			
Sulfate	11211400			
All resin acids	xxxxP030	<0.001	<0.001	
Fatty acids except following		<0.001	<0.001	
Lauric acid	LAURP030			
Lignoceric acid	LIGNP030			
Myristic Acid	MYRIP030			
Palmitric acid	PALMP030		0.005	
Palustric acid	PALUP030			
Stearic acid	STEAP030		0.002	
AOX	AOX-DM01	0.01	<0.01	
Mercury	Hg-T0310		<0.00005	
Al	Al-T0041			
Al	Al-T0040		<0.10	
Al dissolved	Al-D0030			
As hydride	As-T0181		<0.001	
As hydride disso	As-D0181			
Arsenic	As-T0041			
Ba	Ba-T0041			
Ba	Ba-T0040		0.02	
Ba dissolved	Ba-D0030			
B	B--T0041			
B dissolved	B--D0030			
Ca	Ca-T0041			
Ca	Ca-T0040		15.9	
Ca dissolved	Ca-D0030			
Cd	Cd-T0060		<0.0005	
Cd dissolved	Cd-D0050			
Co	Co-T0041			
Co	Co-T0040		<0.1	
Co dissolved	Co-D0030			
Cr	Cr-T0060	7	<0.005	

Cr dissolved	Cr-D0050		
Cu	Cu-T0040		<0.01
Cu gfaa	Cu-T0060		
Cu dissolved	Cu-D0050		
Fe	Fe-T0041		0.05
Fe	Fe-T0040		
Fe dissolved	Fe-D0030		
K	K--D1331		
K ICP	K--T0041		
Mg	Mg-T0041		
Mg	Mg-T0040		3.23
Mg dissolved	Mg-D0030		
Mn	Mn-T0040		<0.01
Mn	Mn-T0060		
Mn dissolved	Mn-D0050		
Mo	Mo-T0041		
Mo	Mo-T0040		<0.01
Mo dissolved	Mo-D0030		
Sodium	Na-T0041		
Sodium	Na-D1331		
Ni	Ni-T0041		
Ni	Ni-T0040		<0.05
Ni dissolved	Ni-D0030		
Pb	Pb-T0060		
Pb dissolved	Pb-D0050		
Phos T diss	P--D1390		
Phos total	P--T1390		
Phos total	P--T139A		
Tl	mtspmtsp		
Tl dissolved	mtspmtsp		
Sr	Sr-T0041		
V	V--T0040		
V dissolved	V--D0030		
Zn	Zn-T0040		
Zn	Zn-T0060		
TOC	0103calc		
TIC	01240930	12	
Carbon total	C--T0910	13	
E. coli	01476013		
Enterococcus	01486014		
Coliform fecal	04502480		
Chlorate	pscppscp	0.03	
Chloroform		<0.001	<0.001

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

		Site	Date/Time	Form #	Form #	Date/Time
	Columbia	bia @ Waneta	91/10/29	10003033	10003032	91/10/29
		00200559	0.46	10003034	10003036	11:05
		Result mg/L	Result mg/L	Result mg/L	Result mg/L	Relative SD
Parameter	Sparcode	1	2=Site A	3=Site B	4=Site C	limit<18% @ >5x mdc
Color true	213000	<5	5	5	5	0%
pH	41220	7.3	7.4	7.5	7.4	
NFR=TSS	81070	1	1	2	2	38%
Sp. Cond	111160	123	123	123	123	0%
Turbidity	151140	0.7	0.5	0.5	0.4	24%
Color TAC	241310	2	4	4	2	38%
FR=TDS	7H1032	84	78	80	82	3%
Phenol. Alk	1011211	<0.5	<0.5	<0.5	<0.5	
Total Alk.	1021210	50.1	51.8	51.7	51.1	2%
TKN	01131360	0.10	0.09			7%
TKN	0113136A					
Color SW	10521320	6	<5	6	6	0%
Chloride	11041330	0.7	0.7	0.8	0.8	8%
Fluoride	11061341	0.12	0.11	0.12	0.12	4%
Ammonia	11081351	0.011	<0.005	0.008	0.009	16%
NO3+NO2	11091350	0.09	0.08	0.09	0.08	7%
Phosphorus Ortl	11181380	0.005	0.003	0.004	0.004	20%
Silica Reactive	11201381	3.8	3.9	3.9	3.8	1%
Sulfate	11211400	8.9	9.1	9.0	8.7	2%
All resin acids	xxxxP030	<0.001	<0.001			
Fatty acids except following		<0.001	<0.001			
Lauric acid	LAURP030					
Lignoceric acid	LIGNP030					
Myristic Acid	MYRIP030	0.004	0.006			28%
Palmitric acid	PALMP030	0.002				
Palustric acid	PALUP030					
Stearic acid	STEAP030					
AOX	AOX-DM01	0.02	0.01			47%
Mercury	Hg-T0310	<0.00005	<0.00005	<0.00005	0.00006	
Al	Al-T0041					
Al	Al-T0040		<0.10			
Al dissolved	Al-D0030					
As hydride	As-T0181	<0.001	<0.001			
As hydride disso	As-D0181					
Arsenic	As-T0041					
Ba	Ba-T0041					
Ba	Ba-T0040	0.02	0.02			0%
Ba dissolved	Ba-D0030					
B	B--T0041					
B dissolved	B--D0030					
Ca	Ca-T0041					
Ca	Ca-T0040	16.6	16.7			0%
Ca dissolved	Ca-D0030					
Cd	Cd-T0060	<0.0005	<0.0005			
Cd dissolved	Cd-D0050					
Co	Co-T0041					
Co	Co-T0040	<0.1	<0.1			
Co dissolved	Co-D0030					
Cr	Cr-T0060	<0.005	<0.005			

Cr dissolved	Cr-D0050					
Cu	Cu-T0040	<0.01	<0.01			
Cu gfaa	Cu-T0060					
Cu dissolved	Cu-D0050					
Fe	Fe-T0041					
Fe	Fe-T0040	0.03	0.03			0%
Fe dissolved	Fe-D0030					
K	K--D1331	0.6	0.6		0.6	0%
K ICP	K--T0041					
Mg	Mg-T0041					
Mg	Mg-T0040	3.61	3.61			0%
Mg dissolved	Mg-D0030					
Mn	Mn-T0040	<0.01	<0.01			
Mn	Mn-T0060					
Mn dissolved	Mn-D0050					
Mo	Mo-T0041					
Mo	Mo-T0040	<0.01	<0.01			
Mo dissolved	Mo-D0030					
Sodium	Na-T0041					
Sodium	Na-D1331	1.2	1.3	1.2	1.2	4%
Ni	Ni-T0041					
Ni	Ni-T0040	<0.05	<0.05			
Ni dissolved	Ni-D0030					
Pb	Pb-T0060	0.003	0.004			20%
Pb dissolved	Pb-D0050					
Phos T diss	P--D1390	0.005	0.004	0.004		13%
Phos total	P--T1390	0.013	0.009	0.010	0.010	16%
Phos total	P--T139A					
Tl	mtspmtsp	<0.1	<0.1			
Tl dissolved	mtspmtsp					
Sr	Sr-T0041					
V	V--T0040	<0.01	<0.01			
V dissolved	V--D0030					
Zn	Zn-T0040	0.01	0.01			0%
Zn	Zn-T0060					
TOC	0103calc	3	4			20%
TIC	01240930	14	12			11%
Carbon total	C--T0910	17	17			0%
E. coli	01476013	<2	3			
Enterococcus	01486014	1	1			0%
Coliform fecal	04502480		<2			
Chlorate	pscppscp	0.03	0.03			0%
Chloroform						

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

		Site	Date/Time	Form #	Form #	Date/Time
		Columbiambia @ Waneta	91/11/26	10003031	10003329	91/11/26
		00200559	13:30	10003328	10003330	91/11/26
Parameter	Sparcode	Result mg/L 1	Result mg/L 2=Site A	Result mg/L 3=Site B	Result mg/L 4=Site C	**Relative SD limit<18% @ >5x mdc**
Color true	213000		5	<5	<5	
pH	41220		7.6	7.4	7.7	
NFR=TSS	81070		2	1	1	**43%**
Sp. Cond	111160		133	133	133	**0%**
Turbidity	151140		0.4	0.6	0.7	**27%**
Color TAC	241310		3	2	4	**33%**
FR=TDS	7H1032		74	78	84	**6%**
Phenol. Alk	1011211		<0.5	<0.5	<0.5	
Total Alk.	1021210		56.6	56.6	56.6	**0%**
TKN	01131360		<0.04	<0.04	<0.04	
TKN	0113136A					
Color SW	10521320		5	<5	<5	
Chloride	11041330		0.8	0.9	1	**11%**
Fluoride	11061341		<0.10	<0.10	<0.10	
Ammonia	11081351		0.009	0.009	0.007	**14%**
NO3+NO2	11091350		0.13	0.13	0.13	**0%**
Phosphorus Ortr	11181380		<0.003	<0.003	<0.003	
Silica Reactive	11201381		4.1	4.2	4.1	**1%**
Sulfate	11211400		9.9	9.9	10.1	**1%**
All resin acids	xxxxP030					
Fatty acids except following		<0.001				
Lauric acid	LAURP030	0.11				
Lignoceric acid	LIGNP030					
Myristic Acid	MYRIP030	0.088				
Palmitric acid	PALMP030	0.05				
Palustric acid	PALUP030					
Stearic acid	STEAP030	0.05				
AOX	AOX-DM01	0.02	0.01			**47%**
Mercury	Hg-T0310		0.0001	0.0001		**0%**
Al	Al-T0041					
Al	Al-T0040		<0.10	<0.10	<0.10	
Al dissolved	Al-D0030		<0.1	<0.1		
As hydride	As-T0181		<0.001	<0.001	<0.001	
As hydride disso	As-D0181		<0.001	<0.001		
Arsenic	As-T0041					
Ba	Ba-T0041					
Ba	Ba-T0040		0.02	0.02		**0%**
Ba dissolved	Ba-D0030		0.02	0.02	0.02	**0%**
B	B--T0041					
B dissolved	B--D0030		<0.01	<0.01		
Ca	Ca-T0041					
Ca	Ca-T0040		18.0	18.2	18.2	**1%**
Ca dissolved	Ca-D0030		17.8	17.9		**0%**
Cd	Cd-T0060		<0.0005	<0.0005	<0.0005	
Cd dissolved	Cd-D0050		<0.0005	<0.0005		
Co	Co-T0041					
Co	Co-T0040		<0.1	<0.1	<0.1	
Co dissolved	Co-D0030		<0.1	<0.1		
Cr	Cr-T0060		<0.005	<0.005	<0.005	

Cr dissolved	Cr-D0050		<0.005	<0.005		
Cu	Cu-T0040					
Cu gfaa	Cu-T0060		0.002	0.001	0.001	**43%**
Cu dissolved	Cu-D0050		0.002	0.001		**47%**
Fe	Fe-T0041					
Fe	Fe-T0040		0.05	0.05	0.06	**11%**
Fe dissolved	Fe-D0030		0.01	0.01		**0%**
K	K--D1331		0.6	0.6	0.7	**9%**
K ICP	K--T0041					
Mg	Mg-T0041					
Mg	Mg-T0040		4.17	4.19	4.15	**0%**
Mg dissolved	Mg-D0030		4.14	4.11		**1%**
Mn	Mn-T0040					
Mn	Mn-T0060		0.003	0.003	0.003	**0%**
Mn dissolved	Mn-D0050		0.002	0.002		**0%**
Mo	Mo-T0041					
Mo	Mo-T0040		<0.01	<0.01	<0.01	
Mo dissolved	Mo-D0030		<0.01	<0.01		
Sodium	Na-T0041					
Sodium	Na-D1331		1.3	1.3	1.4	**4%**
Ni	Ni-T0041					
Ni	Ni-T0040		<0.05	<0.05	<0.05	
Ni dissolved	Ni-D0030		<0.05	<0.05		
Pb	Pb-T0060		0.001	0.001	0.001	**0%**
Pb dissolved	Pb-D0050		0.001	0.001		**0%**
Phos T diss	P--D1390		<0.003	<0.003	<0.003	
Phos total	P--T1390					
Phos total	P--T139A		0.005	0.005	0.005	**0%**
Tl	mtspmtsp		<0.1	<0.1	<0.1	
Tl dissolved	mtspmtsp		<0.1	<0.1	<0.1	
Sr	Sr-T0041					
V	V--T0040		<0.01	<0.01	<0.01	
V dissolved	V--D0030		<0.01	<0.01		
Zn	Zn-T0040		<0.005	0.006	0.006	**0%**
Zn	*Zn-T0060*					
TOC	0103calc					
TIC	01240930	11	11			
Carbon total	C--T0910	14	14			**0%**
E. coli	01476013	4	4			
Enterococcus	01486014	2	1			
Coliform fecal	04502480		2			
Chlorate	pscppscp	0.01	0.01			**0%**
Chloroform						

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

		Site	Date/Time	Form #	Form #	Date/Time
	Columbi	umbia @ Waneta	91/12/17		10003326	91/12/17
		00200559	12:42	10003325	10003327	12:33
Parameter	Sparcode	1	2=Site A	3=Site B	4=Site C	Relative SD limit<18% @ >5x mdc
Color true	213000		<5	5	5	0%
pH	41220		7.3	7.4	7.4	
NFR=TSS	81070		1	1	<1	0%
Sp. Cond	111160		140	140	140	0%
Turbidity	151140		0.5	0.4	0.4	13%
Color TAC	241310		4	3	3	17%
FR=TDS	7H1032		74	76	76	2%
Phenol. Alk	1011211		<0.5	<0.5	<0.5	
Total Alk.	1021210		58.5	58.3	58.4	0%
TKN	01131360		0.14	0.1	0.12	17%
TKN	0113136A					
Color SW	10521320		<5	5	<5	
Chloride	11041330		1	1	1	0%
Fluoride	11061341		0.12	0.11	0.12	5%
Ammonia	11081351		0.049	0.045	0.046	4%
NO3+NO2	11091350		0.14	0.13	0.14	4%
Phosphorus Ortl	11181380		0.017	0.017	0.017	0%
Silica Reactive	11201381		1	2	1.3	36%
Sulfate	11211400		10.4	10.5	10.5	1%
All resin acids	xxxxP030					
Fatty acids except following						
Lauric acid	LAURP030		0.008			
Lignoceric acid	LIGNP030		0.04			
Myristic Acid	MYRIP030					
Palmitric acid	PALMP030		0.08			
Palustric acid	PALUP030					
Stearic acid	STEAP030					
AOX	AOX-DM01		0.03			
Mercury	Hg-T0310		0.00012	0.00012		0%
Al	Al-T0041					
Al	Al-T0040		<0.10	<0.10	<0.10	
Al dissolved	Al-D0030					
As hydride	As-T0181		<0.001	<0.001	<0.001	
As hydride disso	As-D0181					
Arsenic	As-T0041					
Ba	Ba-T0041					
Ba	Ba-T0040		0.02	0.02	0.02	0%
Ba dissolved	Ba-D0030					
B	B--T0041					
B dissolved	B--D0030					
Ca	Ca-T0041					
Ca	Ca-T0040		19.1	19.5	19.1	1%
Ca dissolved	Ca-D0030					
Cd	Cd-T0060		0.0006	0.0005	0.0006	10%
Cd dissolved	Cd-D0050					
Co	Co-T0041					
Co	Co-T0040		<0.1	<0.1	<0.1	
Co dissolved	Co-D0030					
Cr	Cr-T0060		13	<0.005	<0.005	

Cr dissolved	Cr-D0050				
Cu	Cu-T0040				
Cu gfaa	Cu-T0060	0.003	0.003	0.004	**17%**
Cu dissolved	Cu-D0050				
Fe	Fe-T0041				
Fe	Fe-T0040	0.03	0.05	0.04	**25%**
Fe dissolved	Fe-D0030				
K	K--D1331	0.6	0.6	0.6	**0%**
K ICP	K--T0041				
Mg	Mg-T0041				
Mg	Mg-T0040	4.3	4.41	4.32	**1%**
Mg dissolved	Mg-D0030				
Mn	Mn-T0040				
Mn	Mn-T0060	0.002	0.002	0.002	**0%**
Mn dissolved	Mn-D0050				
Mo	Mo-T0041				
Mo	Mo-T0040	<0.01	<0.01	<0.01	
Mo dissolved	Mo-D0030				
Sodium	Na-T0041				
Sodium	Na-D1331	1.5	1.5	1.5	**0%**
Ni	Ni-T0041				
Ni	Ni-T0040	<0.05	<0.05	<0.05	
Ni dissolved	Ni-D0030				
Pb	Pb-T0060	0.006	0.005	0.005	**11%**
Pb dissolved	Pb-D0050				
Phos T diss	P--D1390	0.018	0.017	0.018	**3%**
Phos total	P--T1390				
Phos total	P--T139A	0.021	0.02	0.022	**5%**
Tl	mtspmtsp	<0.1	<0.1	<0.1	
Tl dissolved	mtspmtsp				
Sr	Sr-T0041				
V	V--T0040	<0.01	<0.01	<0.01	
V dissolved	V--D0030				
Zn	Zn-T0040				
Zn	Zn-T0060	0.014	0.018	0.018	**14%**
TOC	0103calc				
TIC	01240930	13			
Carbon total	C--T0910	14			
E. coli	01476013				
Enterococcus	01486014				
Coliform fecal	04502480				
Chlorate	pscppscp	0.03			
Chloroform					

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

		Site	Date/Time	Form #	Form #	Date/Time
	Columbia	olumbia @ Waneta	92/01/21	10003283	10003167	92/01/21
		00200559	12:19	10003166	10003168	12:25
		Result mg/L	Result mg/l	Result mg/L	Result mg/L	**Relative SD**
Parameter	Sparcode	1	2=Site A	3=Site B	4=Site C	**limit<18% @ >5x mdc**
Color true	213000			<5	<5	
pH	41220		7.7	7.7	7.7	
NFR=TSS	81070		2	1	1	**43%**
Sp. Cond	111160		136	136	137	**0%**
Turbidity	151140		0.5	0.5	0.5	**0%**
Color TAC	241310		2	4	2	**43%**
FR=TDS	7H1032		82	78	80	**3%**
Phenol. Alk	1011211		<0.5	<0.5	<0.5	
Total Alk.	1021210		58.2	58.2	58.4	**0%**
TKN	01131360					
TKN	0113136A		0.08	0.08	0.07	**8%**
Color SW	10521320		5	5	<5	**0%**
Chloride	11041330		0.9	0.9	0.9	**0%**
Fluoride	11061341		0.10	0.10	0.10	**0%**
Ammonia	11081351		0.04	0.036	0.04	**6%**
NO3+NO2	11091350		0.10	0.12	0.11	**9%**
Phosphorus Ortl	11181380		<0.003	0.003	<0.003	
Silica Reactive	11201381		4.0	4.0	4.0	**0%**
Sulfate	11211400		10.0	9.9	10.0	**1%**
All resin acids	xxxxP030		<0.001			
Fatty acids except following			<0.001			
Lauric acid	LAURP030					
Lignoceric acid	LIGNP030					
Myristic Acid	MYRIP030					
Palmitric acid	PALMP030					
Palustric acid	PALUP030					
Stearic acid	STEAP030					
AOX	AOX-DM01	0.01				
Mercury	Hg-T0310		0.00062	0.00064		**2%**
Al	Al-T0041		0.03	0.04	0.03	**17%**
Al	Al-T0040					
Al dissolved	Al-D0030					
As hydride	As-T0181					
As hydride disso	As-D0181					
Arsenic	As-T0041		<0.04	<0.04	<0.04	
Ba	Ba-T0041		0.018	0.018	0.016	**7%**
Ba	Ba-T0040					
Ba dissolved	Ba-D0030					
B	B--T0041		0.060	0.036	0.062	**27%**
B dissolved	B--D0030					
Ca	Ca-T0041		18	19.3	16.8	**7%**
Ca	Ca-T0040					
Ca dissolved	Ca-D0030					
Cd	Cd-T0060		<0.0005	<0.0005	<0.0005	
Cd dissolved	Cd-D0050					
Co	Co-T0041		<0.003	<0.003	<0.003	
Co	Co-T0040					
Co dissolved	Co-D0030					
Cr	Cr-T0060		<0.005	<0.005	<0.005	

Cr dissolved	Cr-D0050					
Cu	Cu-T0040					
Cu gfaa	Cu-T0060		0.001	0.004	0.001	**87%**
Cu dissolved	Cu-D0050					
Fe	Fe-T0041		0.040	0.023	0.023	**34%**
Fe	Fe-T0040					
Fe dissolved	Fe-D0030					
K	K--D1331		0.6	0.6	0.8	**17%**
K ICP	K--T0041		0.6	0.4	1.4	**66%**
Mg	Mg-T0041		4.1	4.38	3.81	**7%**
Mg	Mg-T0040					
Mg dissolved	Mg-D0030					
Mn	Mn-T0040					
Mn	Mn-T0060		0.003	0.002	0.002	**25%**
Mn dissolved	Mn-D0050					
Mo	Mo-T0041		<0.004	<0.004	<0.004	
Mo	Mo-T0040					
Mo dissolved	Mo-D0030					
Sodium	Na-T0041		1.43	1.18	0.80	**28%**
Sodium	Na-D1331		1.4		1.4	**0%**
Ni	Ni-T0041		<0.008	<0.008	<0.008	
Ni	Ni-T0040					
Ni dissolved	Ni-D0030					
Pb	Pb-T0060		0.001	<0.001	0.001	**0%**
Pb dissolved	Pb-D0050					
Phos T diss	P--D1390		0.005	0.003	0.004	**25%**
Phos total	P--T1390					
Phos total	P--T139A					
Tl	mtspmtsp			0.016		
Tl dissolved	mtspmtsp					
Sr	Sr-T0041		0.103	0.112	0.096	**8%**
V	V--T0040			<0.003		
V dissolved	V--D0030					
Zn	Zn-T0040					
Zn	Zn-T0060		0.005	0.007	0.005	**20%**
TOC	0103calc					
TIC	01240930	12				
Carbon total	C--T0910	13				
E. coli	01476013	10				
Enterococcus	01486014	1				
Coliform fecal	04502480					
Chlorate	pscppscp		0.01			
Chloroform						

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

		Site	Date/Time	Form #	Form #	Date/Time	
		Columbia @ Waneta	92/02/18	10003284	10003084		
		00200559	92/02/18	10003083	10003085		
		Result mg/L	Result mg/L	Result mg/l	Result mg/L		**Relative SD**
Parameter	Sparcode	1	2=Site A	3=Site B	4=Site C		**limit<18% @ >5x mdc**
Color true	213000			<5	<5		
pH	41220		7.5	7.5	7.5		
NFR=TSS	81070		1	<1	1		**0%**
Sp. Cond	111160		148	147	148		**0%**
Turbidity	151140		0.8	0.5	0.4		**37%**
Color TAC	241310		2.	3	3		**22%**
FR=TDS	7H1032		88	86	92		**3%**
Phenol. Alk	1011211		<0.5	<0.5	<0.5		
Total Alk.	1021210		62.7	62.5	62.6		**0%**
TKN	01131360						
TKN	0113136A		0.17	0.17	0.15		**7%**
Color SW	10521320		<5	<5	<5		
Chloride	11041330		1.2	1.2	1.3		**5%**
Fluoride	11061341		0.11	0.11	0.12		**5%**
Ammonia	11081351		0.040	0.035	0.038		**7%**
NO3+NO2	11091350		0.13	0.13	0.14		**4%**
Phosphorus Ortl	11181380		0.018	0.018	0.018		**0%**
Silica Reactive	11201381		<0.5	<0.5	<0.5		
Sulfate	11211400		11.1	11.0	11.0		**1%**
All resin acids	xxxxP030						
Fatty acids except following							
Lauric acid	LAURP030	<0.001	<0.001				
Lignoceric acid	LIGNP030						
Myristic Acid	MYRIP030	<0.001	<0.001				
Palmitric acid	PALMP030	0.002	<0.001				
Palustric acid	PALUP030						
Stearic acid	STEAP030	,<0.001	<0.001				
AOX	AOX-DM01	0.02	0.03				**28%**
Mercury	Hg-T0310		<0.00005	<0.00005			
Al	Al-T0041						
Al	Al-T0040		0.04	0.04	0.04		**0%**
Al dissolved	Al-D0030						
As hydride	As-T0181						
As hydride disso	As-D0181						
Arsenic	As-T0041		<0.04	<0.04	<0.04		
Ba	Ba-T0041						
Ba	Ba-T0040		0.022	0.023	0.022		**3%**
Ba dissolved	Ba-D0030						
B	B--T0041						
B dissolved	B--D0030						
Ca	Ca-T0041						
Ca	Ca-T0040		21.0	21.4	21.4		**1%**
Ca dissolved	Ca-D0030						
Cd	Cd-T0060		<0.0005	<0.0005	<0.0005		
Cd dissolved	Cd-D0050						
Co	Co-T0041						
Co	Co-T0040		<0.003	<0.003	<0.003		
Co dissolved	Co-D0030						
Cr	Cr-T0060		<0.005	<0.005	<0.005		

Cr dissolved	Cr-D0050					
Cu	Cu-T0040					
Cu gfaa	Cu-T0060		0.003	0.002	0.002	25%
Cu dissolved	Cu-D0050					
Fe	Fe-T0041					
Fe	Fe-T0040		0.037	0.041	0.038	5%
Fe dissolved	Fe-D0030					
K	K--D1331		0.6	0.6	0.6	0%
K ICP	K--T0041		0.7	0.8	0.6	14%
Mg	Mg-T0041					
Mg	Mg-T0040		4.83	4.91	4.90	1%
Mg dissolved	Mg-D0030					
Mn	Mn-T0040					
Mn	Mn-T0060		0.003	0.003	0.003	0%
Mn dissolved	Mn-D0050					
Mo	Mo-T0041					
Mo	Mo-T0040		<0.004	<0.004	<0.004	
Mo dissolved	Mo-D0030					
Sodium	Na-T0041					
Sodium	Na-D1331		1.7	1.7	1.7	0%
Ni	Ni-T0041					
Ni	Ni-T0040		<0.008	<0.008	<0.008	
Ni dissolved	Ni-D0030					
Pb	Pb-T0060		0.002	0.002	0.002	0%
Pb dissolved	Pb-D0050					
Phos T diss	P--D1390		0.018	0.018	0.022	12%
Phos total	P--T1390					
Phos total	P--T139A					
Tl	mtspmtsp					
Tl dissolved	mtspmtsp					
Sr	Sr-T0041					
V	V--T0040		<0.003	<0.003	<0.003	
V dissolved	V--D0030					
Zn	Zn-T0040		0.014	0.011	0.010	18%
Zn	Zn-T0060					
TOC	0103calc					
TIC	01240930	12	13			6%
Carbon total	C--T0910	14	15			5%
E. coli	01476013	10	10			
Enterococcus	01486014	4	5			
Coliform fecal	04502480		8			
Chlorate	pscppscp	0.03	0.03			0%
Chloroform						

Columbia

Parameter	Sparcode	MDC	UNITS if not mg/L
Color true	213000	5	Colour units
pH	41220		pH units
NFR=TSS	81070	1	
Sp. Cond	111160		uhmos/cm
Turbidity	151140	0.1	NTU
Color TAC	241310	1	TAC units
FR=TDS	7H1032	1	
Phenol. Alk	1011211	0.5	
Total Alk.	1021210	0.05	
TKN	01131360	0.04	
TKN	0113136A	0.04	
Color SW	10521320	5	SW units
Chloride	11041330	0.50	
Fluoride	11061341	0.10	
Ammonia	11081351	0.005	
NO3+NO2	11091350	0.02	
Phosphorus Ortl	11181380	0.003	
Silica Reactive	11201381	0.50	
Sulfate	11211400	0.01	
All resin acids	xxxxP030	0.001	
Fatty acids except following		0.001	
Lauric acid	LAURP030		
Lignoceric acid	LIGNP030		
Myristic Acid	MYRIP030		
Palmitric acid	PALMP030		
Palustric acid	PALUP030		
Stearic acid	STEAP030		
AOX	AOX-DM01	0.01	
Mercury	Hg-T0310	0.00005	
Al	Al-T0041	0.02	
Al	Al-T0040		
Al dissolved	Al-D0030		
As hydride	As-T0181	0.001	
As hydride disso	As-D0181		
Arsenic	As-T0041	0.04	
Ba	Ba-T0041	0.001	
Ba	Ba-T0040		
Ba dissolved	Ba-D0030		
B	B--T0041	0.008	
B dissolved	B--D0030		
Ca	Ca-T0041	0.01	
Ca	Ca-T0040		
Ca dissolved	Ca-D0030		
Cd	Cd-T0060	0.0005	
Cd dissolved	Cd-D0050		
Co	Co-T0041	0.003	
Co	Co-T0040		
Co dissolved	Co-D0030		
Cr	Cr-T0060	0.005	

Cr dissolved	Cr-D0050		
Cu	Cu-T0040		
Cu gfaa	Cu-T0060	0.001	
Cu dissolved	Cu-D0050		
Fe	Fe-T0041	0.003	
Fe	Fe-T0040		
Fe dissolved	Fe-D0030		
K	K--D1331	0.1	
K ICP	K--T0041	0.4	
Mg	Mg-T0041	0.02	
Mg	Mg-T0040		
Mg dissolved	Mg-D0030		
Mn	Mn-T0040		
Mn	Mn-T0060	0.001	
Mn dissolved	Mn-D0050		
Mo	Mo-T0041	0.004	
Mo	Mo-T0040		
Mo dissolved	Mo-D0030		
Sodium	Na-T0041	0.01	
Sodium	Na-D1331	0.5	
Ni	Ni-T0041	0.008	
Ni	Ni-T0040		
Ni dissolved	Ni-D0030		
Pb	Pb-T0060	0.001	
Pb dissolved	Pb-D0050		
Phos T diss	P--D1390	0.003	
Phos total	P--T1390		
Phos total	P--T139A	0.003	
Tl	mtspmtsp	0.003	
Tl dissolved	mtspmtsp		
Sr	Sr-T0041	0.001	
V	V--T0040	0.003	
V dissolved	V--D0030		
Zn	Zn-T0040	0.002	
Zn	Zn-T0060	0.005	
TOC	0103calc		
TIC	01240930	2	
Carbon total	C--T0910	3	
E. coli	01476013	1	CFU
Enterococcus	01486014	1	CFU
Coliform fecal	04502480	2	CFU
Chlorate	pscppscp	0.1	
Chloroform			

Comments

Columbia Acceptable difference =25% for laboratory duplicates when both concentrations are > 5x mdc.

Parameter	Sparcode	Result mg/l 2	% Difference	Acceptance limits for field duplicates should be larger and set by the client.
Color true	213000			Colour units
pH	41220			log value cannot be compared
NFR=TSS	81070			mdc=1
Sp. Cond	111160			uS/cm
Turbidity	151140			NTU, mdc=0.1
Color TAC	241310			TAC, mdc=1
FR=TDS	7H1032			
Phenol. Alk	1011211			
Total Alk.	1021210			
TKN	01131360			mdc=0.03
TKN	0113136A			
Color SW	10521320			SWU
Chloride	11041330			
Fluoride	11061341			
Ammonia	11081351			
NO3+NO2	11091350			
Phosphorus Ortt	11181380			
Silica Reactive	11201381			
Sulfate	11211400			
All resin acids	xxxxP030			
Fatty acids except following				
Lauric acid	LAURP030			
Lignoceric acid	LIGNP030			
Myristic Acid	MYRIP030			
Palmitric acid	PALMP030			
Palustric acid	PALUP030			
Stearic acid	STEAP030			
AOX	AOX-DM01			mdc=0.01
Mercury	Hg-T0310			
Al	Al-T0041			
Al	Al-T0040			
Al dissolved	Al-D0030			
As hydride	As-T0181			
As hydride disso	As-D0181			
Arsenic	As-T0041			
Ba	Ba-T0041			
Ba	Ba-T0040			
Ba dissolved	Ba-D0030			
B	B--T0041			
B dissolved	B--D0030			
Ca	Ca-T0041			
Ca	Ca-T0040			
Ca dissolved	Ca-D0030			
Cd	Cd-T0060			
Cd dissolved	Cd-D0050			
Co	Co-T0041			
Co	Co-T0040			
Co dissolved	Co-D0030			
Cr	Cr-T0060			

Cr dissolved	Cr-D0050	
Cu	Cu-T0040	
Cu gfaa	Cu-T0060	mdc=.001
Cu dissolved	Cu-D0050	mdc=.001
Fe	Fe-T0041	
Fe	Fe-T0040	
Fe dissolved	Fe-D0030	
K	K--D1331	
K ICP	K--T0041	
Mg	Mg-T0041	
Mg	Mg-T0040	
Mg dissolved	Mg-D0030	
Mn	Mn-T0040	
Mn	Mn-T0060	
Mn dissolved	Mn-D0050	
Mo	Mo-T0041	
Mo	Mo-T0040	
Mo dissolved	Mo-D0030	
Sodium	Na-T0041	
Sodium	Na-D1331	
Ni	Ni-T0041	
Ni	Ni-T0040	
Ni dissolved	Ni-D0030	
Pb	Pb-T0060	
Pb dissolved	Pb-D0050	
Phos T diss	P--D1390	
Phos total	P--T1390	
Phos total	P--T139A	
Tl	mtspmtsp	
Tl dissolved	mtspmtsp	
Sr	Sr-T0041	
V	V--T0040	
V dissolved	V--D0030	
Zn	Zn-T0040	mdc=0.002
Zn	Zn-T0060	
TOC	0103calc	
TIC	01240930	
Carbon total	C--T0910	
E. coli	01476013	
Enterococcus	01486014	
Coliform fecal	04502480	
Chlorate	pscppscp	
Chloroform		

ZENON ENVIRONMENTAL LABORATORIES INC (BC) **TABLE II**

Travelling Blanks Units= mg/L except when shown otherwise.

		Site	Date/Form	Site II-1	Date/Form	Site	Date/Form
		Columbia @ Waneta	91/11/27	ve PE1272	91/11/27	@ Waneta	92/02/18
		00200559	10003332	00200183	10003331	00200559	10003285
Color true	213000	<5		<5			Colour units
pH	41220	6.3		5.4			pH units
NFR=TSS	81070	<1		<1			
Sp. Cond	111160	2		2			umhos/cm
Turbidity	151140	0.1		0.2			NTU
Color TAC	241310	2		<1			TAC units
FR=TDS	7H1032	<1		2			
Phenol. Alk	1011211	<0.5		<0.5			
Total Alk.	1021210	1.9		1.9			
TKN	01131360	<0.04		<0.04			
Color SW	10521320	<5		<5			SW colour uni
Chloride	11041330	<0.5		<0.5			
Fluoride	11061341	<0.10		<0.10			
Ammonia	11081351	<0.005		<0.005			
NO3+NO2	11091350	<0.02		<0.02			
Phosphorus Ortho	11181380	<0.003		<0.003			
Silica Reactive	11201381	<0.5		<0.5			
Sulfate	11211400	<1.0		1.0			
All resin acids	xxxxP030	<0.001				<0.001	
Fatty acids except following		<0.001					
Myristic Acid	MYRIP030	0.017					
AOX	AOX-DM01	0.01				<0.01	
Al	Al-T0040	<0.10					
Al dissolved	Al-D0030	<0.10					
As hydride	As-T0181	<0.001					
As hydride dissolve	As-D0181	<0.001					
Ba	Ba-T0040	<0.01					
Ba dissolved	Ba-D0030	<0.01					
B dissolved	B--D0030	<0.01					

ZENON ENVIRONMENTAL LABORATORIES INC (BC) **TABLE II**

Travelling Blanks

Units= mg/L except when shown otherwise.

		Site	Date/Form	Site I-1	Date/Form	Site	Date/Form
		Columbia @ Waneta	91/11/27	ve PE1272	91/11/27	@ Waneta	92/02/18
		00200559	10003332	00200183	10003331	00200559	10003285
Ca	Ca-T0040	<0.02					
Ca dissolved	Ca-D0030	<0.02					
Cd	Cd-T0060	<0.0005					
Cd dissolved	Cd-D0050	<0.0005					
Co	Co-T0040	<0.10					
Co dissolved	Co-D0030	<0.10					
Cr gfaa	Cr-T0060	<0.005					
Cr dissolved	Cr-D0050	<0.005					
Cu gfaa	Cu-T0060	0.001					
Cu dissolved	Cu-D0050	<0.001					
Fe	Fe-T0040	<0.01					
Fe dissolved	Fe-D0030	<0.01					
Mercury	Hg-T0310	0.0001					
K	K--D1331	<0.1		<0.1			
Mg	Mg-T0040	<0.02					
Mg dissolved	Mg-D0030	<0.02					
Mn	Mn-T0060	<0.001					
Mn dissolved	Mn-D0050	<0.001					
Mo	Mo-T0040	<0.01					
Mo dissolved	Mo-D0030	<0.01					
Sodium	Na-D1331	<0.5		<0.5			
Ni	Ni-T0040	<0.05					
Ni dissolved	Ni-D0030	<0.05					
Pb	Pb-T0060	<0.001					
Pb dissolved	Pb-D0050	<0.001					
Phos T diss	P--D1390	<0.003		<0.003			
Phos total	P--T139A	<0.003		<0.003			
Tl	mtspmtsp	<0.10					
Tl dissolved	mtspmtsp	<0.10					

ZENON ENVIRONMENTAL LABORATORIES INC (BC) **TABLE II**

Travelling Blanks

Units= mg/L except when shown otherwise.

		Site	Date/Form	Site	Date/Form	Site	Date/Form
	Columbia	@ Waneta	91/11/27	ve PE1272	91/11/27	@ Waneta	92/02/18
		00200559	10003332	00200183	10003331	00200559	10003285
V	V--T0040	<0.01					
V dissolved	V--D0030	<0.01					
Zn	Zn-T0060	<0.005					
Zn dissolved	Zn-D0050	<0.005					
TIC	01240930	<1		<1		<1	
Carbon total	C--T0910	<1		<1		<1	
Chlorate	pscppscp	<0.01		<0.01		<0.01	

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

TABLE III

ICP BLANK DATA FOR DIGESTED WATER SAMPLES.

BLANK CELL MEANS < MDC. UNITS= MG/L

DATE:		91/09/04		91/09/04		91/09/04		91/09/12		91/09/12		91/09/16		91/09/19		91/09/25	
BATCH #:		775		790		776		805		807		820		840		870	
ELEMENT	mdc	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2
Ag	0.01																
Al	0.02								0.075								
As	0.04																
B	0.008																
Ba	0.001																
Be	0.001																
Bi	0.02																
Ca	0.01	0.16	0.099	0.047	0.061	0.037	0.041	0.051	0.045	0.023	0.029	0.021	0.087	0.026	0.034		
Cd	0.002																
Co	0.003																
Cr	0.002																
Cu	0.001	0.013															
Fe	0.003	0.01		0.011				0.029	0.029								
K	0.4																
Mg	0.02																
Mn	0.002																
Mo	0.004																
Na	0.01	0.25	0.11		0.1	0.15	0.18	0.13	0.13	0.2	0.22	0.15	0.19	0.08	0.17	0.12	0.1
Ni	0.008																
P	0.04																
Pb	0.02																
S	0.03																
Sb	0.015																
Se	0.03																
Si	0.03																
Sn	0.02																
Sr	0.001																
Te	0.02																
Ti	0.003																
Tl	0.003																
V	0.003																
Zn	0.002	0.02	0.009	0.028	0.009			0.075		0.027	0.047			0.012	0.01	0.011	0.009
Zr	0.003																

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

ICP BLANK DATA FOR DIGESTED WATER SAMPLES.

BLANK CELL MEANS < MDC. UNITS= MG/L

DATE:		01/11/21		91/11/21		91/12/02		91/12/12		91/12/12		91/12/23		91/12/23		91/12/23	
BATCH #:		1132		1144		1202		1210		1233		1320		1278		1299	
ELEMENT	mdc	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2
Ag	0.01																
Al	0.02								0.061						0.05		0.064
As	0.04																
B	0.008																
Ba	0.001																
Be	0.001																
Bi	0.02																
Ca	0.01	0.095	0.14	0.044	0.034	0.058	0.059	0.081	0.058	0.028	0.039	0.042	0.03	0.03	0.03	0.072	0.16
Cd	0.002																
Co	0.003																
Cr	0.002																
Cu	0.001															0.013	0.026
Fe	0.003	0.02	0.03	0.26	0.027	0.043	0.016	0.026	0.03		0.013	0.03	0.026		0.017	0.022	0.023
K	0.4																
Mg	0.02		0.04					0.14									
Mn	0.002																
Mo	0.004																
Na	0.01	0.06	0.06	0.1	0.1	0.19	0.16	0.6	0.2	0.17	0.19	0.15	0.19	0.13	0.14	0.14	0.11
Ni	0.008																
P	0.04																
Pb	0.02																
S	0.03																
Sb	0.015																
Se	0.03																
Si	0.03																
Sn	0.02																
Sr	0.001																
Te	0.02																
Ti	0.003																
Tl	0.003																
V	0.003																
Zn	0.002	0.017	0.016	0.009	0.007	0.005	0.009	0.01	0.014								
Zr	0.003																

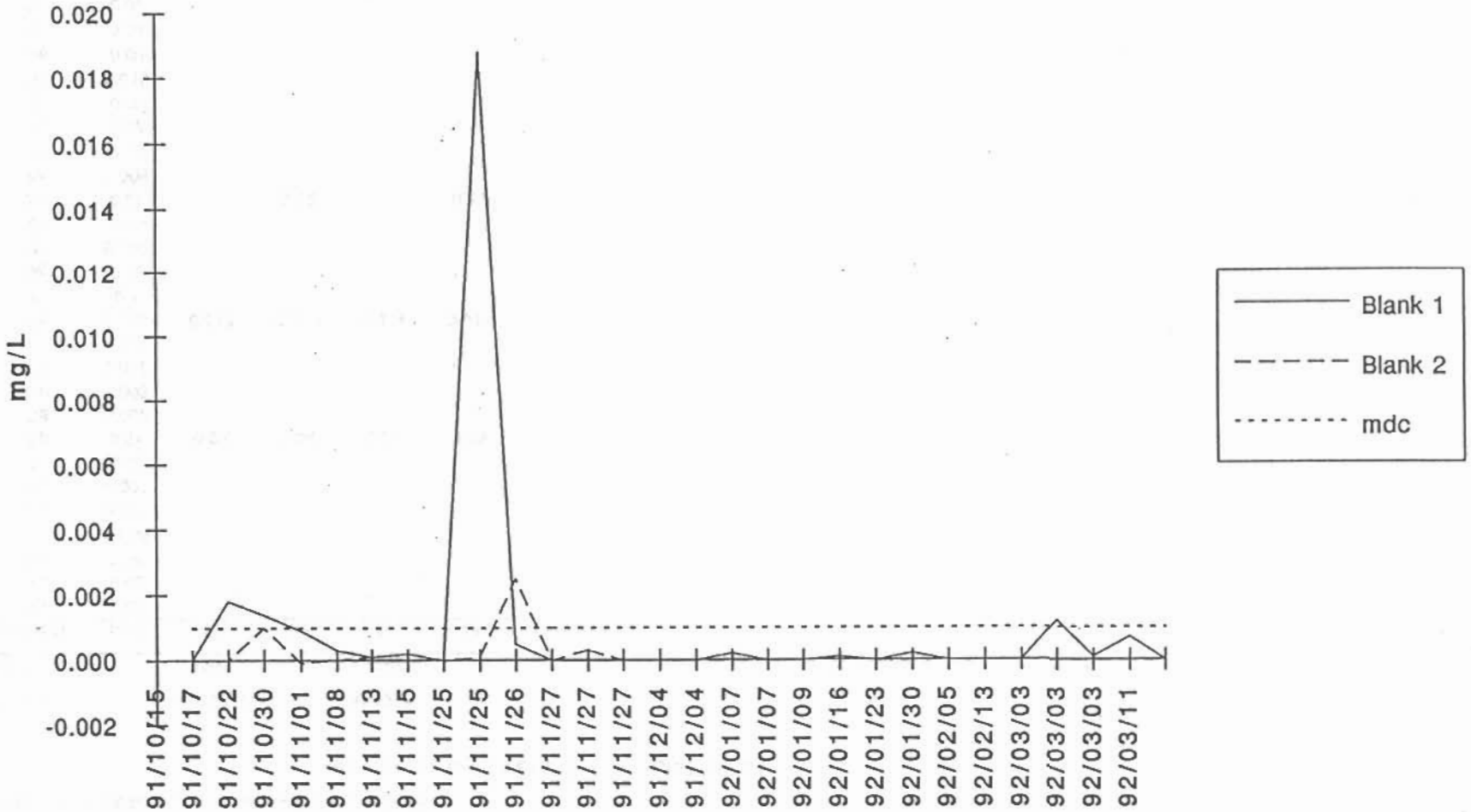
ZENON ENVIRONMENTAL LABORATORIES INC (BC)

ICP BLANK DATA FOR DIGESTED WATER SAMPLES.

BLANK CELL MEANS < MDC. UNITS= MG/L

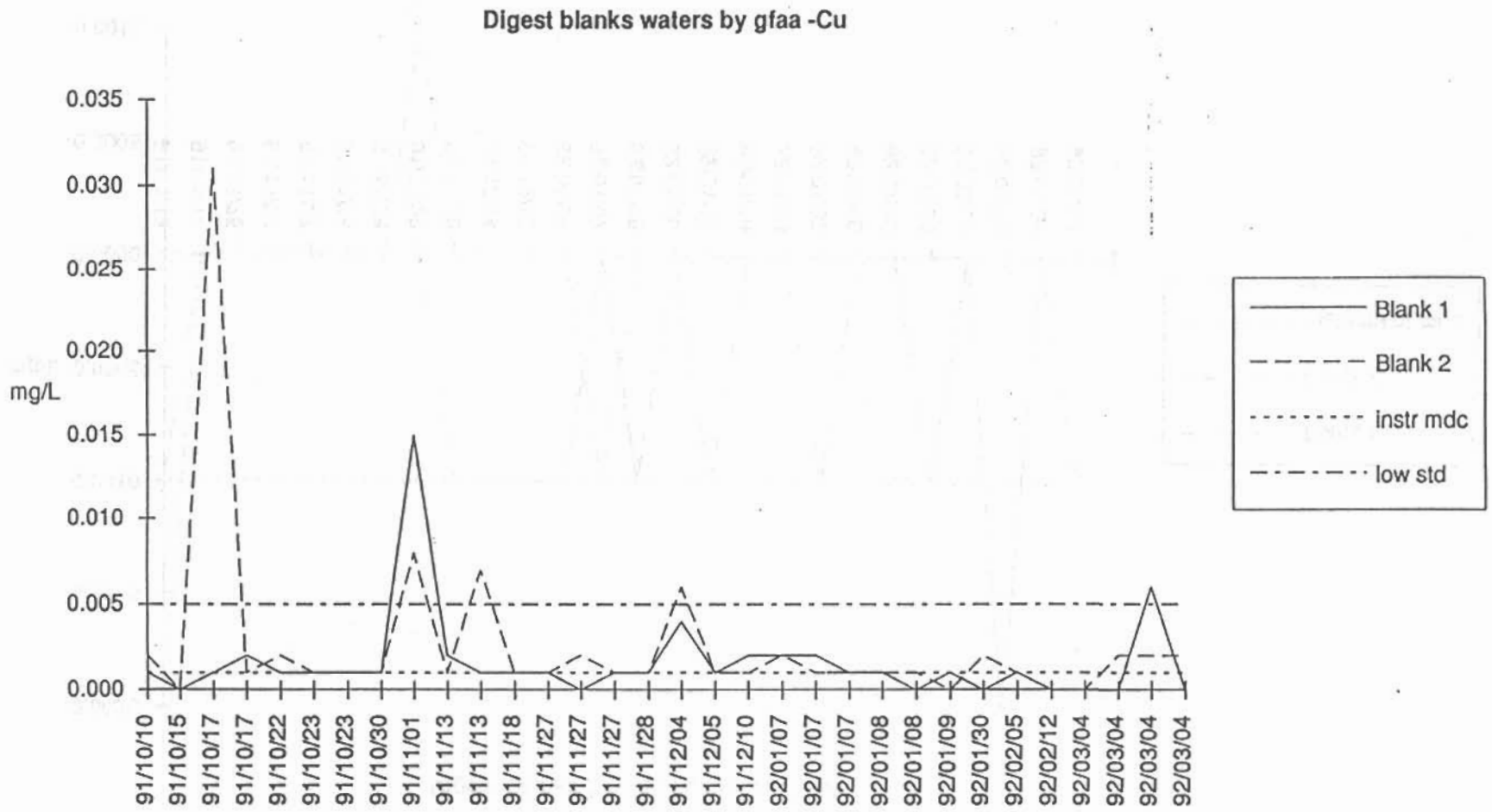
DATE:		91/12/23		91/12/23	
BATCH #:		1266		1292	
ELEMENT	mdc	#1	#2	#1	#2
Ag	0.01				
Al	0.02				
As	0.04				
B	0.008				
Ba	0.001				
Be	0.001				
Bi	0.02				
Ca	0.01	0.03	0.04	0.04	0.05
Cd	0.002				
Co	0.003				
Cr	0.002				
Cu	0.001				
Fe	0.003	0.017	0.017	0.014	0.011
K	0.4				
Mg	0.02				
Mn	0.002				
Mo	0.004				
Na	0.01		0.12		0.11
Ni	0.008				
P	0.04				
Pb	0.02				
S	0.03				
Sb	0.015				
Se	0.03				
Si	0.03				
Sn	0.02				
Sr	0.001				
Te	0.02				
Ti	0.003				
Tl	0.003				
V	0.003				
Zn	0.002		0.011		
Zr	0.003				

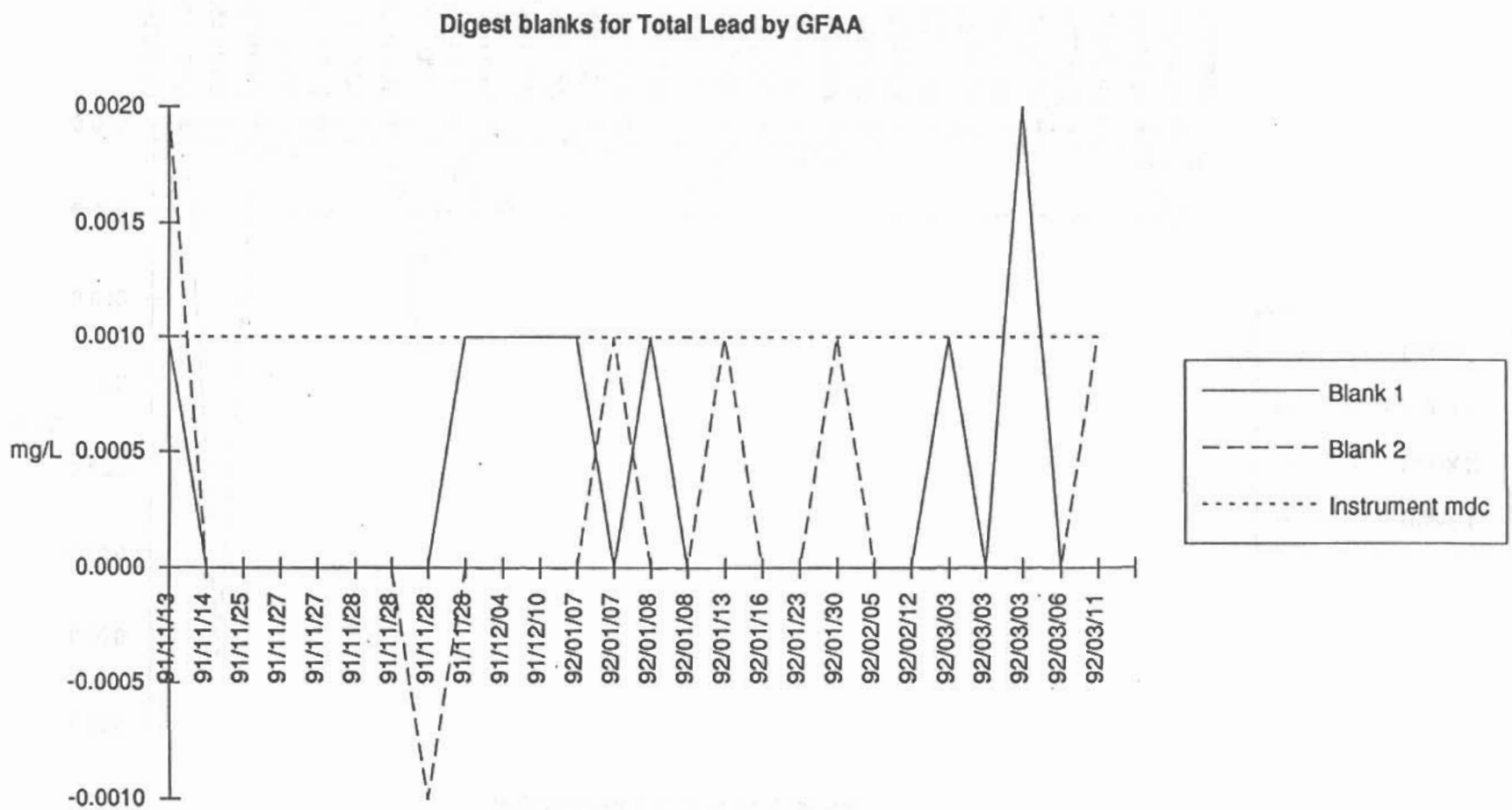
Digest blanks waters by gfaa - Cd

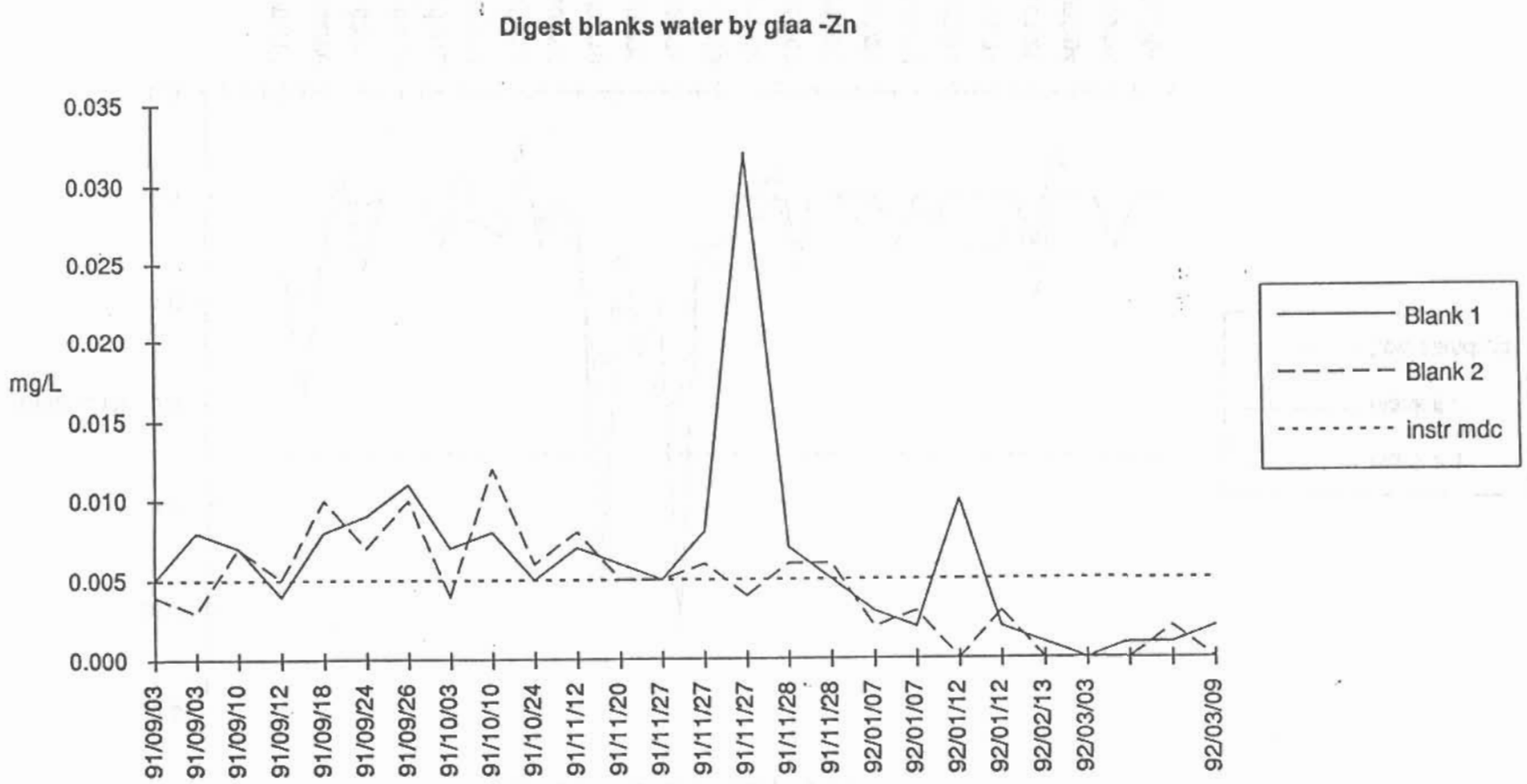


Note: Nov 25/91 Cd blanks: graphite furnace total results are blank corrected. When a high blank like occurs protocol as for Zinc. Cd blanks are typically in the 0 to 0.0003 mg/L range. A QH stanar digested and run, which can be used to verify that the blank correction is appropriate.

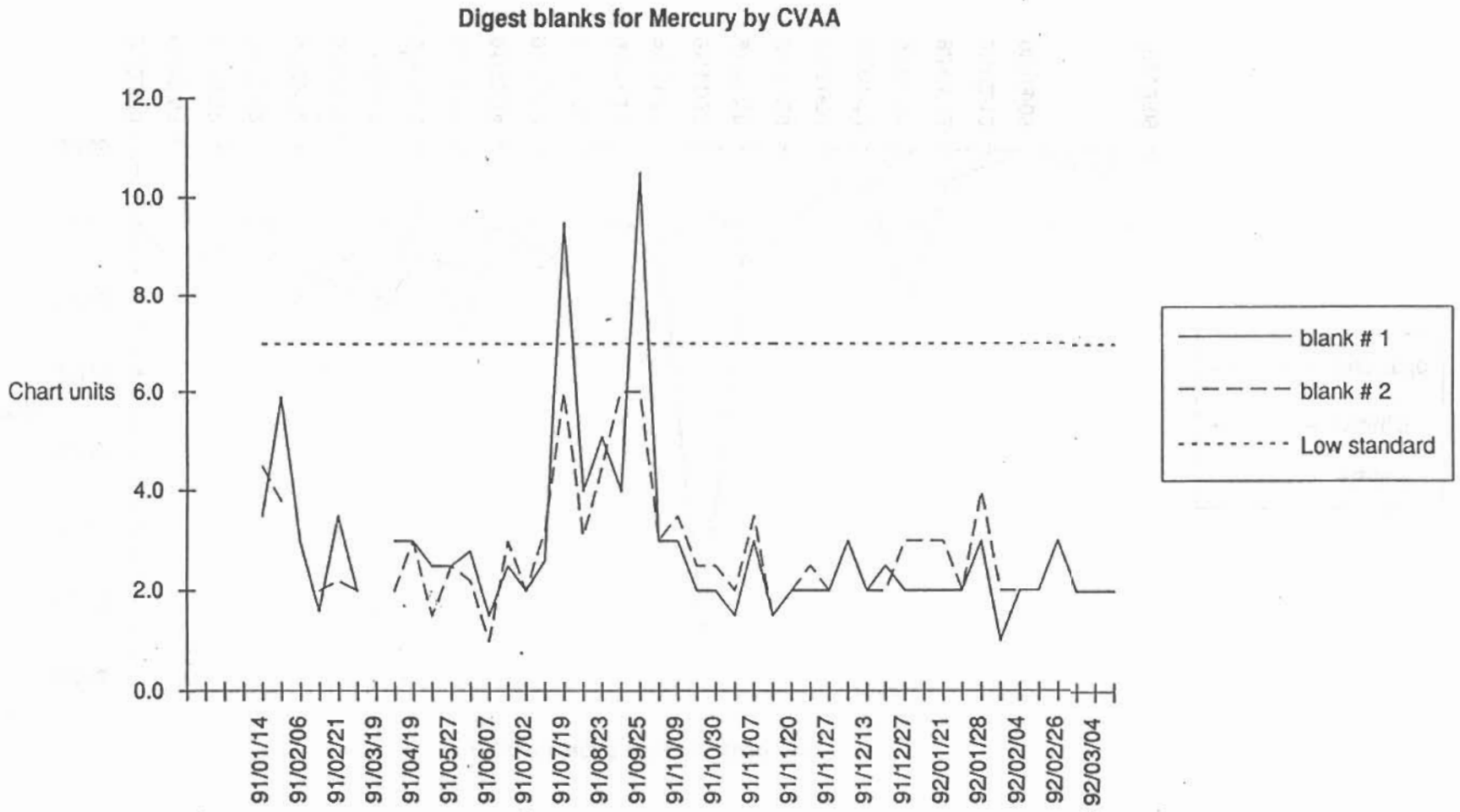
FIGURE 1


Digest blanks waters by gfaa -Cu
mg/L
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
91/10/10
91/10/15
91/10/17
91/10/17
91/10/22
91/10/23
91/10/23
91/10/30
91/11/01
91/11/13
91/11/13
91/11/18
91/11/27
91/11/27
91/11/27
91/11/28
91/12/04
91/12/05
91/12/10
92/01/07
92/01/07
92/01/07
92/01/08
92/01/08
92/01/09
92/01/30
92/02/05
92/02/12
92/03/04
92/03/04
92/03/04
92/03/04
Blank 1
Blank 2
instr mdc
low std


Digest blanks for Total Lead by GFAA
0.0020
0.0015
0.0010
mg/L 0.0005
0.0000
-0.0005
-0.0010
91/11/13
91/11/14
91/11/25
91/11/27
91/11/27
91/11/28
91/11/28
91/11/28
91/11/28
91/12/04
91/12/10
92/01/07
92/01/07
92/01/08
92/01/08
92/01/13
92/01/16
92/01/23
92/01/30
92/02/05
92/02/12
92/03/03
92/03/03
92/03/03
92/03/06
92/03/11
Blank 1
Blank 2
Instrument mdc

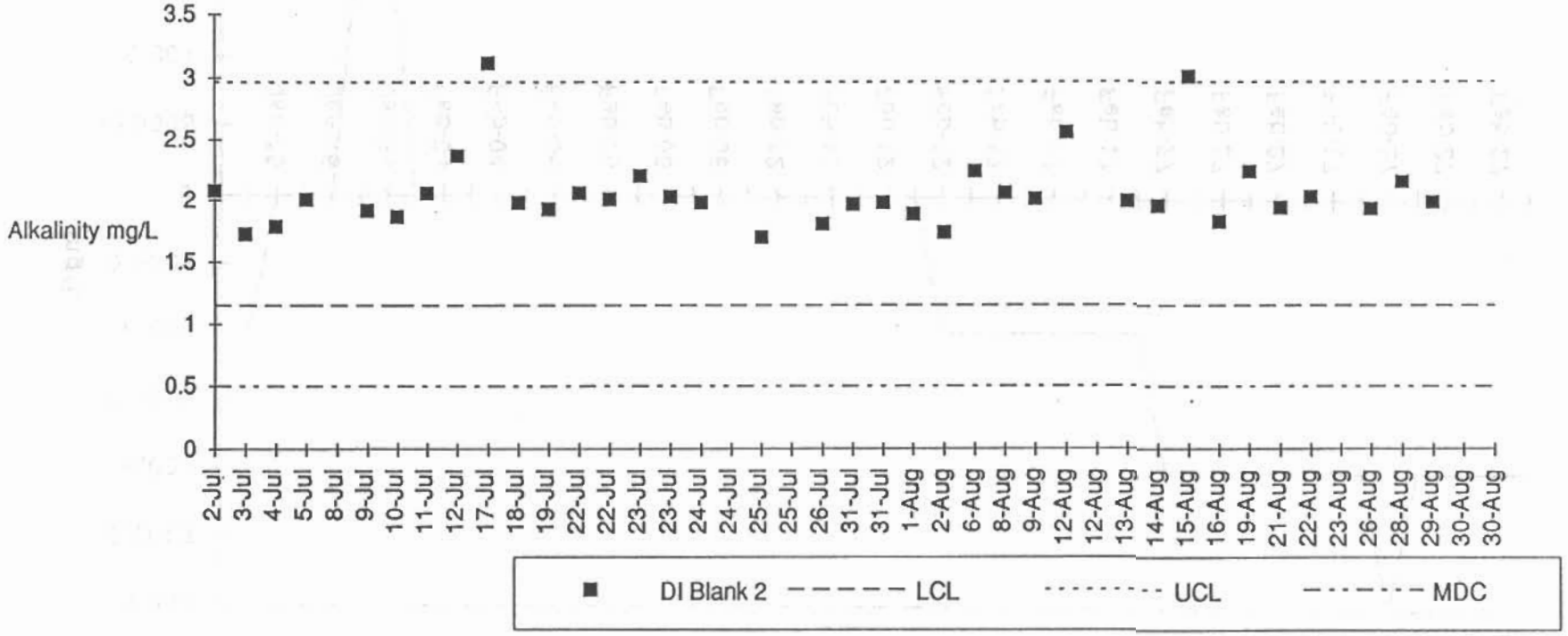


Note: Nov 27/91: Zn is a common contaminant. Protocol for high blanks: if one high blank and one low blank, and no high samples in the batch assume high blank was an isolated case, and batch accepted. Otherwise batch re-digested.

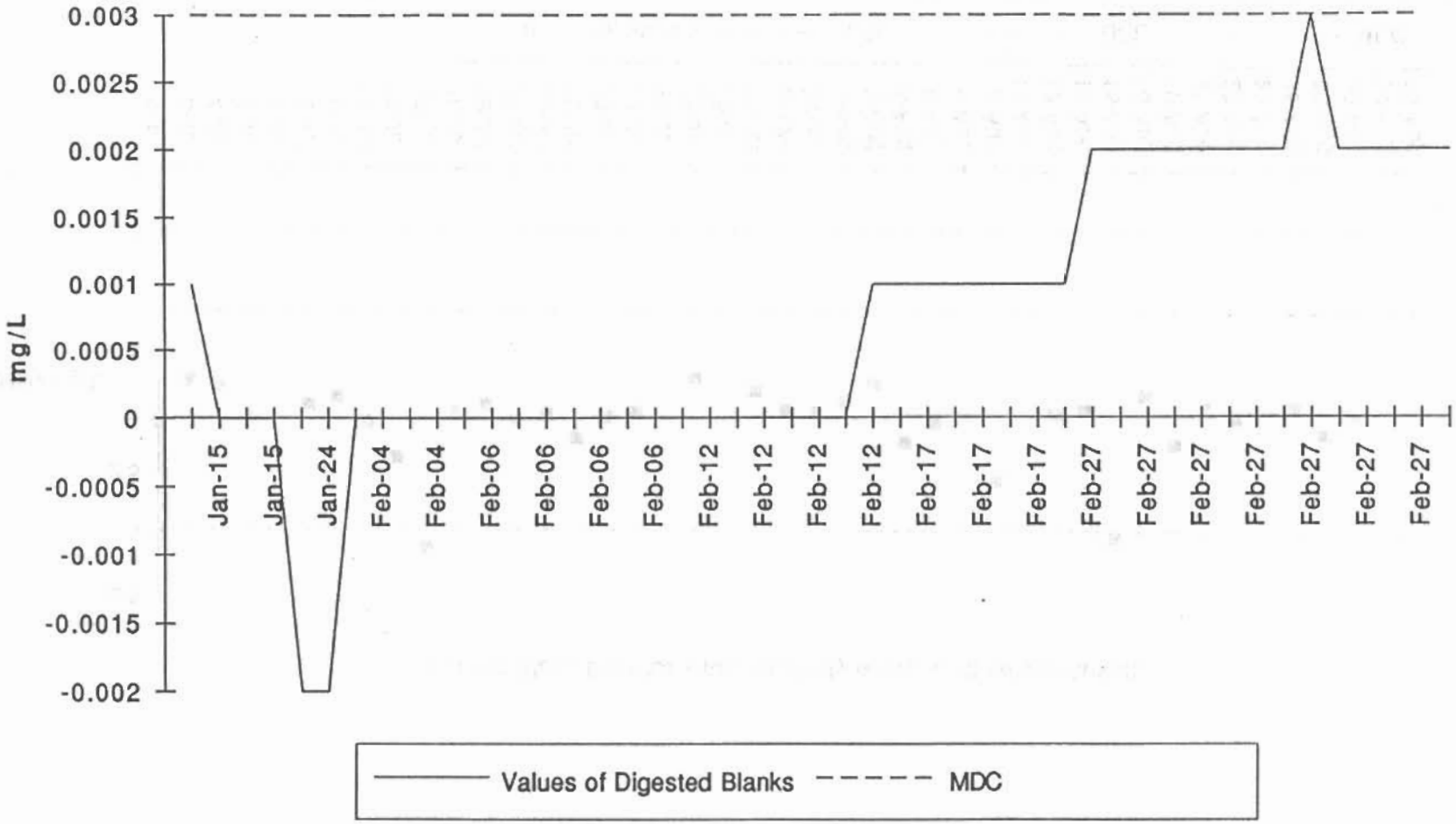


Note: Hg by CVAA: Instrument response shown on chart is an average value. On 91/0719 the low standard was reading 11 chart units. Low standard on 91/09/25 was reading 14 chart units.

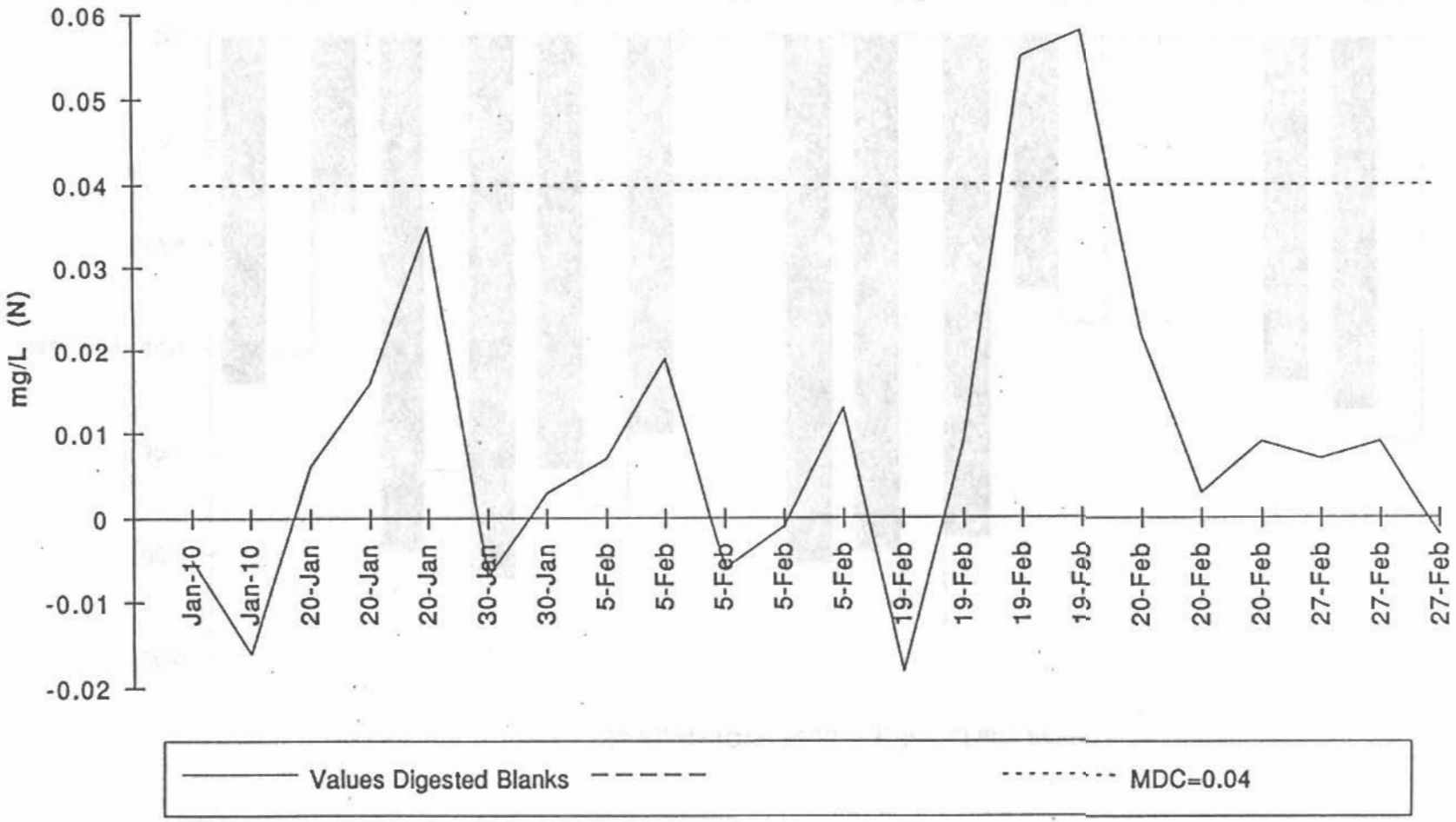
1991 DI Blank Data for Total Alkalinity (limits +/- 3 sd on blank2).



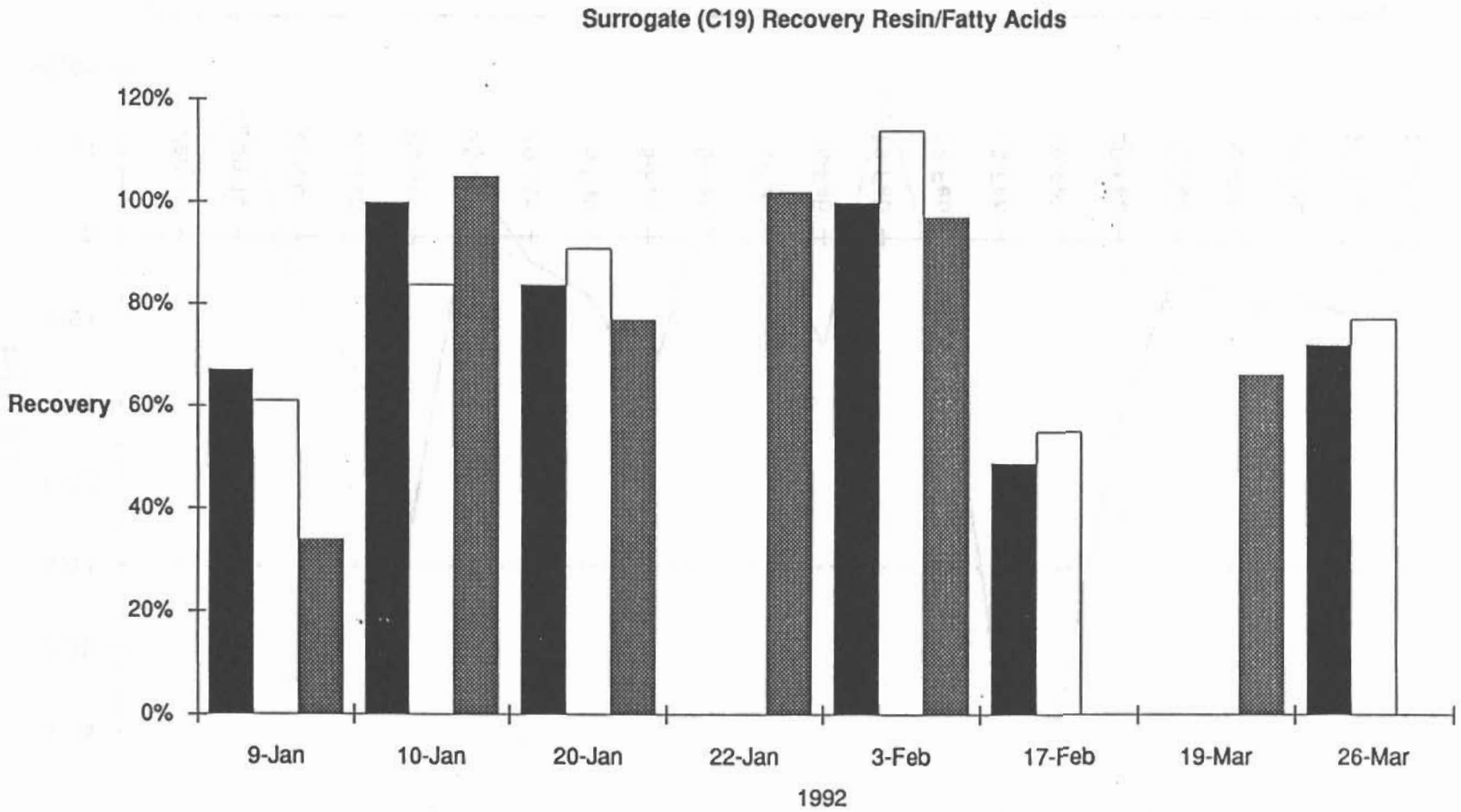
Total Phosphorus digested blanks 1992



Digested Blanks for Total Kjeldahl Nitrogen for 1992

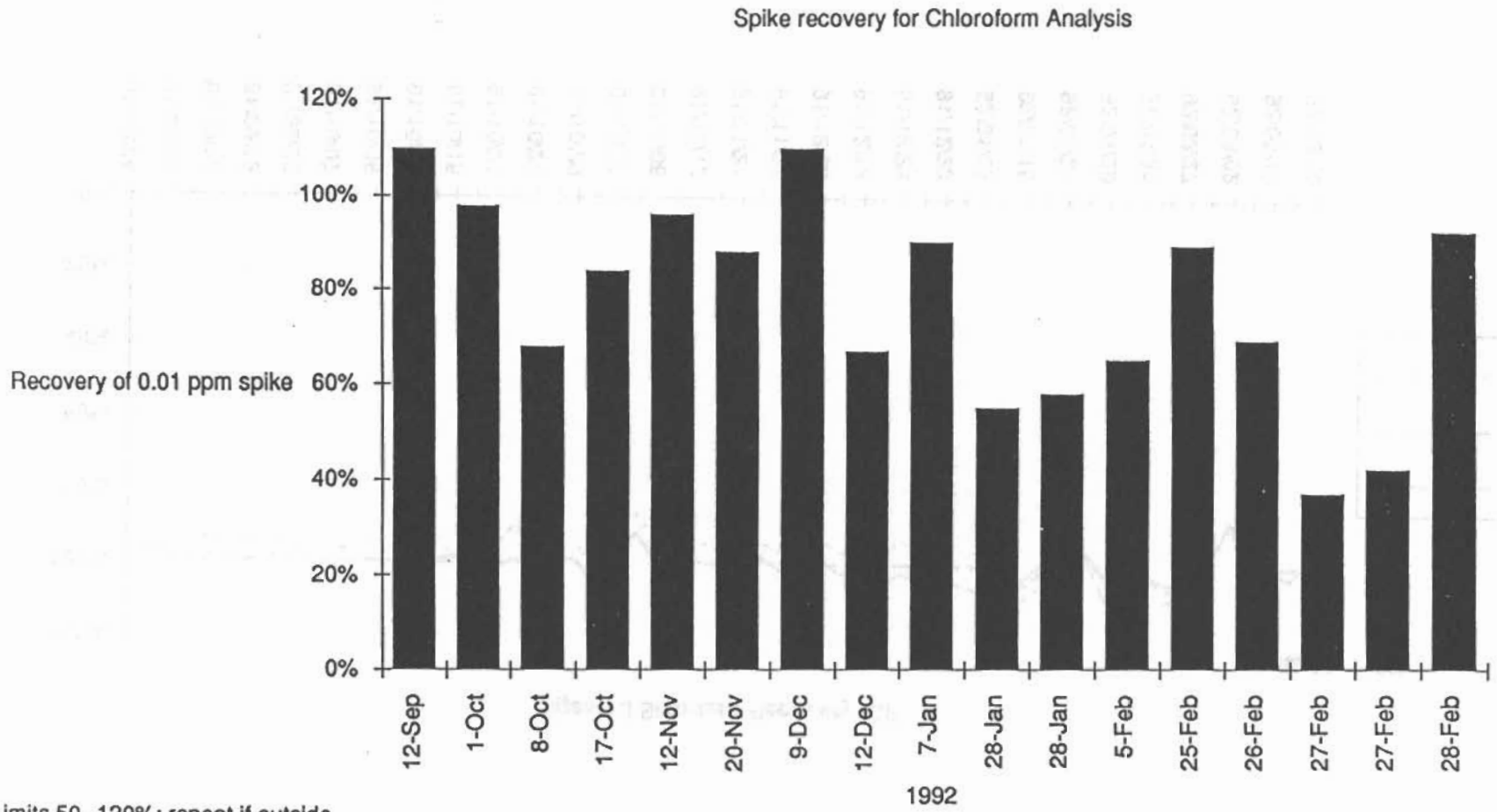


Note: Feb 19/92 : 4 batches were digested, 2 had blanks < MDC; 2 had blanks > MDC. Suspect tube contamination for the latter 2 blanks. /BH

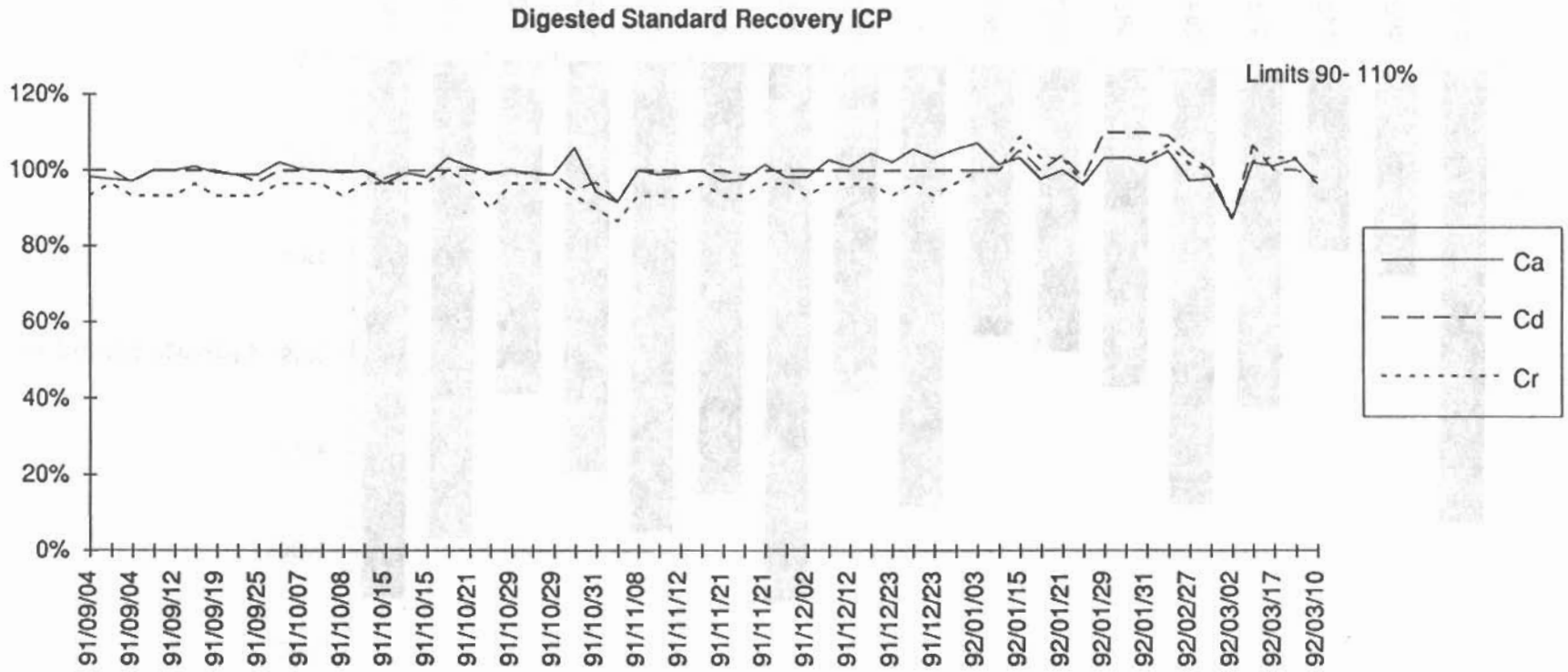


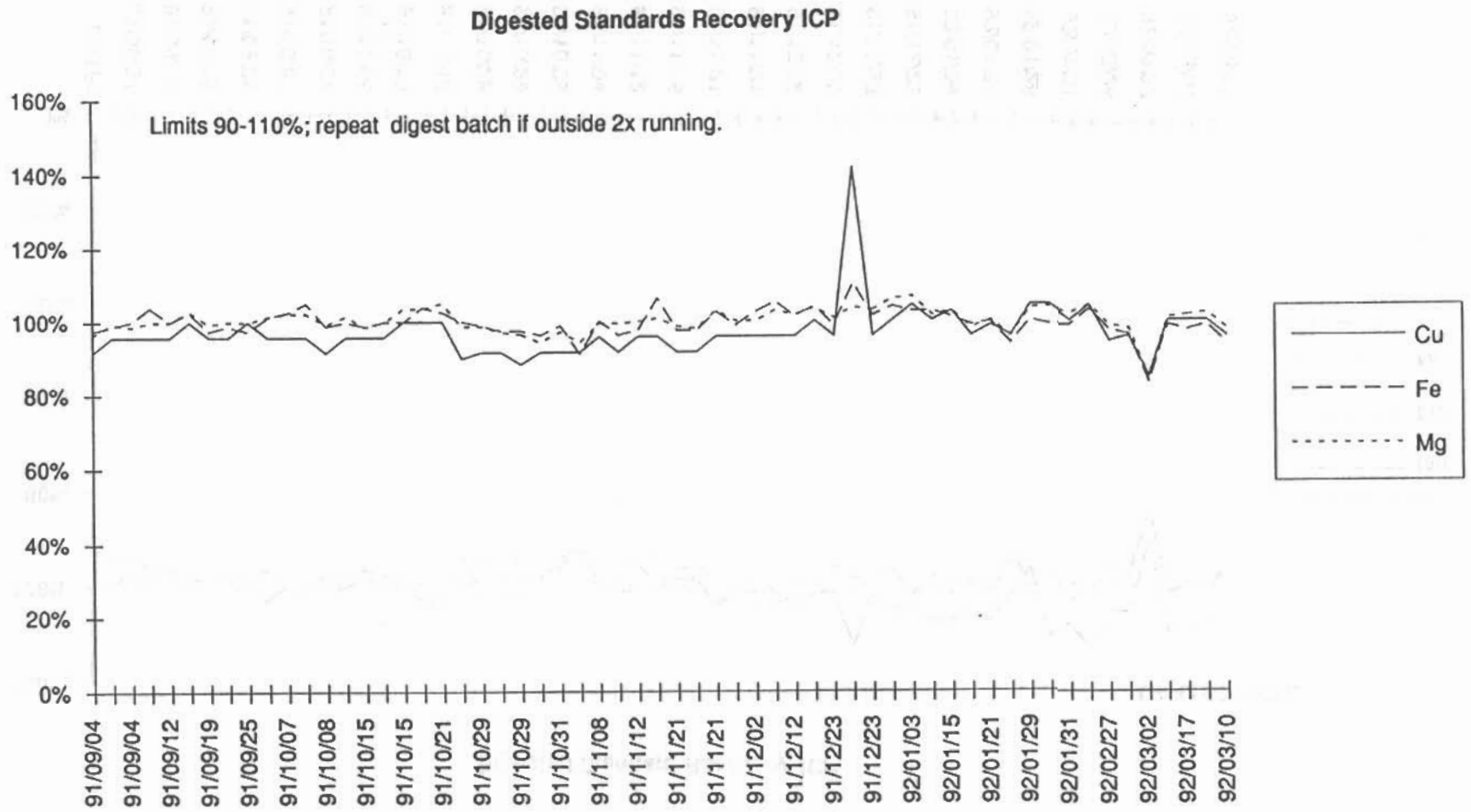
Note: Limits for resin/fatty acid surrogate recoveries: 60-120%. Samples outside this limit are repeated.

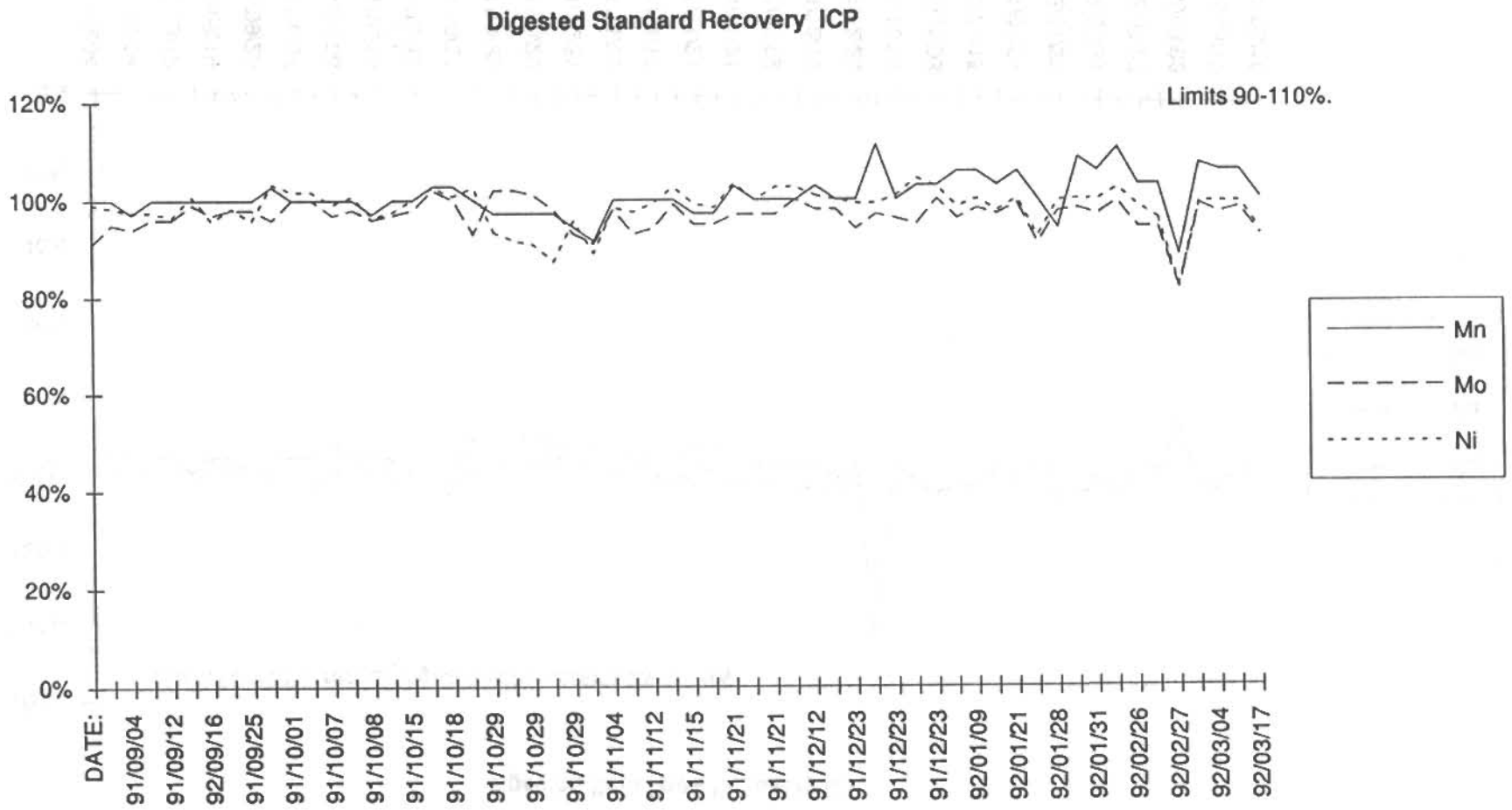
ZENON ENVIRONMENTAL LABORATORIES INC (BC)



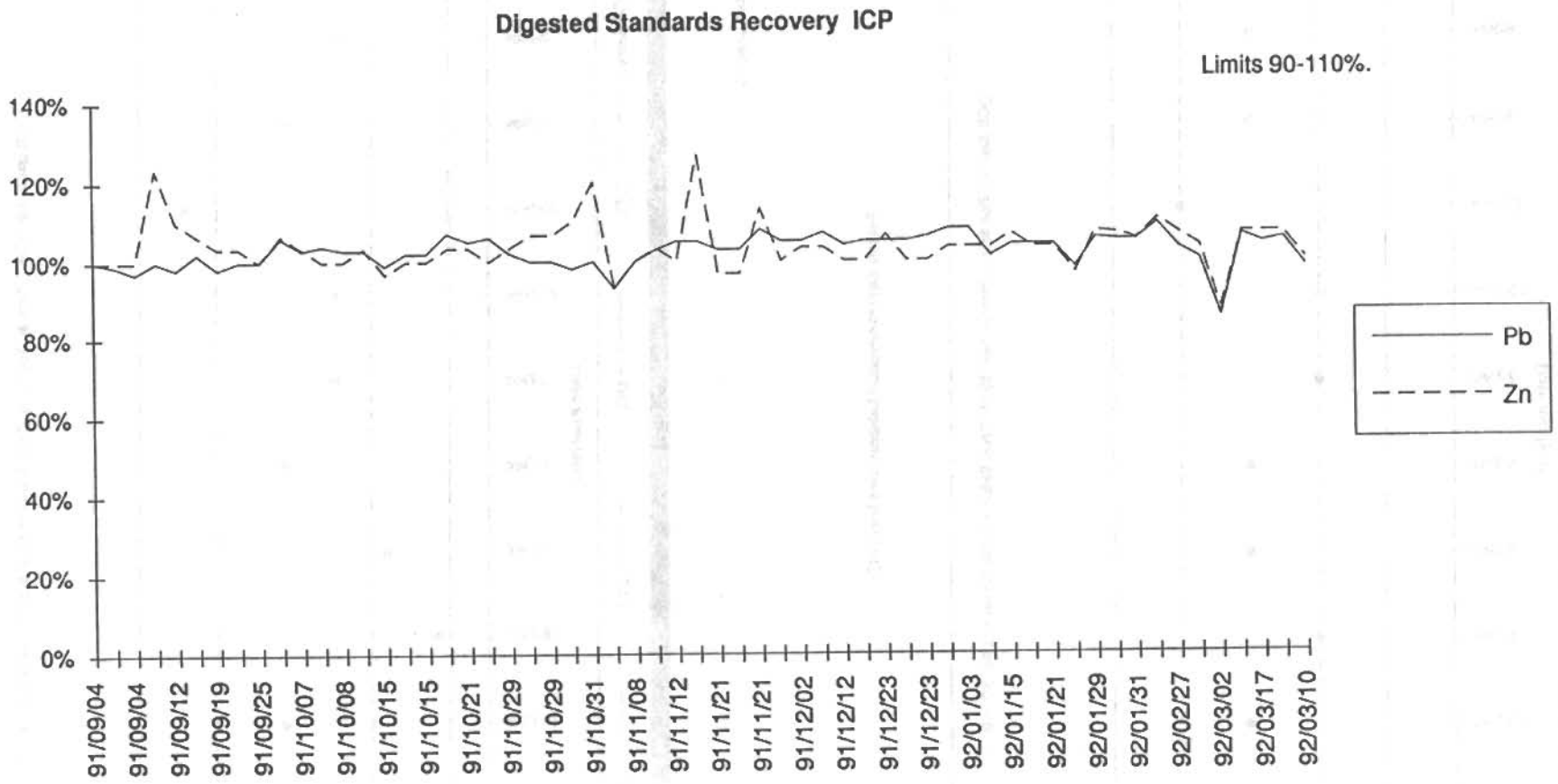
Limits 50--120%; repeat if outside.


Digested Standard Recovery ICP
Limits 90- 110%
120%
100%
80%
60%
40%
20%
0%
91/09/04
91/09/04
91/09/12
91/09/19
91/09/25
91/10/07
91/10/08
91/10/15
91/10/15
91/10/21
91/10/29
91/10/29
91/10/31
91/11/08
91/11/12
91/11/21
91/11/21
91/12/02
91/12/12
91/12/23
91/12/23
92/01/03
92/01/15
92/01/21
92/01/29
92/01/31
92/02/27
92/03/02
92/03/17
92/03/10
Ca
Cd
Cr


Digested Standards Recovery ICP
Limits 90-110%; repeat digest batch if outside 2x running.
160%
140%
120%
100%
80%
60%
40%
20%
0%
91/09/04
91/09/04
91/09/12
91/09/19
91/09/25
91/10/07
91/10/08
91/10/15
91/10/15
91/10/21
91/10/29
91/10/29
91/10/31
91/11/08
91/11/12
91/11/21
91/11/21
91/12/02
91/12/12
91/12/23
91/12/23
92/01/03
92/01/15
92/01/21
92/01/29
92/01/31
92/02/27
92/03/02
92/03/17
92/03/10
Cu
Fe
Mg


Digested Standard Recovery ICP
Limits 90-110%.
120%
100%
80%
60%
40%
20%
0%
DATE:
91/09/04
91/09/12
92/09/16
91/09/25
91/10/01
91/10/07
91/10/08
91/10/15
91/10/18
91/10/29
91/10/29
91/10/29
91/11/04
91/11/12
91/11/15
91/11/21
91/11/21
91/12/12
91/12/23
91/12/23
91/12/23
92/01/09
92/01/21
92/01/28
92/01/31
92/02/26
92/02/27
92/03/04
92/03/17
Mn
Mo
Ni

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

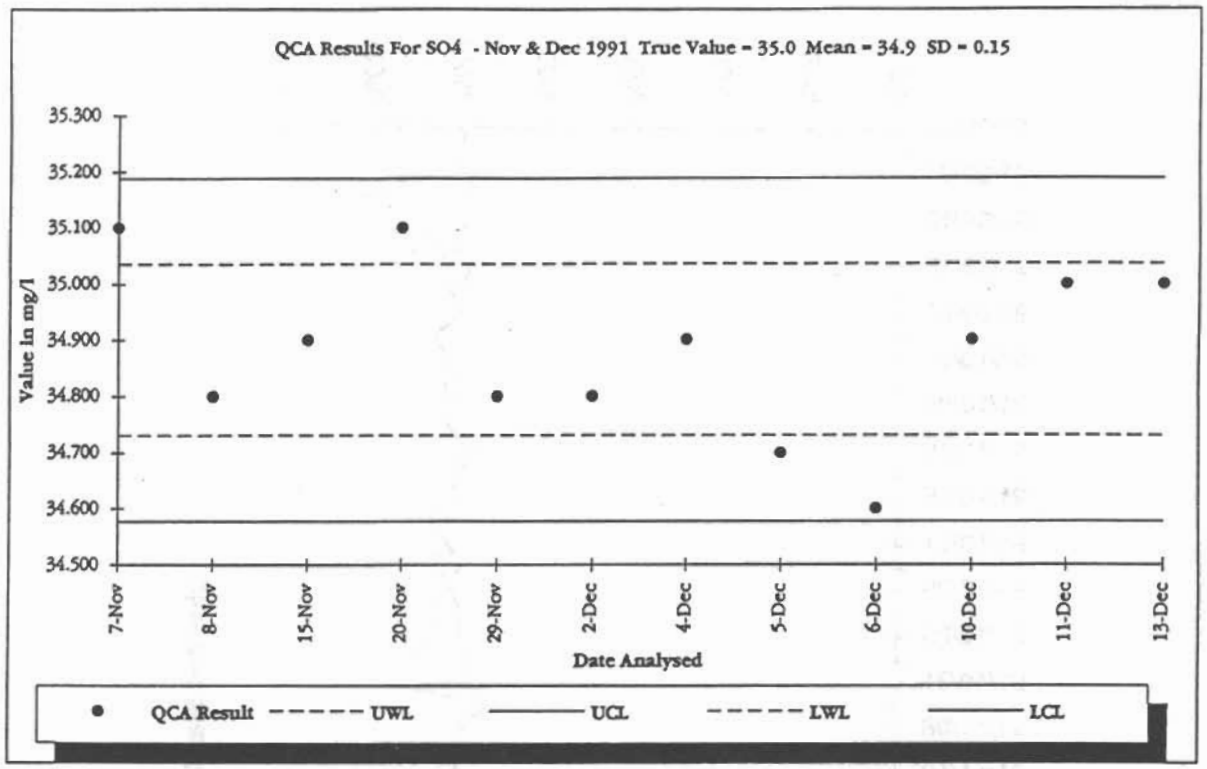


ICPC ˙XLC

FIGURE

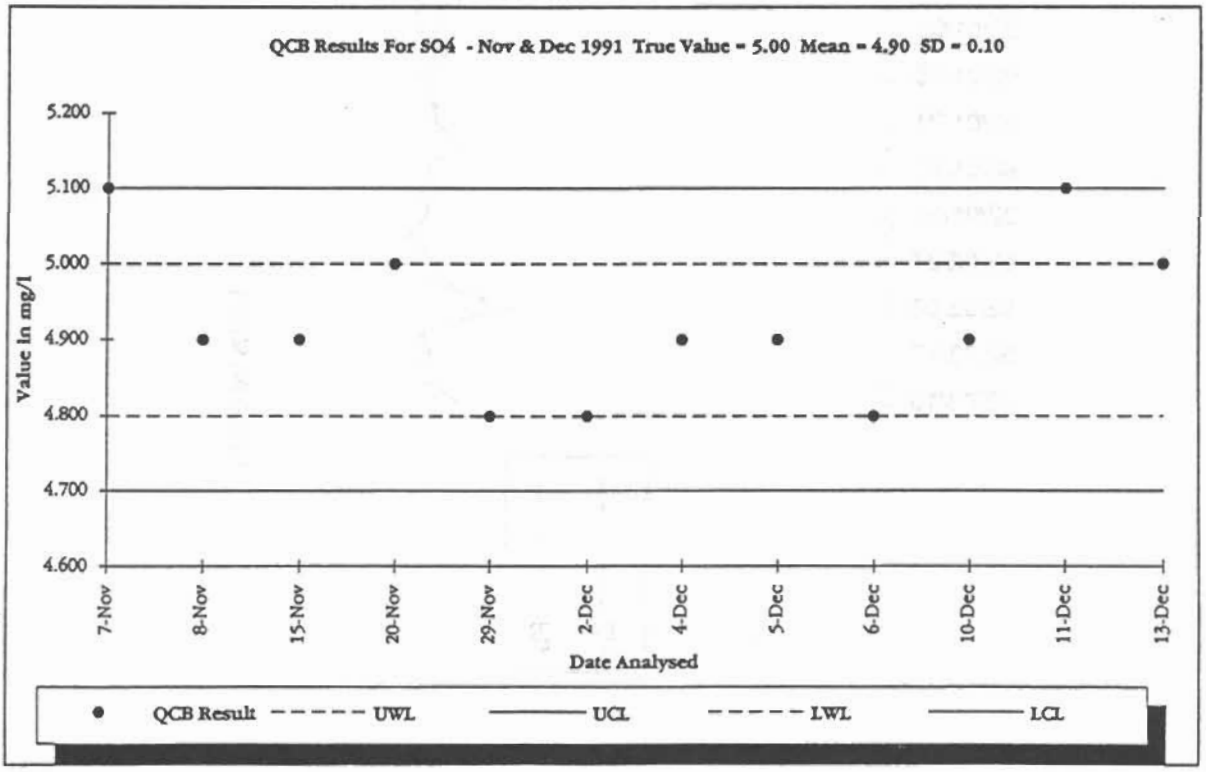
4/2/92

Zenon Environmental Laboratories Inc. (BC)



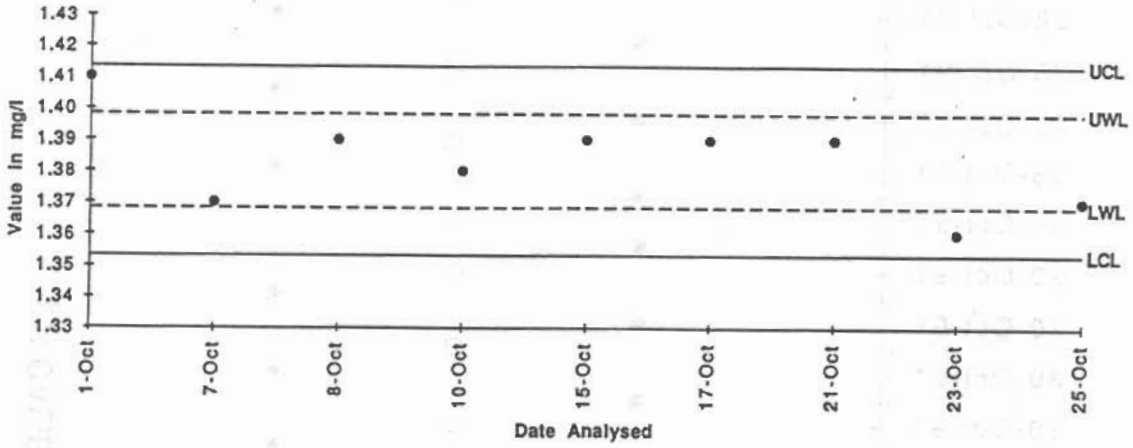
QCA SO4 Chart - Nov/Dec/91 1/21/92

Zenon Environmental Laboratories Inc. (BC)



QCA Results For Fluoride - October 1991

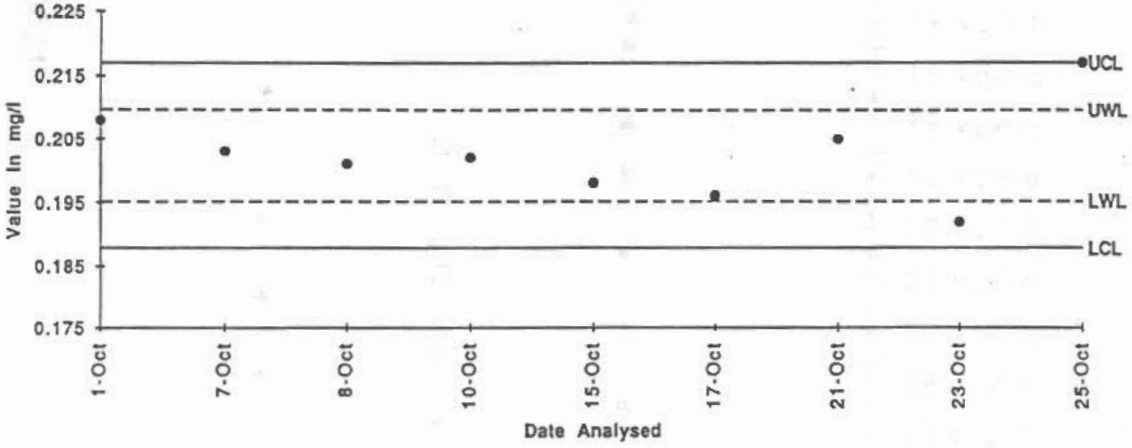
True Value = 1.40 Mean = 1.38 SD = .015



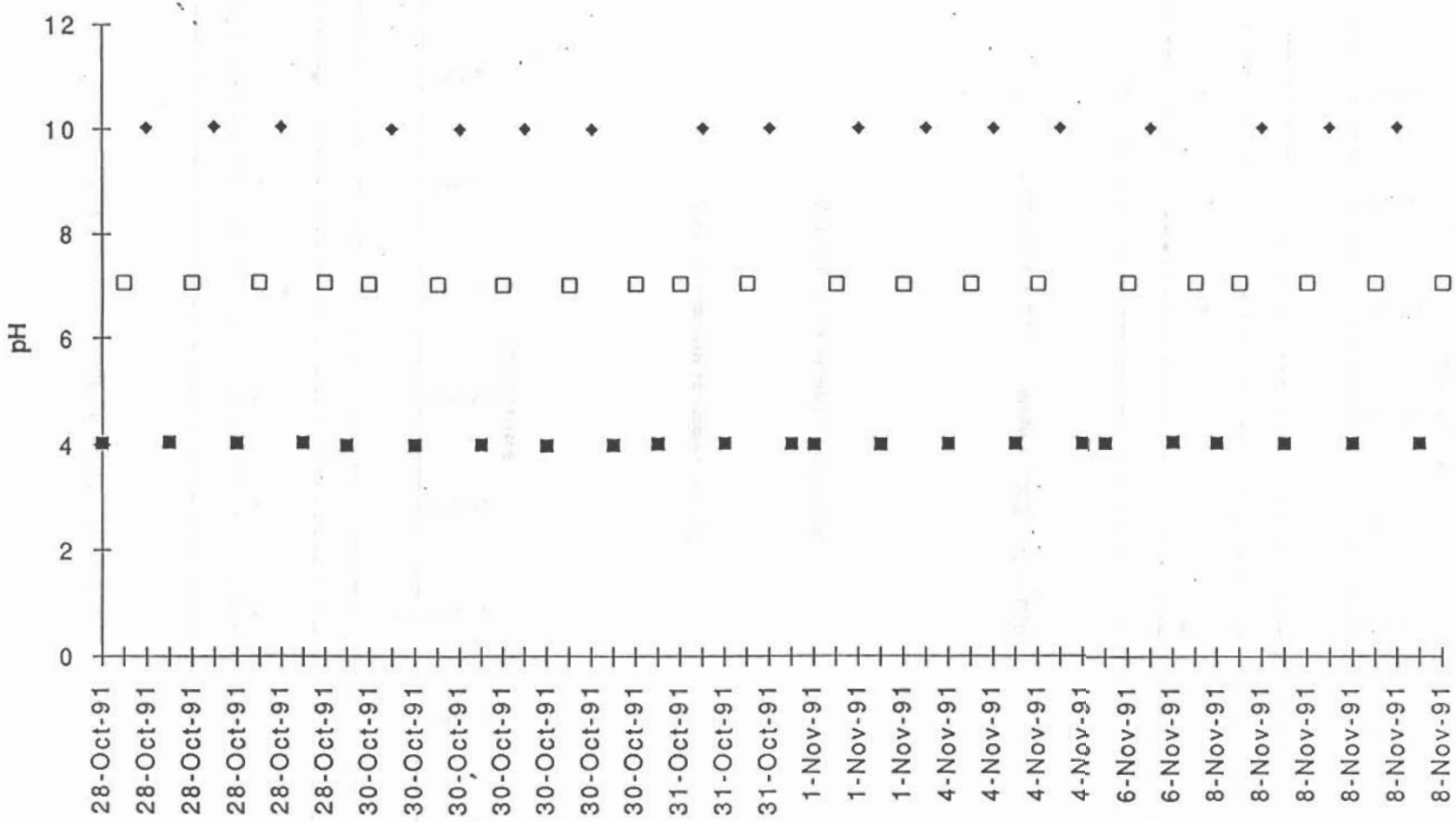
Zenon Environmental Laboratories Inc. - BC

QCB Results For Fluoride - October 1991

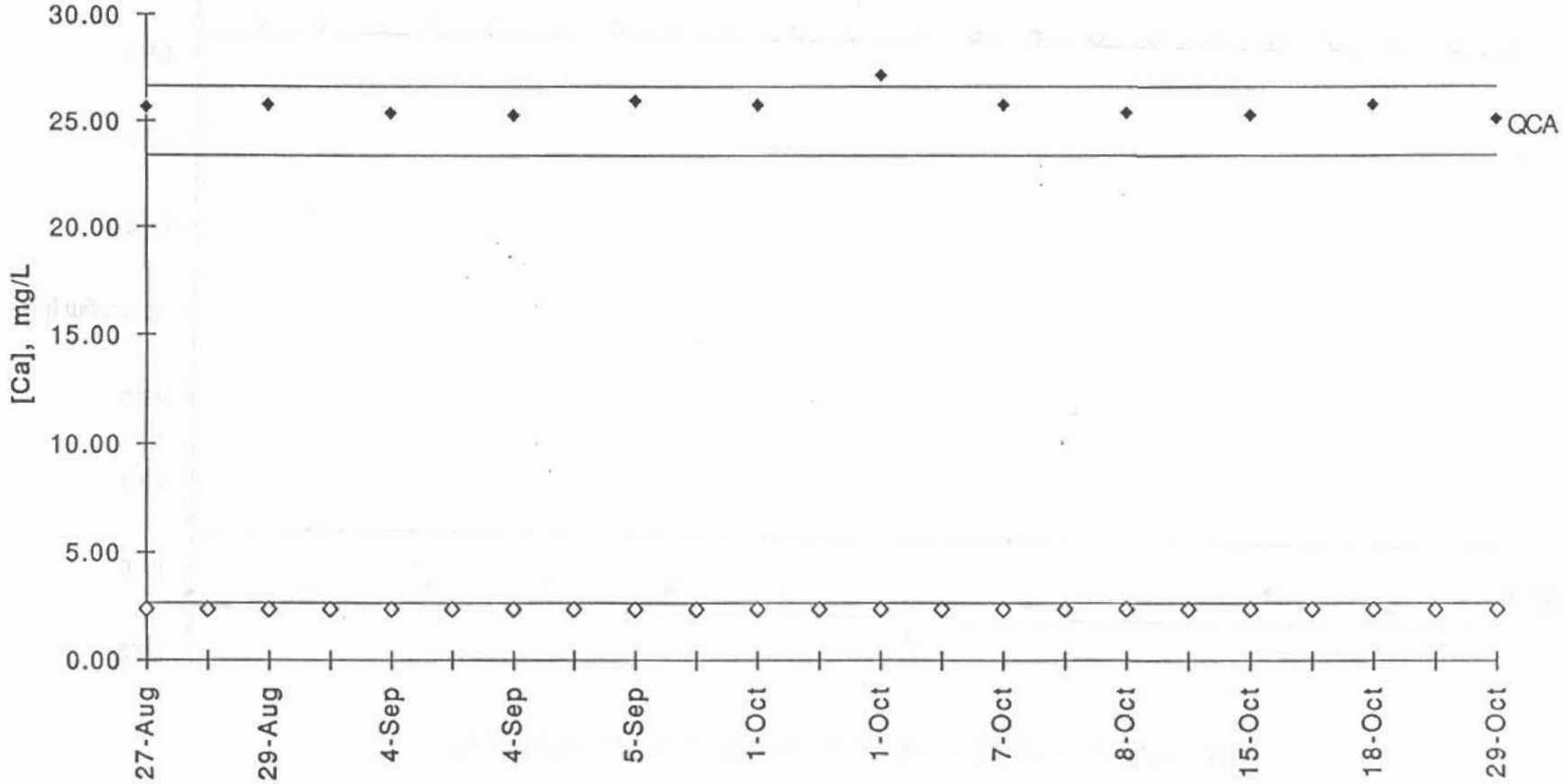
True Value = 0.200 Mean = 0.203 SD = 0.009



pH CALIBRATION CHECK PARAMETER CODE 0004.



Ca by ICP (Jarrell Ash 61E) 1991 QCA/QCB :Control limits Design +/- 3sd.



Cd by ICP (Jarrell Ash 61E) 1991 :QCA/QCB Control Limits Design +/- 3 sd

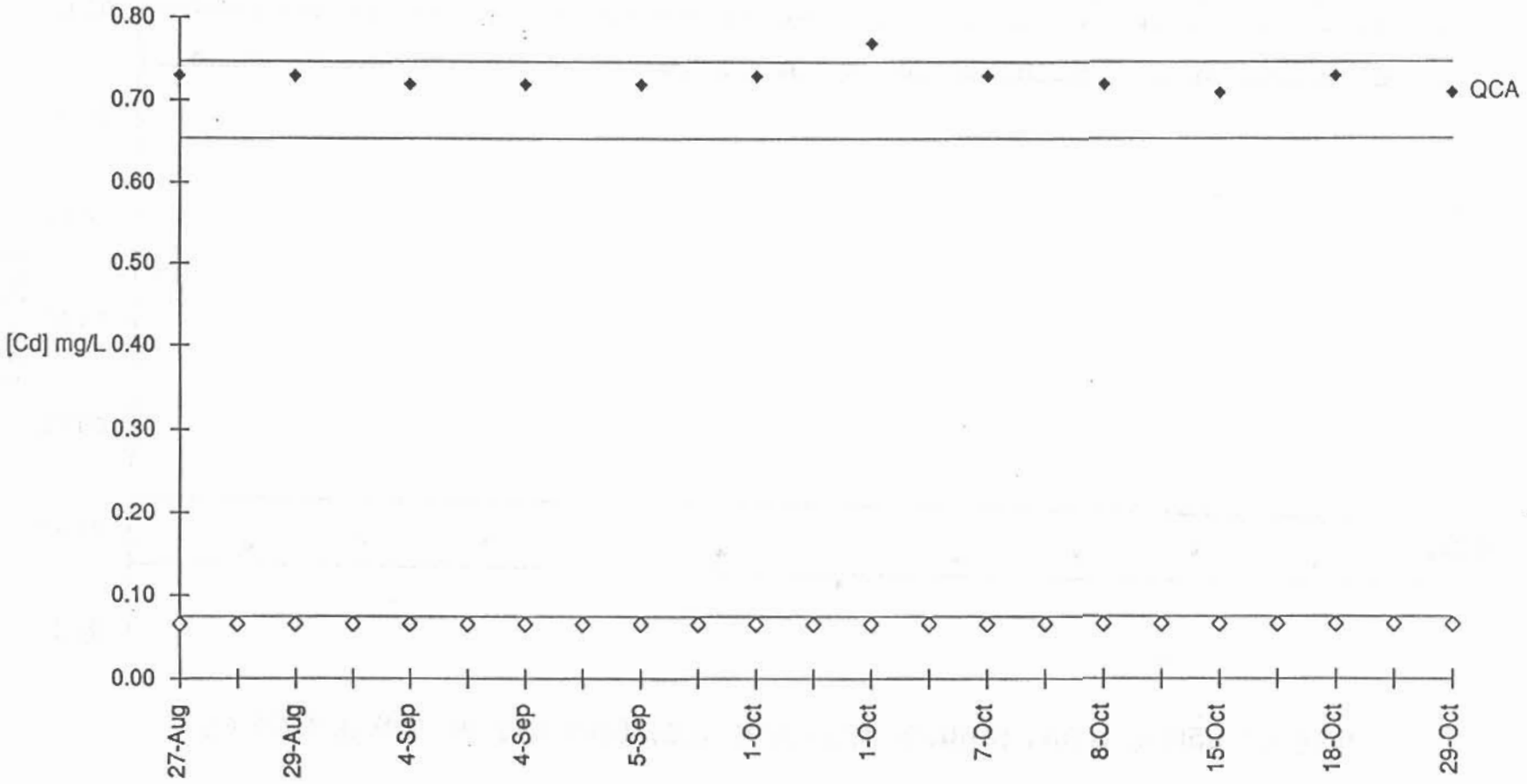


FIGURE 20

Iron by ICP (Jarrell Ash 61E) 1991 QCA/QCB: control limits Design +/- 3sd.

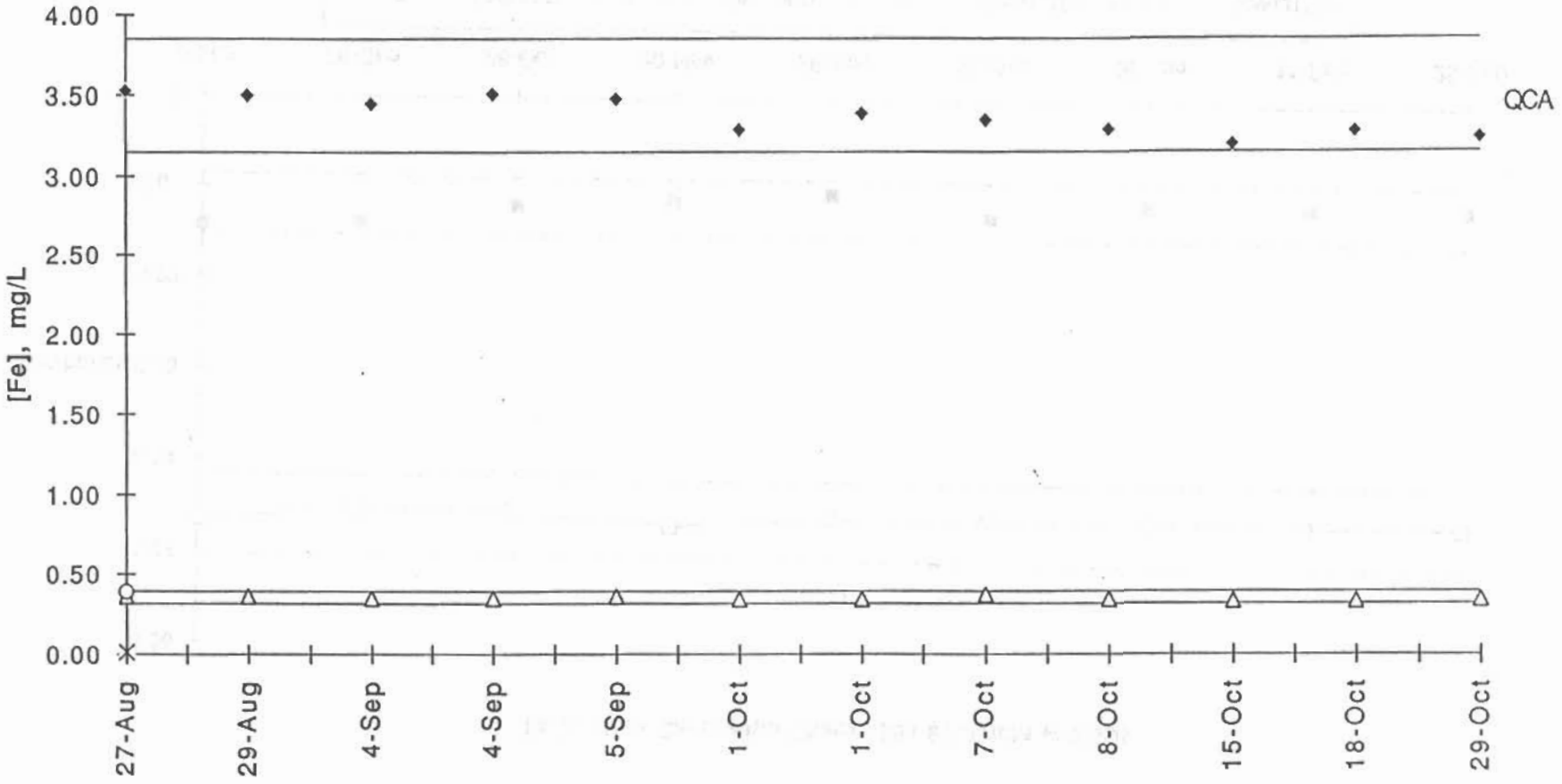
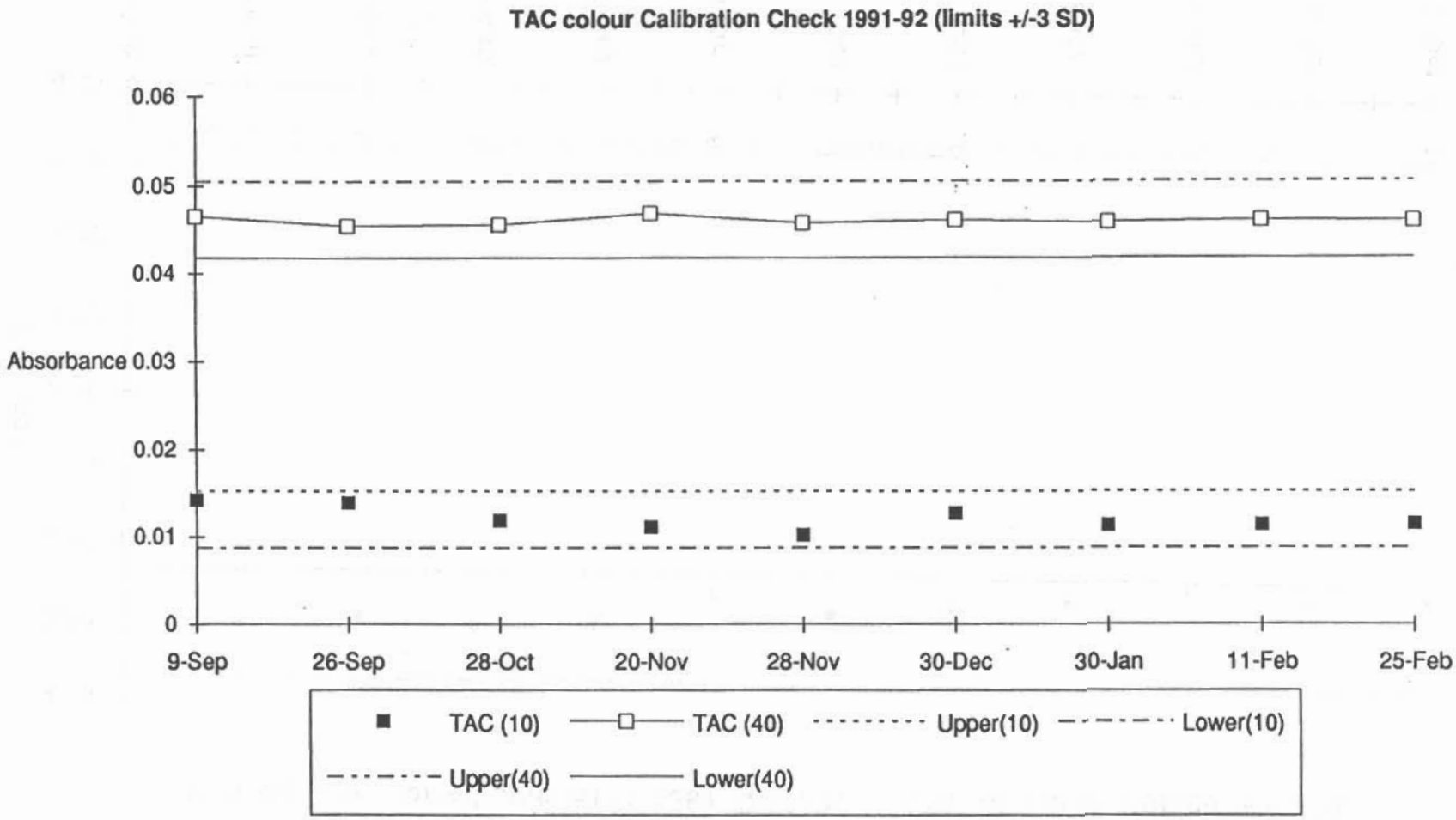
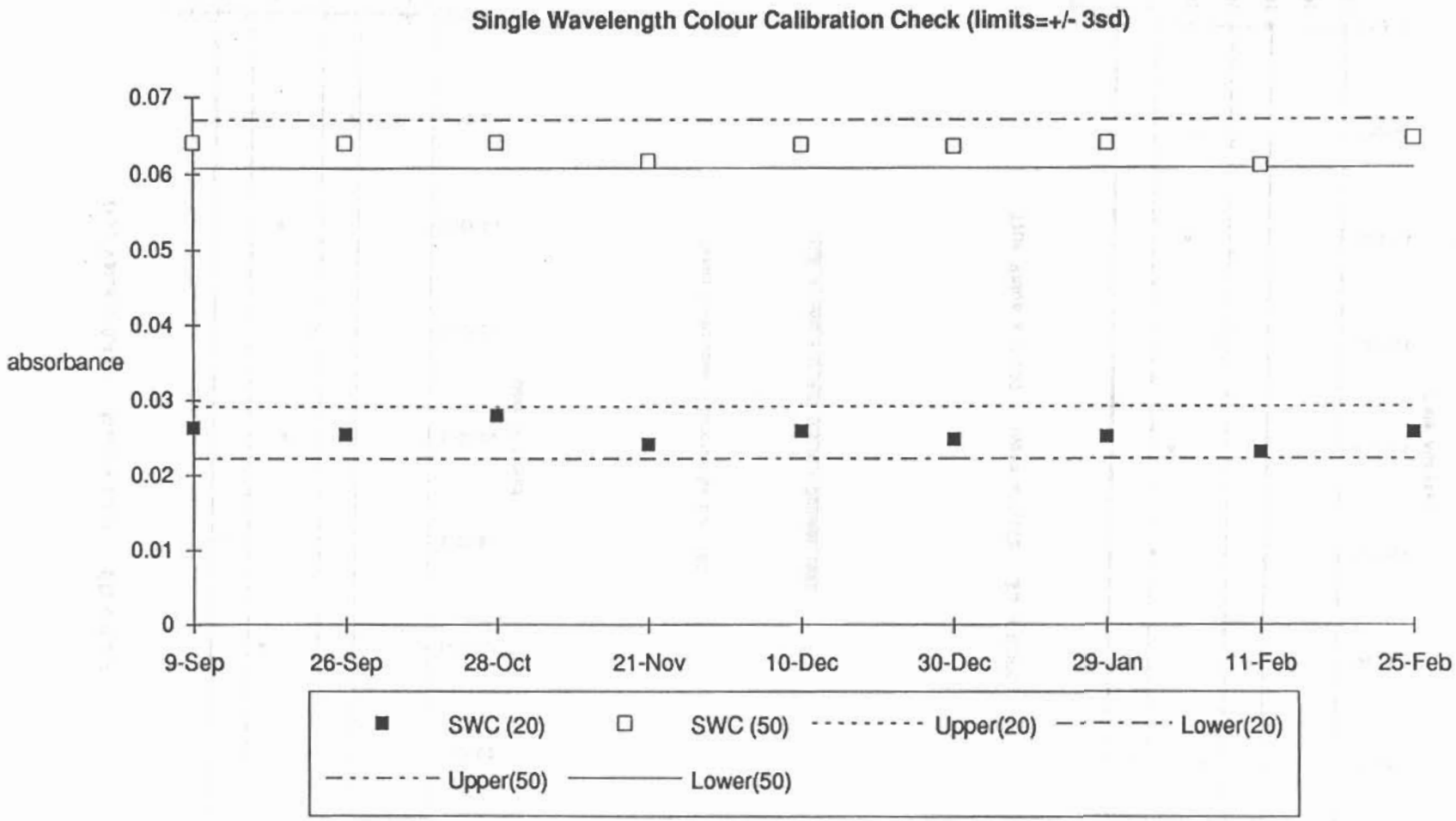
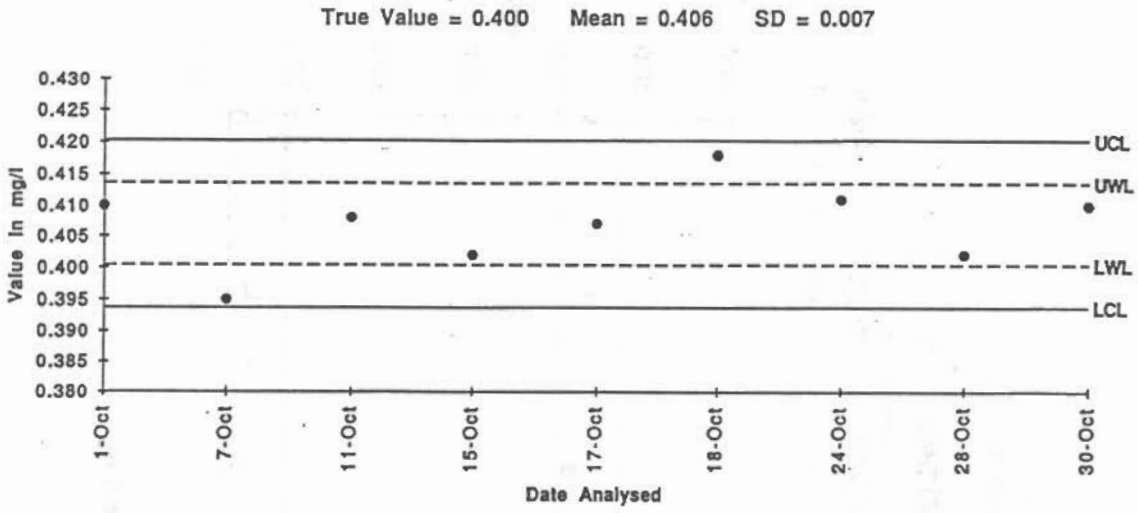


FIGURE 21


TAC colour Calibration Check 1991-92 (limits +/-3 SD)
Absorbance
0.06
0.05
0.04
0.03
0.02
0.01
0
9-Sep
26-Sep
28-Oct
20-Nov
28-Nov
30-Dec
30-Jan
11-Feb
25-Feb
TAC (10)
TAC (40)
Upper(10)
Lower(10)
Upper(40)
Lower(40)


Single Wavelength Colour Calibration Check (limits=+/- 3sd)
absorbance
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
9-Sep
26-Sep
28-Oct
21-Nov
10-Dec
30-Dec
29-Jan
11-Feb
25-Feb
SWC (20)
SWC (50)
Upper(20)
Lower(20)
Upper(50)
Lower(50)

QCA Results For NH3 (as N)- October 1991



Zenon Environmental Laboratories Inc. - BC

QCB Results For NH3 (as N) - October 1991

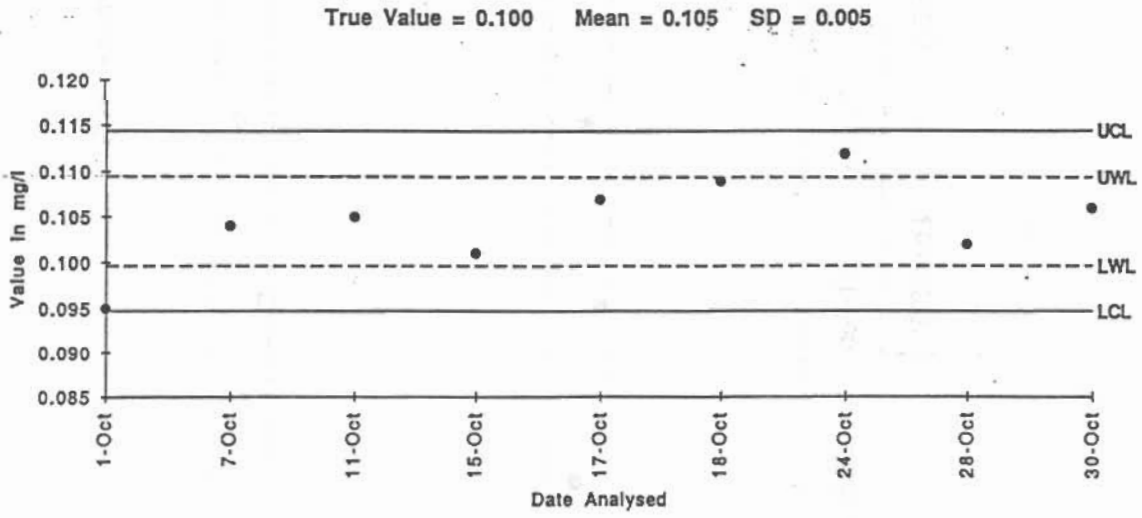
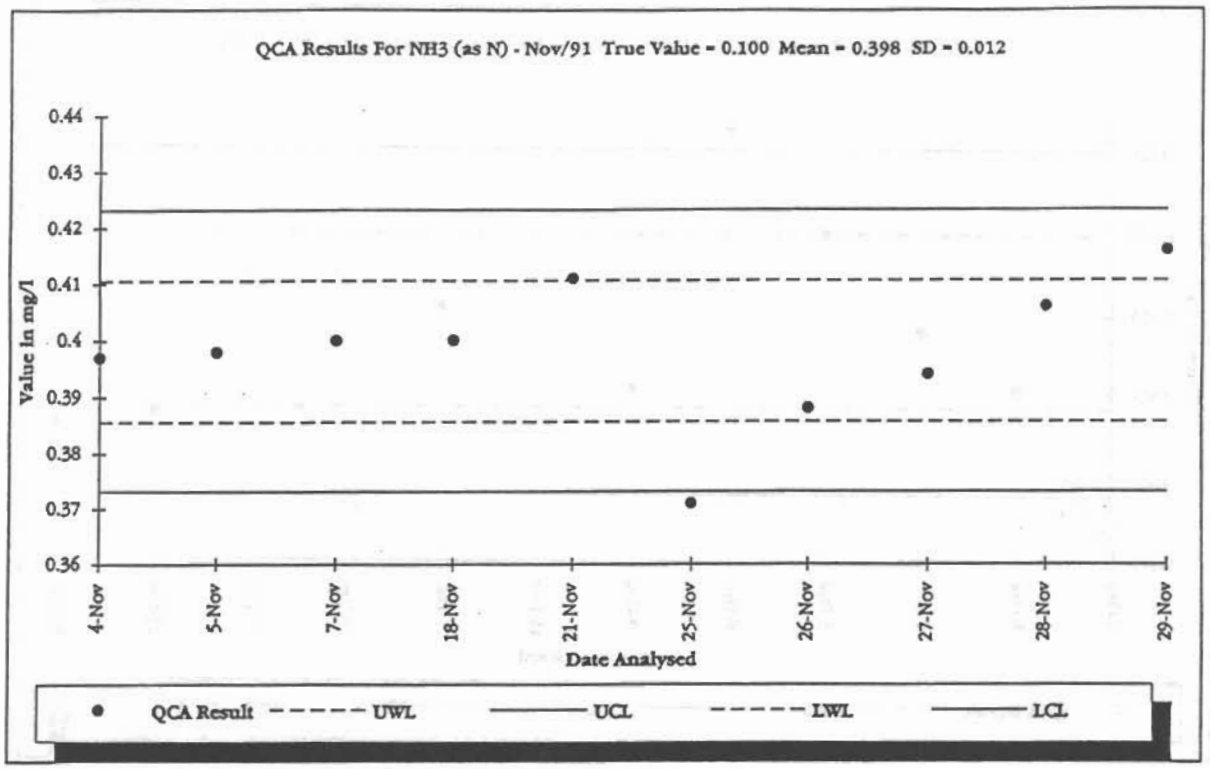


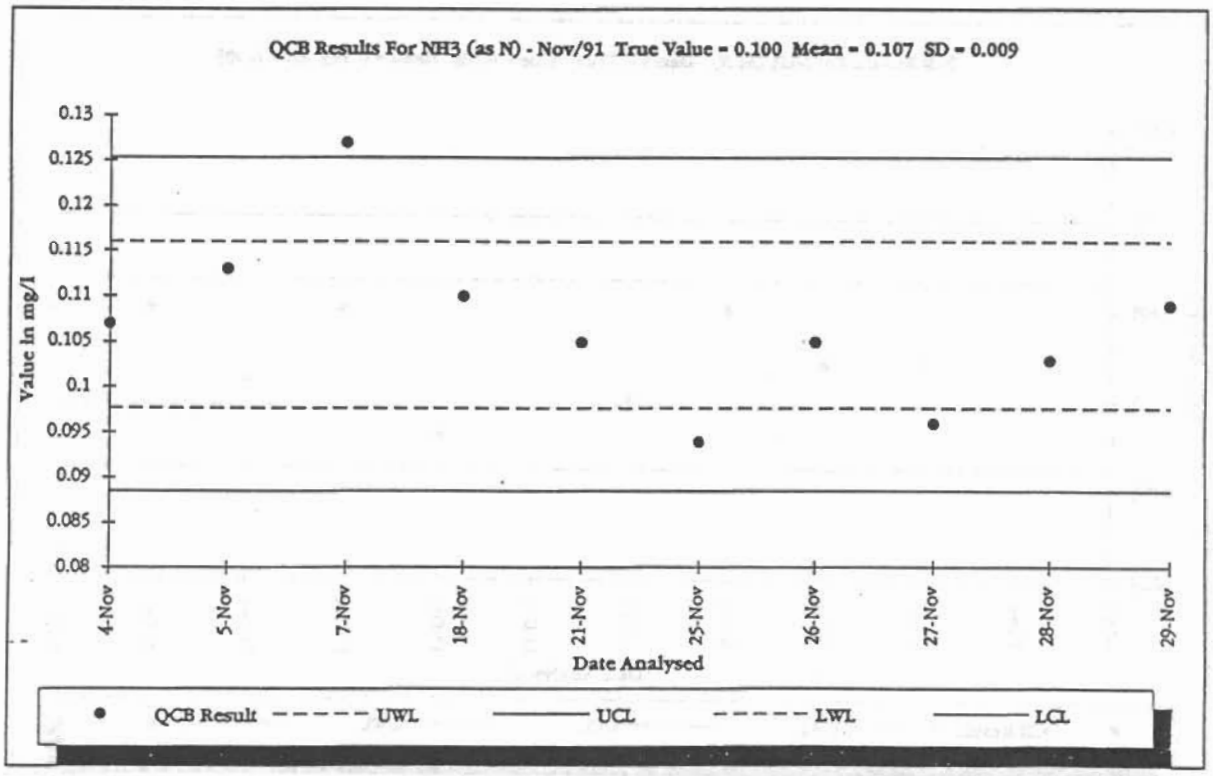
FIGURE 24



QCA NH3 Chart - Nov/91

1/21/92

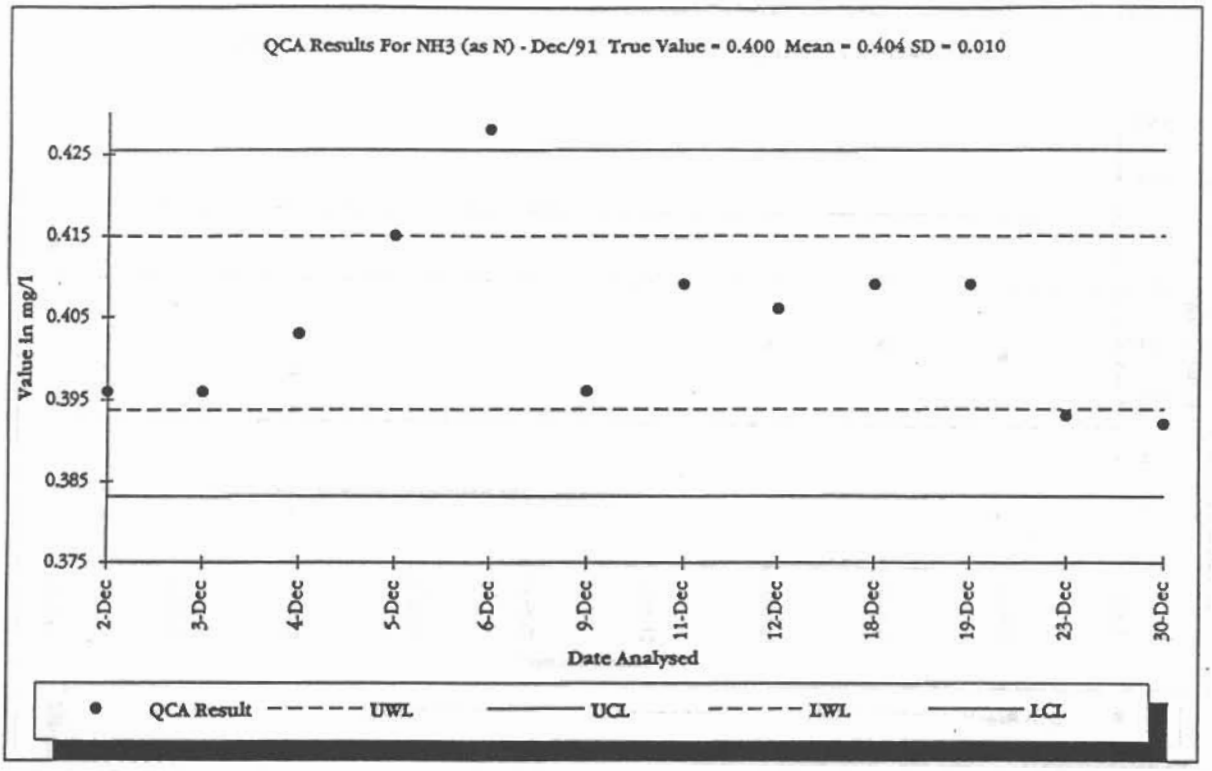
Zenon Environmental Laboratories Inc. (BC)



QCB NH3 Chart - Nov/91

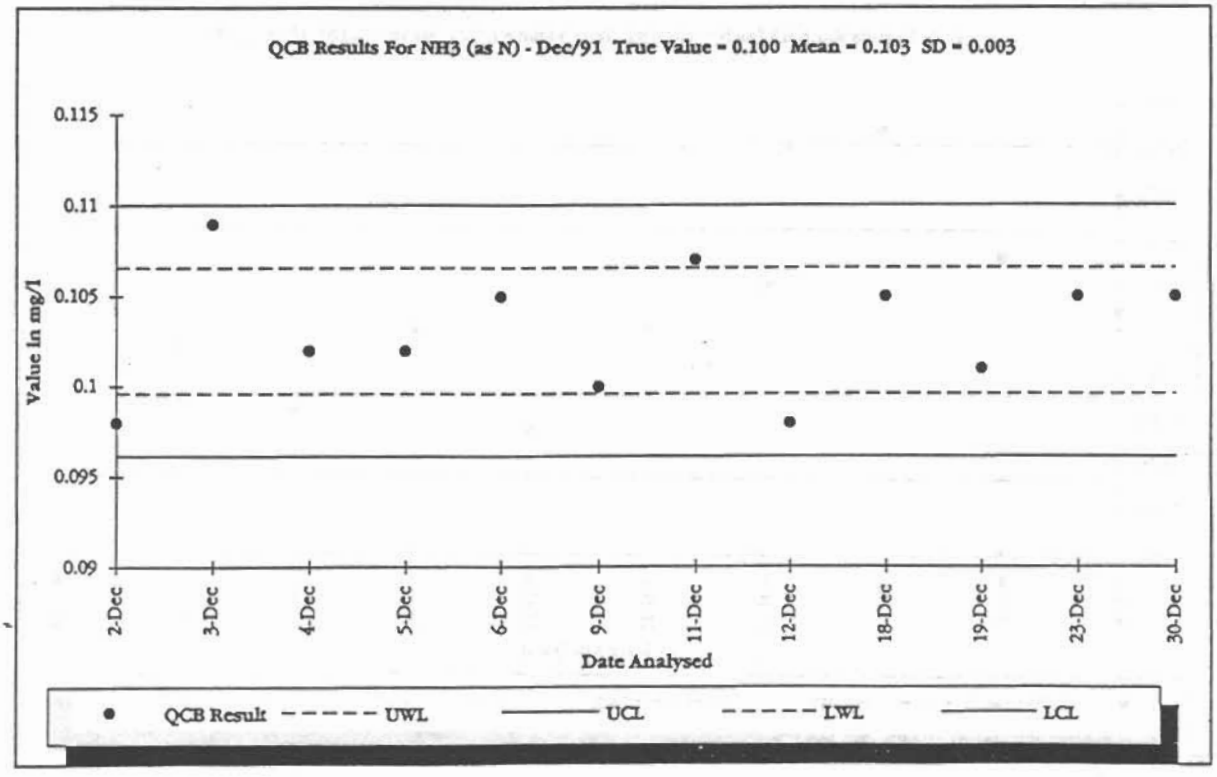
FIGURE 25

1/21/92



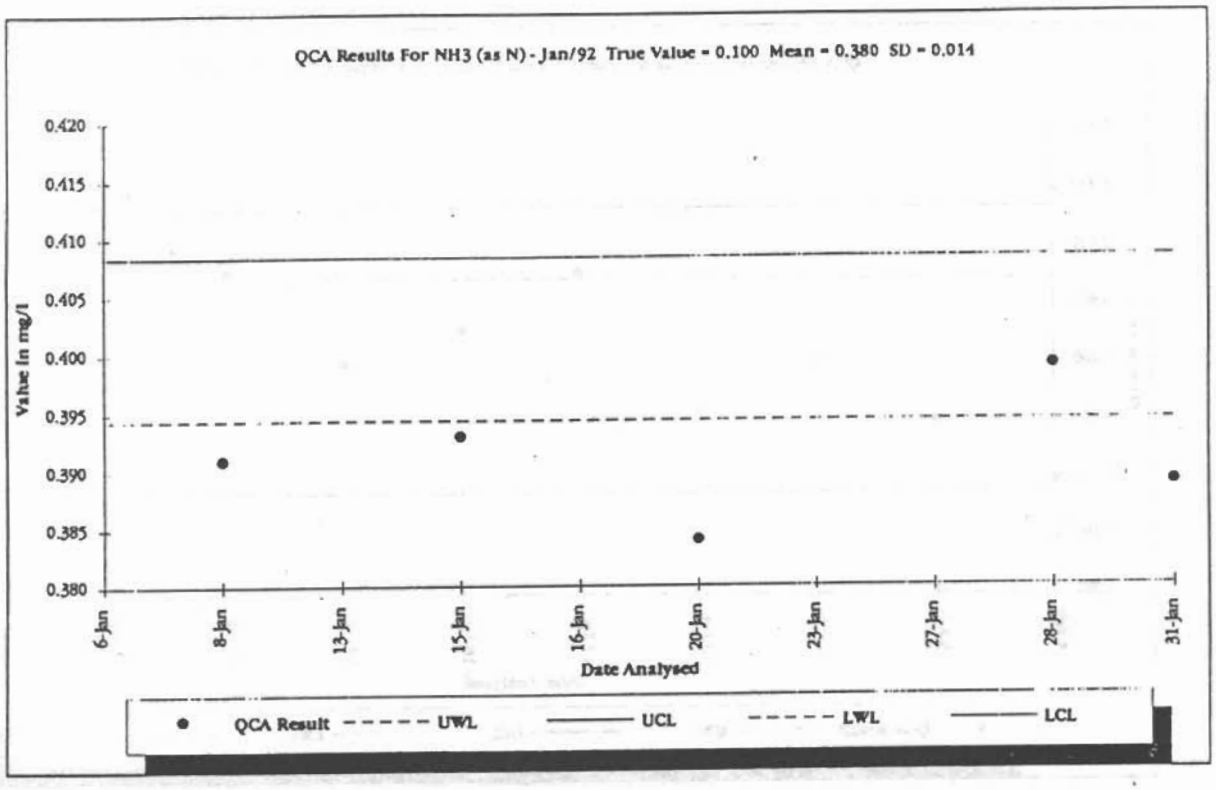
QCA NH3 CHART - Dec/91 1/21/92

Zenon Environmental Laboratories Inc. (BC)



QCB NH3 Chart - Dec/91 FIGURE 26 1/21/92

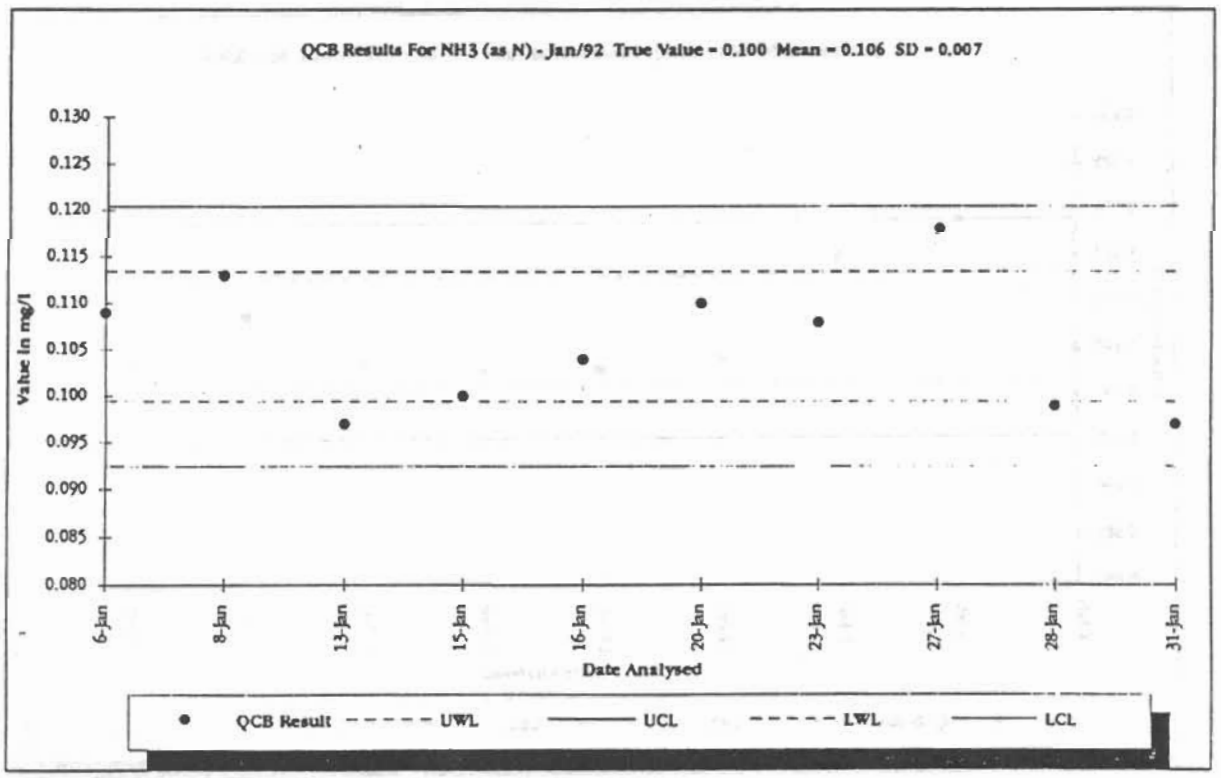
Zenon Environmental Laboratories Inc. (BC)



QCA NH3 CHART - 01/92

3/23/92

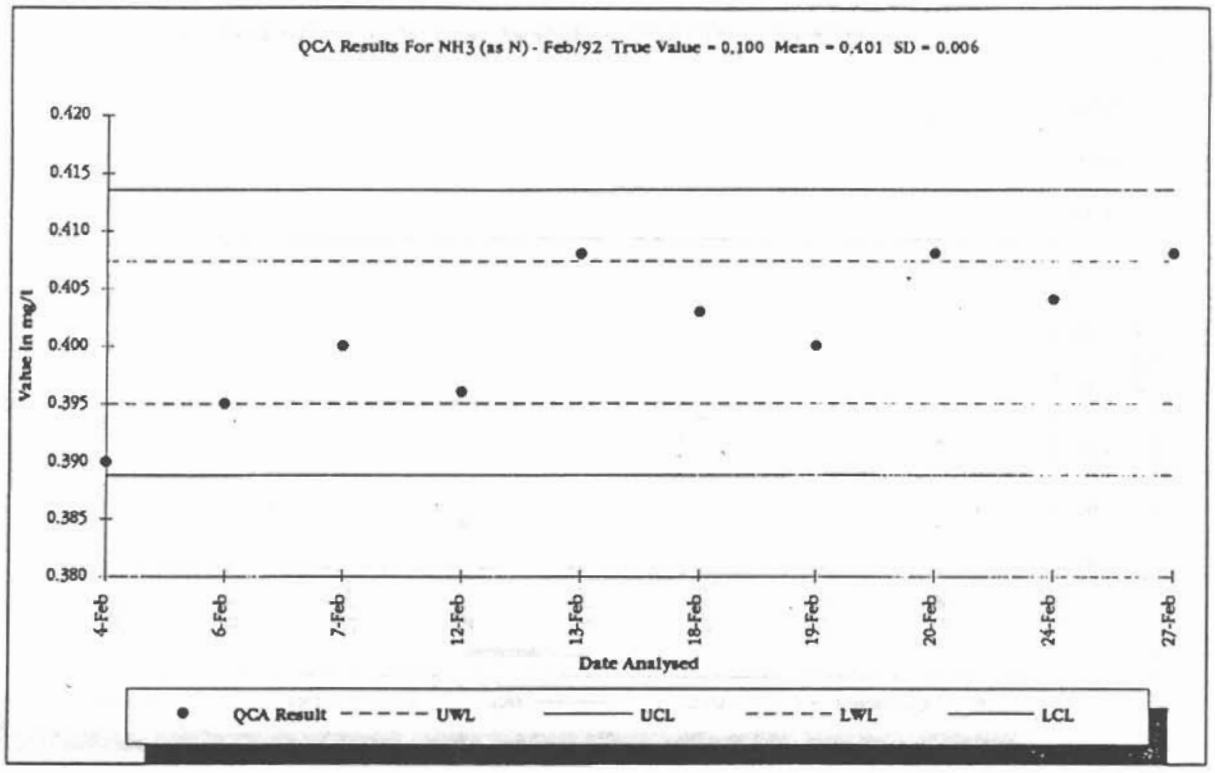
Zenon Environmental Laboratories Inc. (BC)



QCB NH3 Chart - 01/92

FIGURE 27

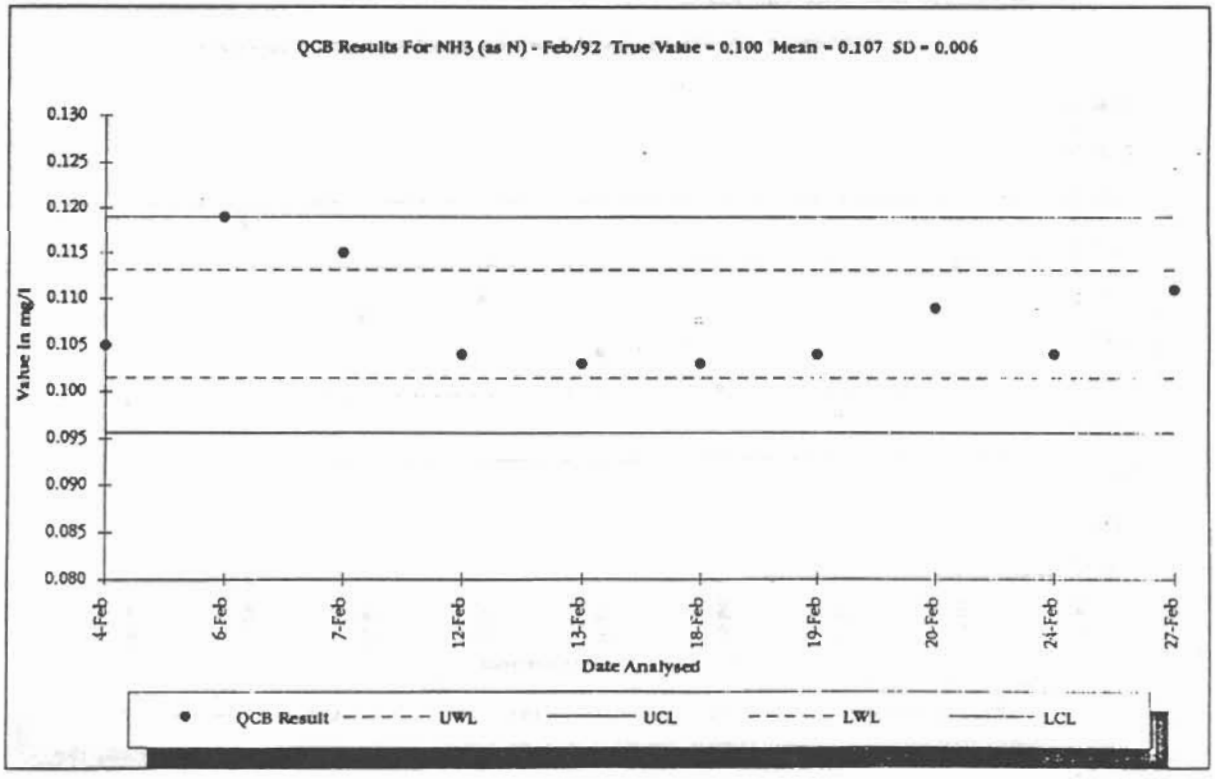
3/23/92



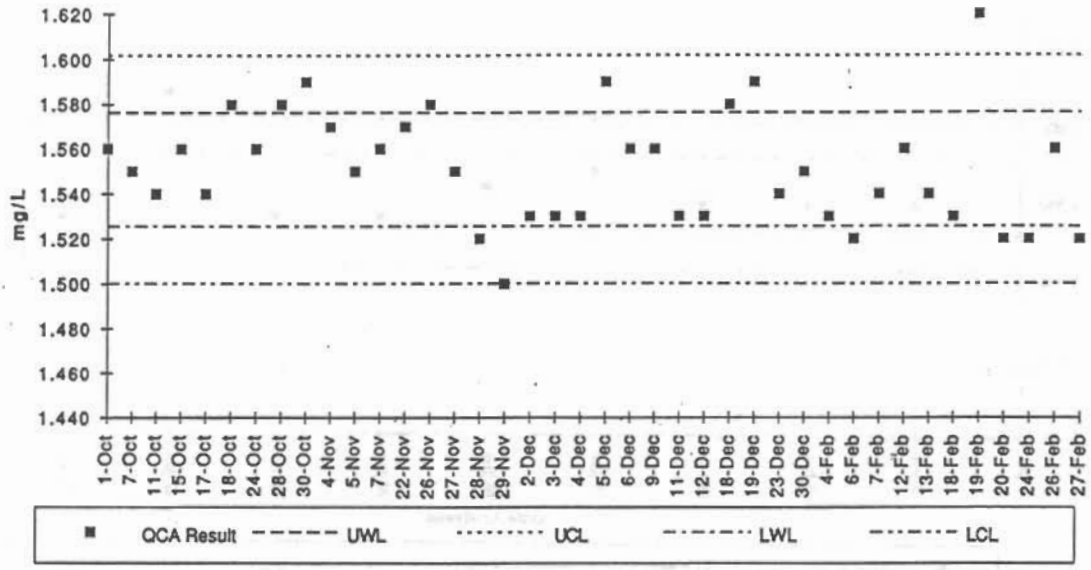
QCA NH3 CHART - 02/92

3/23/92

Zenon Environmental Laboratories Inc. (BC)



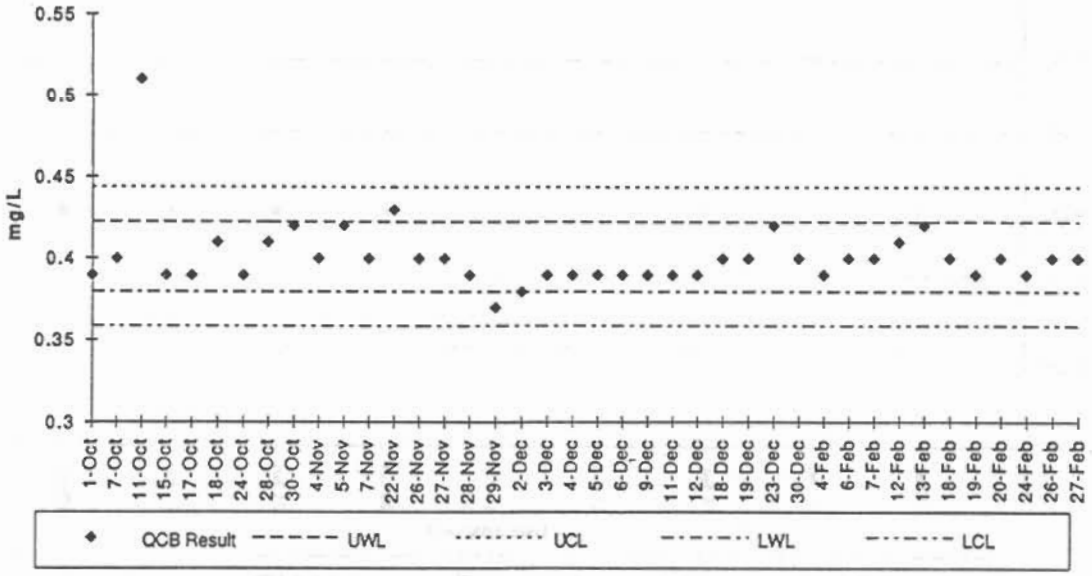
CALIBRATION CONTROL - QCA - NO3 OCT '91 - FEB '92 (WL= 1SD CL=2SD)



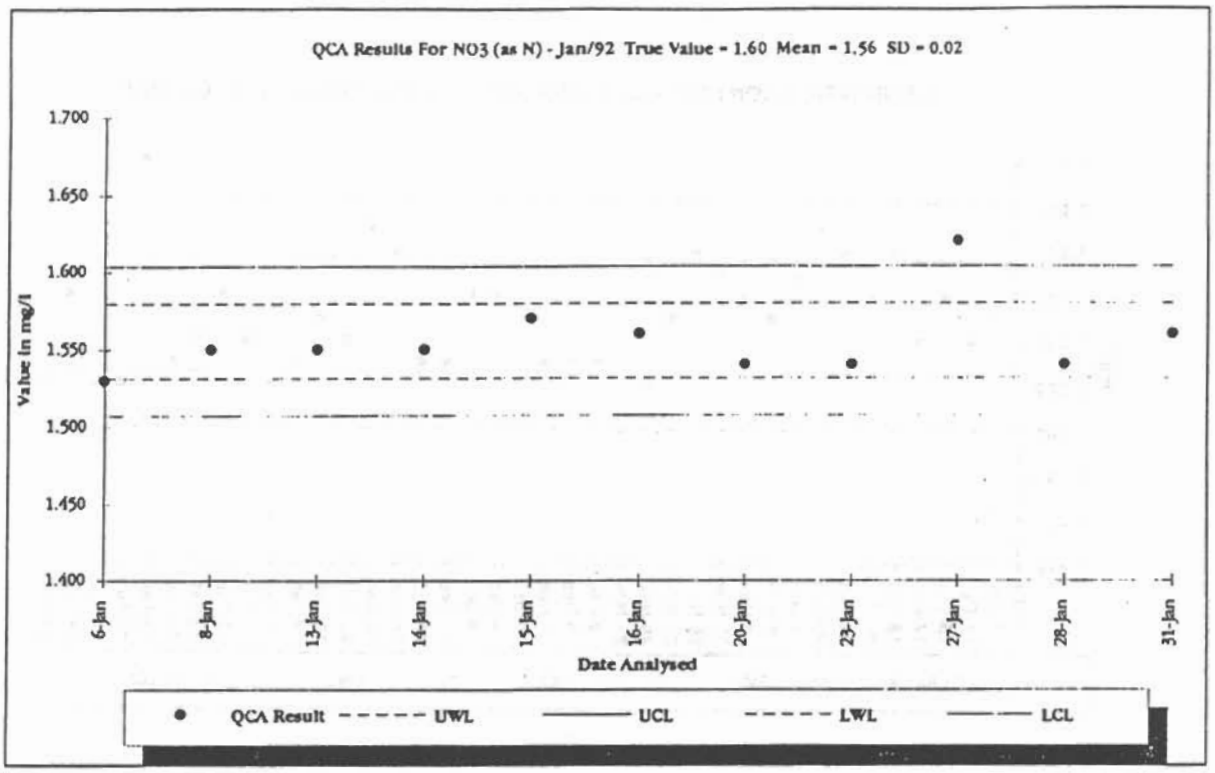
QCANO3OCT91FEB92.XLC 3/27/92

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

CALIBRATION CONTROL - QCB - NO3 OCT '91 - FEB '92 (WL=1SD CL=2SD)



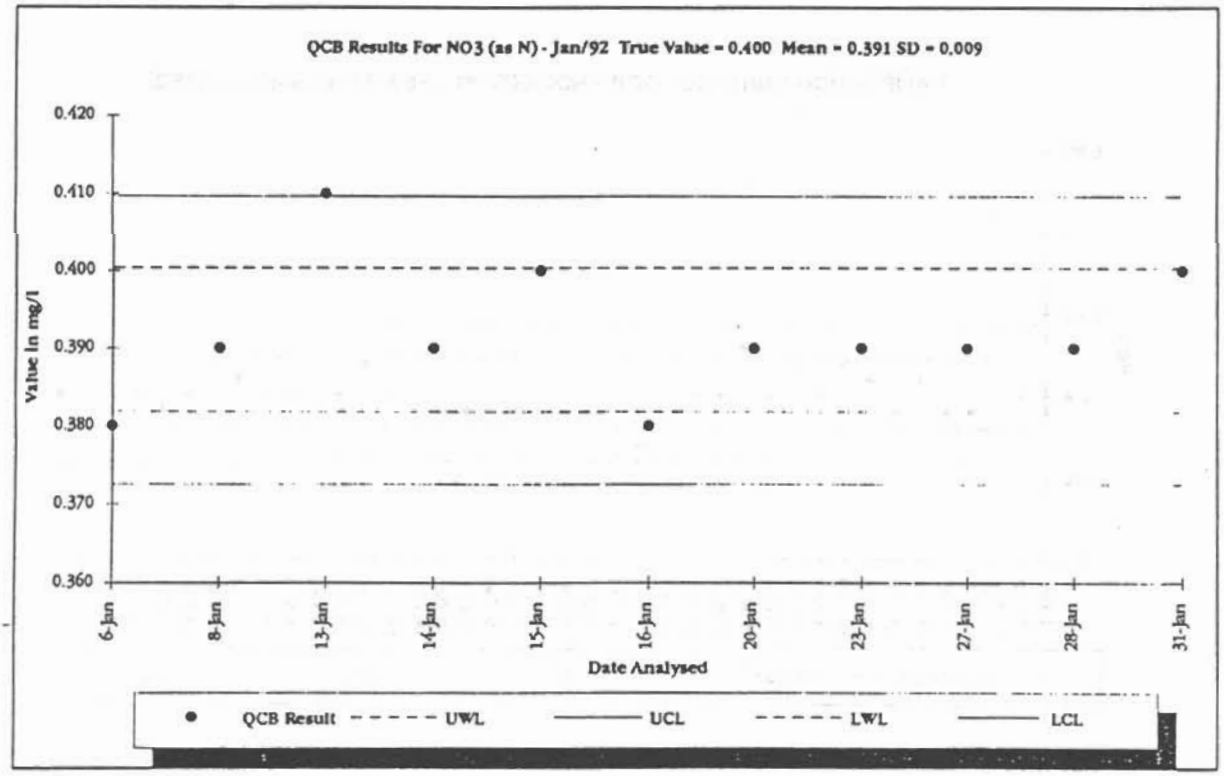
qcbno3oct91feb92.xlc FIGURE 29 3/27/92



QCA NO3 Chart - 01/92

3/23/92

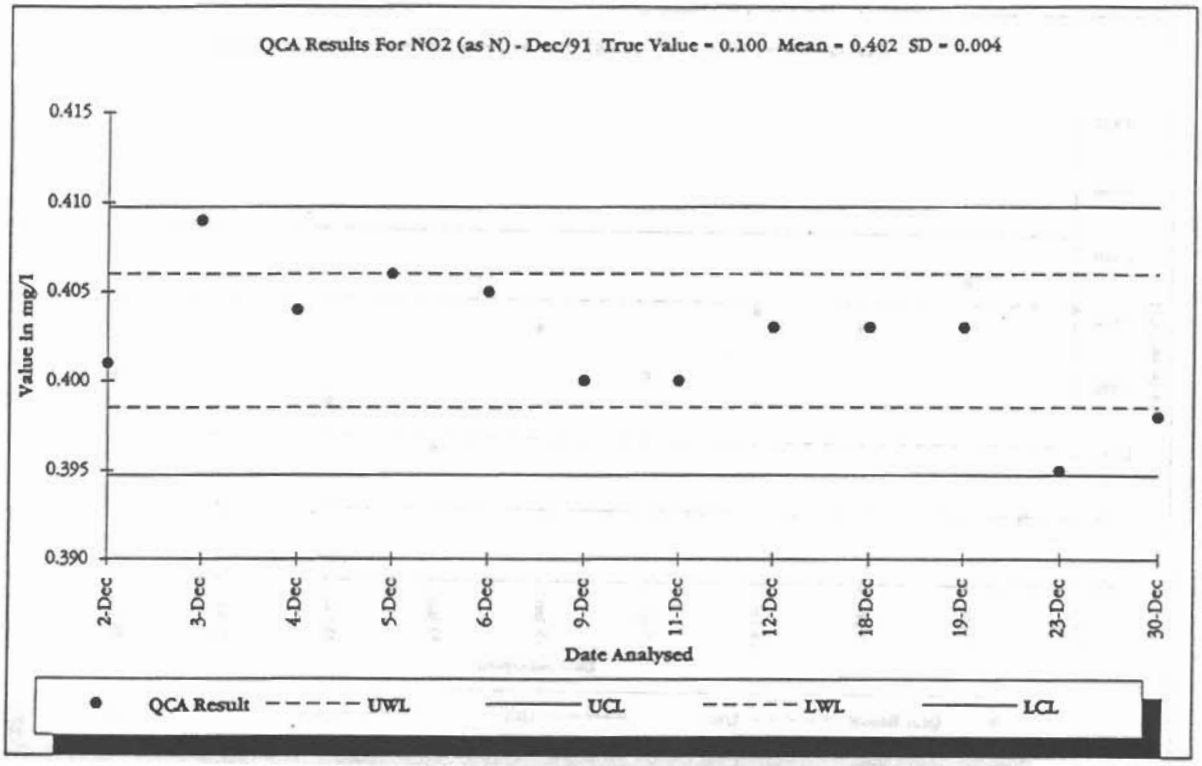
Zenon Environmental Laboratories Inc. (BC)



QCB NO3 Chart - 01/92

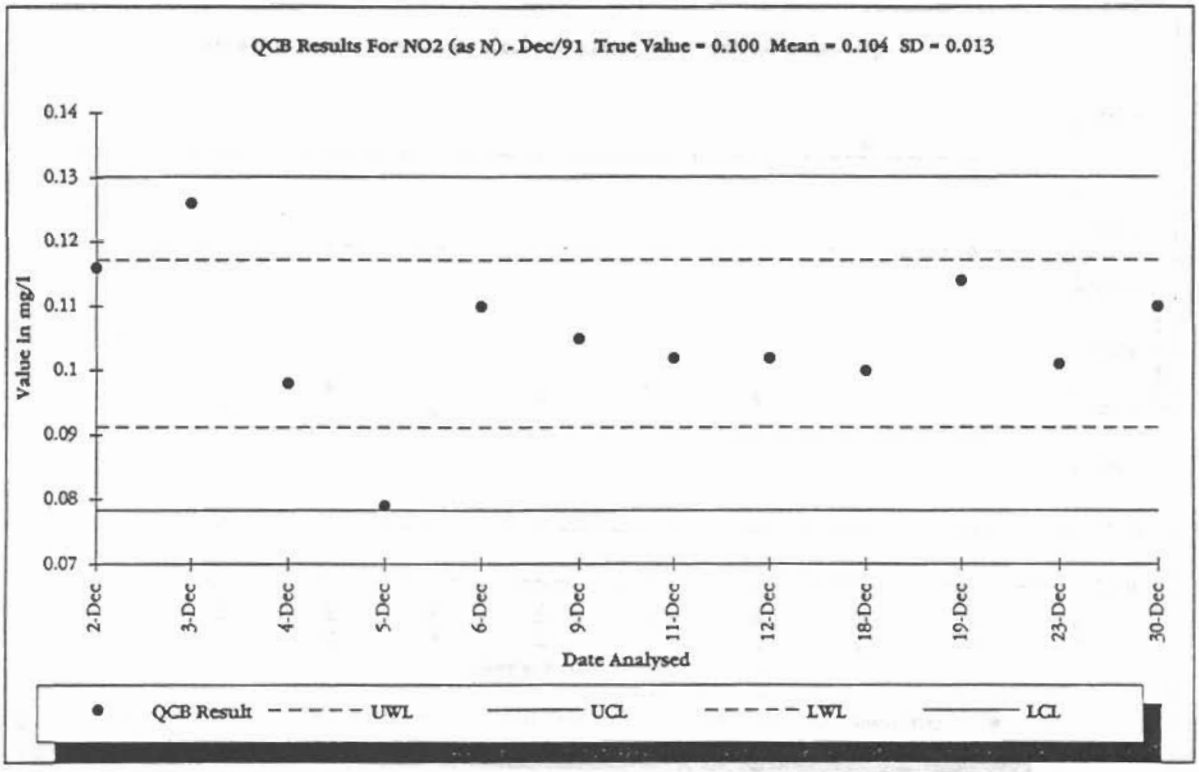
FIGURE 30

3/23/92

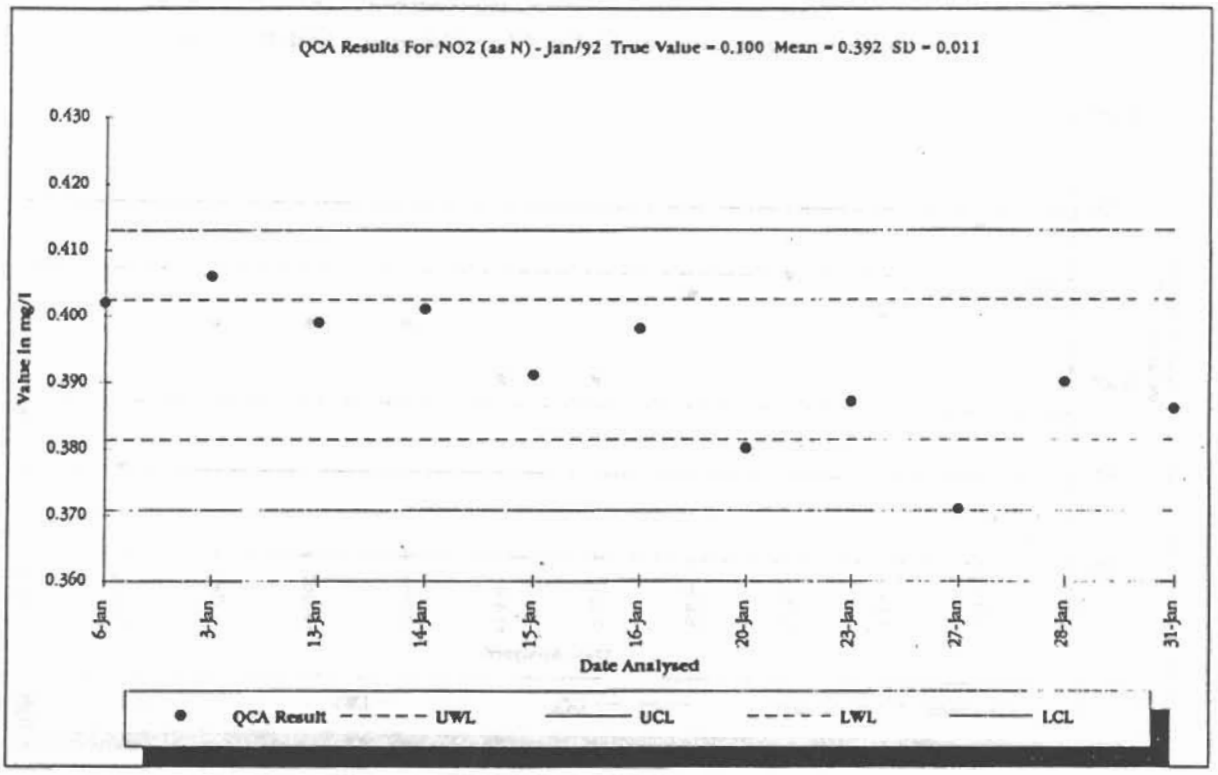


QCA NO2 Chart - Dec/91 1/21/92

Zenon Environmental Laboratories Inc. (BC)



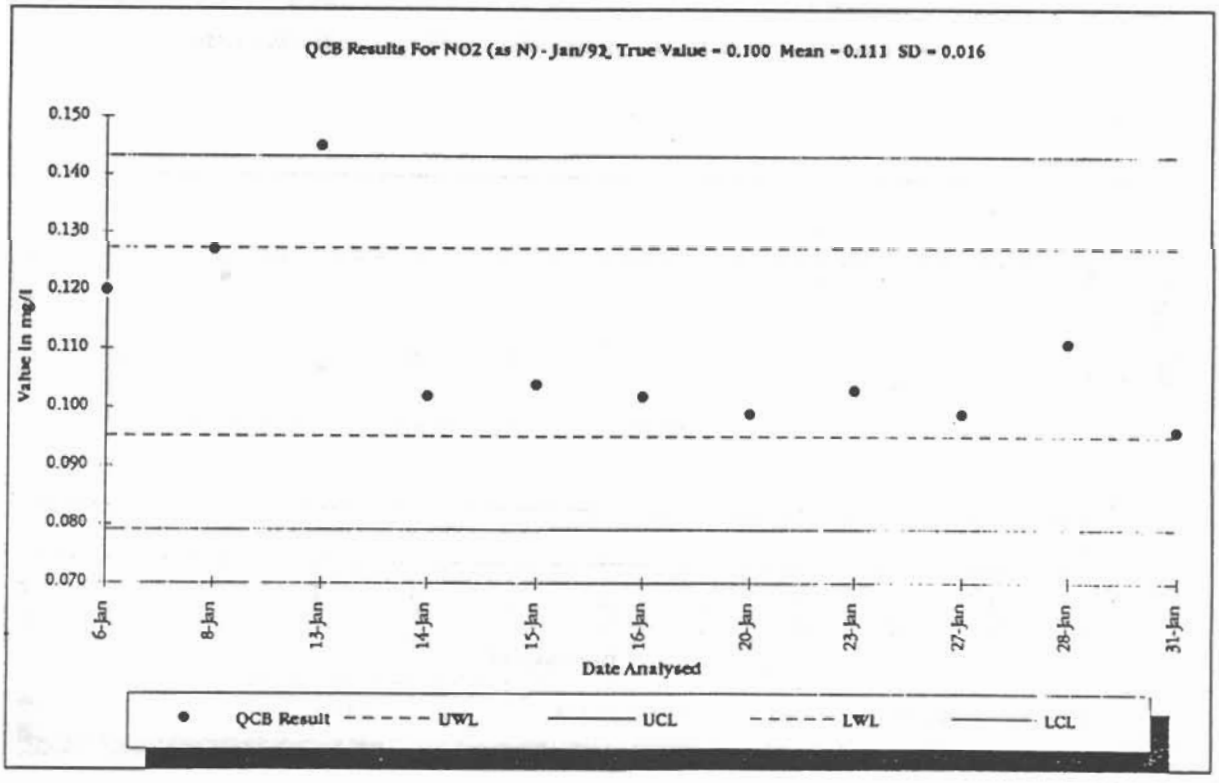
QCB NO2 Chart - Dec/91 FIGURE 31 1/21/92



QCA NO2 Chart - 01/92

3/23/92

Zenon Environmental Laboratories Inc. (BC)

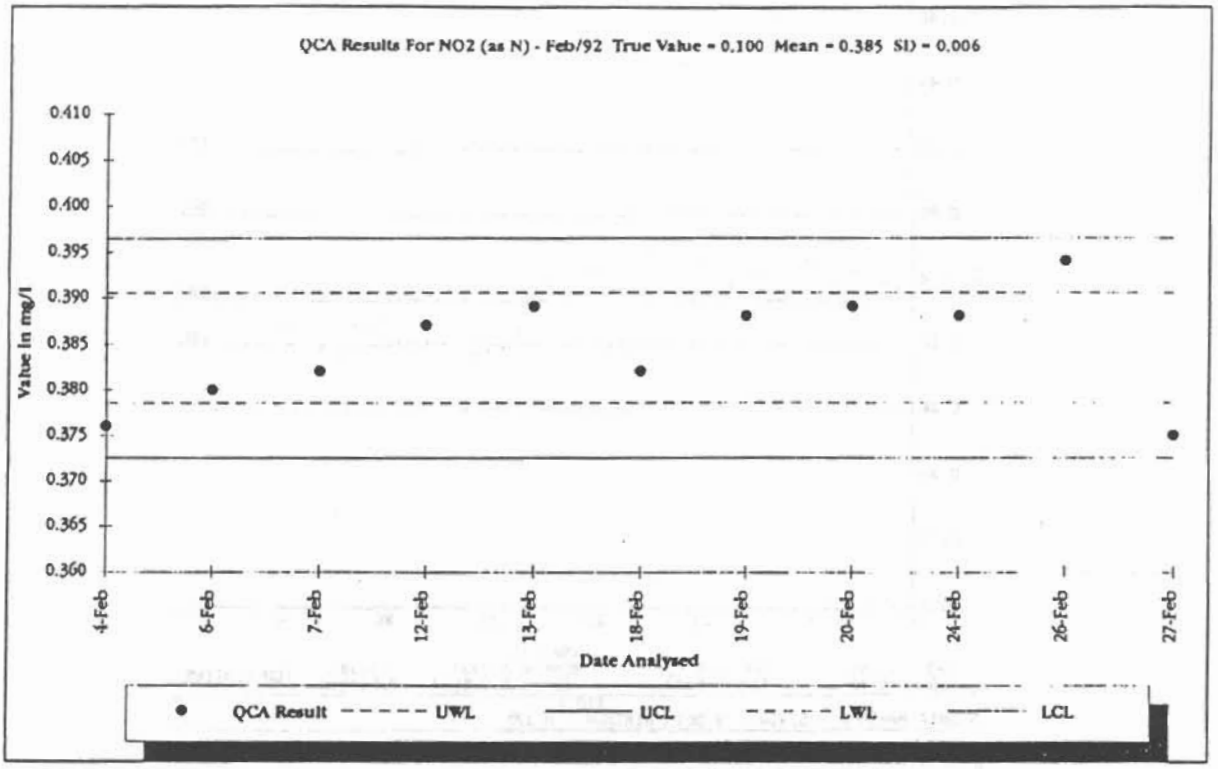


QCB NO2 Chart - 01/92

FIGURE 32

3/23/92

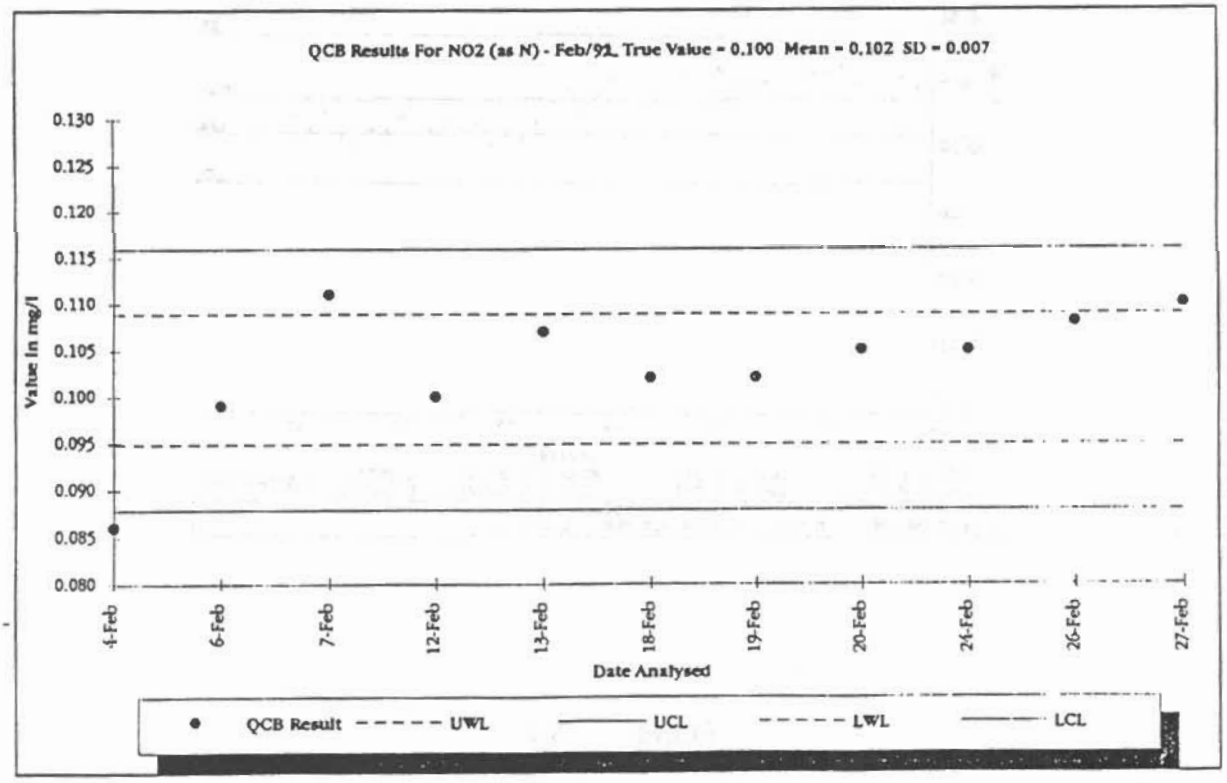
Zenon Environmental Laboratories Inc. (BC)



QCA NO2 Chart - 02/92

3/23/92

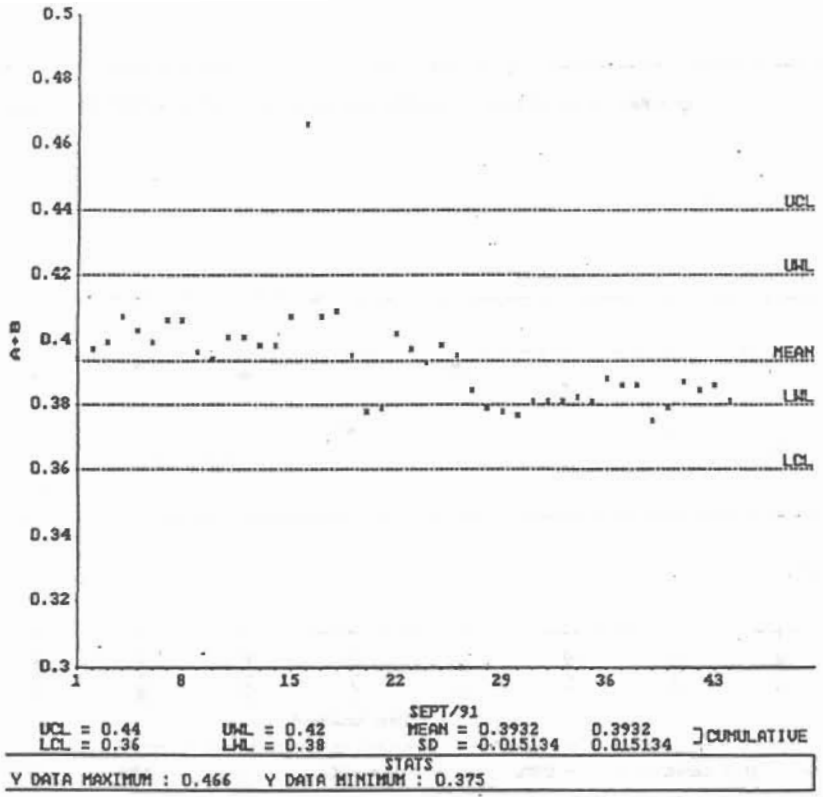
Zenon Environmental Laboratories Inc. (BC)



QCB NO2 Chart - 02/92

FIGURE 33

3/23/92


0.5
0.48
0.46
0.44
0.42
0.4
0.38
0.36
0.34
0.32
0.3
A+B
UCL
UWL
MEAN
LWL
LCL
1
8
15
22
29
36
43
SEPT/91
UCL = 0.44
LCL = 0.36
UWL = 0.42
LWL = 0.38
MEAN = 0.3932
SD = 0.015134
0.3932
0.015134
CUMULATIVE
STATS
Y DATA MAXIMUM : 0.466
Y DATA MINIMUM : 0.375

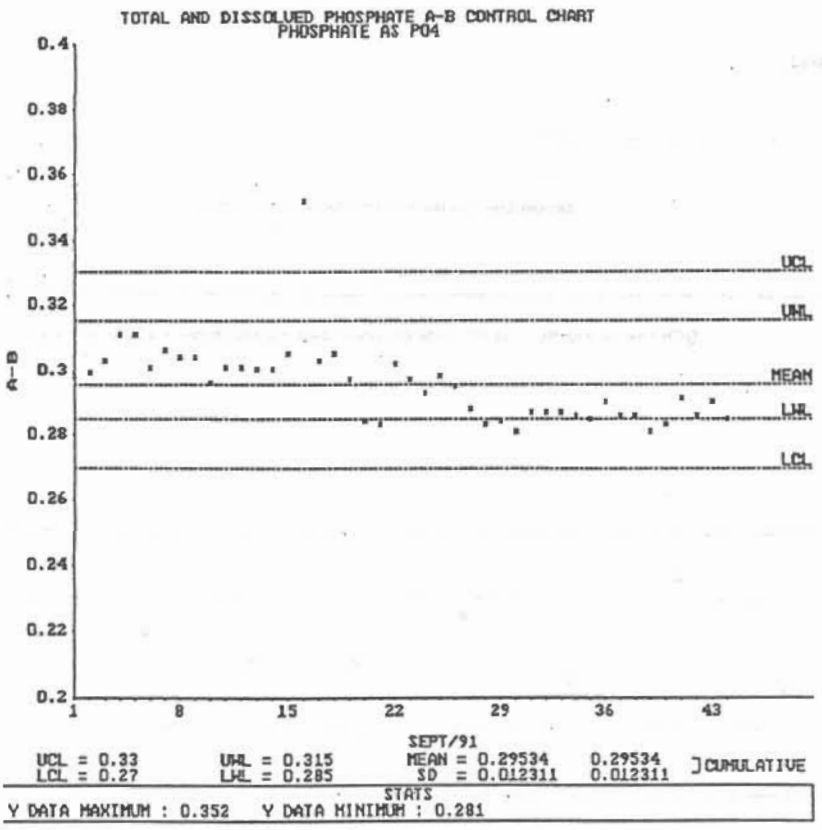
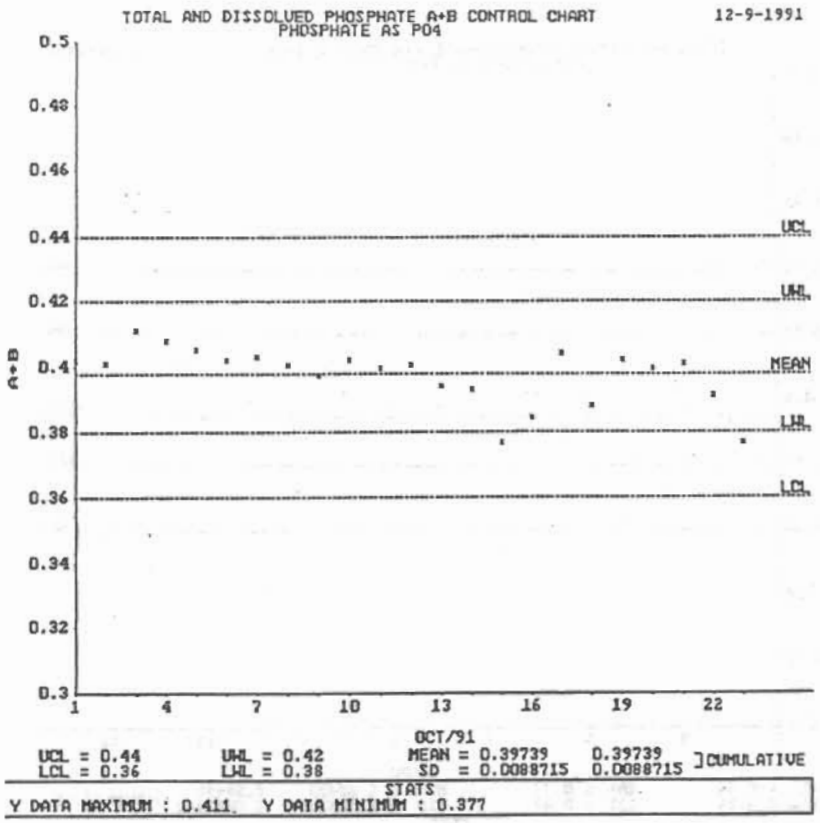

TOTAL AND DISSOLVED PHOSPHATE A-B CONTROL CHART
PHOSPHATE AS PO4
0.4
0.38
0.36
0.34
0.32
0.3
0.28
0.26
0.24
0.22
0.2
A-B
UCL
UWL
MEAN
LWL
LCL
1
8
15
22
29
36
43
SEPT/91
UCL = 0.33
LCL = 0.27
UWL = 0.315
LWL = 0.285
MEAN = 0.29534
SD = 0.012311
0.29534
0.012311
CUMULATIVE
STATS
Y DATA MAXIMUM : 0.352
Y DATA MINIMUM : 0.281

FIGURE 34


TOTAL AND DISSOLVED PHOSPHATE A+B CONTROL CHART
PHOSPHATE AS PO4
12-9-1991
A+B
UCL
UWL
MEAN
LWL
LCL
OCT/91
UCL = 0.44
LCL = 0.36
UWL = 0.42
LWL = 0.38
MEAN = 0.39739
SD = 0.0088715
0.39739
0.0088715
CUMULATIVE
STATS
Y DATA MAXIMUM : 0.411
Y DATA MINIMUM : 0.377

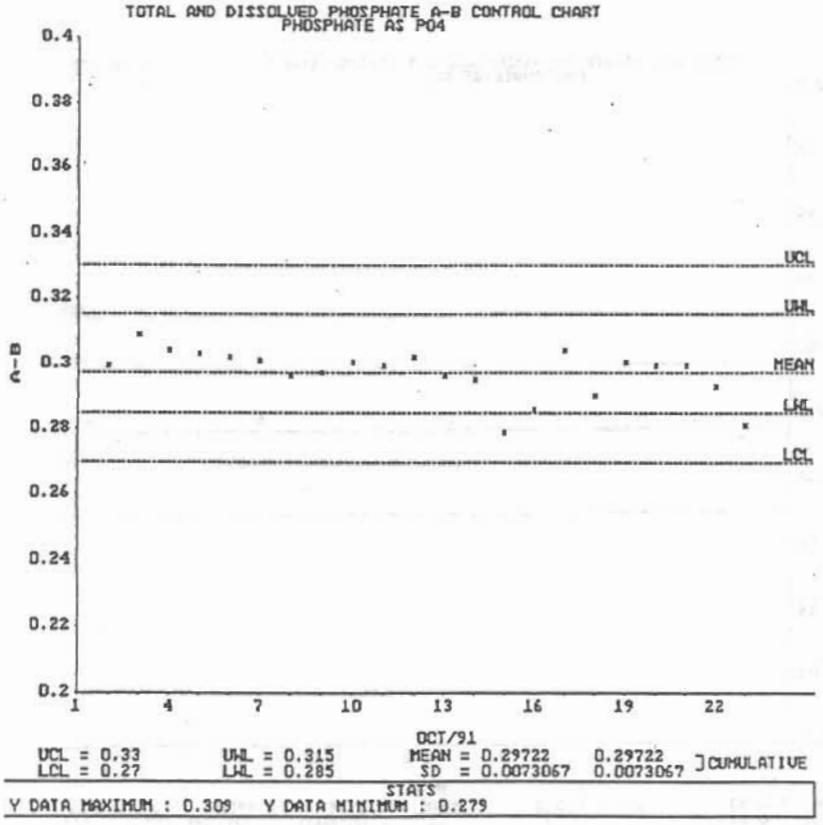
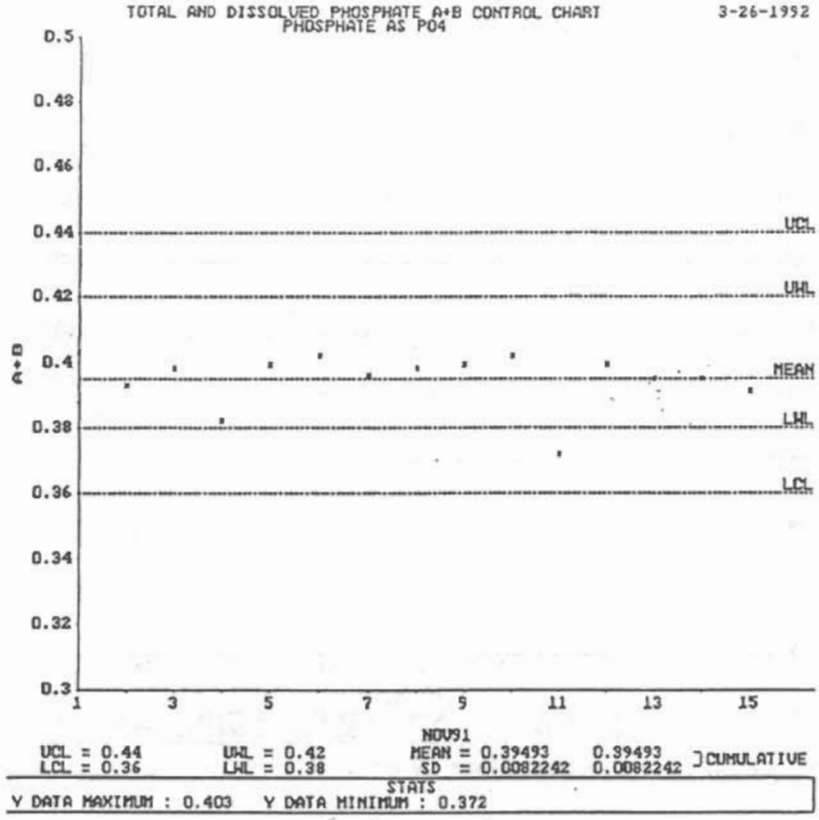
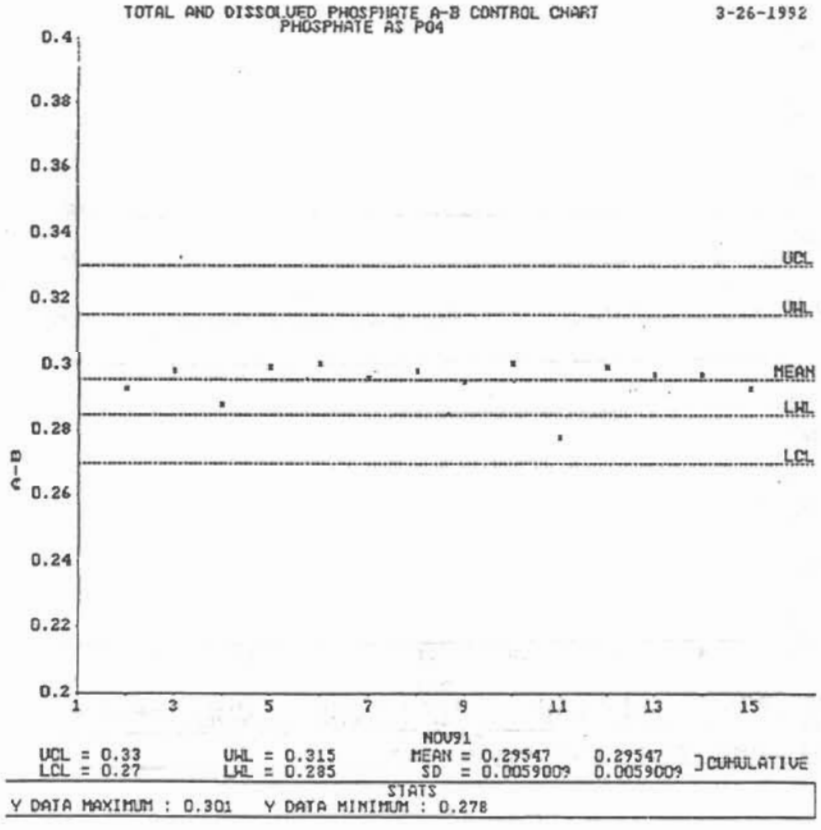

TOTAL AND DISSOLVED PHOSPHATE A-B CONTROL CHART
PHOSPHATE AS PO4
A-B
UCL
UWL
MEAN
LWL
LCL
OCT/91
UCL = 0.33
LCL = 0.27
UWL = 0.315
LWL = 0.285
MEAN = 0.29722
SD = 0.0073067
0.29722
0.0073067
CUMULATIVE
STATS
Y DATA MAXIMUM : 0.309
Y DATA MINIMUM : 0.279

FIGURE 35

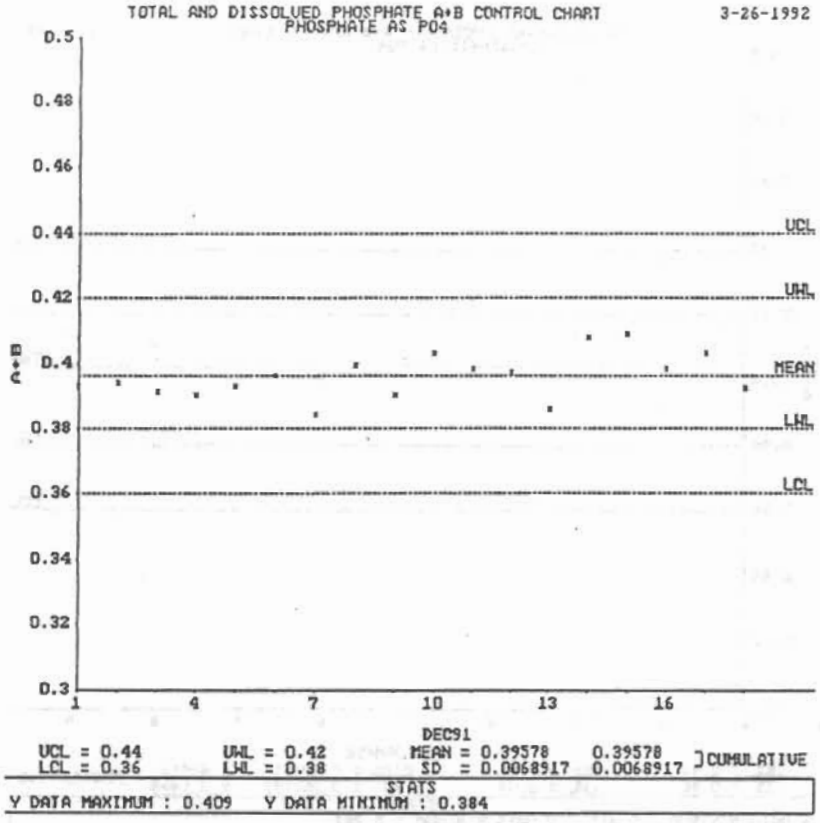

TOTAL AND DISSOLVED PHOSPHATE A+B CONTROL CHART
PHOSPHATE AS PO4
3-26-1992
A+B
UCL
UWL
MEAN
LWL
LCL
NOV91
UCL = 0.44
LCL = 0.36
UWL = 0.42
LWL = 0.38
MEAN = 0.39493
SD = 0.0082242
0.39493
0.0082242
CUMULATIVE
STATS
Y DATA MAXIMUM : 0.403
Y DATA MINIMUM : 0.372

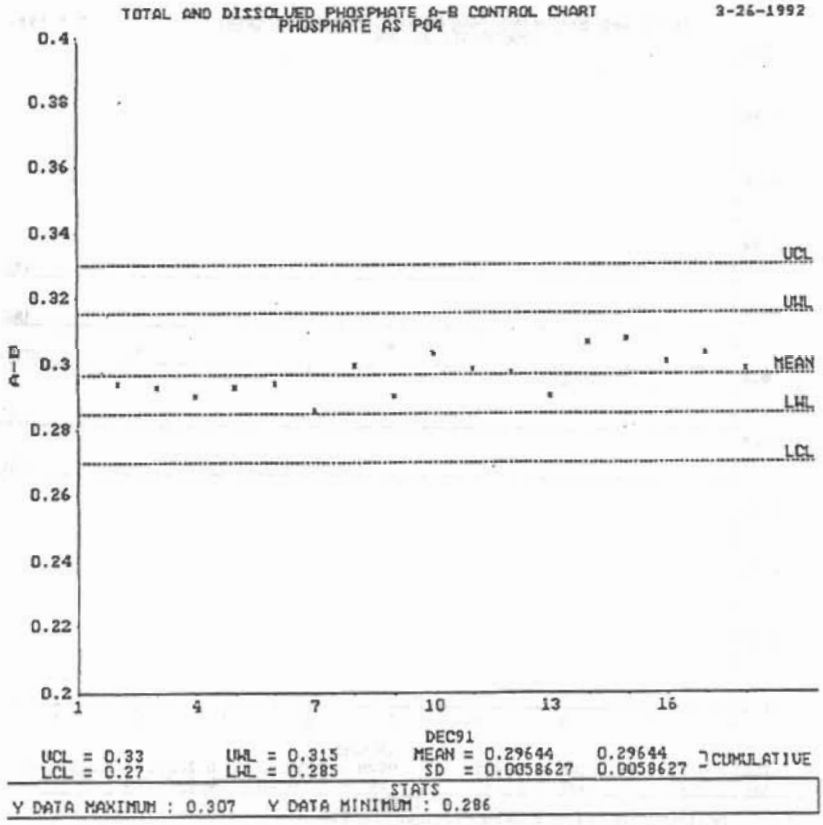
c


TOTAL AND DISSOLVED PHOSPHATE A-B CONTROL CHART
PHOSPHATE AS PO4
3-26-1992
A-B
UCL
UWL
MEAN
LWL
LCL
NOV91
UCL = 0.33
LCL = 0.27
UWL = 0.315
LWL = 0.285
MEAN = 0.29547
SD = 0.0059009
0.29547
0.0059009
CUMULATIVE
STATS
Y DATA MAXIMUM : 0.301
Y DATA MINIMUM : 0.278

c

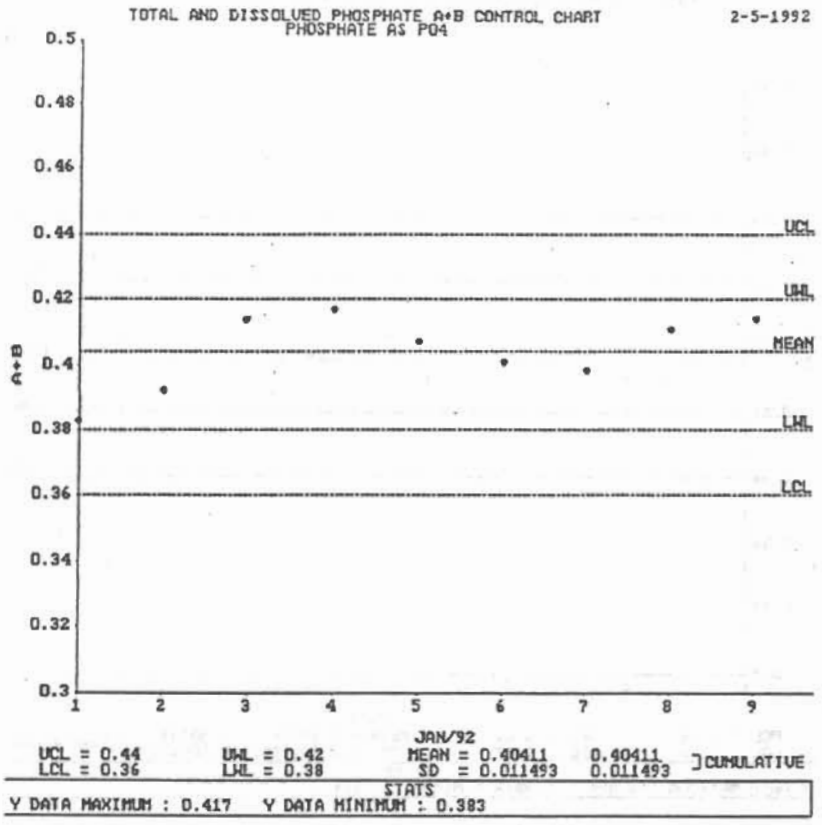
FIGURE 36


TOTAL AND DISSOLVED PHOSPHATE A+B CONTROL CHART
PHOSPHATE AS PO4
3-26-1992
A+B
0.5
0.48
0.46
0.44
0.42
0.4
0.38
0.36
0.34
0.32
0.3
UCL
UWL
MEAN
LWL
LCL
1
4
7
10
13
16
DEC91
UCL = 0.44
LCL = 0.36
UWL = 0.42
LWL = 0.38
MEAN = 0.39578
SD = 0.0068917
0.39578
0.0068917
CUMULATIVE
STATS
Y DATA MAXIMUM : 0.409
Y DATA MINIMUM : 0.384

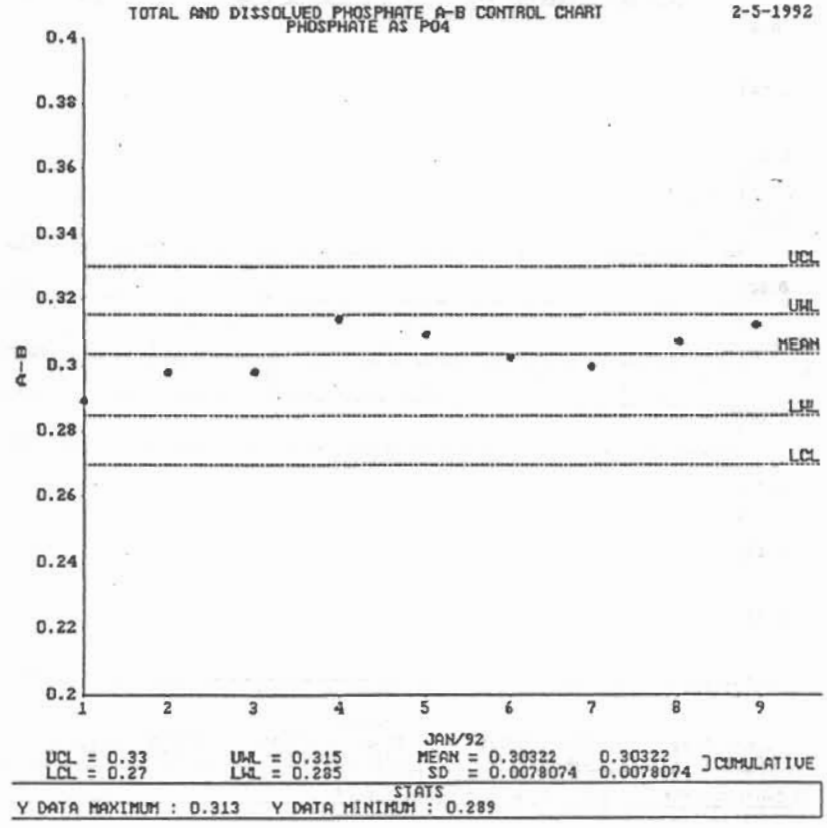

TOTAL AND DISSOLVED PHOSPHATE A-B CONTROL CHART
PHOSPHATE AS PO4
3-26-1992
A-B
0.4
0.38
0.36
0.34
0.32
0.3
0.28
0.26
0.24
0.22
0.2
UCL
UWL
MEAN
LWL
LCL
1
4
7
10
13
16
DEC91
UCL = 0.33
LCL = 0.27
UWL = 0.315
LWL = 0.285
MEAN = 0.29644
SD = 0.0058627
0.29644
0.0058627
CUMULATIVE
STATS
Y DATA MAXIMUM : 0.307
Y DATA MINIMUM : 0.286

c

FIGURE 37

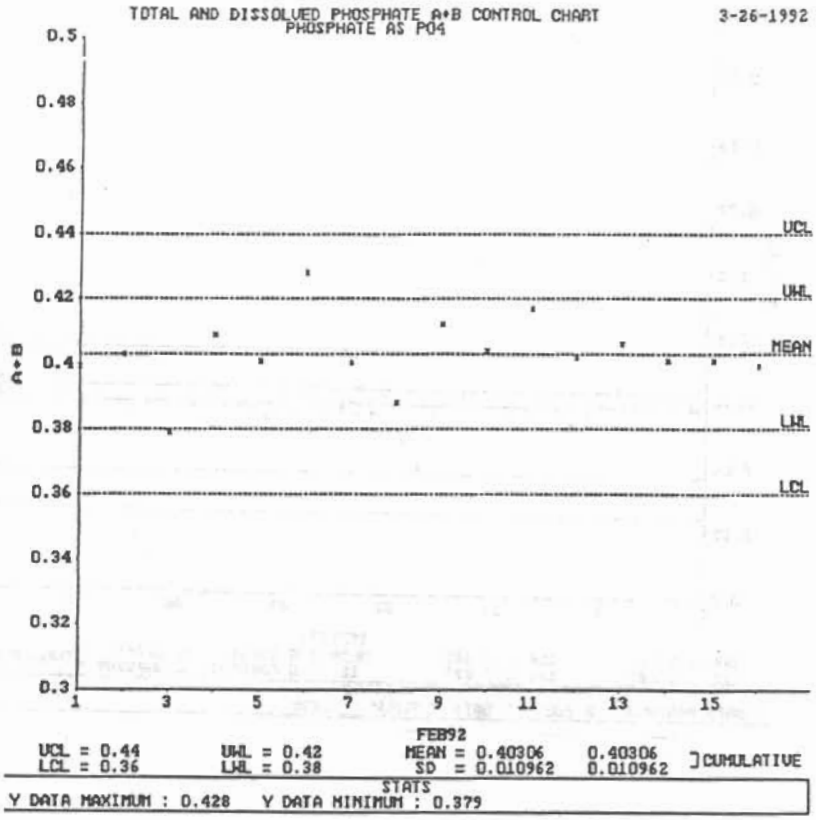

TOTAL AND DISSOLVED PHOSPHATE A+B CONTROL CHART
PHOSPHATE AS PO4
2-5-1992
A+B
0.5
0.48
0.46
0.44
0.42
0.4
0.38
0.36
0.34
0.32
0.3
UCL
UWL
MEAN
LWL
LCL
1
2
3
4
5
6
7
8
9
JAN/92
UCL = 0.44
LCL = 0.36
UWL = 0.42
LWL = 0.38
MEAN = 0.40411
SD = 0.011493
0.40411
0.011493
CUMULATIVE
STATS
Y DATA MAXIMUM : 0.417
Y DATA MINIMUM : 0.383

c

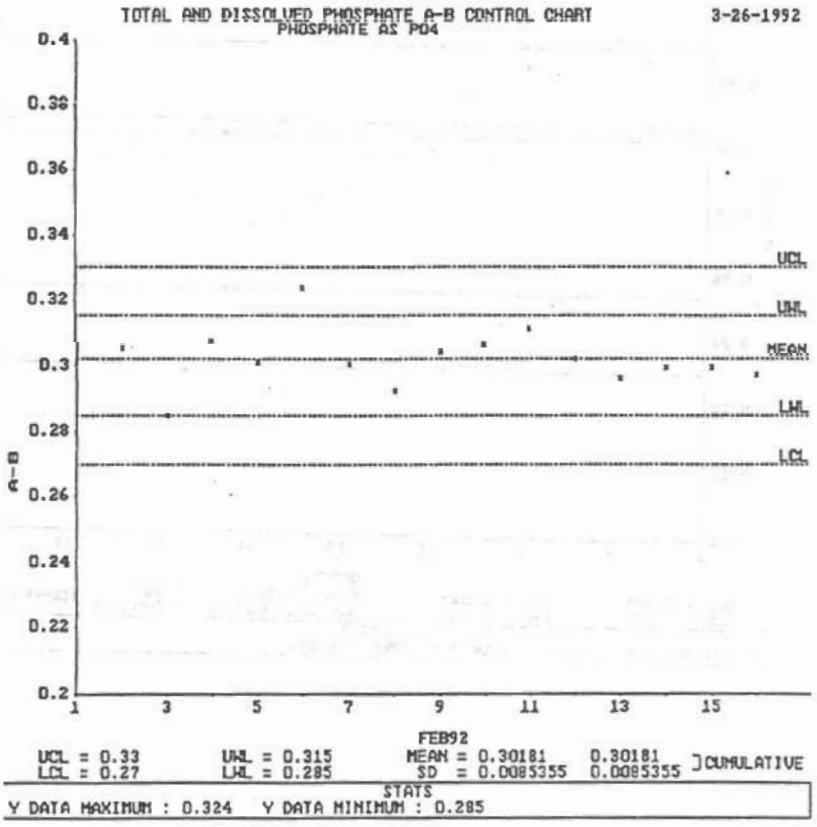

TOTAL AND DISSOLVED PHOSPHATE A-B CONTROL CHART
PHOSPHATE AS PO4
2-5-1992
A-B
0.4
0.38
0.36
0.34
0.32
0.3
0.28
0.26
0.24
0.22
0.2
UCL
UWL
MEAN
LWL
LCL
1
2
3
4
5
6
7
8
9
JAN/92
UCL = 0.33
LCL = 0.27
UWL = 0.315
LWL = 0.285
MEAN = 0.30322
SD = 0.0078074
0.30322
0.0078074
CUMULATIVE
STATS
Y DATA MAXIMUM : 0.313
Y DATA MINIMUM : 0.289

c

FIGURE 38

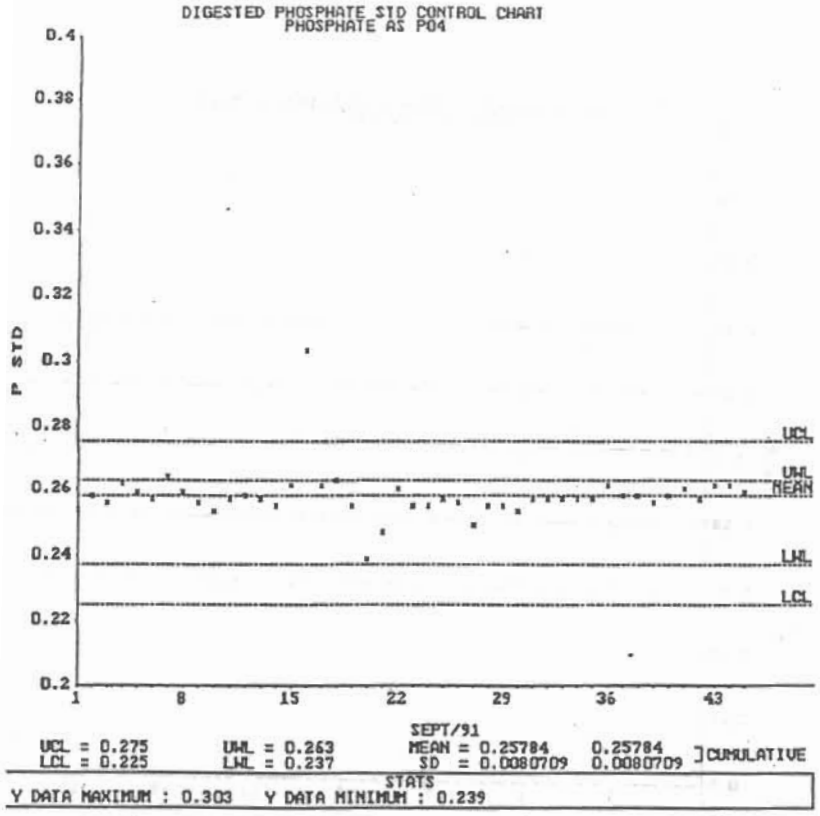

TOTAL AND DISSOLVED PHOSPHATE A+B CONTROL CHART
PHOSPHATE AS PO4
3-26-1992
A+B
UCL
UWL
MEAN
LWL
LCL
FEB92
UCL = 0.44
LCL = 0.36
UWL = 0.42
LWL = 0.38
MEAN = 0.40306
SD = 0.010962
0.40306
0.010962
CUMULATIVE
STATS
Y DATA MAXIMUM : 0.428
Y DATA MINIMUM : 0.379

c


TOTAL AND DISSOLVED PHOSPHATE A-B CONTROL CHART
PHOSPHATE AS PO4
3-26-1992
A-B
UCL
UWL
MEAN
LWL
LCL
FEB92
UCL = 0.33
LCL = 0.27
UWL = 0.315
LWL = 0.285
MEAN = 0.30181
SD = 0.0085355
0.30181
0.0085355
CUMULATIVE
STATS
Y DATA MAXIMUM : 0.324
Y DATA MINIMUM : 0.285

c

FIGURE 39


DIGESTED PHOSPHATE STD CONTROL CHART
PHOSPHATE AS PO4
P STD
0.4
0.38
0.36
0.34
0.32
0.3
0.28
0.26
0.24
0.22
0.2
UCL
UWL
MEAN
LWL
LCL
1
8
15
22
29
36
43
SEPT/91
UCL = 0.275
LCL = 0.225
UWL = 0.263
LWL = 0.237
MEAN = 0.25784
SD = 0.0080709
0.25784
0.0080709
]CUMULATIVE
STATS
Y DATA MAXIMUM : 0.303
Y DATA MINIMUM : 0.239

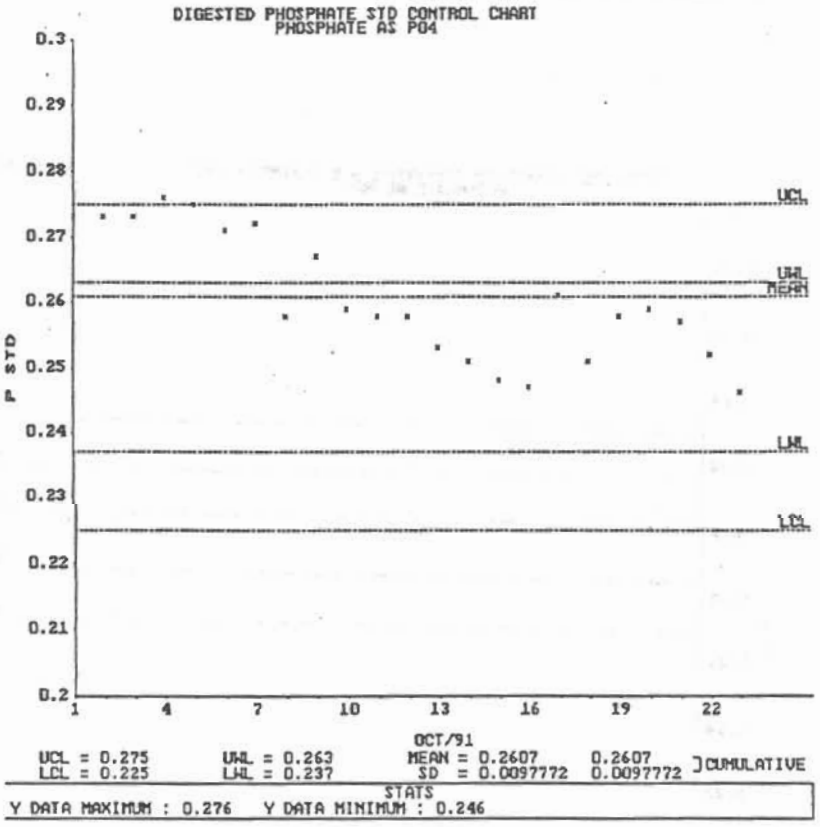
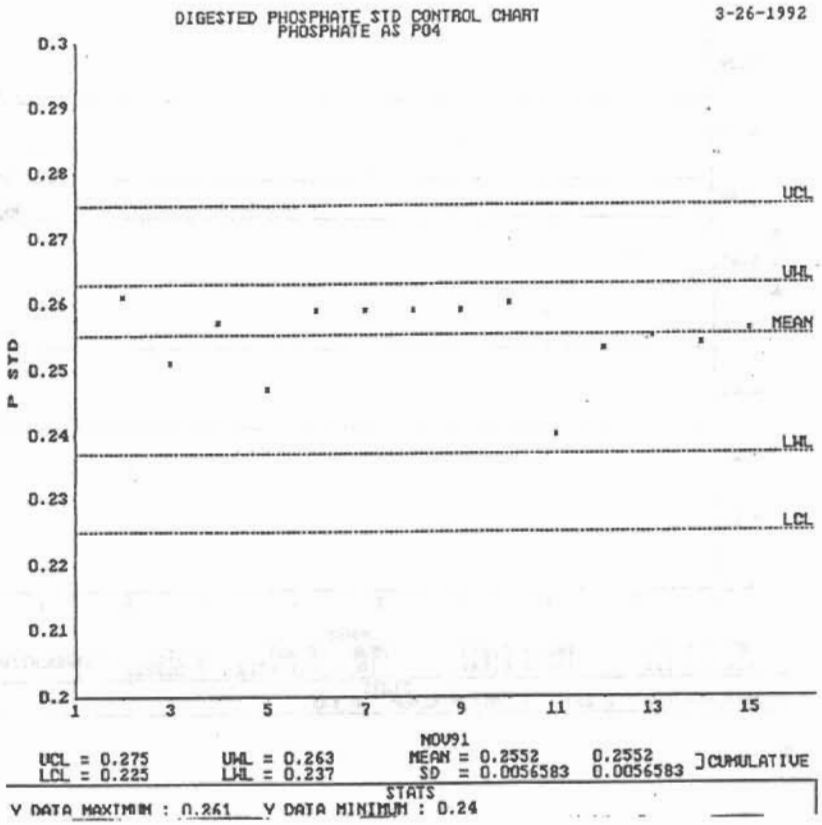

DIGESTED PHOSPHATE STD CONTROL CHART
PHOSPHATE AS PO4
P STD
0.3
0.29
0.28
0.27
0.26
0.25
0.24
0.23
0.22
0.21
0.2
UCL
UWL
MEAN
LWL
LCL
1
4
7
10
13
16
19
22
OCT/91
UCL = 0.275
LCL = 0.225
UWL = 0.263
LWL = 0.237
MEAN = 0.2607
SD = 0.0097772
0.2607
0.0097772
]CUMULATIVE
STATS
Y DATA MAXIMUM : 0.276
Y DATA MINIMUM : 0.246

FIGURE 40


DIGESTED PHOSPHATE STD CONTROL CHART
PHOSPHATE AS PO4
3-26-1992
P STD
UCL
UWL
MEAN
LWL
LCL
NOV91
UCL = 0.275
LCL = 0.225
UWL = 0.263
LWL = 0.237
MEAN = 0.2552
SD = 0.0056583
0.2552
0.0056583
CUMULATIVE
STATS
Y DATA MAXIMUM : 0.261
Y DATA MINIMUM : 0.24

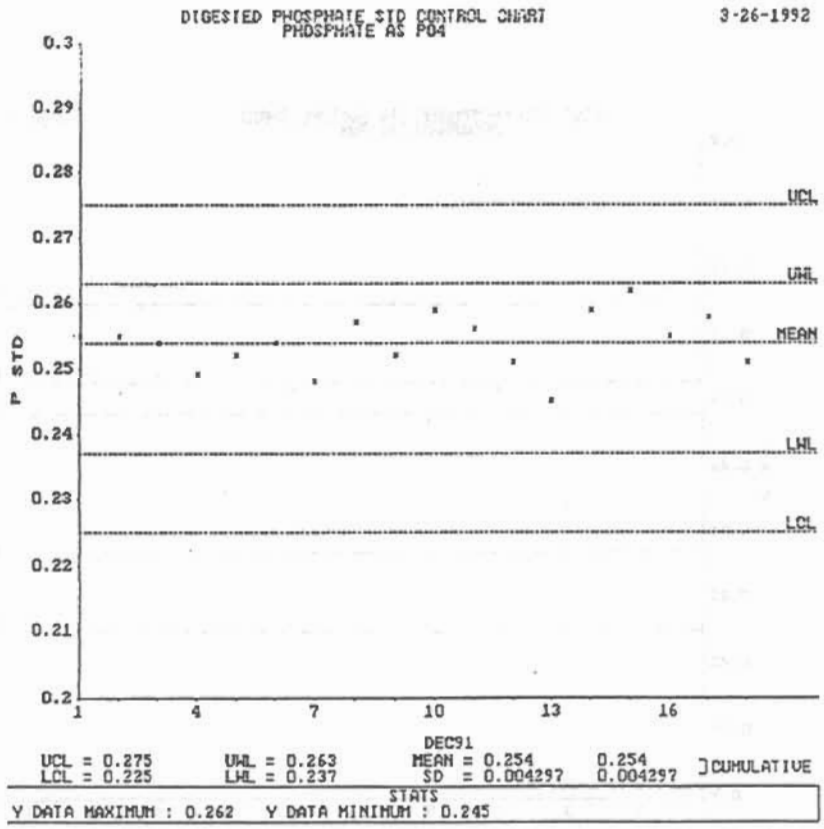
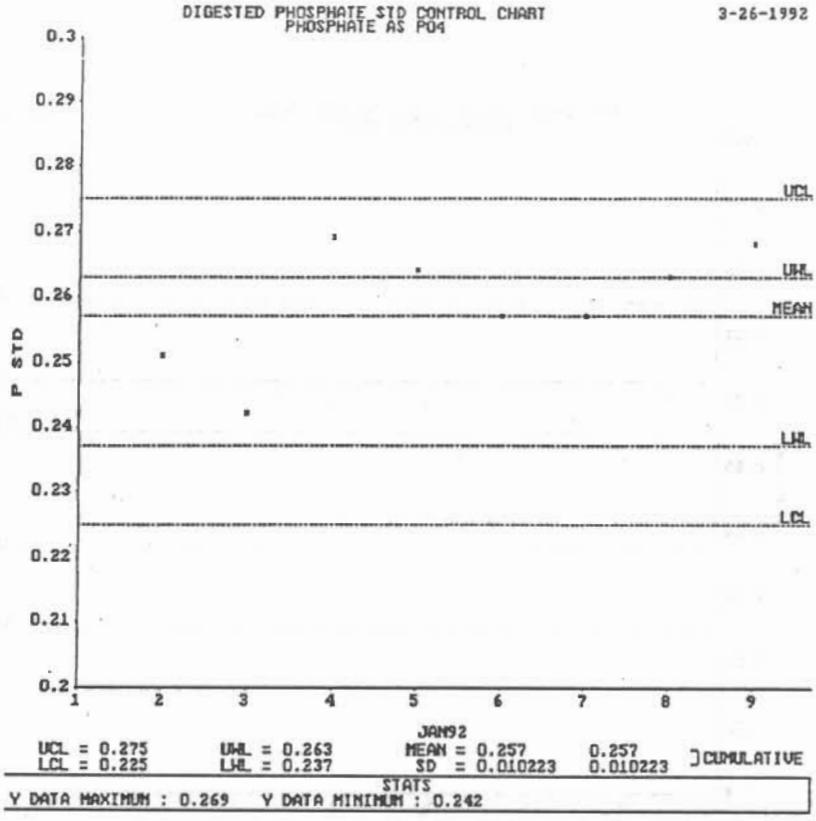

DIGESTED PHOSPHATE STD CONTROL CHART
PHOSPHATE AS PO4
3-26-1992
P STD
UCL
UWL
MEAN
LWL
LCL
DEC91
UCL = 0.275
LCL = 0.225
UWL = 0.263
LWL = 0.237
MEAN = 0.254
SD = 0.004297
0.254
0.004297
CUMULATIVE
STATS
Y DATA MAXIMUM : 0.262
Y DATA MINIMUM : 0.245

FIGURE 41


DIGESTED PHOSPHATE STD CONTROL CHART
PHOSPHATE AS PO4
3-26-1992
P STD
UCL
UWL
MEAN
LWL
LCL
JAN92
UCL = 0.275
LCL = 0.225
UWL = 0.263
LWL = 0.237
MEAN = 0.257
SD = 0.010223
0.257
0.010223
CUMULATIVE
STATS
Y DATA MAXIMUM : 0.269
Y DATA MINIMUM : 0.242

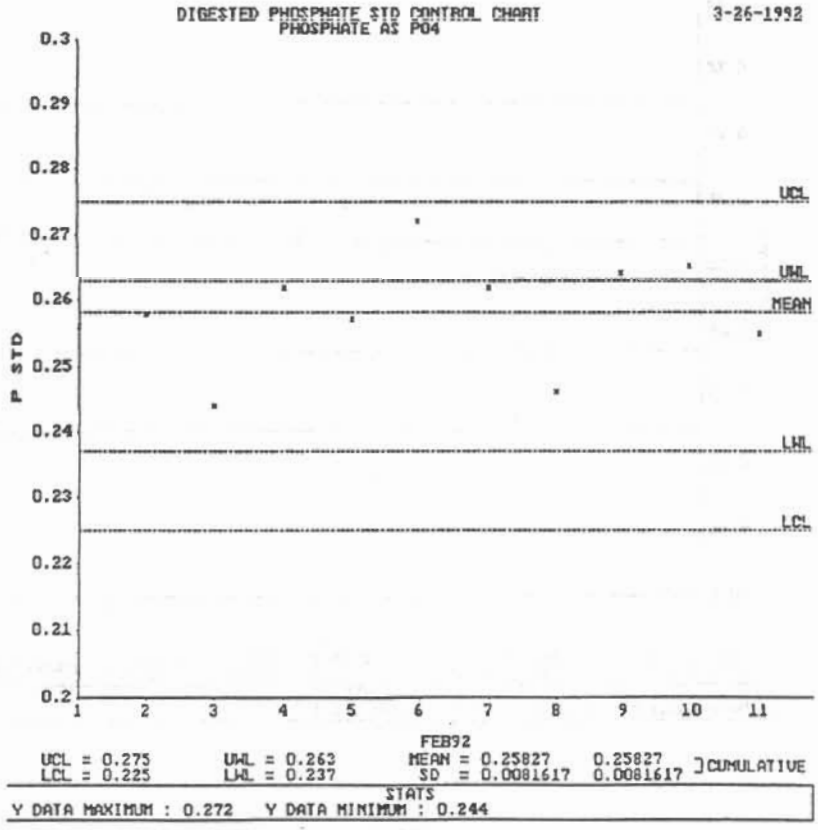
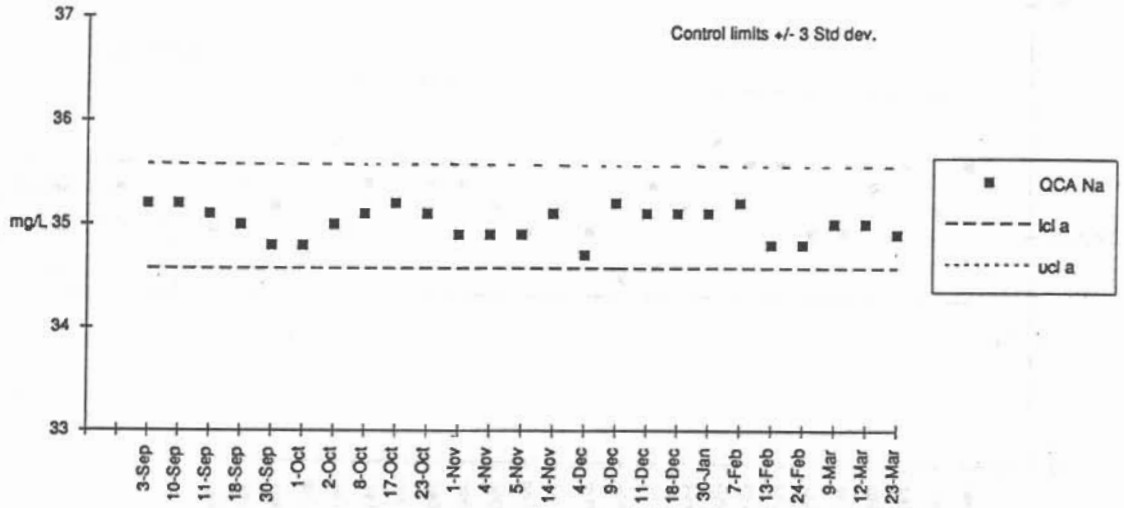

DIGESTED PHOSPHATE STD CONTROL CHART
PHOSPHATE AS PO4
3-26-1992
P STD
UCL
UWL
MEAN
LWL
LCL
FEB92
UCL = 0.275
LCL = 0.225
UWL = 0.263
LWL = 0.237
MEAN = 0.25827
SD = 0.0081617
0.25827
0.0081617
CUMULATIVE
STATS
Y DATA MAXIMUM : 0.272
Y DATA MINIMUM : 0.244

FIGURE 42

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

QCA - Na FES 1991-92



OCANA912.XLC

4/3/92

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

QCB - Na FES 1991-92

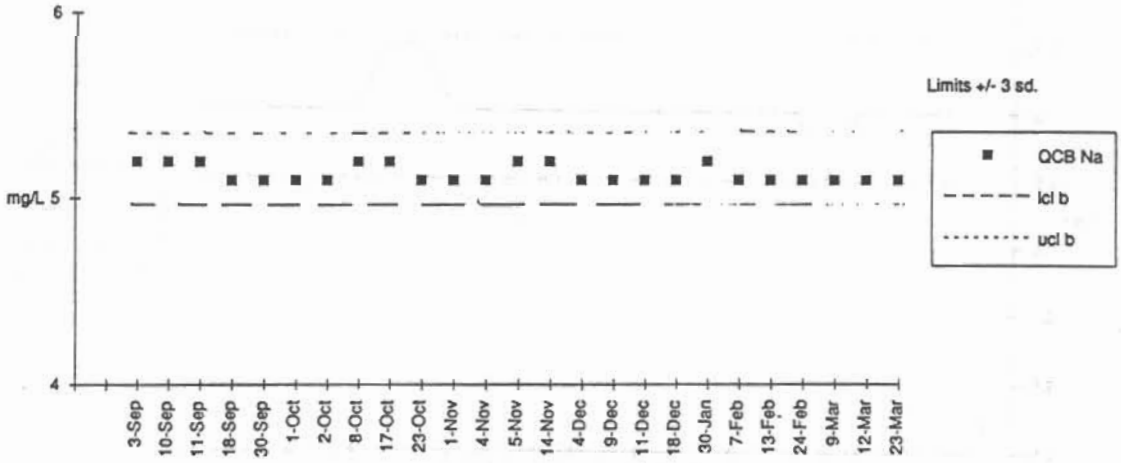


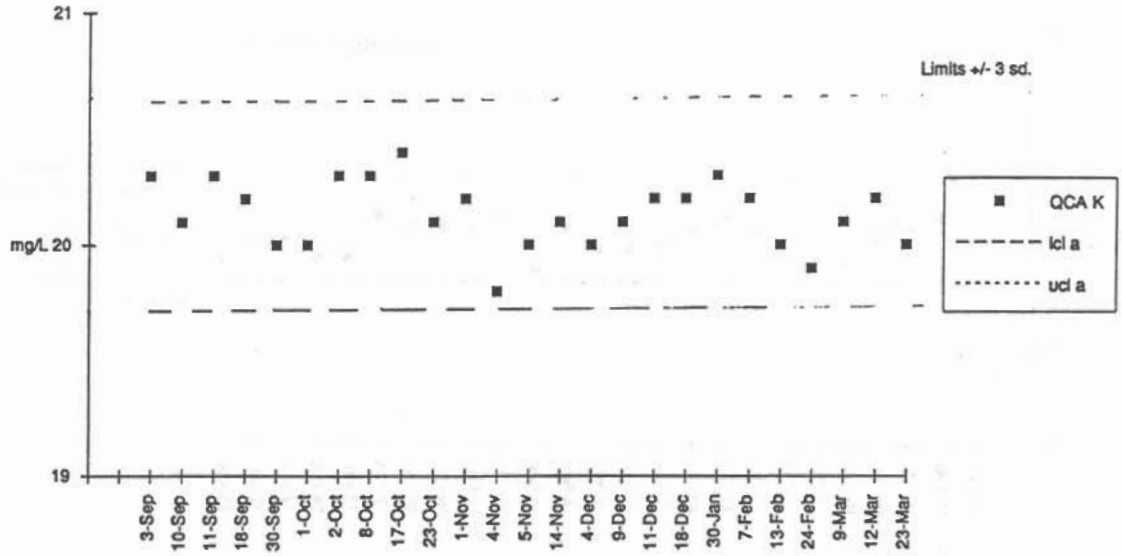
FIGURE 43

QCBNA912.XLC

4/3/92

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

QCA - K FES 1991-92



QCAK9192.XLC 4/3/92

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

QCB - K 1991-92

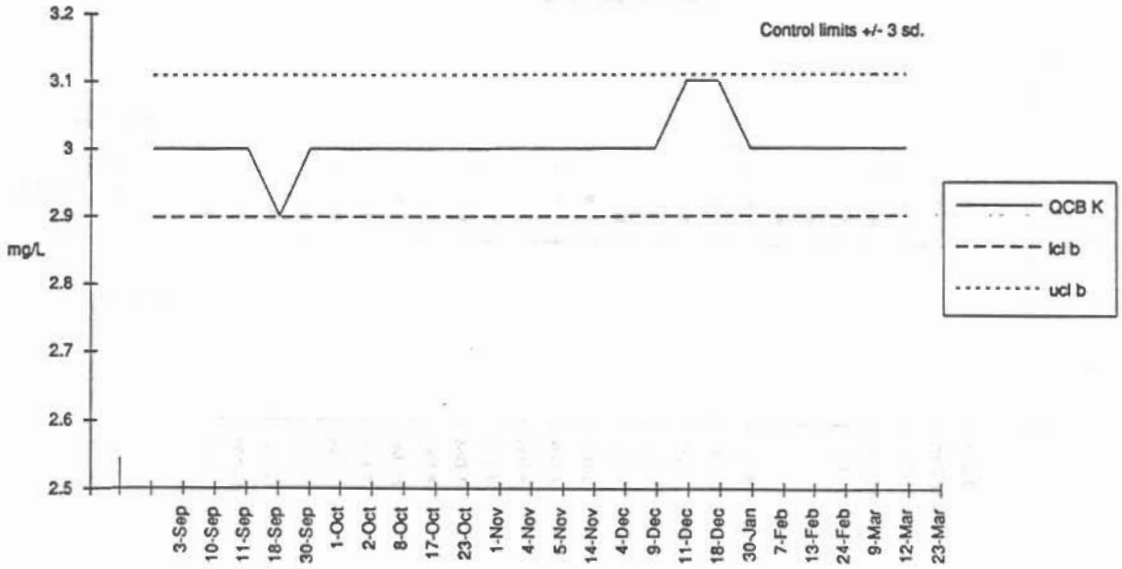
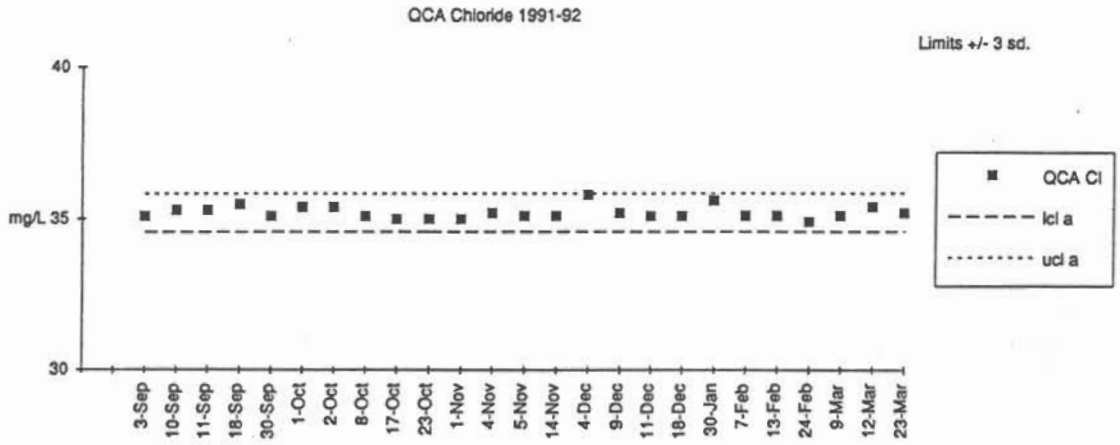


FIGURE 44

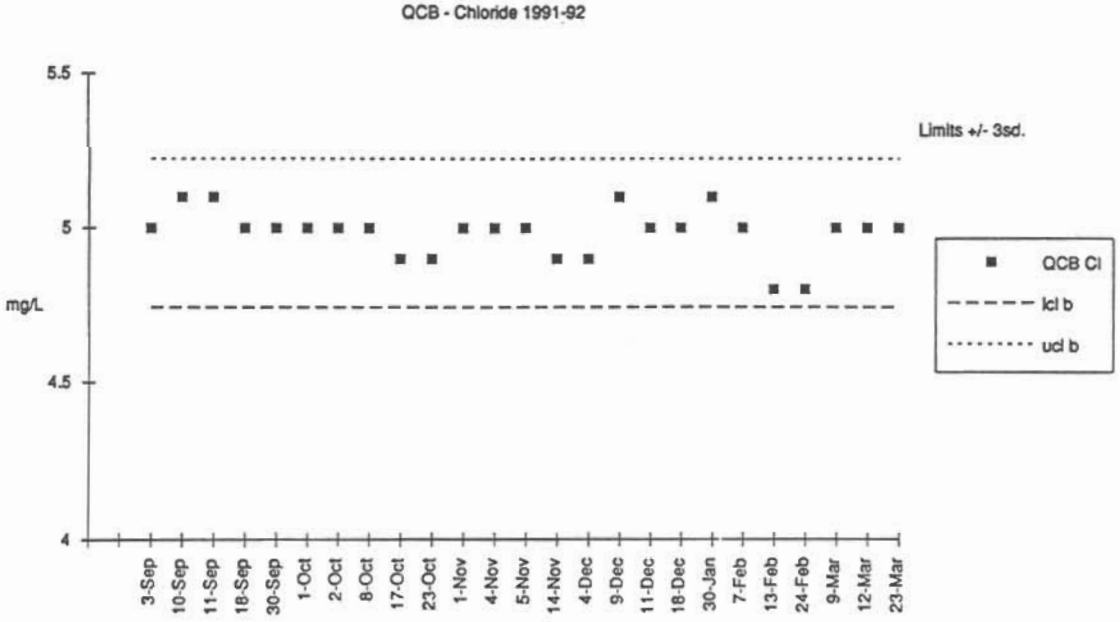
QCBK9192.XLC 4/3/92



QCACL912.XLC

4/3/92

ZENON ENVIRONMENTAL LABORATORIES INC (BC)



QCBCL912.XLC

FIGURE 45

ZENON ENVIRONMENTAL LABORATORIES INC. (BC) dj920127

Standard Reference Materials Report for CRIEMP Sept-Dec 1991

Environment Canada IW Reference Water CM-Ion-91

Analysis date: Nov-91 Units=mg/L

Parameter	Ref value	95% CI lower	95% CI upper	Zenon Value	% of ref value
Na	1.28	0.75	1.81	1.32	103%
K	0.48	0.39	0.57	0.5	104%
Ca	12.72	11.44	14	13.3	105%
Mg	2.76	2.24	3.24	2.85	103%

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

SECOND HALF CRIEMP QC REPORT

prepared by Dorothy A. Jeffery, Ph. D., QA/QC Officer

February 4, 1993

ZENON ENVIRONMENTAL LABORATORIES QUALITY CONTROL REPORT FOR CRIEMP PROJECT

This report covers the period March 1992 - October 1992.

The items as specified in "PROPOSED QA/QC PROGRAM FROM COLUMBIA RIVER WATER QUALITY STUDY" of September 1991 written by Terry Baturin, will be used as an outline. More information on specific questions may be available. As much as possible I have attempted to match Figure and Table #'s from the first half QC report with this report. Because of the addition, combination or deletion of some data Figure and Table #'s will not always be consecutive.

1. Comparison of blind replicates submitted by the client as samples.

Table I gives data for parameters measured for the routine site (Columbia River at Waneta), and sites A, B, and C. Relative Standard Deviation (RSD) has been calculated. The normal laboratory duplicate limit of <25% difference has been adjusted to <18% for RSD. These samples are field replicates, so limits for acceptance should be somewhat larger to reflect this additional source of variation. These limits should be set by the client.

Values determined near (within 5x) the minimum detection concentration (MDC) are subject to more relative variation, therefore the <18% limit does not apply.

Variation among replicates is generally within limits with RSD's greater than 18% only for samples near the MDC. This reflects well on the sampling program and the analysis.

During the course of the CRIEMP project Zenon has continued to verify MDC's for parameters measured. Some changes have been made to parameters included in this study. Table I lists the originally quoted MDC. Among the changes, was an evaluation of total (digested) water MDC for metals. In many cases the MDC for total metals was approximately double the MDC for dissolved MDC's. Where this is relevant it has been noted in the comments to Table I. Other changed MDC's were for carbon total, organic, and inorganic, and for filterable and non-filterable residues (NFR and FR).

Specific comments are necessary about some replicates with large relative standard deviations. Colour, single wavelength, on May 12, 1992 sampling shows values at sites A, B, and C of 34, 9260, and <5. The data reported and entered in the SAMAN database was incorrect.

Laboratory worksheets show the correct data to be 5, 4, <5 giving an acceptable relative standard deviation. For the data reported in this QC report this represents <1% transcription error rate.

An extremely high value of 3340 mg/L for sodium (sparcode Na-T0041) for the metals sample taken on March 17, 1992 at site A was reported. This is a saturating level of sodium for the ICP instrument which may cause some interference with other measured metals. This may explain the high replicate for iron of 0.222 mg/L. The sample was diluted 1 in 10 and run again, but still gave saturating sodium levels. A separate unpreserved sample sent to the autoanalysis section gave an expected sodium value (sparcode Na-D1331) of 1.6 mg/L. We speculate that the sample sent to metals was contaminated in some way, perhaps by addition of the wrong preservative during field preservation. Sodium hydroxide was also available for preservation of resin/fatty acid samples, and a mix-up may have caused the sodium contamination.

A high value of 10.4 Na-T0041 at Site A October 27, 1992, could not be explained. It was not a transcription error. The problem may be carry-over.

TKN replicates for March 17, 1992 sampling were 27% relative standard deviation. Review of the analytical runs indicated that the TKN sample for Site C (result 0.34 mg/L), was the third sample following an off-scale result. The higher result may have been due to carry-over. The normal procedure is to re-run the two samples after a high sample; this may not have been sufficient to prevent carry-over in this case.

Some parameters have been reported in this table which were not requested. They are part of packages and in some cases are not the analytical route of choice (eg. Boron total, Sodium by ICP).

2. Field blanks (identified as travelling blanks) were received for Columbia River at Waneta (forms 10003001, & 10003293) and Columbia River above PE1272 (forms 10003207 & 10003194) They were sampled on May 12, 1992, and August 4, 1992. Samples taken on October 27, 1992 (forms 10003004 and 10003003) do not appear to be blanks and showed labelling irregularities.

Table II summarises these blanks. There were no important values greater than MDC. Evaluation of MDC's for total metals as described above, revealed that apparently high blanks for Ca, Fe, Si and Zn based on dissolved MDC's, were in fact not high compared to the total metals MDC.

Total alkalinity has been shown to have a consistent blank of 1.8 mg/L. The blank values recorded for the CRIEMP blanks are in this range.

3. Assessment of laboratory blanks for all analyzed parameters.

Instrument blanks (usually DI water, or background solvent) are analyzed throughout the run for all parameters and in many cases the instrument is zeroed against this blank. Because of this blank values are not compiled in these cases.

Digested water blanks are show in Table III. The data was originally tabulated in relation to dissolved MDC's, so any values less than the dissolved MDC are left as empty cells. Average blanks shown at the end of the table represent only the blanks which were greater than MDC. An estimate for the average for all samples could be calculated. Thirteen metals have averages greater than the total MDC. Of these, three metals, Cr, Cu and Zn, have "average for blanks>dissolved MDC" greater than total MDC and approximately half or more values >dissolved MDC. Only Chromium may be of concern, whereas the other two metals are within rounding error of the Total MDC.

Digested waters blanks for graphite furnace atomic absorption analysis of Cadmium and Lead are shown in Figures 1 and 2. Control limits for blanks have now been set as 2 standard deviations above the long term blank. Blank correction is done when batch blanks exceed the MDC and if not more than one of the two batch blanks exceeds the control limit. Digest batches are repeated if both batch blanks exceed the control limit. This did not occur for either lead or cadmium.

Figure 6 shows alkalinity blanks. The upper control limit has been set as 2 standard deviations above the long term average blank. For samples with an alkalinity above 50 mg/L the blank does not contribute significantly to the result.

Residue blanks are shown in Figures 9a & 9b. No values exceed the blank control limits.

4. Evaluation of surrogate recoveries for major organic groups analyzed by GC.

The surrogate, nonadecanoic acid (referred to as C19), is used for Resin acid/fatty acid analysis. Figure 10 shows surrogate recovery.

5. Recoveries of analytes from spiked samples

Chloroform spikes are used in this analytical procedure (Figure 11).

Moderately clean water samples, which the Columbia River samples are, behave much like de-ionized water when spiked; therefore at Zenon we do not make a practice of spiking this type of sample. We run calibration check solutions (usually one high 70% of full scale, QCA, and one low 20% of full scale, QCB) with each batch of most analyses. These are essentially the same as spiked samples for clean water dissolved samples.

These calibration checks are presented graphically for several of the parameters in the CRIEMP project:

Copper ICP	March-Sept 1992	Figure 19
Nickel ICP	March-Sept 1992	Figure 20a
Thallium ICP	March-Sept 1992	Figure 20b
Iron ICP	March-Sept 1992	Figure 21a
Zinc ICP	March-Sept 1992	Figure 21b
Ammonia	Jan-Dec 1992	Figure 24
Nitrate	Jan-Dec 1992	Figure 29
Alkalinity	March-Nov 1992	Figure 46.

Control limits are generally set as ±3 x Standard deviation of the mean value determined over a period of time when the analytical system is known to be in control. If a check value falls outside the limits, it is repeated and if it still falls outside the limits the batch is repeated. Some plots show interim limits because we have not been accumulating data long enough to set control limits.

The ICP charts (Figures 19 - 21) show some values outside the control limits. For March 9, QCA was slightly high for Ni and Zn. This was probably due to carry over from a previous 1 mg/L multi-element standard. Other QC checks were acceptable so it was decided to proceed with the run. A similar situation applied for the high Zn QCB on March 19 and May 6 and Tl QCB on June 22.

On June 16, high QCB values occurred for Cu, Ni and Zn. This was attributed to evaporative concentration of the solution at the end of the bottle. A new solution was prepared.

On June 11, a hydrogen fluoride resistant torch was used in the ICP. This gave higher values for Ni and Fe. Sample values were corrected for this difference prior to reporting. QCA Fe was high on September. Since other QC checks at 0.350, 0.1 and 0.01 were acceptable the run was allowed to proceed.

The Nitrogen parameters are very stable, so control limits are set as mean ± 2 standard deviations. Figure 29 QCA/QCB for nitrate and Figure 24 for ammonia show points outside control limits on ~ March 12, ~April 15, ~July 23 and ~ August 15, 1992. These out of control points were followed immediately by a re-build of the autoanalysis system. A re-build consists of replacing tubing in the system, which must be done periodically. Out of control points are a warning that re-build is required. Points barely out of control limits in January and April for ammonia, resulted from a switch to long term control limits from the monthly limits in effect at the time the data was recorded. Long term control limits are somewhat tighter than the monthly limits.

6. An evaluation of standard reference materials analyzed during the study:

Few standard reference waters are available so they are not run routinely. In addition for the reasons discussed above, those that are available, serve more as a calibration check than as a matrix effect check. Environment Canada, CCIW, has some reference waters, two of which are CM-Ion-91 (Lake Superior Water), and CM-Ion-94 (soft coloured water). APG 7878 is a commercially available multi-element reference material. These have been run on several occasions.

See Table IV.

7. Summary of FPQA and other relevant QC studies for period March 1992-Nov 1992

<u>Federal Provincial Quality Assurance #58 - FPQA 58, was run in April 1992.</u>

Zenon's performance was rated moderate with 6.1% flags (4 flags). Sixty-one parameters were acceptable. We were 8th out of nineteen labs.

Surprisingly we were flagged high 55% for 1 TKN when the acceptable deviation was 40%. The study mean concentration for that sample was 0.43 mg/L. Our TKN value for the other sample was close to the study mean of 0.068 mg/L. No obvious cause for the high value has been found.

We were flagged high for total nitrogen at 11% when the acceptable deviation was 10%. This is a problem of the study evaluation, since some labs report total nitrogen from a UV digest method known to give low results. This pulls down the study mean for other methods.

Boron was flagged low at a study mean concentration of 0.018 mg/L. Low end calibration for B had drifted out. This standard has since been replaced. Molybdenum was high at a study mean level of 0.0057. This was a transient effect, perhaps unstable instrument performance, since re-run of the sample gave close to this value.

These studies cover a wide range of inorganic parameters. The following parameters are included in CRIEMP:

specific conductance	hardness
nitrate + nitrite	silica
ammonia	
fluoride	potassium
sodium	chloride
Ph	total alkalinity
calcium	magnesium
phosphorus total	sulfate
aluminum	lead
manganese	iron
copper	zinc
cadmium.	

Federal Provincial Quality Assurance Study 59 - general parameters, ions, and dissolved metals. The analysis for this study was done in May and June 1992.

Zenon had 3 flags (4.7%) out of 64 reported results and rated very good to excellent. Zenon was fifth of 15 laboratories reporting.

Two of the flags were for total nitrogen. We calculate total nitrogen from TKN + nitrate, a method included in the methods listing for FPQA. The components for our values were acceptable yet the sum was not. This is because the other contributors to the consensus study mean use UV digest methods which give lower values. The problem is non-comparability of the methods by contributing laboratories. This has been discussed with Mr. Alkema the study co-ordinator.

The other flag was from low level aluminum (by graphite furnace atomic absorption). Our results were high (131% of study mean) at 0.05 mg/L. The problem was traced to incorrect selection of a calibration when more than one analytical run had been made. Criteria for judging acceptance of calibration has been reviewed with the analyst.

FPQA 60. This analysis for this study was done in August 1992.

Zenon had no flagged results in 63 results reported. This was the best performance of 19 laboratories that participated.

Parameters successfully analyzed were

Specific Conductance	Turbidity
Boron	TKN
Nitrate+nitrite	Ammonia
Fluoride	Alkalinity total
pH	Hardness
Sodium	Magnesium
Silica	Phosphorous total
Sulfate	Chloride
Potassium	Calcium
Aluminum	Vanadium
Chromium	Manganese
Iron	Cobalt
Nickel	Copper
Zinc	Strontium
Molybdenum	Cadmium
Barium	Lead
Ion Balance.	

FPQA 61. This analysis for this study was done in October 1992.

Zenon had 2 flagged results in 64 results reported. This was the second best performance of 17 laboratories that participated.

Parameters were listed above. Alkalinity was flagged high for a low level result (16.4 mg/L ZEL result for a sample with study mean 14.2 mg/L). The cause for this may be a low level blank, which is significant for samples <50 mg/L. Our long term blank for de-ionized waters averages 1.8 mg/L. It has not been our practice to blank correct alkalinity results since the dilution water for samples may have a different background level than Zenon's DI water. Another explanation for the blank, which effects both DI water and samples, is an instrument blank of ~2 mg/L because the automatic titrator is overshooting by this amount. Past trends in FPQA results and other QC samples are being reassessed for the effect of blank on low level samples.

Nickel by graphite furnace atomic absorption was flagged low (0.0045 mg/L ZEL result for a sample of study mean 0.0065 mg/L). These values are within 3 times the MDC (0.005 mg/L) where accuracy is lower than other parts of the curve. The study relative standard deviation was 14.7%.

Clinical Microbiology Proficiency Testing Program- Testing #3 - was run in February 1992.

Four of four samples were correctly identified and counted for total,and fecal coliforms, and identified for Klebsiella.

CAEAL Microbiology Performance Evaluation was run in July 1992. Four samples were analyzed for total and fecal coliform. Acceptable PE score (average 75 out of 100) was obtained.

Microbiology Proficiency Testing Program - July 1992 samples -CMPT #4. Twenty laboratories participated in this study. Four samples were provided for measurement of Total and Fecal coliforms. Zenon reported results by both membrane filtration and most probable number (MPN) methods. Zenon's results were within confidence limits for all 8 possible total coliform results. Zenon correctly differentiated Enterobacter aerogenes, which should not grow, for Fecal coliform in the two samples. The fecal coliform count was low in one of two samples containing E. coli by membrane filtration, but not by MPN.

US EPA WSM20. This microbiology work was done in May 1992.

Six samples were tested for presence of total coliforms and fecal coliform/E. coli by membrane filtration (MF). All were correct. Six additional samples were tested for presence of total coliforms and fecal coliform/E. coli by multiple tube fermentation (MTF). All total coliforms results were correct. One of six fecal coliform/E. coli results was wrong, the bacteria was not detected when present. This error could have resulted from failure to re-suspend completely the total sample before making transfer to the fecal media.

CAEAL Microbiology. This microbiology study was done in June 1992.

Four samples were tested for total and fecal coliforms using membrane filtration. Acceptable scores were obtained for both parameters; however, low counts (<50% of reference counts) were reported for fecal coliforms when present, and for one of four total coliforms.

The low counts may be due to using incubation times on the low end of the acceptable range. Zenon now uses incubation times on the high end of the range.

Clinical Microbiology Proficiency Testing #5. This work was done October 1992.

Four samples were tested for Enterococcus faecalis in simulated marine water, and for total and fecal coliforms in simulated recreational beach water.

One Enterococcus result was low; the other was extremely high. The high result was traced to incorrect labelling of plates.

Both total coliforms results were acceptable. One fecal coliforms was low; the other was acceptable. The low counts may be due to the relatively short incubation times as described above.

Canadian Association of Environmental Analytical Laboratories, Performance Evaluation Study #3 - was performed in March and April 1992.

Zenon's average PE score for 26 parameters was 95.2 out of 100. BOD was not successfully analyzed apparently due to failure to properly correct for depletion of dilution water, and possibly because of a failing dissolved oxygen probe. This probe has since been replaced.

Successfully performed parameters were

Alkalinity pH 4.5 Conductivity

Chloride	Fluoride
Potassium	Reactive Silica
Sodium	Sulfate
Nitrate	Total Kjeldahl Nitrogen
Nitrate+ Nitrite	Total Phosphorus
Total Suspended Solids	
Dissolved Calcium	Dissolved Iron
Dissolved Cadmium	Dissolved Magnesium
Dissolved Cobalt	Dissolved Manganese
Dissolved Chromium	Dissolved Nickel
Dissolved Copper	Dissolved Lead
Dissolved Vanadium	Dissolved Zinc

CAEAL #4. The analytical work for this study was done in October 1992. Four samples were tested for each parameter. Preliminary evaluation was received in December.

Three general parameters (alkalinity, conductivity, and total suspended solids), one organics parameter (total PCB's in oil) and one biology parameter (biochemical oxygen demand) were done with no flags.

Nine of 10, autoanalysis parameters were done with no flags. These included:

chloride . . fluoride . . potassium
sodium . . . nitrate . . nitrate+nitrite
reactive silica . . . . . TKN
total phosphorus.

Two sulfate results were flagged high (~15%) at ~ 10 mg/L. Overall for the four samples, the parameter was acceptable.

Two of twelve metals had flagged results. Calcium was 12% high by ICP, at a reference value of 29.3 mg/L. Flame atomic absorption result (FAA), not reported, was correct. The other three samples in the range 3 to 20 mg/L were analyzed correctly, and the parameter was acceptable.

There were two flags for magnesium. In one case a transcription error was made from the SAMAN report to the final CAEAL report. This is a step which is not necessary for client results. An ICP magnesium result was 23% high for a sample at a reference value of 0.79 mg/L. Again the FAA result was correct.

Overall in CAEAL study #4, Zenon had 5.7% flags, which resulted in two failed parameters (also 5.7%).

B.C. Ministry of Environment Lab Registration study - general parameters, ions and total metals. (EDQA) was performed in April 1992.

The final report was received in August 1992. Zenon had acceptable PE scores in 15 of 16 parameters. Our average PE score was 96 out of 100.

Two of four non-filterable residue (NFR) results were high (118, and 136% of design). We are concerned that non-standardized methodology among laboratories could affect study mean results. Zenon's NFR method uses drying to 105 C, while some methods dry to 180 C. If the sample contains heat labile compounds this difference in drying temperatures could cause different results.

Parameters successfully analyzed included:

biochemical oxygen demand	chloride
conductivity	sodium
nitrate	+nitrite
pH	sulfate
total cadmium	total copper
total iron	total Kjeldahl nitrogen
total phosphorus	total lead
total zinc.	

U.S. Environmental Protection Agency Water Systems Study 29, was performed in November and December 1991.

Thirteen metals were analyzed, 12 of them acceptably. These were antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, and silver. The concentrations ranged from 0.5 ug/L for mercury to 230 ug/L for copper. Thallium was not detected when it was present at 9.73 ug/L. This failure was attributed to an improper standard which has since been replaced, and poor precision of repeated measurements in that range.

Major ions, and general parameters (nitrate, fluoride, turbidity, calcium, pH, alkalinity, sodium, sulfate and cyanide) were all correctly analyzed.

Trihalomethane values were not acceptable because a dilution factor error was made in calculations. Increased attention is being focused on this aspect of calculations to reduce this type of error.

U.S. Environmental Protection Agency Water Pollution. Study 29
Study 29 was performed in October 1992.

The laboratory had 6 (6%) flags out of 108 parameters/samples analyzed.

Parameters analyzed successfully in EPA WP29:

General (0 flags in 20 analyses)

pH	specific conductance
total alkalinity	total dissolved solids
chemical oxygen demand	non-filterable residue
total organic carbon	cyanide total
oil & grease	phenols

Biology (0 flags in 2 analyses)

biochemical oxygen demand

Autoanalysis (0 flags in 20 analyses)

sodium	potassium
chloride	fluoride
sulfate	ammonia
nitrate	phosphate ortho
total Kjeldahl nitrogen	phosphorus total

Metals (2 flags in 42 analyses, 5% flags)

aluminum	arsenic
cadmium	cobalt
chromium	copper
iron	mercury
manganese	nickel
lead	selenium
vanadium	zinc
antimony	molybdenum
strontium	titanium

Trihalomethanes including

bromodichloromethane bromoform.

Beryllium by ICP was low at a design value of 40 ug/L (74% of design), acceptable but low at 100 ug/L (80% of design). The other metals problem was thallium, which was high at a design value of 33.9 ug/L (127% of design). The calibration for these metals is being re-examined.

Chloroform and dibromochloromethane values at a design of 15 to 60 ug/L were reported low (44-62% of design). Zenon will be moving the THM analysis to a Purge and Trap method in the near future. This change should reduce the loss of volatile components which is inherent in the current method.

US EPA WS030. Analytical work for this study was done in April and May of 1992.

All 10 autoanalysis and general parameters were analyzed to an acceptable level. This included:

nitrate	nitrite	fluoride
turbidity	pH	alkalinity
sodium	sulfate	total cyanide
total filterable residue.		

Thirteen of fourteen metals were analyzed successfully including:

calcium	arsenic	barium
beryllium	boron	cadmium
chromium	copper	lead
mercury	nickel	selenium
silver.		

Levels ranged from 3 to 1000 µg/L.

Thallium at 5.3 µg/L was not detected; however, this is below our MDC of 20 µg/L.

Three of four trihalomethanes were acceptable. Zenon result, for chlorodibromomethane at a true value of 36 µg/L, was low at 28.

The microbiology portion of this study was reported above as EPA WSM020.

8. SPARCODE changes - impact on reporting

During the period of this study metals package SPARCODES have been changed, resulting in the direct reporting down to the new metals MDC's. Four parameters previously available only from the autoanalysis unit of the laboratory are now also available from the metals section as part of the metals package. The initial change of SPARCODES resulted in some analyses normally done in autoanalysis being done only in metals. These samples have been traced and the samples re-run by the requested autoanalysis route.

Arsenic hydride (low level) requests were also effected by the SPARCODE change. Again, all samples where arsenic low level had been run as arsenic ICP no hydride, were re-run by the low level route.

On reports and in SEAM it is necessary to refer to the SPARCODE to determine the analytical route that has been used.

These routes are summarized below.

Descriptor	(previous) SPARCODE autoanalysis	(new) SPARCODE metals
Sodium dissolved	Na-D1331	Na_D0031
Sodium Total		Na_T0041
Potassium dissolved	K--D1331	K__D0031
Potassium Total		K__T0041
Phosphorus dissolved	P--D139A	P__D0031
Phosphorus Total	P--T139A	P__T0041

9. Methods

"A Laboratory Manual for the Chemical Analysis of Waters, Wastewaters, Sediments and Biological Materials", 1976 and Part II Supplement, 1989 has been provided to Mr. Baturin and Mr. T Tremblay of Environment Canada. Methods which have been revised since publication of these manuals are being provided.

10. Sample bottle and Preservation preparation

a. GV - general variables - 2 litre polyethylene bottles and caps are de-ionized water (DI) rinsed, drained and capped, prior to packing in coolers for shipping to the field .

GV bottles are unpreserved.

b. AO RF - AOX and resin and fatty acids - 500 mL and 1 litre amber glass bottles with teflon lined polypropylene caps are purchased pre-cleaned from Eagle Picher. Wash 'A' procedure is as follows:

1. Bottles, liners, and caps washed in laboratory grade non-phosphate detergent.
2. Rinsed three times with distilled water.
3. Rinsed with 1:1 nitric acid.
4. Rinsed three times with ASTM-Type 1 organic free water.
5. Oven dried for one hour.
6. Rinsed with hexane.
7. Oven dried for one hour.

For resin acids the preservative in acid washed 5 mL plastic vials is 10N sodium hydroxide made from pellets (BDH assured grade).

For AOX the preservative is nitric acid (2 mL) in plastic vials.

c. TOC - total organic carbon - 250 mL polyethylene bottles prepared as for GV bottles.

d. CO - coliform - 250 mL bottles are capped and autoclaved then shipped to the field.

e. HG - mercury - bottles are 1 litre clear glass bottles purchased pre-cleaned from Eagle Picher. Cleaning procedure is as described for AO RF.

Preservative, shipped in 8 mL acid washed glass vials, is 4 mL of 10% potassium dichromat (analytical grade) and 4 mL of concentrated sulfuric acid (reagent grade).

f. M - metals - 250 mL high density polyethylene bottles purchased pre-cleaned from Environmental Sampling Supply (ESS). Cleaning procedure is as follows:

1. Bottles and caps washed in laboratory grade non-phosphate detergent.
2. Rinsed three times with hot tap water.
3. Rinsed with 1:1 nitric acid.
4. Rinsed three times with ASTM-Type 1 deionized water.
5. Invert and air dry in contamination free environment.
6. Cap bottle.

Preservative, shipped in 5 mL acid washed polyethylene vials, is nitric acid (analytical grade).

g. NFR - non-filterable residue - bottles are 500 mL bottles prepared as for GV.

h. CH - chlorate - are 500 mL amber glass bottles purchased from Eagle Picher and cleaned by the procedure described for AO RF.

Acid testing - nitric acid is tested for metals content by graphite furnace atomic absorption by random sampling of bottles from batches of bottles of acid received.

Preservative blanks are checked periodically for preservatives as sent to the field in vials. This was done in May 1992. The results of this check for mercury preservatives indicated contamination to the an equivalent of 0.28 ug/L water sample. All components of the mercury preservative and sample bottle system were checked and the source of the contamination was found to be sulfuric acid in a plastic dispenser (Table V). Mr. Baturin was advised on June 8 of this problem and all mercury preservative vials in the field were recalled and replaced. The use of plastic dispensers for mercury any solutions involved with mercury analysis has been discontinued. Review of the field replicates for mercury (Table I), shows they have not had detectable mercury since July 1992. Prior to that mercury concentrations of 0.00006 to 0.00064 ug/L were reported in months October - December 1991, January 1992, and March - June 1992.

ZENON ENVIRONMENTAL LAB (BC) TABLE II

Travelling Blanks

Parameter	Sparcode	92/05/12:1141	92/05/12:0820	92/08/04:0830	92/08/04:1150	92/10/27:1115	92/10/27:0820	MDC for total metals
Date/Time		92/05/12:1141	92/05/12:0820	92/08/04:0830	92/08/04:1150	92/10/27:1115	92/10/27:0820	
Form #		10003001	10003207	10003194	10003293	10003004	10003003	
Site name		Columbia R. at Waneta	Columbia R above PE1272	Columbia R above PE1272	Columbia R. at Waneta	Columbia R. at Waneta	Columbia R above PE1272	
Site #		0200559	0200183	0200183	0200559	0200559	0200183	
		xcept when shown otherwise. Result mg/L				Blank ??	reported as Birchbank	
Carbon total	C–T0910	<3	<3	<3	<3	15	15	
pH	41220	5.5	5.8	5.7	5.7			
Color true	213000	<5	<5	<5	<5			
Color TAC	241310	1	1	2	2			
Color SW	10521320	<5	<5	<5	<5			
Sp. Cond	111160		2	2	2			
NFR=TSS	81070		<1	<1	<1			
FR=TDS	7H1032		2	8	8			
Turbidity	151140		0.1	0.1	0.1			
Hardness	107CALC	<0.2			<0.1			
HCO3 as CaCO3								
Phenol. Alk	1011211	<0.5	<0.5	<0.5	<0.5			
Total Alk.	1021210	1.9	2.2	2.2	2.2			
Chloride	11041330	<0.5	<0.5	<0.5	<0.5			
Fluoride	11061341	<0.10	<0.10	<0.10	<0.10			
TOC	0103calc	<3	<3	<3	<3	<3	<3	
TIC	01240930	<2	<2	<2	<2	15	15	
TKN	0113136A	<0.04	<0.04	<0.04	<0.04			
Ammonia	11081351	<0.005	<0.005	<0.005	<0.005			
NO3+NO2	11091350	0.04	<0.02	<0.02	<0.02			
Phosphorus Ortho	11181380		<0.003	<0.003	<0.003			
Silica Reactive	11201381		<0.5	<0.5	<0.5			
Sulfate	11211400		<1.0	<1.0	<1.0			
Silver	Ag-T0041	<0.01			<0.01			
All resin acids excep	xxxxP030	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	
Behenic acid			<0.001	<0.001				
Isopimaric acid								
Levo Pimaric Acid								
Fatty acids except following		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	
Lauric acid	LAURP030		0.001	0.001				
Lignoceric acid	LIGNP030							
Myristic Acid	MYRIP030							
Oleic Acid								
Palmitric acid	PALMP030							

ZENON ENVIRONMENTAL LAB (BC) TABLE II

Travelling Blanks

Parameter	Sparcode	92/05/12:1141	92/05/12:0820	92/08/04:0830	92/08/04:1150	92/10/27:1115	92/10/27:0820	MDC for total metals
Date/Time		92/05/12:1141	92/05/12:0820	92/08/04:0830	92/08/04:1150	92/10/27:1115	92/10/27:0820	
Form #		10003001	10003207	10003194	10003293	10003004	10003003	
Site name		Columbia R. at Waneta	Columbia R above PE1272	Columbia R above PE1272	Columbia R. at Waneta	Columbia R. at Waneta	Columbia R above PE1272	
Site #		0200559	0200183	0200183	0200559	0200559	0200183	
xcept when shown otherwise. Result mg/L							reported as Birchbank	
						Blank ??		
Stearic acid	STEAP030							
AOX	AOX-DM01	<0.01	<0.01	<0.01	<0.01	0.02	0.01	
Al	Al-T0041				<0.02			
As hydride	As-T0181	<0.001			<0.001			
B	B--T0041	0.065			0.039			
Ba	Ba-T0041				<0.001			
Beryliium	Be-T0041	<0.001			<0.001			
Bismuth	Bi-T0041	<0.02			<0.02			
Ca	Ca-T0041	0.06			<0.01			0.05
Cd	Cd-T0060	<0.0005			<0.0005			
Cd dissolved	Cd-D0050							
Co	Co-T0041	<0.003			<0.003			
Co	Co-T0040							
Cr	Cr-T0060	<0.002			0.003			
Cr dissolved	Cr-D0050							
Cu	Cu-T0041	<0.001			<0.001			
Fe	Fe-T0041	0.014			0.006			0.05
Mercury	Hg-T0310	0.00015			<0.00005			
K ICP	K--T0041	<0.4			<0.4			
Mg	Mg-T0041	<0.02			<0.02			
Mn	Mn-T0041	<0.002			<0.002			
Mn	Mn-T0060							
Mo	Mo-T0041	<0.004			<0.004			
Sodium	Na-T0041	0.13						
Sodium	Na-D1331		<0.5	<0.5	0.10			
Ni	Ni-T0041	<0.008			<0.008			
Pb	Pb-T0060	<0.001			<0.001			
Phos T diss	P--D1390		<0.003	<0.003	<0.003			
Phos total	P--T0041				<0.04			
Phos total	P--T139A		<0.003	<0.003	<0.003			
K	K--D1331		<0.1	<0.1	<0.1			
Antimony	Sb-T0041	<0.015			<0.015			
Sulfur	S--T0041	<0.03			<0.03			
Selenium	Se-T0041	<0.03			<0.03			

ZENON ENVIRONMENTAL LAB` `(BC) **TABLE II**

Travelling Blanks

Parameter	Sparcode	92/05/12:1141	92/05/12:0820	92/08/04:0830	92/08/04:1150	92/10/27:1115	92/10/27:0820	MDC for total metals
	Date/Time	92/05/12:1141	92/05/12:0820	92/08/04:0830	92/08/04:1150	92/10/27:1115	92/10/27:0820	
	Form #	10003001	10003207	10003194	10003293	10003004	10003003	
	Site name	Columbia R. at Waneta	Columbia R above PE1272	Columbia R above PE1272	Columbia R. at Waneta	Columbia R. at Waneta	Columbia R above PE1272	
	Site #	0200559	0200183	0200183	0200559	0200559	0200183	
		xcept when shown otherwise. Result mg/L						
						Blank ??	reported as Birchbank	
Silicon	Si-T0041	0.14			0.10			0.8
Sr	Sr-T0041	<0.001			<0.001			
Tin	Sn-T0041	<0.02			<0.02			
Tellurium	Te-T0041	<0.02			<0.02			
Thallium	Tl-T0041	<0.003			<0.003			
Titanium	Ti-T0041	<0.003			<0.003			
V	V--T0041	<0.003			<0.003			
Zn	Zn-T0041	0.009			<0.002			0.01
Zirconium	Zr-T0041	<0.003			<0.003			
E. coli	01476013						<2	
Enterococcus	01486014						<2	
Coliform fecal	04502480							
Chlorate	pscppscp	<0.01	<0.01	<0.01	<0.01	0.03	0.02	
Chloroform								

Table III

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

ICP BLANK DATA FOR DIGESTED WATER units=mg/L Empty cells = <dissolved MDC.

DATE:		92/01/03		92/01/09		92/01/15		92/01/15		92/01/21
BATCH #:		1337		8		22		41		73
ELEMENT	dissolved MDC	#1	#2	#1	#2	#1	#2	#1	#2	#1
Ag	0.01									
Al	0.02	0.04				0.0293		0.0259	0.0209	
As	0.04									
B	0.008					0.0352	0.0104	0.0397	0.0505	
Ba	0.001									
Be	0.001									
Bi	0.02									
Ca	0.01	0.03		0.04		0.0383	0.0177	0.0292	0.0182	
Cd	0.002									
Co	0.003									
Cr	0.002									0.0035
Cu	0.001	0.013				0.0066	0.0012	0.0015	0.0032	
Fe	0.003	0.01		0.03		0.0465	0.0106	0.0093	0.0123	0.022
K	0.4									
Mg	0.02									
Mn	0.002									
Mo	0.004									
Na	0.01	0.16	0.11	0.06	0.06	0.1065	0.0556	0.082	0.1033	0.065
Ni	0.008					0.0234				
P	0.04									
Pb	0.02									
S	0.03					0.0479	0.0513	0.0418		
Sb	0.015									
Se	0.03									
Si	0.03					0.1148	0.066	0.146	0.345	
Sn	0.02									
Sr	0.001									
Te	0.02									
Ti	0.003									
Tl	0.003									
V	0.003									
Zn	0.002					0.008	0.003			
Zr	0.003									

ICP BLANK DATA

DATE:			92/01/21		92/01/28		92/01/29		92/01/31	
BATCH #:			56		95		120		117	
ELEMENT	dissolved MDC	#2	#1	#2	#1	#2	#1	#2	#1	#2
Ag	0.01									
Al	0.02				0.0268	0.014	0.0407			0.0512
As	0.04									
B	0.008	0.009	0.0284	0.0253	0.075	0.0612	0.0639	0.0715	0.0522	0.1165
Ba	0.001									
Be	0.001									
Bi	0.02									
Ca	0.01	0.027	0.0484	0.0052			0.0127	0.0246	0.0106	0.0141
Cd	0.002									
Co	0.003									
Cr	0.002	0.0076								
Cu	0.001			0.001			0.0018		0.003	0.0026
Fe	0.003	0.045	0.0072	0.0139	0.0038	0.0062	0.0074		0.013	0.003
K	0.4									
Mg	0.02									
Mn	0.002									
Mo	0.004									
Na	0.01	0.053	0.0809	0.0762	0.107	0.1007	0.0955	0.1091	0.1145	0.1682
Ni	0.008									
P	0.04				0.0408	0.034				
Pb	0.02									
S	0.03									
Sb	0.015									
Se	0.03									
Si	0.03		0.1574	0.1737	0.246	0.1747	0.218	0.165	0.0936	0.2008
Sn	0.02									
Sr	0.001									
Te	0.02									
Ti	0.003									
Tl	0.003						0.0244			
V	0.003									
Zn	0.002		0.0073			0.0086				
Zr	0.003									

ICP BLANK DATA

DATE:		92/01/31		92/02/26		92/02/26		92/02/27		92/02/27
BATCH #:		131/132		259		262		265		277
ELEMENT	dissolved MDC	#1	#2	#1	#2	#1	#2	#1	#2	#1
Ag	0.01									
Al	0.02	0.027	0.0653	0.0264	0.0182	0.0271	0.00219		0.0381	
As	0.04									
B	0.008	0.031	0.0298	0.0481	0.0527	0.0222	0.0222	0.0095	0.0012	0.0339
Ba	0.001									
Be	0.001									
Bi	0.02									
Ca	0.01	0.0106	0.0222	0.0275	0.0165	0.0166	0.0161	0.0159	0.0328	0.0274
Cd	0.002									
Co	0.003									
Cr	0.002								0.015	
Cu	0.001	0.0012	0.0026						0.004	
Fe	0.003	0.0112	0.0139	0.0159	0.0072	0.0071		0.0269	0.039	0.0078
K	0.4									
Mg	0.02									
Mn	0.002									
Mo	0.004									
Na	0.01	0.0783	0.072	0.0731	0.0798	0.0566	0.0391	0.0257	0.0708	0.0306
Ni	0.008									
P	0.04									
Pb	0.02									
S	0.03								0.027	
Sb	0.015									
Se	0.03									
Si	0.03	0.0511	0.2136	0.2357	0.1712	0.1264	0.0962	0.056	0.1265	0.1445
Sn	0.02									
Sr	0.001									
Te	0.02									
Ti	0.003									
Tl	0.003	0.0098	0.0089							
V	0.003									
Zn	0.002			0.002					0.005	
Zr	0.003									

ICP BLANK DATA

DATE:			92/03/02		92/03/04		92/03/06		92/03/10	
BATCH #:			298		313		328		337	
ELEMENT	dissolved MDC	#2	#1	#2	#1	#2	#1	#2	#1	#2
Ag	0.01									
Al	0.02		0.0331	0.0318			0.0264	0.0189		
As	0.04									
B	0.008	0.0253	0.0221	0.0631	0.0091	0.0289	0.0236	0.0315	0.042	
Ba	0.001		0.001							
Be	0.001									
Bi	0.02									
Ca	0.01	0.0195	0.0315	0.0284	0.0153	0.0256	0.0274	0.0149	0.054	0.014
Cd	0.002		0.006		0.006					
Co	0.003									
Cr	0.002									
Cu	0.001		0.0026	0.0015		0.0023			0.0013	
Fe	0.003	0.005	0.0141	0.0109			0.021	0.0105	0.0067	0.0081
K	0.4									
Mg	0.02		0.0143	0.014						
Mn	0.002									
Mo	0.004									
Na	0.01	0.0329	0.0439	0.0714		0.0271	0.084	0.063	0.1983	0.071
Ni	0.008									
P	0.04									
Pb	0.02									
S	0.03						0.028			
Sb	0.015									
Se	0.03									
Si	0.03	0.1289	0.2458	0.3246	0.1285	0.1233	0.142	0.182	0.1141	0.1381
Sn	0.02									
Sr	0.001									
Te	0.02									
Ti	0.003									
Tl	0.003									
V	0.003									
Zn	0.002		0.003	0.0021					0.0057	0.0034
Zr	0.003									

ICP BLANK DATA

DATE:		92/03/17		92/03/17		92/03/24		92/03/24		92/03/27
BATCH #:		384		387		413		434		452
ELEMENT dissolved	MDC	#1	#2	#1	#2	#1	#2	#1	#2	#1
Ag	0.01									
Al	0.02									
As	0.04									
B	0.008	0.047	0.048	0.051	0.059		0.014		0.0331	0.0517
Ba	0.001									
Be	0.001									
Bi	0.02									
Ca	0.01	0.019	0.014	0.014	0.016					0.0107
Cd	0.002					0.002				
Co	0.003									
Cr	0.002									
Cu	0.001	0.002								
Fe	0.003	0.008	0.008	0.005	0.013	0.0073	0.0046	0.0049		0.0032
K	0.4									0.3915
Mg	0.02									
Mn	0.002									
Mo	0.004									
Na	0.01	0.011	0.011	0.01	0.011		0.006		0.052	0.0738
Ni	0.008									
P	0.04									
Pb	0.02									
S	0.03									
Sb	0.015									
Se	0.03									
Si	0.03	0.092	0.098	0.24	0.18	0.045	0.081	0.098	0.181	0.1716
Sn	0.02									
Sr	0.001									
Te	0.02									
Ti	0.003									
Tl	0.003									
V	0.003									
Zn	0.002	0.002	0.004	0.007	0.002	0.002		0.004		
Zr	0.003									

ICP BLANK DATA

DATE:			92/03/31		92/03/31		92/04/08		92/04/13	
BATCH #:			486		504		514		543	
ELEMENT	dissolved MDC	#2	#1	#2	#1	#2	#1	#2	#1	#2
Ag	0.01									
Al	0.02				0.0204		0.0201		0.0315	0.0279
As	0.04									
B	0.008	0.0137	0.0072	0.0104	0.0135	0.014	0.0343	0.0346	0.0718	0.0727
Ba	0.001									
Be	0.001									
Bi	0.02									
Ca	0.01	0.0099	0.0164	0.0139	0.0247	0.0293	0.0275	0.0189	0.0106	0.0138
Cd	0.002									
Co	0.003									
Cr	0.002									
Cu	0.001			0.0077	0.002					
Fe	0.003	0.0049	0.0081	0.017	0.0105	0.0062	0.0061	0.0116	0.0197	0.0062
K	0.4	0.4174								
Mg	0.02								0.0279	0.0348
Mn	0.002									
Mo	0.004									
Na	0.01	0.0211	0.061	0.0461			0.1457	0.1368	0.1234	0.1348
Ni	0.008									
P	0.04									
Pb	0.02									
S	0.03									
Sb	0.015									
Se	0.03									
Si	0.03	0.1414	0.1109	0.1332	0.1482	0.1081	0.0674	0.0559	0.0321	0.1514
Sn	0.02									
Sr	0.001									
Te	0.02									
Ti	0.003									
Tl	0.003									
V	0.003									
Zn	0.002		0.0055	0.006	0.0016		0.0027	0.0057		0.0036
Zr	0.003									

ICP BLANK DATA

DATE:		92/04/13		92/04/21		92/04/23		92/04/23		92/04/06
BATCH #:		554		576		595		604		urgent
ELEMENT	dissolved MDC	#1	#2	#1	#2	#1	#2	#1	#2	#1
Ag	0.01									0.0332
Al	0.02	0.0256	0.0288	0.0209	0.0201		0.0264			
As	0.04									
B	0.008	0.2734	0.023	0.0816	0.0677	0.0408	0.0435	0.0255	0.0244	0.0868
Ba	0.001									
Be	0.001									
Bi	0.02									
Ca	0.01	0.0268	1.433	0.0694	0.032	0.0172	0.0334	0.0265	0.0113	0.0156
Cd	0.002									
Co	0.003									
Cr	0.002	0.0686	0.0702			0.003	0.0019	0.0029		
Cu	0.001			0.002				0.0015		
Fe	0.003	0.2329	0.2355	0.0099	0.0069	0.0188	0.0327	0.0246	0.0183	
K	0.4									
Mg	0.02	0.0241	0.2534							
Mn	0.002	0.004	0.005							
Mo	0.004									
Na	0.01	0.4017	0.1369	0.263	0.104	0.0754	0.0837	0.0702	0.0624	0.1277
Ni	0.008	0.0283	0.0291							
P	0.04									
Pb	0.02									
S	0.03			1.484	0.0486	0.0189	0.0379			
Sb	0.015									
Se	0.03									
Si	0.03	0.0679	0.0333	0.1665	0.209	0.0539	0.0794	0.054	0.0356	0.1672
Sn	0.02									
Sr	0.001									
Te	0.02									
Ti	0.003									
Tl	0.003									
V	0.003									
Zn	0.002	0.0037	0.0028	0.0019	0.0023	0.0036	0.0107	0.0141	0.0018	
Zr	0.003									

ICP BLANK DATA

DATE:			92/04/27		92/04/29		92/04/28		92/05/01	
BATCH #:			615		626		621		635	
ELEMENT	dissolved MDC	#2	#1	#2	#1	#2	#1	#2	#1	#2
Ag	0.01	0.0156	0.023	0.044						
Al	0.02				0.022	0.023		0.024	0.021	
As	0.04									
B	0.008	0.0489	0.043	0.056	0.062	0.075	0.053	0.045	0.049	0.055
Ba	0.001									
Be	0.001									
Bi	0.02									
Ca	0.01	0.0113	0.017	0.083	0.025	0.016	0.025	0.023	0.04	
Cd	0.002								0.017	
Co	0.003									
Cr	0.002			0.005						
Cu	0.001	0.0012		0.017					0.001	
Fe	0.003		0.008	0.031	0.015	0.003	0.004	0.006	0.004	
K	0.4									
Mg	0.02									
Mn	0.002									
Mo	0.004									
Na	0.01	0.0931	0.074	0.22	0.094	0.13	0.11	0.085	0.1	0.096
Ni	0.008									
P	0.04									
Pb	0.02									
S	0.03			0.03						
Sb	0.015									
Se	0.03									
Si	0.03	0.0997	0.18	0.11	0.17	0.2	0.15	0.17	0.18	0.18
Sn	0.02									
Sr	0.001									
Te	0.02									
Ti	0.003									
Tl	0.003									
V	0.003									
Zn	0.002			0.022	0.006		0.002	0.01		
Zr	0.003									

ICP BLANK DATA

DATE:		92/05/04		92/05/11		92/05/12		92/05/12		92/05/20
BATCH #:		640		671		658		665		694
ELEMENT	dissolved MDC	#1	#2	#1	#2	#1	#2	#1	#2	#1
Ag	0.01									
Al	0.02	0.037	0.023							0.027
As	0.04									
B	0.008	0.047	0.009	0.021	0.012	0.053	0.009	0.024	0.018	0.077
Ba	0.001									
Be	0.001									
Bi	0.02									
Ca	0.01	0.038	0.098	0.021	0.027	0.027	0.098	0.21	0.055	0.018
Cd	0.002									
Co	0.003									
Cr	0.002	0.019			0.002			0.003		
Cu	0.001									0.002
Fe	0.003	0.09	0.008			0.026	0.005	0.022	0.012	0.006
K	0.4									
Mg	0.02									
Mn	0.002									
Mo	0.004									
Na	0.01	0.13	0.13	0.07	0.082	0.017	0.062	0.061	0.02	0.093
Ni	0.008	0.008								
P	0.04									
Pb	0.02									
S	0.03	0.053	0.063					0.069		
Sb	0.015									
Se	0.03									
Si	0.03	0.17		0.19	0.065	0.14	0.098	0.072	0.055	0.3
Sn	0.02									
Sr	0.001									
Te	0.02									
Ti	0.003									
Tl	0.003									
V	0.003									
Zn	0.002	0.004	0.003	0.004	0.008	0.004	0.003			0.005
Zr	0.003									

ICP BLANK DATA

DATE:			92/05/20		92/05/20		92/05/25		92/05/25	
BATCH #:			701		709		710		736	
ELEMENT	dissolved MDC	#2	#1	#2	#1	#2	#1	#2	#1	#2
Ag	0.01									
Al	0.02	0.023					0.025	0.021		
As	0.04									
B	0.008	0.097	0.033	0.042	0.025	0.028	0.066	0.073	0.017	0.03
Ba	0.001									
Be	0.001									
Bi	0.02									
Ca	0.01	0.017	0.03	0.012	0.036	0.017	0.024	0.02	0.046	0.031
Cd	0.002									
Co	0.003									
Cr	0.002		0.003				0.002			0.003
Cu	0.001	0.001			0.001	0.001				
Fe	0.003		0.009	0.01	0.007	0.008	0.015	0.059	0.01	0.011
K	0.4									
Mg	0.02		0.027							
Mn	0.002									
Mo	0.004									
Na	0.01	0.124	0.113	0.106	0.097	0.076	0.116	0.125	0.342	0.126
Ni	0.008									
P	0.04									
Pb	0.02									
S	0.03								0.16	0.04
Sb	0.015									
Se	0.03									
Si	0.03	0.199	0.126	0.141	0.113	0.101	0.242	0.365	0.253	0.253
Sn	0.02									
Sr	0.001									
Te	0.02									
Ti	0.003									
Tl	0.003									
V	0.003									
Zn	0.002	0.004	0.015	0.003	0.005	0.004		0.004	0.008	0.004
Zr	0.003									

ICP BLANK DATA

DATE:		92/06/02		92/06/08		92/06/08		92/06/15		92/06/16
BATCH #:		766		784		799		807		860
ELEMENT dissolved	MDC	#1	#2	#1	#2	#1	#2	#1	#2	#1
Ag	0.01									
Al	0.02							0.022		
As	0.04									
B	0.008	0.031	0.047	0.039	0.021	0.042	0.034	0.034	0.013	0.04
Ba	0.001									
Be	0.001									
Bi	0.02									
Ca	0.01	0.171	0.07	0.058	0.029	0.183	0.062	0.045	0.022	
Cd	0.002									
Co	0.003									
Cr	0.002	0.003	0.003	0.007	0.007	0.004	0.004	0.005	0.005	0.003
Cu	0.001	0.002					0.002		0.002	
Fe	0.003	0.021	0.013	0.034	0.032	0.017	0.026	0.036	0.032	0.017
K	0.4									
Mg	0.02	0.029				0.059	0.022			
Mn	0.002									
Mo	0.004									
Na	0.01	0.219	0.227	0.084	0.072	0.13	0.131	0.1	0.065	0.115
Ni	0.008									
P	0.04									
Pb	0.02									
S	0.03	0.062	0.033			0.047				
Sb	0.015									
Se	0.03									
Si	0.03	0.116	0.189	0.148	0.223	0.185	0.127	0.087	0.054	0.038
Sn	0.02									
Sr	0.001	0.001								
Te	0.02									
Ti	0.003			0.004						
Tl	0.003									
V	0.003									
Zn	0.002	0.784	0.284	0.007	0.005	0.011	0.052	0.005	0.004	0.003
Zr	0.003									

ICP BLANK DATA

DATE:			92/06/16		92/06/24		92/06/25		92/06/26	
BATCH #:			846		868		875		889	
ELEMENT	dissolved MDC	#2	#1	#2	#1	#2	#1	#2	#1	#2
Ag	0.01									
Al	0.02	0.024	0.03	0.029	0.035					0.02
As	0.04									
B	0.008	0.056	0.067	0.092	0.071	0.064				0.032
Ba	0.001			0.001						
Be	0.001									
Bi	0.02									
Ca	0.01	0.042	0.03	0.235	0.025	0.018	0.015	0.019	0.041	0.03
Cd	0.002									
Co	0.003									
Cr	0.002	0.004	0.005	0.005	0.008	0.002	0.004	0.005		
Cu	0.001	0.002		0.004			0.002	0.002	0.001	0.006
Fe	0.003	0.018	0.011	0.034	0.049	0.022	0.012	0.016	0.009	
K	0.4									
Mg	0.02	0.038	0.021							
Mn	0.002									
Mo	0.004									
Na	0.01	0.118	0.089	0.174	0.11	0.09	0.08	0.1	0.09	0.44
Ni	0.008									
P	0.04									
Pb	0.02									
S	0.03	0.037								
Sb	0.015									
Se	0.03									
Si	0.03	0.131	0.333	0.248	0.28	0.24	0.17	0.14	0.13	0.15
Sn	0.02									
Sr	0.001									
Te	0.02									
Ti	0.003									
Tl	0.003									
V	0.003									
Zn	0.002	0.003		0.006	0.003		0.004	0.004	0.003	0.003
Zr	0.003									

ICP BLANK DATA

DATE:		92/06/30		92/07/02		92/07/02		92/07/02		92/07/06
BATCH #:		896		908		926		909		919
ELEMENT dissolved	MDC	#1	#2	#1	#2	#1	#2	#1	#2	#1
Ag	0.01									
Al	0.02					0.532	0.191	0.0257	0.377	0.022
As	0.04									
B	0.008	0.024	0.011	0.011	0.014	0.033	0.023	0.018	0.017	0.023
Ba	0.001									
Be	0.001									
Bi	0.02									
Ca	0.01	0.026				0.069	0.05	0.037		0.026
Cd	0.002									
Co	0.003									
Cr	0.002					0.005	0.005	0.003	0.003	0.007
Cu	0.001					0.002	0.003		0.001	0.002
Fe	0.003	0.019	0.004	0.013	0.009	0.013	0.022	0.01	0.01	0.026
K	0.4									
Mg	0.02							0.031	0.022	
Mn	0.002									
Mo	0.004									
Na	0.01	0.078	0.048	0.048	0.05	0.075	0.071	0.0732	0.069	0.14
Ni	0.008									
P	0.04									
Pb	0.02									0.074
S	0.03							0.304		
Sb	0.015									
Se	0.03									
Si	0.03	0.132	0.092	0.094	0.07	0.133	0.091	0.138	0.116	0.15
Sn	0.02									
Sr	0.001									
Te	0.02									
Ti	0.003									
Tl	0.003									
V	0.003									0.004
Zn	0.002	0.005	0.003			0.003	0.004	0.003		0.004
Zr	0.003				0.004					

ICP BLANK DATA

DATE:			92/07/07		92/07/13		92/07/13		92/07/13	
BATCH #:			962		977		984		978	
ELEMENT	dissolved MDC	#2	#1	#2	#1	#2	#1	#2	#1	#2
Ag	0.01									
Al	0.02		0.024	0.035	0.033		0.032	0.025		
As	0.04									
B	0.008	0.019	0.041	0.025	0.029	0.036	0.078	0.085	0.021	0.022
Ba	0.001									
Be	0.001									
Bi	0.02									
Ca	0.01	0.017	0.024	0.02						
Cd	0.002				0.009					
Co	0.003	0.005								
Cr	0.002	0.005	0.005	0.006	0.007	0.004	0.004	0.005	0.006	0.005
Cu	0.001		0.002							
Fe	0.003	0.02	0.018	0.029	0.034	0.018	0.018	0.028	0.019	0.018
K	0.4									
Mg	0.02									
Mn	0.002									
Mo	0.004									
Na	0.01	0.08	0.1	0.08	0.08	0.11	0.12	0.18	0.08	0.06
Ni	0.008									
P	0.04									
Pb	0.02		0.021							
S	0.03									
Sb	0.015									
Se	0.03									
Si	0.03	0.08	0.17	0.13	0.15	0.13	0.3	0.21	0.08	0.15
Sn	0.02									
Sr	0.001									
Te	0.02									
Ti	0.003									
Tl	0.003									
V	0.003									
Zn	0.002	0.003	0.003	0.004	0.005	0.003	0.003	0.002	0.004	0.007
Zr	0.003									

ICP BLANK DATA

DATE:		92/07/13		92/07/14		92/07/14		92/07/17		92/07/21
BATCH #:		990		999		1003		1021		1028
ELEMENT	dissolved MDC	#1	#2	#1	#2	#1	#2	#1	#2	#1
Ag	0.01									
Al	0.02			0.036		0.025		0.052	0.032	
As	0.04									
B	0.008	0.012	0.025	0.034	0.038	0.053	0.063	0.079	0.076	0.069
Ba	0.001					0.001				
Be	0.001									
Bi	0.02									
Ca	0.01			0.019	0.033	0.024				
Cd	0.002									
Co	0.003									
Cr	0.002	0.003	0.005	0.005	0.004	0.004	0.003	0.004		0.004
Cu	0.001				0.002	0.001	0.001	0.003	0.002	0.002
Fe	0.003	0.016	0.028	0.044	0.024	0.021	0.018	0.022	0.012	0.015
K	0.4									
Mg	0.02			0.021						
Mn	0.002	0.004	0.004							
Mo	0.004									
Na	0.01	0.062	0.074	0.108	0.128	0.132	0.124	0.11	0.12	0.07
Ni	0.008									
P	0.04									
Pb	0.02									
S	0.03			0.049	0.05					
Sb	0.015									
Se	0.03									
Si	0.03		0.1	0.147	0.079	0.183	0.148	0.27	0.31	0.25
Sn	0.02									
Sr	0.001									
Te	0.02									
Ti	0.003									
Tl	0.003									
V	0.003									
Zn	0.002	0.004	0.005	0.003	0.011	0.004	0.004	0.019	0.006	0.003
Zr	0.003									

ICP BLANK DATA

DATE:			92/07/29		92/07/29		92/08/04		92/08/11	
BATCH #:			1032		1040		1082		1062	
ELEMENT	dissolved MDC	#2	#1	#2	#1	#2	#1	#2	#1	#2
Ag	0.01									
Al	0.02									
As	0.04									
B	0.008	0.063	0.068	0.039	0.019	0.029	0.016	0.023	0.02	0.065
Ba	0.001									
Be	0.001									
Bi	0.02									
Ca	0.01				0.016		0.011	0.012	0.026	0.013
Cd	0.002									
Co	0.003									
Cr	0.002	0.004		0.003					0.003	
Cu	0.001	0.002				0.003			0.002	
Fe	0.003	0.019	0.015	0.016	0.008	0.009	0.027	0.01	0.009	0.005
K	0.4									
Mg	0.02									
Mn	0.002									
Mo	0.004									
Na	0.01	0.08	0.09	0.08	0.069	0.129	0.083	0.104	0.105	0.098
Ni	0.008					0.015				
P	0.04									
Pb	0.02									
S	0.03		0.174	0.19	0.079	0.104			0.034	
Sb	0.015									
Se	0.03									
Si	0.03	0.28	0.28	0.22	0.035	0.029	0.077	0.089	0.126	0.212
Sn	0.02									
Sr	0.001									
Te	0.02									
Ti	0.003									
Tl	0.003									
V	0.003									
Zn	0.002	0.003	0.005		0.004	0.005	0.01	0.004	0.025	0.002
Zr	0.003									

ICP BLANK DATA

DATE:		92/08/11		92/08/11		92/08/18		92/08/18		92/08/18
BATCH #:		1067		1127		1189		1070		1131
ELEMENT	dissolved MDC	#1	#2	#1	#2	#1	#2	#1	#2	#1
Ag	0.01									
Al	0.02					0.027		0.021		0.055
As	0.04									
B	0.008		0.024	0.066	0.083	0.011	0.012	0.054	0.047	0.008
Ba	0.001						0.002			
Be	0.001									
Bi	0.02									
Ca	0.01	0.029	0.013	0.024	0.017					0.013
Cd	0.002									
Co	0.003									
Cr	0.002		0.002		0.002	0.008	0.013	0.004	0.004	0.004
Cu	0.001		0.001	0.042		0.002	0.001			
Fe	0.003		0.007	0.005	0.006	0.021	0.046	0.007	0.006	0.003
K	0.4									
Mg	0.02					0.024		0.021		0.027
Mn	0.002									
Mo	0.004									
Na	0.01	0.089	0.079	0.134	0.12	0.094	0.067	0.093	0.108	0.081
Ni	0.008									
P	0.04									
Pb	0.02									0.022
S	0.03									
Sb	0.015									
Se	0.03									
Si	0.03		0.317	0.204	0.209	0.091	0.178	0.169	0.16	0.089
Sn	0.02									
Sr	0.001									
Te	0.02									
Ti	0.003									
Tl	0.003									
V	0.003									
Zn	0.002	0.006	0.005	0.006	0.008		0.003		0.002	
Zr	0.003									

ICP BLANK DATA

DATE:			92/08/18		92/08/18		92/08/20		92/08/20	
BATCH #:			1136		1164		1230		1231	
ELEMENT	dissolved MDC	#2	#1	#2	#1	#2	#1	#2	#1	#2
Ag	0.01									
Al	0.02				0.02					
As	0.04									
B	0.008			0.01	0.032	0.057	0.029	0.053	0.058	0.066
Ba	0.001									
Be	0.001									
Bi	0.02									
Ca	0.01	0.018		0.01	0.04	0.012			0.014	0.019
Cd	0.002									
Co	0.003									
Cr	0.002	0.005	0.002			0.003				0.002
Cu	0.001								0.006	0.002
Fe	0.003	0.022	0.006		0.005			0.004	0.005	0.007
K	0.4									
Mg	0.02									
Mn	0.002									
Mo	0.004									
Na	0.01	0.099	0.034	0.059	0.117	0.137	0.054	0.073	0.087	0.11
Ni	0.008									
P	0.04									
Pb	0.02									
S	0.03				0.046					
Sb	0.015									
Se	0.03									
Si	0.03	0.066	0.077	0.119	0.211	0.317	0.19	0.275	0.262	0.236
Sn	0.02									
Sr	0.001									
Te	0.02									
Ti	0.003									
Tl	0.003									
V	0.003									
Zn	0.002	0.002			0.007	0.002	0.002		0.004	0.003
Zr	0.003									

ICP BLANK DATA

DATE:		92/08/20		92/08/24		92/08/25		92/08/25		92/08/26
BATCH #:		1199		1236		1249		1265		1281
ELEMENT	dissolved MDC	#1	#2	#1	#2	#1	#2	#1	#2	#1
Ag	0.01									
Al	0.02									
As	0.04									
B	0.008	0.017	0.016	0.016	0.013	0.058	0.08		0.01	0.05
Ba	0.001									
Be	0.001									
Bi	0.02									
Ca	0.01	0.011	0.014						0.017	0.02
Cd	0.002									
Co	0.003									
Cr	0.002									
Cu	0.001									
Fe	0.003	0.009	0.004	0.027	0.021	0.006	0.003	0.02	0.017	0.015
K	0.4									
Mg	0.02									
Mn	0.002									
Mo	0.004									
Na	0.01	0.061	0.08	0.046	0.042	0.117	0.093	0.024	0.023	0.109
Ni	0.008									
P	0.04									
Pb	0.02									
S	0.03									
Sb	0.015									
Se	0.03									
Si	0.03	0.116	0.021	0.077	0.103	0.206	0.279	0.048	0.088	0.229
Sn	0.02									
Sr	0.001									
Te	0.02									
Ti	0.003									
Tl	0.003									
V	0.003									
Zn	0.002	0.003	0.002	0.004	0.005	0.003		0.005		0.003
Zr	0.003									

ICP BLANK DATA

DATE:			92/08/28		92/08/31		92/08/31		92/09/01	
BATCH #:			1300		1301		1302		1308	
ELEMENT	dissolved MDC	#2	#1	#2	#1	#2	#1	#2	#1	#2
Ag	0.01									
Al	0.02	0.02								
As	0.04									
B	0.008	0.033	0.019	0.02	0.03	0.028	0.023	0.015		0.035
Ba	0.001									
Be	0.001									
Bi	0.02									
Ca	0.01	0.018		0.014	0.01	0.025		0.026	0.012	
Cd	0.002									
Co	0.003									
Cr	0.002									
Cu	0.001	0.003								
Fe	0.003	0.006	0.006	0.016	0.01	0.015	0.01	0.011	0.013	0.005
K	0.4									
Mg	0.02									
Mn	0.002									
Mo	0.004									
Na	0.01	0.098	0.03	0.033	0.089	0.089	0.092	0.067	0.052	0.094
Ni	0.008									
P	0.04									
Pb	0.02									
S	0.03						0.035			
Sb	0.015									
Se	0.03									
Si	0.03	0.213	0.064	0.094	0.113	0.075	0.071	0.075	0.054	0.074
Sn	0.02									
Sr	0.001									
Te	0.02									
Ti	0.003									
Tl	0.003									
V	0.003									
Zn	0.002	0.003	0.004	0.004	0.01	0.003	0.004	0.015		
Zr	0.003									

ICP BLANK DATA

DATE:		92/09/09		92/09/09		92/09/09		92/09/09		92/09/23
BATCH #:		1326		1345		1357		1361		1367
ELEMENT	dissolved MDC	#1	#2	#1	#2	#1	#2	#1	#2	#1
Ag	0.01									
Al	0.02							0.02		
As	0.04									
B	0.008	0.041	0.058	0.038	0.031	0.021	0.017	0.052	0.063	0.032
Ba	0.001									
Be	0.001									
Bi	0.02									
Ca	0.01	0.013		0.018	0.014	0.026	0.028	0.035	0.019	0.013
Cd	0.002						0.004			
Co	0.003									
Cr	0.002									
Cu	0.001							0.001	0.001	
Fe	0.003			0.015	0.014	0.009	0.01	0.006	0.004	
K	0.4									
Mg	0.02									
Mn	0.002									
Mo	0.004									
Na	0.01	0.083	0.014	0.095	0.088	0.081	0.105	0.12	0.12	0.067
Ni	0.008									
P	0.04									
Pb	0.02									
S	0.03									
Sb	0.015									
Se	0.03									
Si	0.03	0.047	0.063	0.08	0.087	0.099	0.089	0.194	0.212	0.195
Sn	0.02									
Sr	0.001									
Te	0.02									
Ti	0.003									
Tl	0.003									
V	0.003				0.004					
Zn	0.002			0.017	0.005	0.003	0.01	0.002	0.002	
Zr	0.003									

ICP BLANK DATA

DATE:

BATCH #:

ELEMENT	dissolved MDC	#2
Ag	0.01	
Al	0.02	
As	0.04	
B	0.008	0.064
Ba	0.001	
Be	0.001	
Bi	0.02	
Ca	0.01	0.014
Cd	0.002	
Co	0.003	
Cr	0.002	
Cu	0.001	
Fe	0.003	
K	0.4	
Mg	0.02	
Mn	0.002	
Mo	0.004	
Na	0.01	0.084
Ni	0.008	
P	0.04	
Pb	0.02	
S	0.03	
Sb	0.015	
Se	0.03	
Si	0.03	0.392
Sn	0.02	
Sr	0.001	
Te	0.02	
Ti	0.003	
Tl	0.003	
V	0.003	
Zn	0.002	
Zr	0.003	

ICP BLANK DATA FOR DI

DATE:

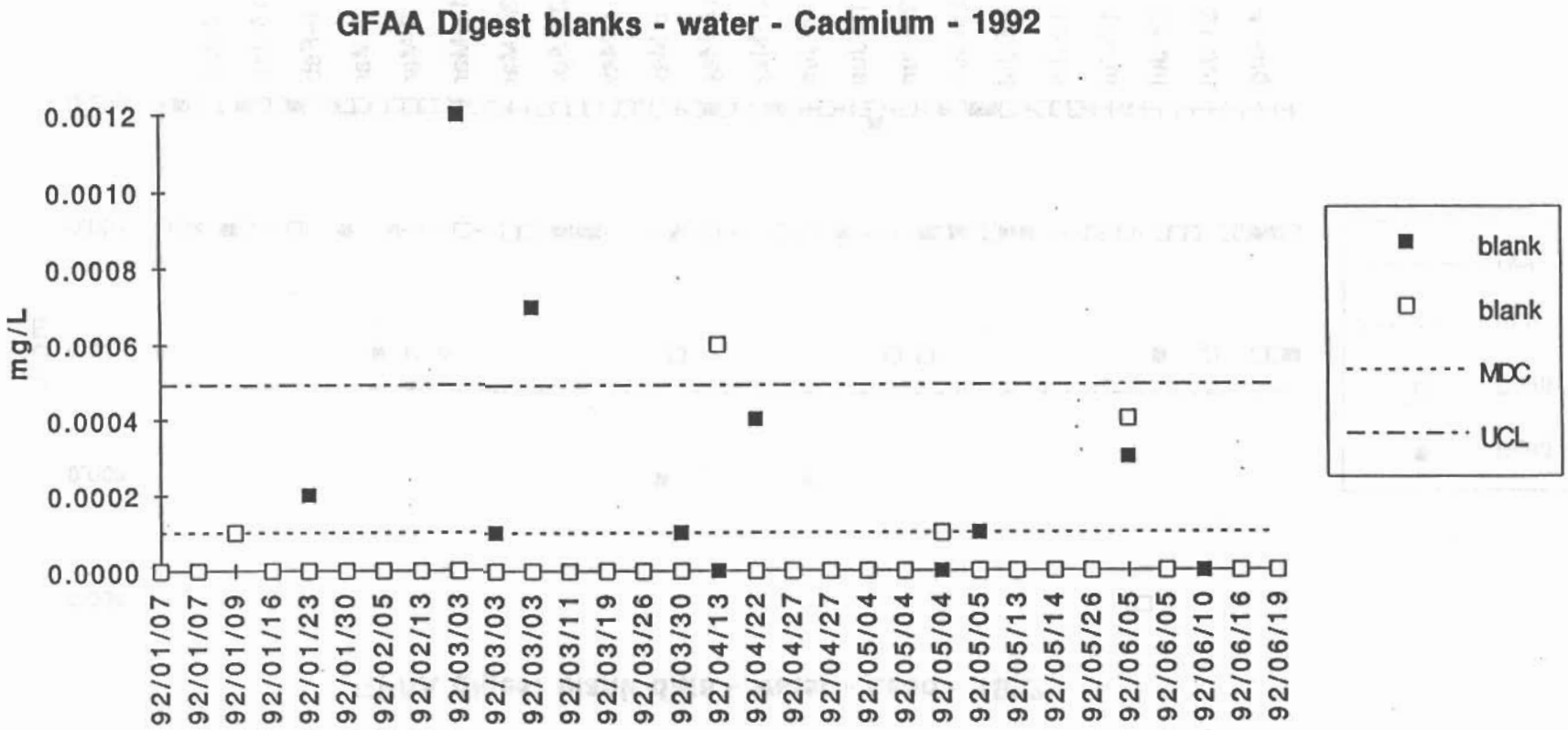
BATCH #:

Average blank for samples > dissolved MDC.

Recommended TOTAL metal MDC

92/11/30 Seasoned glassware

ELEMENT	dissolved MDC	average	std dev	count	ELEMENT	MDC=2 * t 1(0.05)*SD
Ag	0.01	0.029	0.012	4	**Ag**	0.03
Al	0.02	0.044	0.079	64	**Al**	0.06
As	0.04			0	**As**	0.04
B	0.008	0.040	0.029	174	**B**	0.04
Ba	0.001	0.001	0.001	4	**Ba**	0.001
Be	0.001			0	**Be**	0.001
Bi	0.02			0	**Bi**	0.02
Ca	0.01	0.040	0.122	143	**Ca**	0.05
Cd	0.002	0.007	0.005	6	**Cd**	0.002
Co	0.003	0.005		1	**Co**	0.004
Cr	0.002	0.007	0.011	67	**Cr**	0.002
Cu	0.001	0.003	0.006	60	**Cu**	0.002
Fe	0.003	0.018	0.027	168	**Fe**	0.05
K	0.4	0.404	0.018	2	**K**	0.4
Mg	0.02	0.039	0.054	18	**Mg**	0.02
Mn	0.002	0.004	0.000	4	**Mn**	0.002
Mo	0.004			0	**Mo**	0.004
Na	0.01	0.094	0.056	185	**Na**	0.4
Ni	0.008	0.021	0.009	5	**Ni**	0.01
P	0.04	0.037	0.005	2	**P**	0.04
Pb	0.02	0.039	0.030	3	**Pb**	0.03
S	0.03	0.119	0.270	29	**S**	0.1
Sb	0.015			0	**Sb**	0.02
Se	0.03			0	**Se**	0.03
Si	0.03	0.149	0.077	181	**Si**	0.8
Sn	0.02			0	**Sn**	0.02
Sr	0.001	0.001		1	**Sr**	0.001
Te	0.02			0	**Te**	0.02
Ti	0.003	0.004		1	**Ti**	0.003
Tl	0.003	0.014	0.009	3	**Tl**	0.03
V	0.003	0.004	0.000	2	**V**	0.003
Zn	0.002	0.014	0.073	129	**Zn**	0.01
Zr	0.003	0.004		1	**Zr**	0.003


GFAA Digest blanks - water - Cadmium - 1992
mg/L
0.0012
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
92/01/07
92/01/07
92/01/09
92/01/16
92/01/23
92/01/30
92/02/05
92/02/13
92/03/03
92/03/03
92/03/03
92/03/11
92/03/19
92/03/26
92/03/30
92/04/13
92/04/22
92/04/27
92/04/27
92/05/04
92/05/04
92/05/04
92/05/05
92/05/13
92/05/14
92/05/26
92/06/05
92/06/05
92/06/10
92/06/16
92/06/19
blank
blank
MDC
UCL

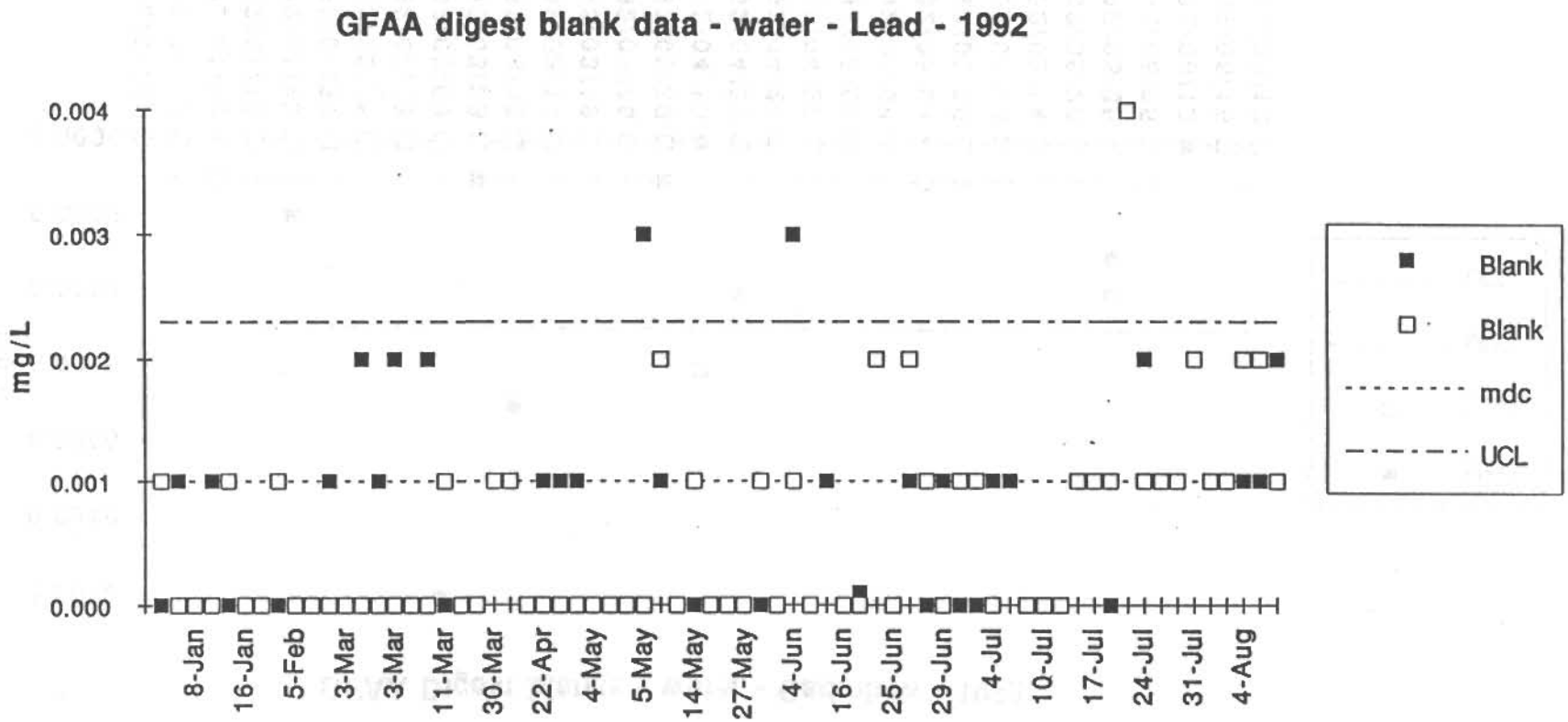

GFAA digest blank data - water - Lead - 1992
mg/L
0.004
0.003
0.002
0.001
0.000
8-Jan
16-Jan
5-Feb
3-Mar
3-Mar
11-Mar
30-Mar
22-Apr
4-May
5-May
14-May
27-May
4-Jun
16-Jun
25-Jun
29-Jun
4-Jul
10-Jul
17-Jul
24-Jul
31-Jul
4-Aug
Blank
Blank
mdc
UCL

Figure 2

Alkalinity 2nd DI blank - 1992 (Limit = 2 SD).

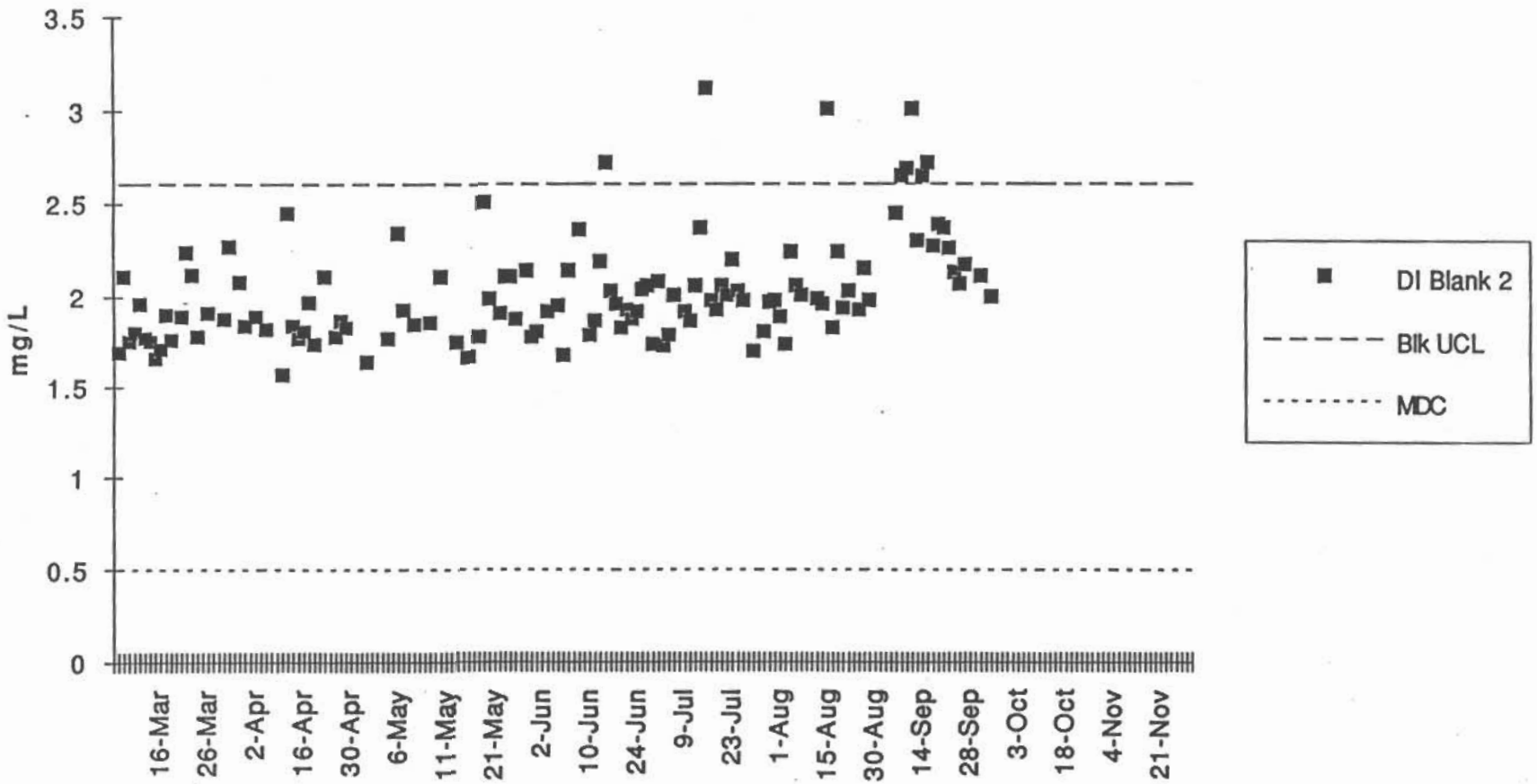
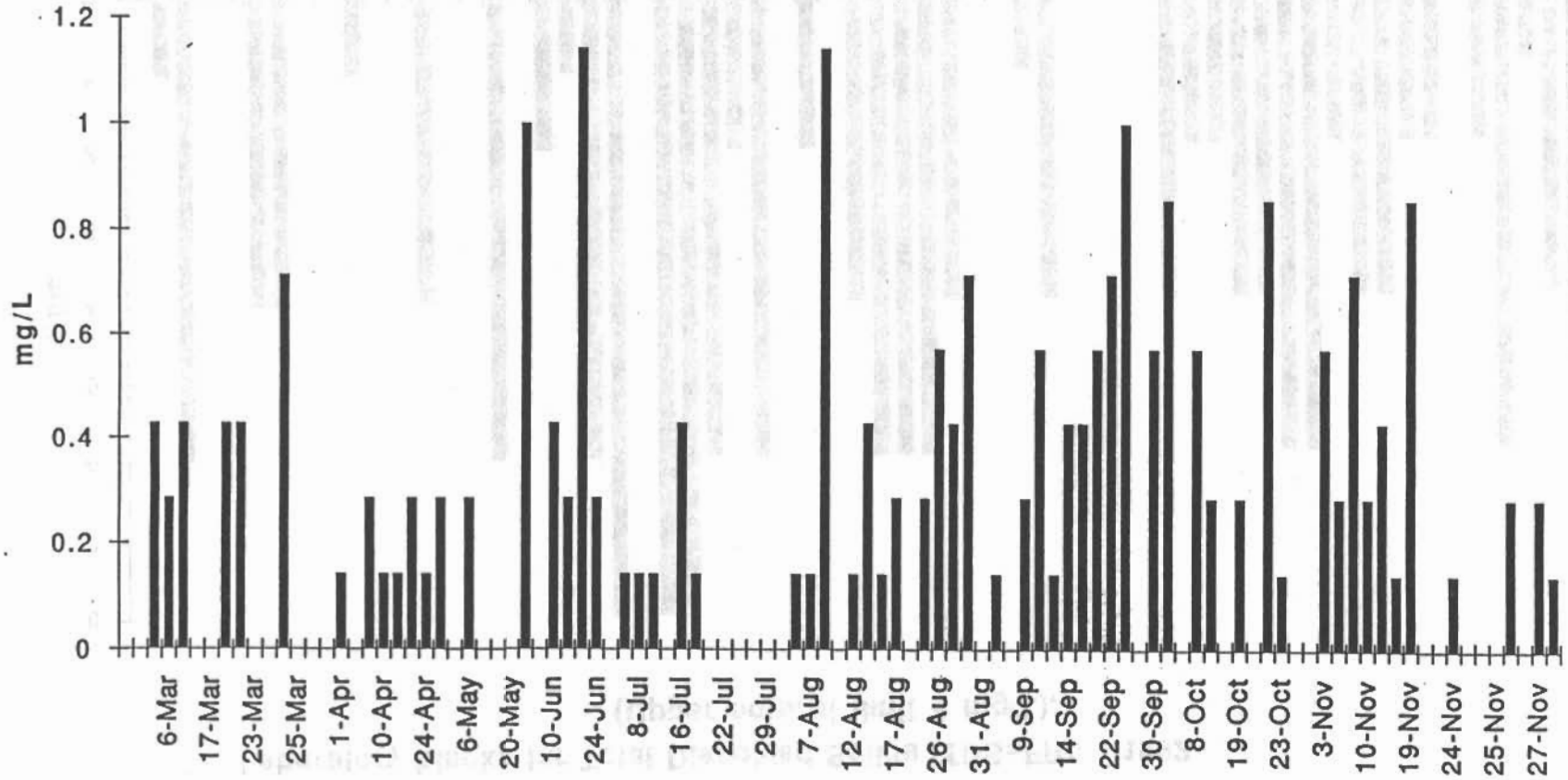
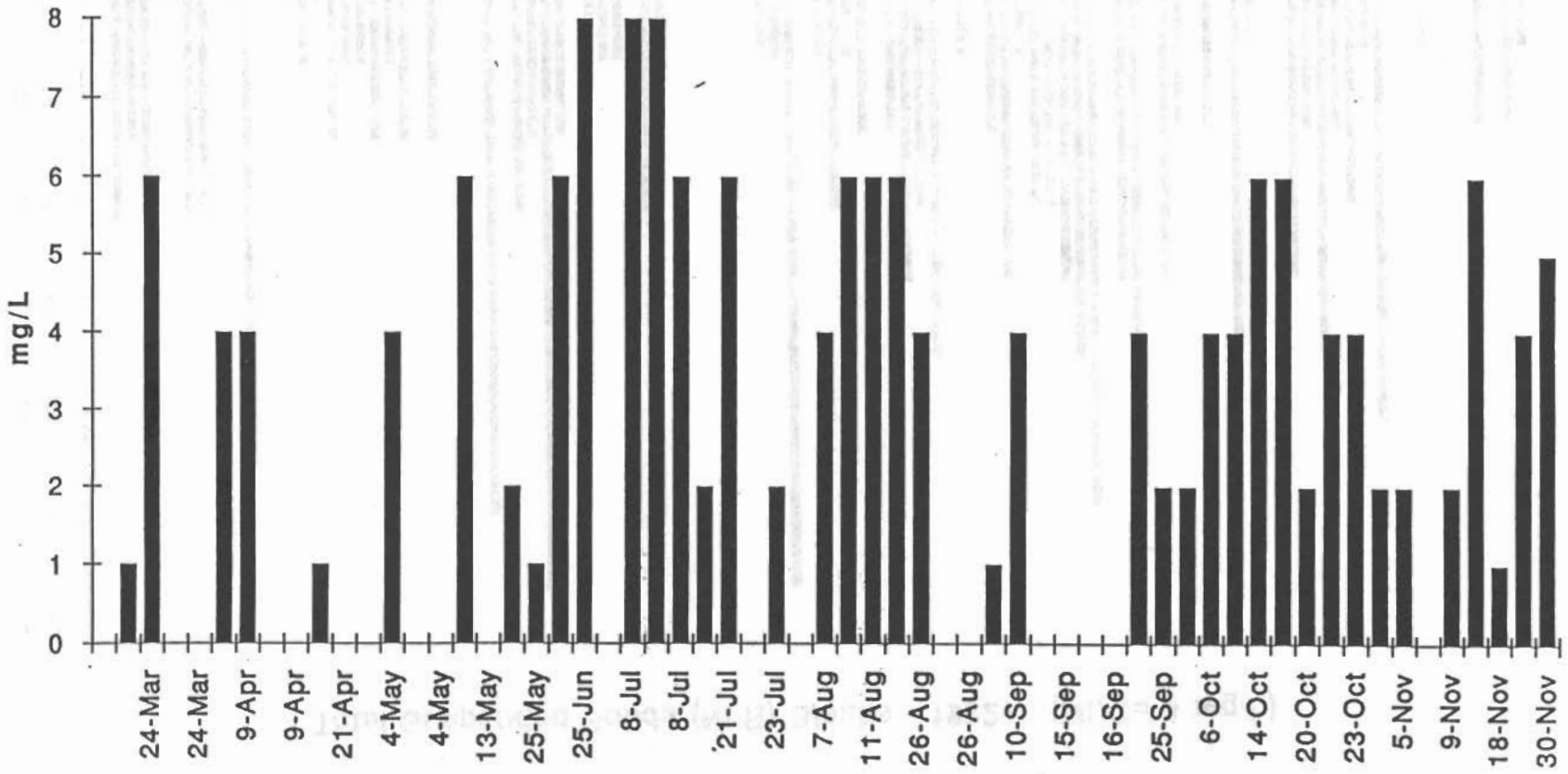


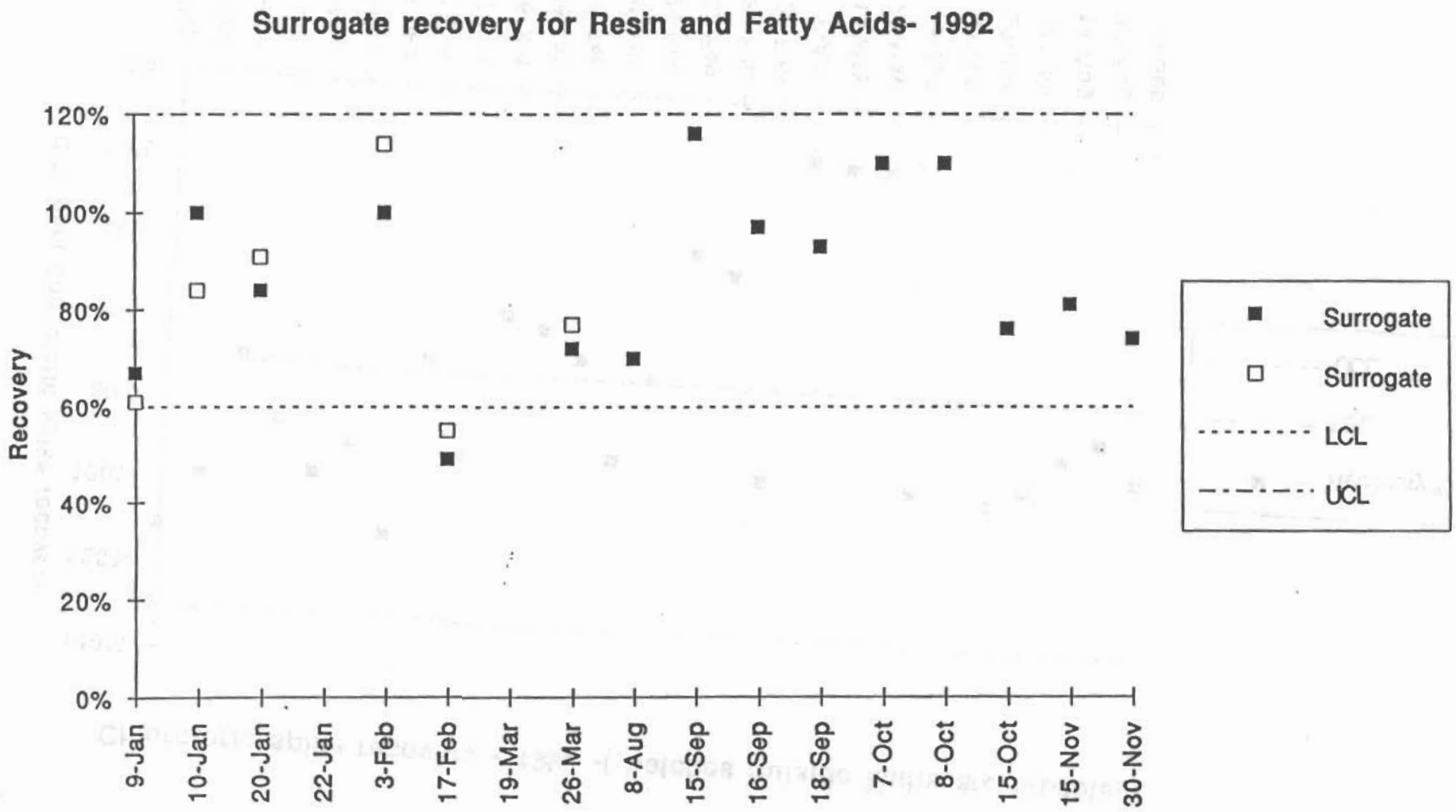
Figure 6

Total Suspended Solids (NFR) Blanks - 1992 (MDC= 4 mg/L)



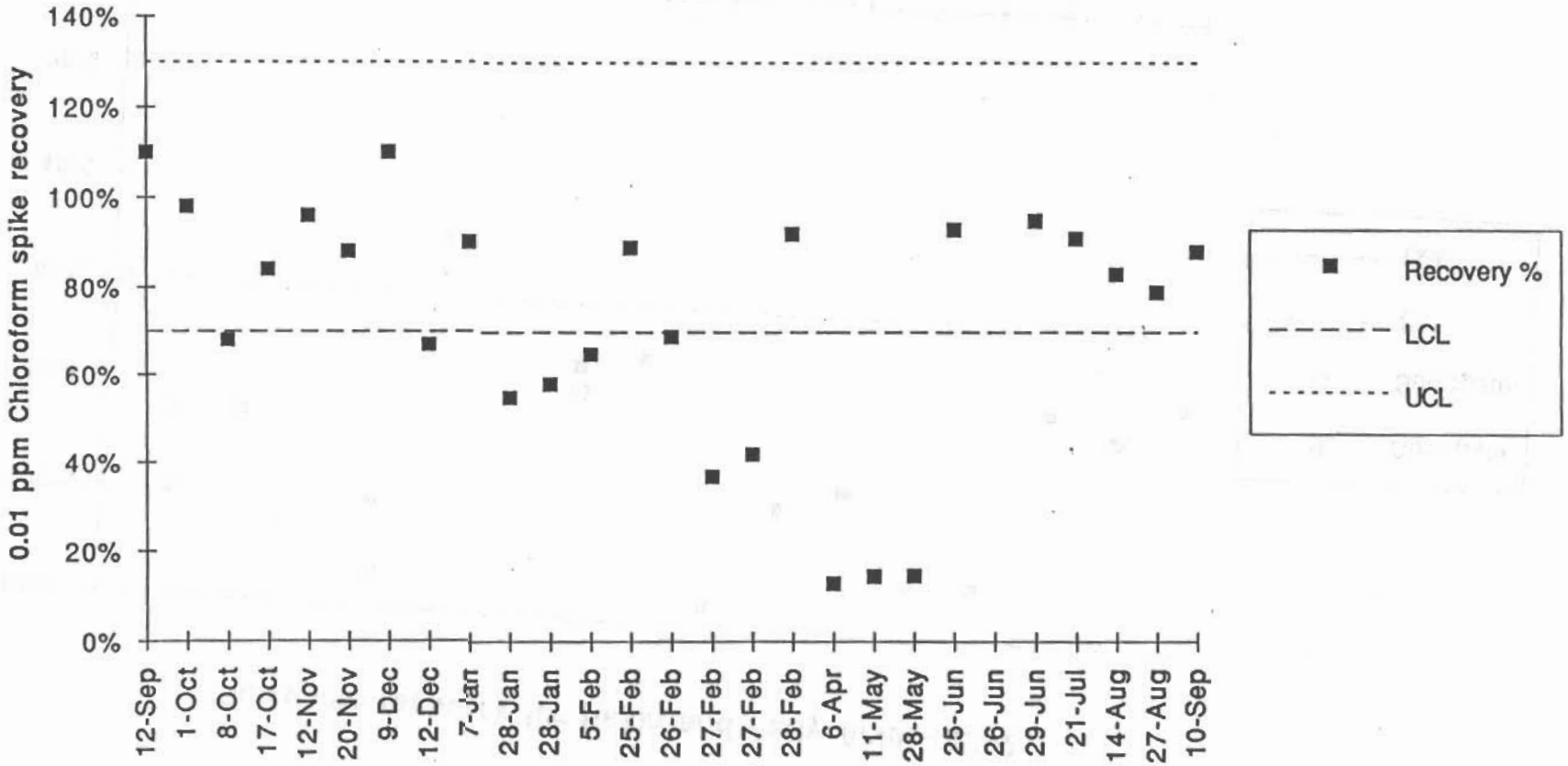
Laboratory blanks for Total Dissolved Solids (TDS=FR) - 1992.
(Upper control limit 8 mg/L).




Surrogate recovery for Resin and Fatty Acids- 1992
120%
100%
80%
60%
40%
20%
0%
Recovery
9-Jan
10-Jan
20-Jan
22-Jan
3-Feb
17-Feb
19-Mar
26-Mar
8-Aug
15-Sep
16-Sep
18-Sep
7-Oct
8-Oct
15-Oct
15-Nov
30-Nov
Surrogate
Surrogate
LCL
UCL

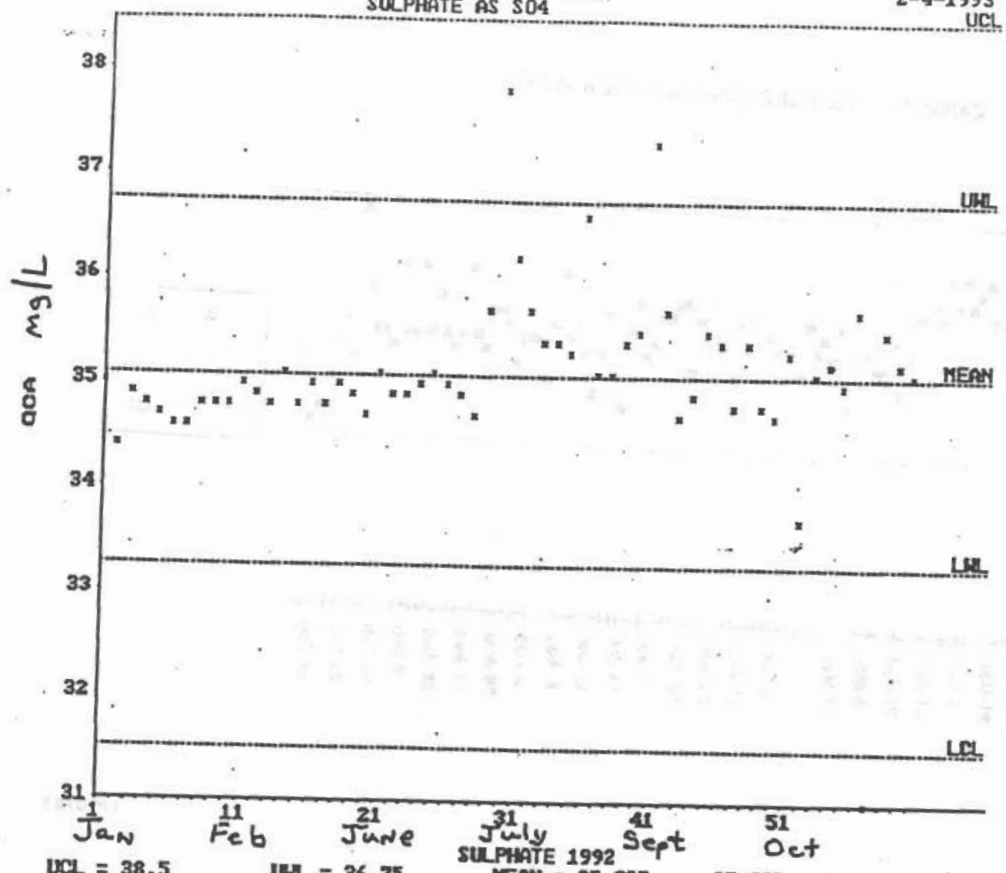
Z

Chloroform spike recovery - 1992 -(batches outside limits are repeated).



SULPHATE QCA CONTROL CHART
SULPHATE AS SO4

2-4-1993

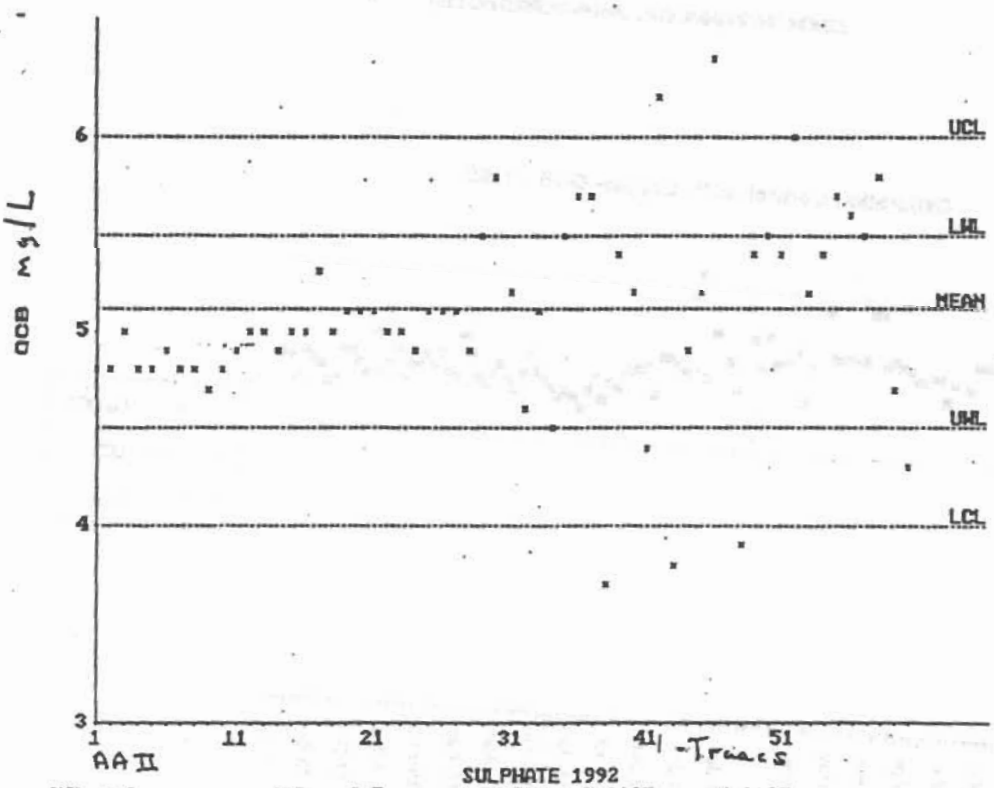


SULPHATE 1992

UCL = 38.5	UWL = 36.75	MEAN = 35.087	35.087	]CUMULATIVE
LCL = 31.5	LWL = 33.25	SD = 0.82103	0.82103	

STATS

Y DATA MAXIMUM : 37.8 Y DATA MINIMUM : 31



SULPHATE 1992

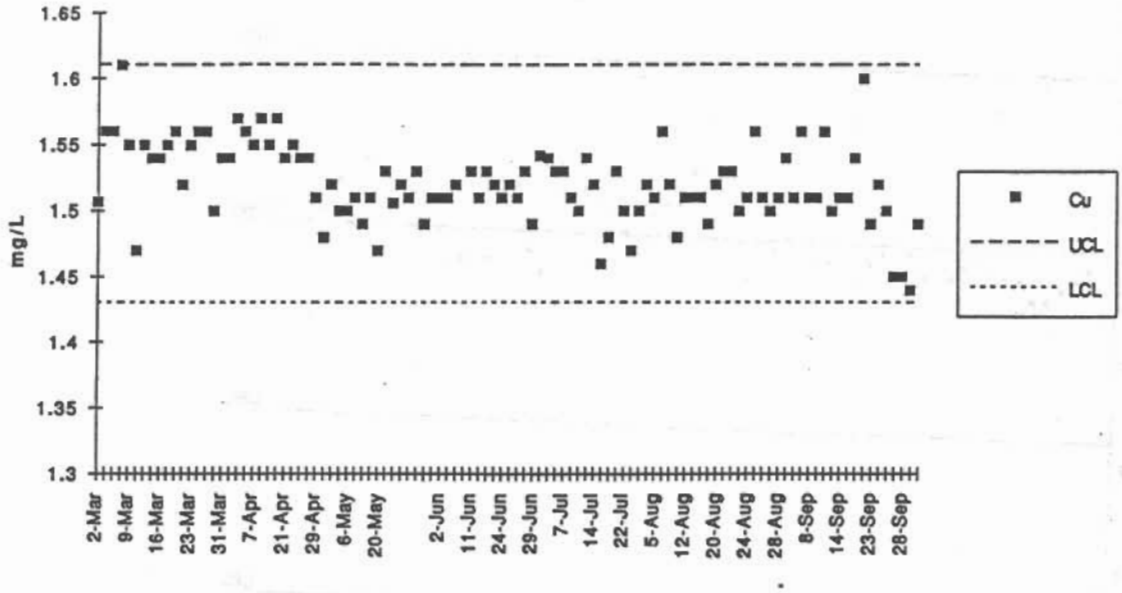
UCL = 6	UWL = 4.5	MEAN = 5.1117	5.1117	]CUMULATIVE
LCL = 4	LWL = 5.5	SD = 0.5536	0.5536	

STATS

Y DATA MAXIMUM : 6.8 Y DATA MINIMUM : 3.7

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

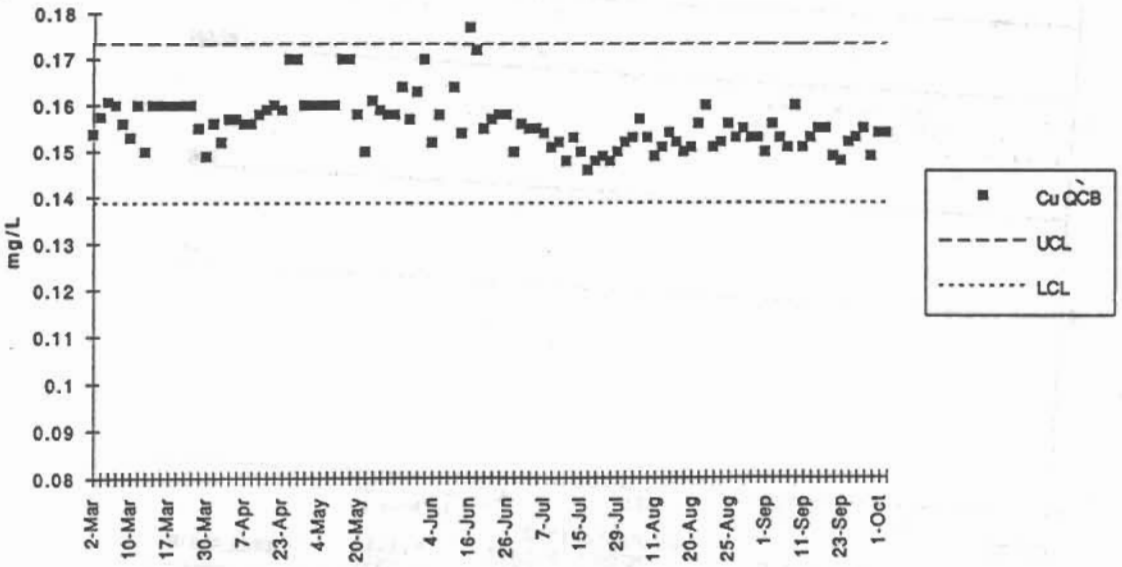
Calibration Control Copper- ICP- QCA -1992



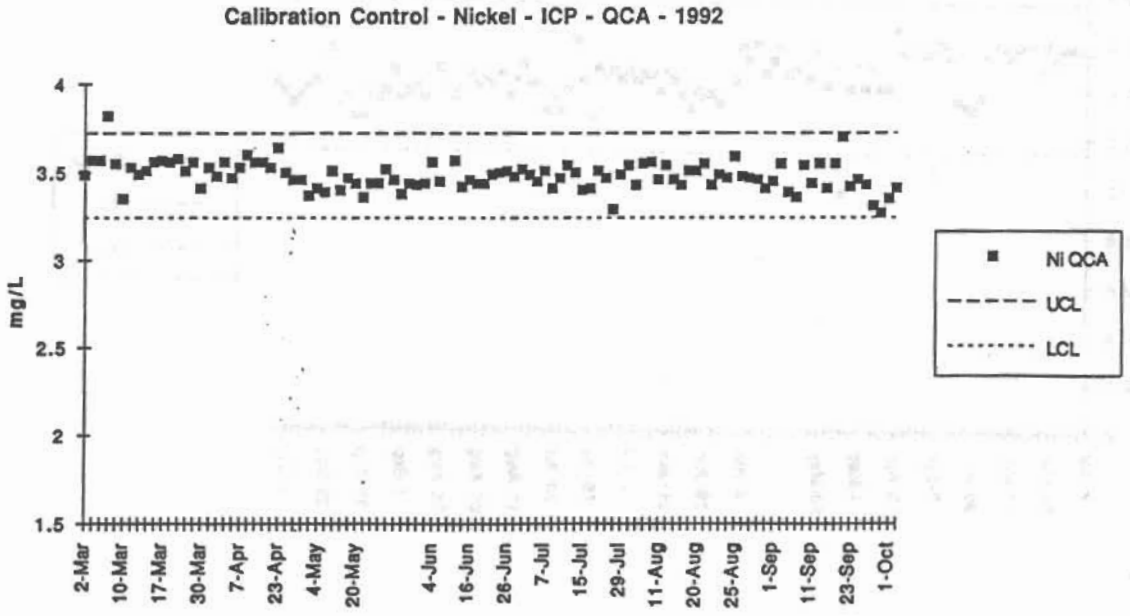
ICPCU92A.XLC 1/30/93

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

Calibration Control -ICP- Copper- QCB - 1992

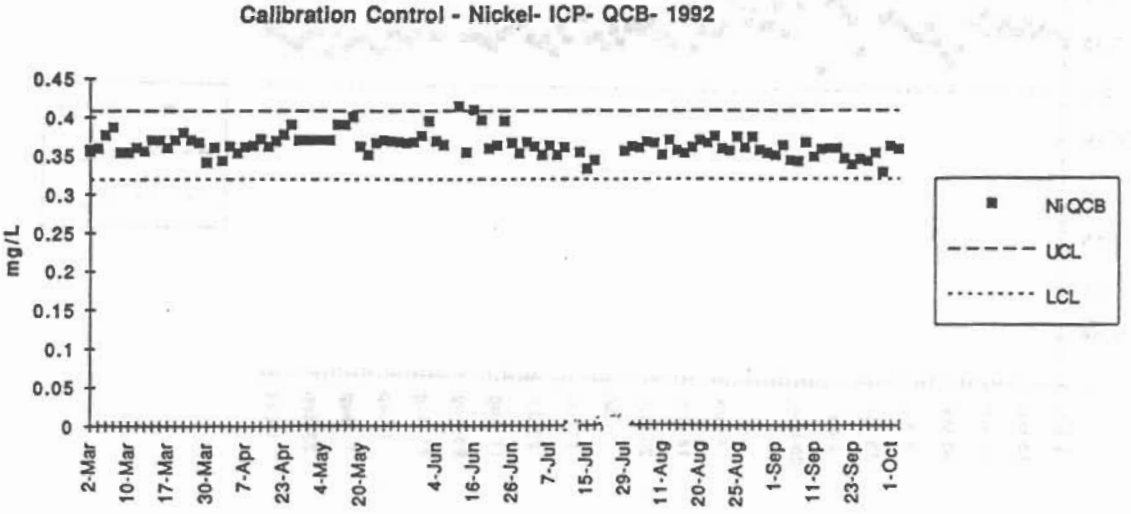


ZENON ENVIRONMENTAL LABORATORIES INC (BC)

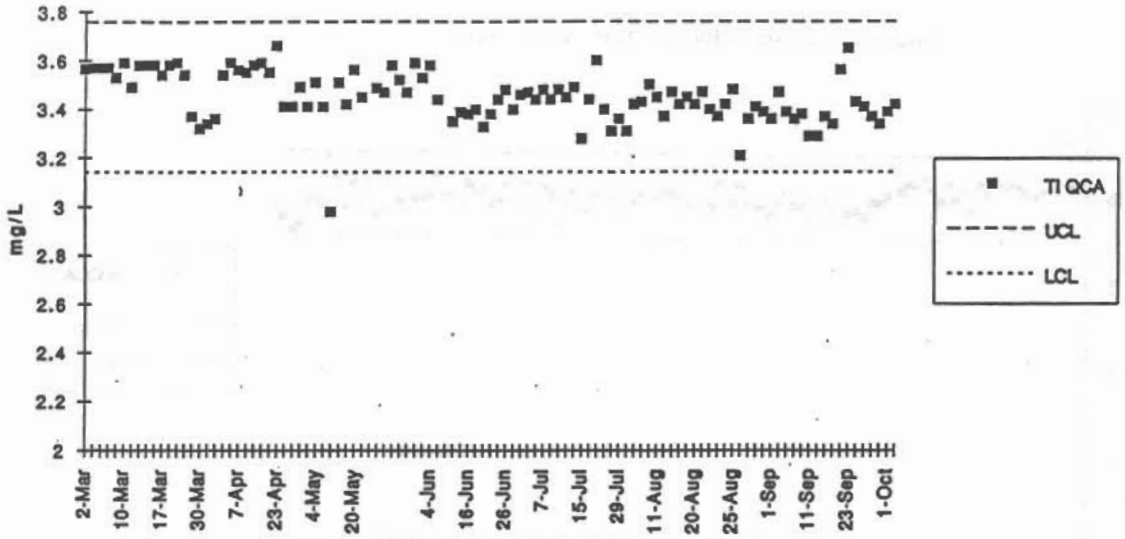


ICPNI92A.XLC 2/1/93

ZENON ENVIRONMENTAL LABORATORIES INC (BC)



Calibration Control - Thallium - ICP - QCA - 1992



ICPTL92A.XLC 1/30/93

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

Calibration control- Thallium - ICP - QCB - 1992

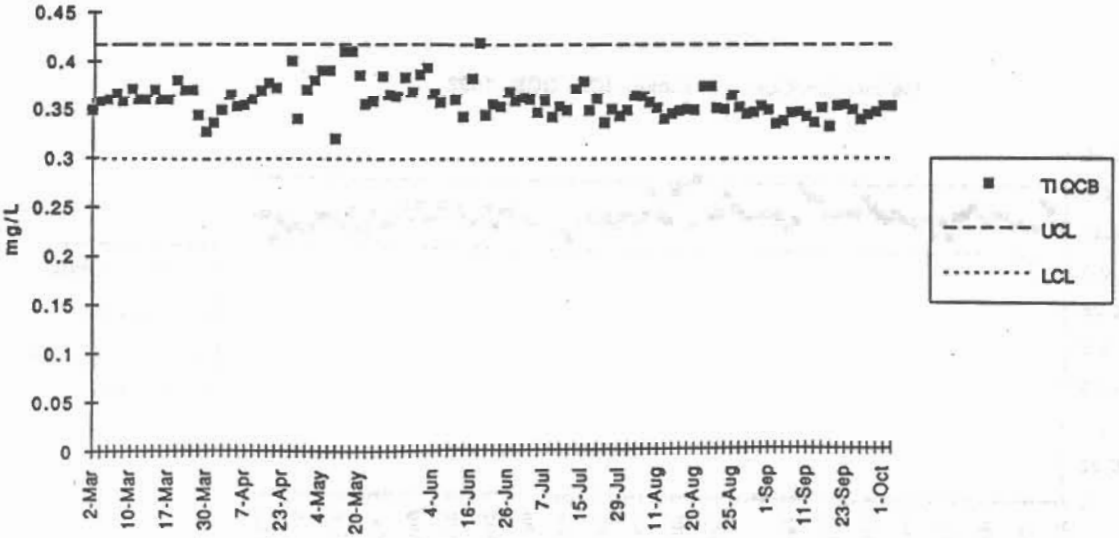
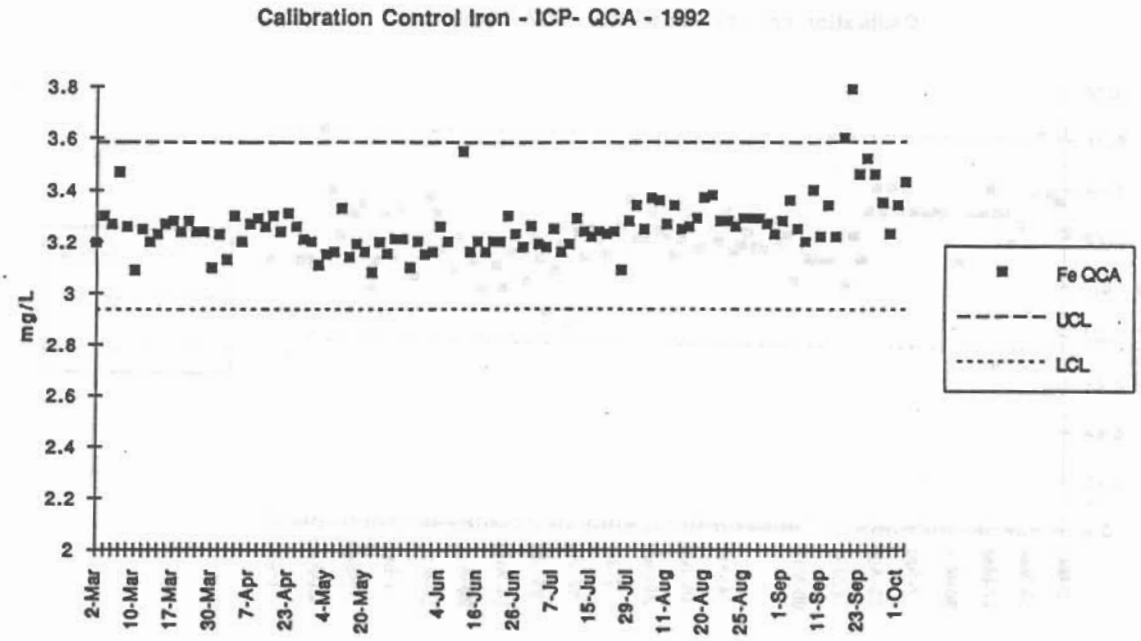


Figure 20 b

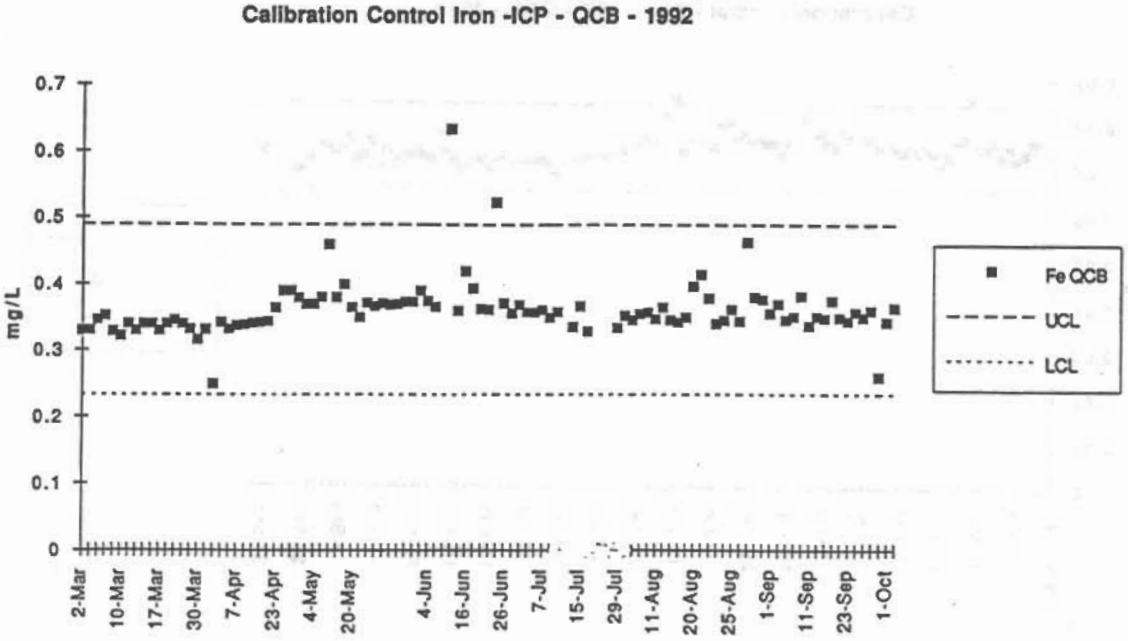
ICPTL92B.XLC 1/30/93

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

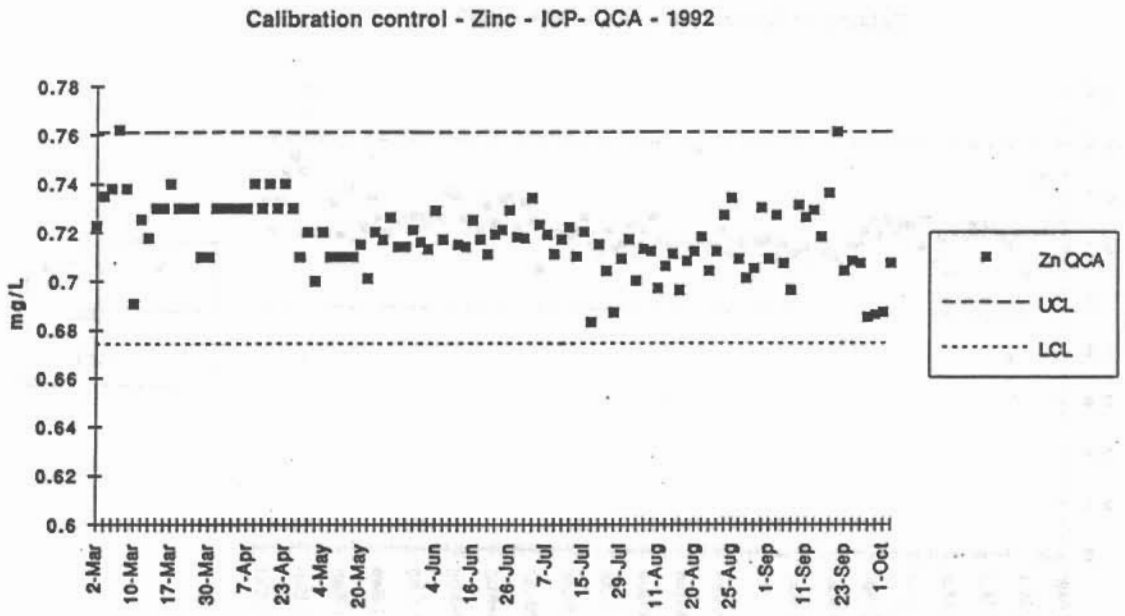


ICPFE92A.XLC 1/30/93

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

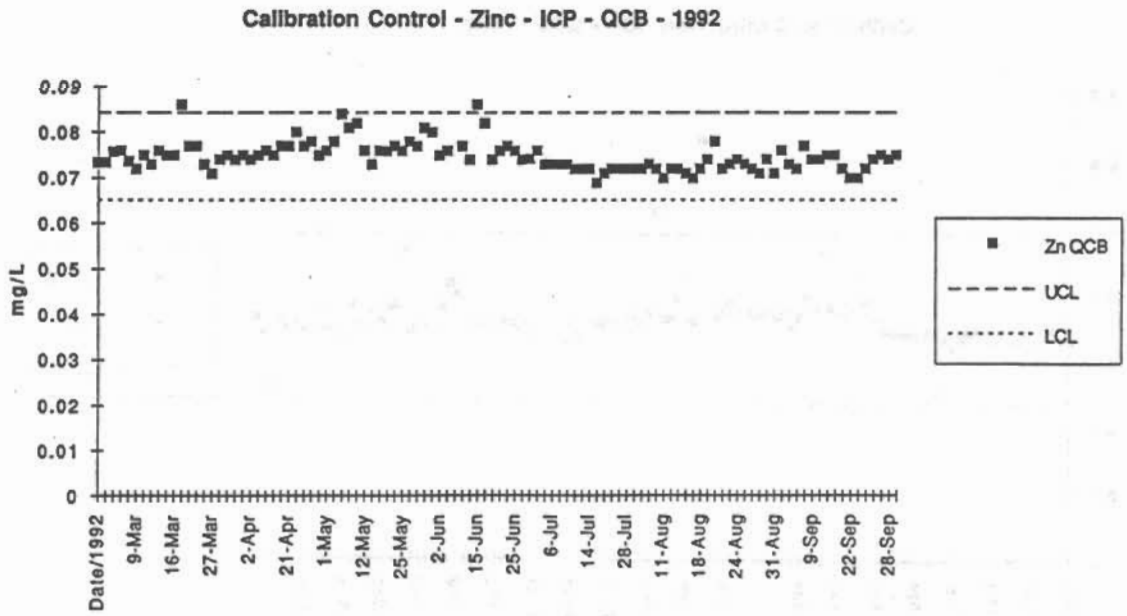


ZENON ENVIRONMENTAL LABORATORIES INC (BC)

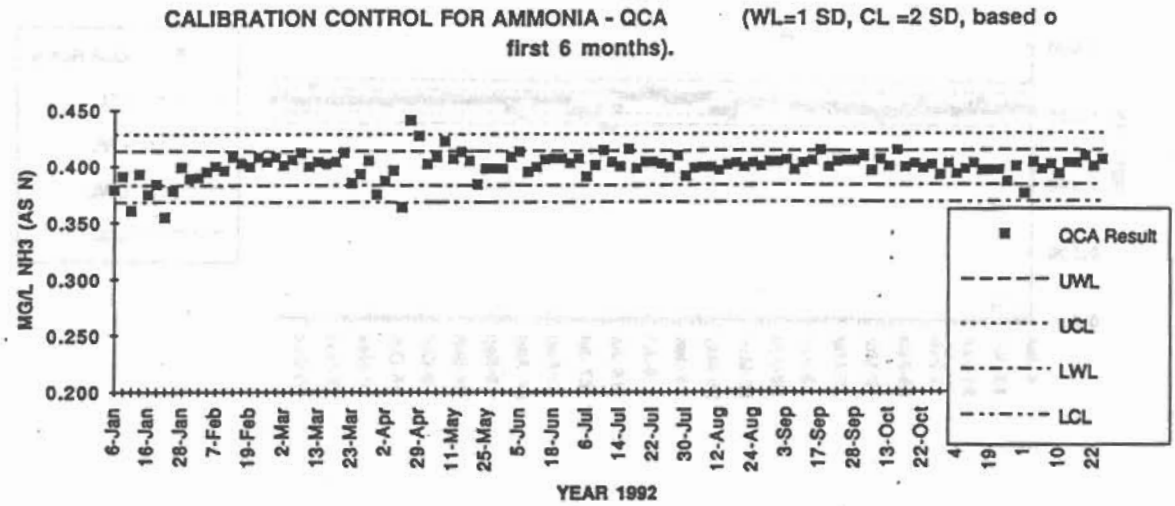


ICPZN92A.XLC 1/30/93

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

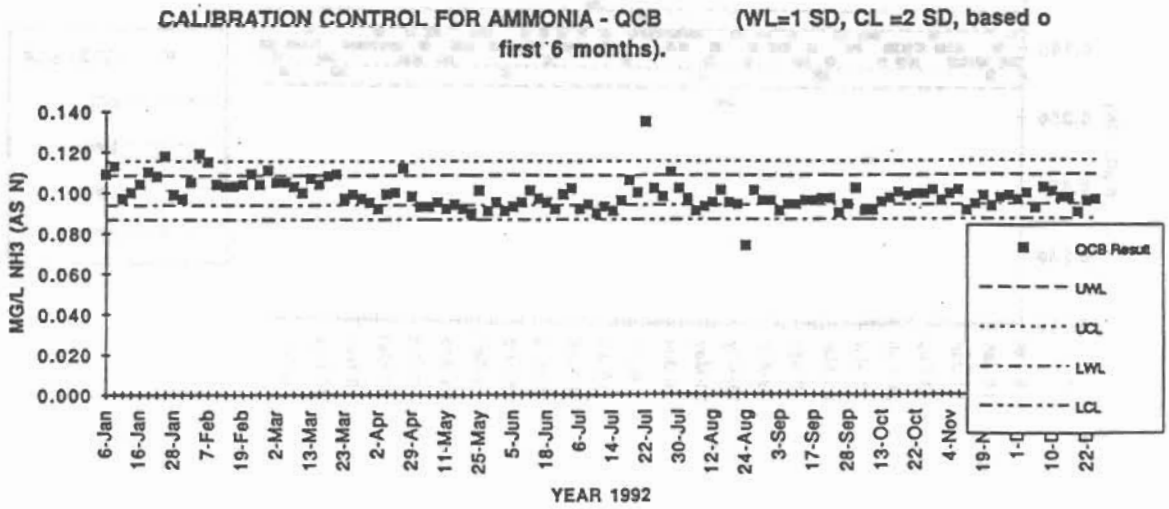


ZENON ENVIRONMENTAL LABORATORIES INC (BC)

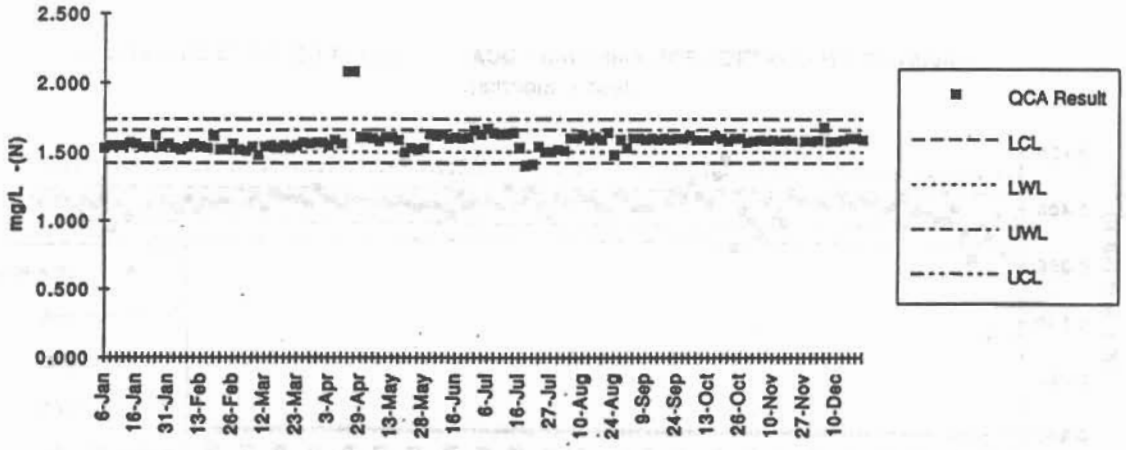


QCA 1992 NH3 chart 1/20/93

ZENON ENVIRONMENTAL LABORATORIES INC (BC)



Calibration Control Nitrate - 1992 -QCA (control limits +/- 2 SD).

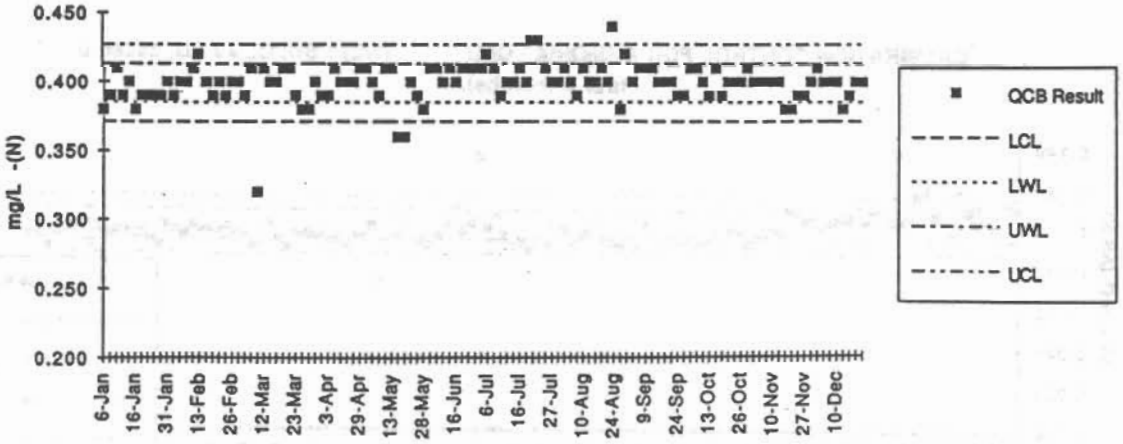


NO3 QCA chart 1992

1/27/93

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

Calibration Control Nitrate -1992- QCB (control limits +/- 2 SD).

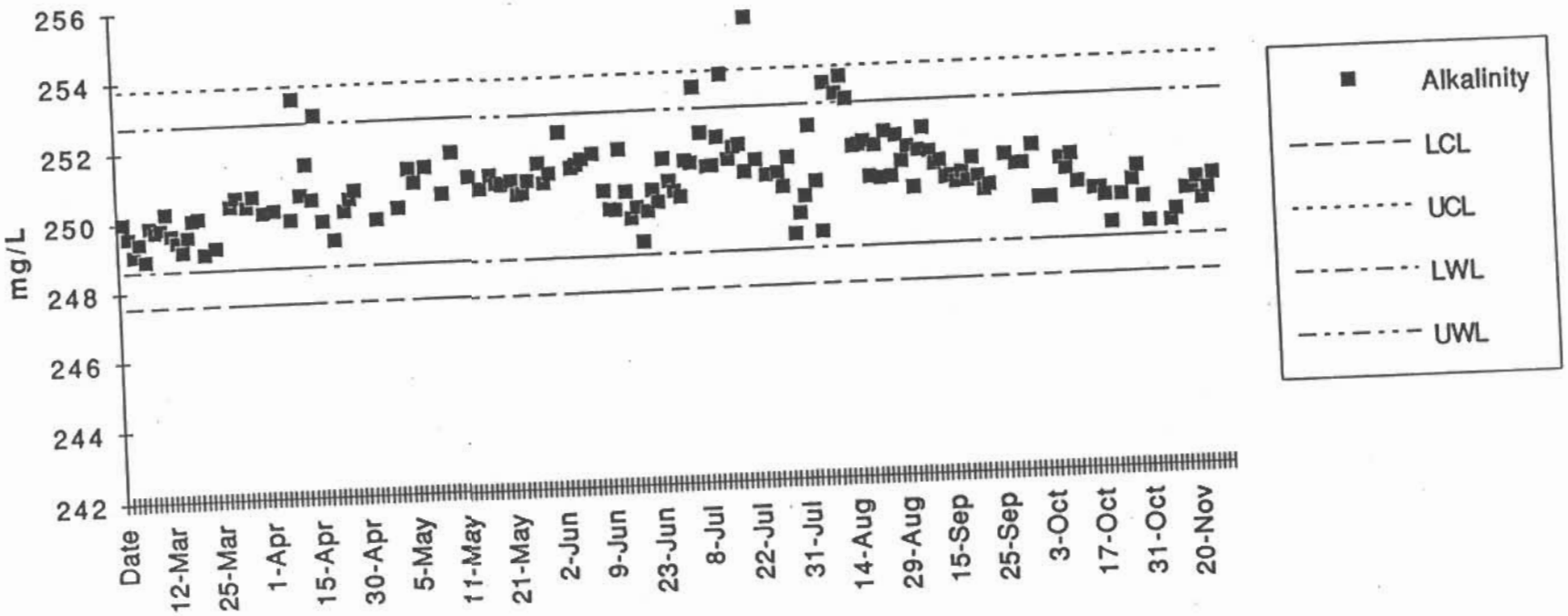


NO3 QCB chart 1992

Figure 29

1/27/93

Calibration control Alkalinity - 1992



1/29/93

ALKCAL92.XLC

Figure 46

ZENON ENVIRONM. AL LABORATORIES (BC)

Standard Reference Materials - Data for the period:

TABLE IV

Parameter	Matrix	SRM Source & #	MDC	ZEL resul	Certified Value	units	Recovery %	Lower limit	Upper Limit	Date	Comments
Ag	digested FW	APG #7878 Lot 9499-950	0.01	0.04	0.042	mg/L	95%	0.030	0.051	27-Mar-92	
Ag x	digested FW	APG #7878 Lot 9499-950	0.01	0.04	0.042	mg/L	95%	0.030	0.051	27-Mar-92	
Al	digested FW	APG #7878 Lot 9499-950	0.02	0.04	0.050	mg/L	80%	0.035	0.071	27-Mar-92	
As	digested FW	APG #7878 Lot 9499-950	0.04	0.08	0.079	mg/L	101%	0.067	0.090	27-Mar-92	
B	digested FW	APG #7878 Lot 9499-950	0.008	0.009	0.079	mg/L	11%	0.040	0.121	27-Mar-92	
Ba	digested FW	APG #7878 Lot 9499-950	0.001	0.286	0.343	mg/L	83%	0.251	0.398	27-Mar-92	
Be	digested FW	APG #7878 Lot 9499-950	0.001	0.03	0.038	mg/L	80%	0.021	0.051	27-Mar-92	
Cd	digested FW	APG #7878 Lot 9499-950	0.002	0.044	0.046	mg/L	95%	0.040	0.052	27-Mar-92	
Co	digested FW	APG #7878 Lot 9499-950	0.003	0.163	0.174	mg/L	94%	0.146	0.191	27-Mar-92	
Cr	digested FW	APG #7878 Lot 9499-950	0.002	0.047	0.047	mg/L	100%	0.033	0.061	27-Mar-92	
Cu	digested FW	APG #7878 Lot 9499-950	0.001	0.032	0.032	mg/L	101%	0.027	0.038	27-Mar-92	
Fe	digested FW	APG #7878 Lot 9499-950	0.003	0.071	0.057	mg/L	125%	0.030	0.084	27-Mar-92	
Mn	digested FW	APG #7878 Lot 9499-950	0.002	0.053	0.056	mg/L	95%	0.048	0.062	27-Mar-92	
Ni	digested FW	APG #7878 Lot 9499-950	0.008	0.071	0.063	mg/L	112%	0.050	0.074	27-Mar-92	
Pb	digested FW	APG #7878 Lot 9499-950	0.02	0.07	0.070	mg/L	100%	0.049	0.087	27-Mar-92	
Sb	digested FW	APG #7878 Lot 9499-950	0.015	<	0.126	mg/L		0.091	0.144	27-Mar-92	
Se	digested FW	APG #7878 Lot 9499-950	0.03	<	0.012	mg/L		0.007	0.018	27-Mar-92	
Tl	digested FW	APG #7878 Lot 9499-950	0.003	0.05	0.064	mg/L	78%	0.044	0.078	27-Mar-92	
V	digested FW	APG #7878 Lot 9499-950	0.003	0.298	0.304	mg/L	98%	0.274	0.326	27-Mar-92	
Zn	digested FW	APG #7878 Lot 9499-950	0.002	0.03	0.027	mg/L	111%	0.021	0.035	27-Mar-92	
Mg	FW	CCIW CM Ion 91		2.93	2.76	ppm	106%	2.24	3.28	21/06/91	average of 3 values
Mg	FW	CCIW CM Ion 91		2.96	2.76	ppm	107%	2.24	3.28	26/06/91	
Mg	FW	CCIW CM Ion 91		2.97	2.76	ppm	108%	2.24	3.28	04-07-91	
Na	FW	CCIW CM Ion 91		1.25	1.28	ppm	98%	0.76	1.8	Jul 4/91	
Na	FW	CCIW CM Ion 91		1.31	1.28	ppm	102%	0.76	1.8	26/06/91	
K Diss	FW	CCIW CM Ion 94	0.1	0.3	0.289	mg/L	104%	0.184	0.394	20-May-92	
Alkalinity Tot	FW	CCIW CM Ion 91	0.5	42.5	41.26	mg/L	103%	37.36	45.16	20-May-92	
K Diss	FW	CCIW CM Ion 91	0.1	0.5	0.48	mg/L	104%	0.39	0.57	20-May-92	
N Tot Diss	FW	CCIW CM Ion 91	0.04	0.35	0.329	mg/L	106%	0.297	0.361	20-May-92	consensus value
Na Diss	FW	CCIW CM Ion 91	0.01	1.4	1.28	mg/L	109%	0.75	1.81	20-May-92	
P Tot Diss	FW	CCIW CM Ion 91	0.003	0.005	0.004	mg/L	125%	0	0.008	20-May-92	
pH	FW	CCIW CM Ion 91		7.6	7.66	pH units		7.14	8.18	20-May-92	calc recovery as [H+]
Sulfate Dis	FW	CCIW CM Ion 91	1	3.5	3.27	mg/L	107%	2.94	3.6	20-May-92	
TKN	FW	CCIW CM Ion 91	0.04	0.07	0.084	mg/L	83%	0.016	0.152	20-May-92	consensus value
Sulfate Dis	FW	CCIW CM Ion 94	1	5.2	3	mg/L	186%	1.91	3.67	20-May-92	Coloured sample, method of analysis?
Alkalinity Tot	FW	CCIW CM Ion 94	0.5	5.3	3.39	mg/L	156%	1.29	5.49	20-May-92	CM ION 94 rec'd July 1990 - outdated?
Ammonia(N)	FW	CCIW CM Ion 94	0.005	0.007	0.007	mg/L	100%	0	0.014	20-May-92	consensus value
N Tot.Diss.	FW	CCIW CM Ion 94	0.04	0.23	0.2	mg/L	115%	0.08	0.32	20-May-92	consensus value
Na Diss	FW	CCIW CM Ion 94	0.01	4.3	4.1	mg/L	105%	3.54	4.66	20-May-92	
P Tot Diss	FW	CCIW CM Ion 94	0.003	0.005	0.007	mg/L	71%	0.004	0.01	20-May-92	
pH	FW	CCIW CM Ion 94		6.3	6.27	pH units		5.88	6.66	20-May-92	calc recovery as [H+]
TKN	FW	CCIW CM Ion 94	0.04	0.23	0.276	mg/L	83%	0.231	0.321	20-May-92	consensus value

ZENON ENVIRONMENTAL LABORATORIES INC (BC)
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Table V

MERCURY PRESERVATIVE CHECKS

Sparcode: Hg-T0310 Requisition: 3025550
sample #: 9689-9694

Procedure: May 20/92
One litre wide mouth clear glass bottles were filled with DI water. Six mL of 10% Potassium dichromate (BDH Analar) solution, and 6 mL of sulfuric acid (Baxter Canlab Reagent Grade Lot 0711.91) were added from individual preservative vials prepared from routine stocks. The samples were sent for analysis.
Total mercury digest and cold vapour atomic absorption was done on May 26.

This test should reflect any contamination present in reagents and not contamination during field or in-lab storage prior to analysis.

MDC 0.05 units ug/L

Sample #:	chart reading #1	chart reading #2	Converted to ug/L		Note:
blank	1		<0.05		
9689	23.5		0.305		contamination
9690	25		0.33		in all
9691	17.5		0.225		samples.
9692	22	22	0.285	0.285	
9693	22.5		0.285		
9694	22		0.285		
average		24.06	0.286		
std dev		2.51	0.035		
n		7	6		
RSD		10%	12%		

COMPONENT CHECKING May 26, 29, & 30, 1992

H2SO4	23	22	0.280	0.265	plastic dispenser in GS
H2SO4	3	3	<0.05		glass bottle
K2Cr207	1.5	1.5	<0.05		sol'n glass bottle
K2Cr07	1.5	1.5	<0.05		freshly prepared sol'n
K2Cr207	1.5	1.5	<0.05		plastic dispenser in GS
vials	1	1	<0.05		stored 1 week with fresh solutions
bottles	1	1	<0.05		stored 1 week with fresh solutions

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

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Field Replicates Report for CRIEMP March to Oct 1992.

		Site	Date/Time	Date/Time	Form #	
		200559	92/03/17:1200		10003286	
			92/03/17:1125		10003300	
			92/03/17:1145		10003082	
Parameter	Sparcode	Result mg/L 1	Result mg/L 2=Site A	Result mg/L 3=Site B	Result mg/L 4=Site C	Relative SD limit<18% @ >5x mdc
Carbon total	C--T0910	15				
pH	41220			7.5	7.5	0%
Color true	213000			5	5	0%
Color TAC	241310			3	4	20%
Color SW	10521320			6	8	20%
Sp. Cond	111160			142	143	0%
NFR=TSS	81070			1	2	47%
FR=TDS -	7H1032			86	86	0%
Turbidity	151140			0.7	0.5	24%
Hardness	107CALC			59.5	71.2	13%
HCO3 as CaCO3						
Phenol. Alk	1011211			<0.5	<0.5	
Total Alk.	1021210			59.2	59.4	0%
Chloride	11041330			1.2	1.2	0%
Fluoride				<0.10	<0.10	
TOC	0103calc	<1				
TIC	01240930	15				
TKN	0113136A			0.23	0.34	27%
Ammonia	11081351			0.025	0.053	51%
NO3+NO2	11091350			0.14	0.13	5%
Phosphorus Ortho	11181380			<0.003	0.009	
Silica Reactive	11201381			4.6	4.8	3%
Sulfate	11211400			10.6	11.3	5%
Silver	Ag-T0041			<0.01	<0.01	
All resin acids excep	xxxxP030	<0.001				
Behenic acid						
Chlorodehydroabietic acid						
Dichl.deh.abietic Acid						
Isopimaric acid						
Levo Pimaric Acid						
Fatty acids except following		<0.001				
Lauric acid	LAURP030	0.004				
Lignoceric acid	LIGNP030	0.010				
Myristic Acid	MYRIP030	0.003				
Oleic Acid						
Palmitric acid	PALMP030	0.005				
Palustric acid	PALUP030	0.003				
Stearic acid	STEAP030	0.002				
AOX	AOX-DM01	0.03				
Al	Al-T0041			<0.02	0.04	
As hydride	As-T0181			<0.001	<0.001	

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

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Field Replicates Report for CRIEMP March to Oct 1992.

		Site	Date/Time	Date/Time	Form #	
		200559	92/03/17:1200		10003286	
			92/03/17:1125		10003300	
			92/03/17:1145		10003082	
		Result mg/L	Result mg/L	Result mg/L	Result mg/L	Relative SD
Parameter	Sparcode	1	2=Site A	3=Site B	4=Site C	limit<18% @ >5x mdc
B	B--T0041			<0.008	0.045	
Ba	Ba-T0041			0.037	0.022	36%
Beryliium	Be-T0041			<0.001	<0.001	
Bismuth	Bi-T0041			<0.02	<0.02	
Ca	Ca-T0041			17.4	21.1	14%
Cd	Cd-T0060			<0.0005	<0.0005	
Co	Co-T0041			<0.003	<0.003	
Cr	Cr-T0041			<0.002	<0.002	
Cu	Cu-T0041			<0.001	0.003	
Fe	Fe-T0041			0.222	0.051	89%
Mercury	Hg-T0310			0.00006		
K ICP	K--T0041			0.6	0.5	13%
Mg	Mg-T0041			3.89	4.49	10%
Mn	Mn-T0041			0.003	0.005	35%
Mo	Mo-T0041			<0.004	<0.004	
Sodium	Na-T0041			3340	1.77	141%
Sodium	Na-D1331			1.6	1.7	4%
Ni	Ni-T0041			<0.008	<0.008	
Pb	Pb-T0060			<0.001	0.004	
Phos T diss	P--D1390			<0.003	0.010	
Phos total	P--T0041					
Phos total	P--T139A			0.004	0.016	85%
K	K--D1331			0.7	0.7	0%
Antimony	Sb-T0041			<0.015	<0.015	
Sulfur	S--T0041			3.6	4.15	10%
Selenium	Se-T0041			<0.03	<0.03	
Silicon	Si-T0041			3.82	2.41	32%
Sr	Sr-T0041			0.105	0.112	5%
Tin	Sn-T0041			<0.02	<0.02	
Tellurium	Te-T0041			<0.02	<0.02	
Thallium	Tl-T0041			<0.003	0.006	
Titanium	Ti-T0041			<0.003	<0.003	
V	V--T0041			<0.003	<0.003	
Zn	Zn-T0041			0.005	0.020	85%
Zirconium	Zr-T0041			<0.003	<0.003	
E. coli	01476013	17				
Enterococcus	01486014	5				
Coliform fecal	04502480					
Chlorate	pscppscp	0.01				
Chloroform						

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

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Field Replicates Report for CRIEMP March to Oct 1992.

		Site	Date/Time	Date/Time	Form #	
		200559	92/04/14:1200		10003289	
			92/04/14		10008638	
			92/04/14		10008639	
			92/04/14:1230		10008640	
		Result mg/L	Result mg/L	Result mg/L	Result mg/L	Relative SD
Parameter	Sparcode	1	2=Site A	3=Site B	4=Site C	limit<18% @ >5x mdc
Carbon total	C--T0910	15	15			0%
pH	41220		7.5	7.4	7.3	23%
Color true	213000		<5	<5	<5	
Color TAC	241310		4	4	4	0%
Color SW	10521320		8	9	5	28%
Sp. Cond	111160		135	135	135	0%
NFR=TSS	81070		1	<1	2	47%
FR=TDS	7H1032		86	86	82	3%
Turbidity	151140		0.2	0.2	0.2	0%
Hardness	107CALC		65.4	66.4	65.0	1%
HCO3 as CaCO3						
Phenol. Alk	1011211		<0.5	<0.5	<0.5	
Total Alk.	1021210		56.8	56.4	56.3	0%
Chloride	11041330		0.9	1.0	1.0	6%
uoride			0.17	0.17	0.17	0%
TOC	0103calc	<3	<3			
TIC	01240930	15	15			0%
TKN	0113136A		0.14	0.11	0.10	18%
Ammonia	11081351		0.044	0.042	0.045	3%
NO3+NO2	11091350		0.10	0.10	0.10	0%
Phosphorus Ortho	11181380		0.020	0.019	0.019	
Silica Reactive	11201381		4.6	4.6	4.5	1%
Sulfate	11211400		10.2	10.2	10.2	0%
Silver	Ag-T0041		<0.01	<0.01	<0.01	
All resin acids excep	xxxxP030	<0.001	<0.0005			
Behenic acid			0.001			
Chlorodehydroabietic acid						
Dichl.deh.abietic Acid						
Isopimaric acid			0.003			
Levo Pimaric Acid						
Fatty acids except following		<0.001	<0.0005			
Lauric acid	LAURP030	0.002	0.015			108%
Lignoceric acid	LIGNP030		0.001			
Myristic Acid	MYRIP030	0.001	0.01			116%
Oleic Acid						
Palmitric acid	PALMP030		0.006			
Palustric acid	PALUP030					
Stearic acid	STEAP030		0.005			
AOX	AOX-DM01	0.01	0.02			47%
Al	Al-T0041		0.04	0.07	0.14	62%
As hydride	As-T0181		<0.001	<0.001	<0.001	

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Field Replicates Report for CRIEMP March to Oct 1992.

		Site	Date/Time	Date/Time	Form #	
		200559	92/04/14:1200		10003289	
			92/04/14		10008638	
			92/04/14		10008639	
			92/04/14:1230		10008640	
Parameter	Sparcode	Result mg/L 1	Result mg/L 2=Site A	Result mg/L 3=Site B	Result mg/L 4=Site C	Relative SD limit<18% @ >5x mdc
B	B--T0041		0.040	0.042	0.032	14%
Ba	Ba-T0041		0.020	0.021	0.020	3%
Beryliium	Be-T0041		<0.001	<0.001	<0.001	
Bismuth	Bi-T0041		<0.02	<0.02	<0.02	
Ca	Ca-T0041		19.4	19.7	19.3	1%
Cd	Cd-T0060		<0.0005	0.0007	<0.0005	
Co	Co-T0041		<0.003	0.004	<0.003	
Cr	Cr-T0041		<0.002	0.003	0.003	0%
Cu	Cu-T0041		0.003	0.004	0.003	17%
Fe	Fe-T0041		0.036	0.055	0.111	58%
Mercury	Hg-T0310	0.00010	0.00008	0.00009		11%
K ICP	K--T0041		0.6	0.6	0.6	0%
Mg	Mg-T0041		4.11	4.17	4.07	1%
Mn	Mn-T0041		0.004	0.004	0.004	0%
Mo	Mo-T0041		<0.004	<0.004	<0.004	
Sodium	Na-T0041		1.66	1.68	1.66	1%
Sodium	Na-D1331		1.6	1.6	1.6	0%
Ni	Ni-T0041		<0.008	<0.008	<0.008	
Pb	Pb-T0060		0.006	0.004	0.005	20%
Phos T diss	P--D1390		0.021	0.021	0.022	3%
Phos total	P--T0041				0.68	
Phos total	P--T139A		0.028	0.026	0.028	4%
K	K--D1331		0.7	0.7	0.7	0%
Antimony	Sb-T0041		<0.015	<0.015	<0.015	
Sulfur	S--T0041		3.52	3.55	3.47	1%
Selenium	Se-T0041		<0.03	<0.03	<0.03	
Silicon	Si-T0041		2.12	1.94	2.13	5%
Sr	Sr-T0041		0.111	0.113	0.111	1%
Tin	Sn-T0041		<0.02	<0.02		
Tellurium	Te-T0041		<0.02	<0.02	<0.02	
Thallium	Tl-T0041		0.008	0.007	<0.003	9%
Titanium	Ti-T0041		<0.003	<0.003	<0.003	
V	V--T0041		<0.003	<0.003	<0.003	
Zn	Zn-T0041		0.014	0.016	0.025	32%
Zirconium	Zr-T0041		<0.003	<0.003	<0.003	
E. coli	01476013					
Enterococcus	01486014					
Coliform fecal	04502480					
Chlorate	pscppscp	0.03	0.03			0%
Chloroform						

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Field Replicates Report for CRIEMP March to Oct 1992.

		Site	Date/Time		Form #	
		Columbia R. at Waneta 0200559	92/05/12:1240		10008632	
			92/05/12:1230		10008631	
			92/05/12:1250		10008630	(Does not include 1).
Parameter	Sparcode	Result mg/L 1	Result mg/L 2=Site A	Result mg/L 3=Site B	Result mg/L 4=Site C	Relative SD limit<18% @ >5x mdc
Carbon total	C--T0910		13			
pH	41220		7.3	7.4	7.5	23%
Color true	213000		<5	<5	<5	
Color TAC	241310		4	4	4	0%
Color SW	10521320		34	9260	<5	140%
Sp. Cond	111160		131	130	130	0%
NFR=TSS	81070		2	2	2.0	0%
FR=TDS	7H1032		78	82	76	4%
Turbidity	151140		0.5	0.5	0.5	0%
Hardness	107CALC		50.8	58.4	60.4	9%
HCO3 as CaCO3						
Phenol. Alk	1011211		<0.5	<0.5	<0.5	
Total Alk.	1021210		55.5	55.6	55.7	0%
Chloride	11041330		0.8	0.9	0.9	7%
uoride			0.10	<0.10	<0.10	
TOC	0103calc		<3			
TIC	01240930		12			
TKN	0113136A		0.10	<0.04	0.08	16%
Ammonia	11081351		0.008	<0.005	0.006	20%
NO3+NO2	11091350		0.12	0.10	0.11	9%
Phosphorus Ortho	11181380		<0.003	<0.003	<0.003	
Silica Reactive	11201381		4.9	5.1	5.1	2%
Sulfate	11211400		9.3	9.3	9.4	1%
Silver	Ag-T0041		<0.01	<0.01	<0.01	
All resin acids excep	xxxxP030		<0.0005			
Behenic acid						
Chlorodehydroabietic acid						
Dichl.deh.abietic Acid						
Isopimaric acid						
Levo Pimaric Acid						
Fatty acids except following			<0.0005			
Lauric acid	LAURP030					
Lignoceric acid	LIGNP030					
Myristic Acid	MYRIP030		0.002			
Oleic Acid						
Palmitric acid	PALMP030		0.002			
Palustric acid	PALUP030					
Stearic acid	STEAP030					
AOX	AOX-DM01					
Al	Al-T0041		0.04	0.05	0.06	20%
As hydride	As-T0181		<0.001	<0.001	<0.001	

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Field Replicates Report for CRIEMP March to Oct 1992.

		Site Columbia R. at Waneta 0200559	Date/Time 92/05/12:1240 92/05/12:1230 92/05/12:1250		Form # 10008632 10008631 10008630	(Does not include 1).
Parameter	Sparcode	Result mg/L 1	Result mg/L 2=Site A	Result mg/L 3=Site B	Result mg/L 4=Site C	Relative SD limit<18% @ >5x mdc
B	B--T0041		0.041	0.031	0.028	20%
Ba	Ba-T0041		0.017	0.020	<0.001	11%
Beryliium	Be-T0041		<0.001	<0.001	<0.001	
Bismuth	Bi-T0041		<0.02	<0.02	<0.02	
Ca	Ca-T0041		14.8	17.0	17.6	9%
Cd	Cd-T0060		<0.0005	<0.0005	<0.0005	
Co	Co-T0041		<0.003	<0.003	<0.003	
Cr	Cr-T0041		<0.002	<0.002	0.004	
Cu	Cu-T0041		0.002	0.003	0.003	22%
Fe	Fe-T0041		0.040	0.069	0.073	30%
Mercury	Hg-T0310		0.00033	0.00030		7%
K ICP	K--T0041		0.6	0.6	0.8	17%
Mg	Mg-T0041		3.35	3.88	4.00	9%
Mn	Mn-T0041		0.003	0.004	0.004	16%
Mo	Mo-T0041		<0.004	<0.004	<0.004	
Sodium	Na-T0041		1.16	1.30	1.33	7%
Sodium	Na-D1331		1.5	1.5	1.5	0%
Ni	Ni-T0041		<0.008	<0.008	<0.008	
Pb	Pb-T0060		0.004	0.002	0.002	43%
Phos T diss	P--D1390		<0.003	<0.003	<0.003	
Phos total	P--T0041					
Phos total	P--T139A		0.004	0.004	0.004	0%
K	K--D1331				0.6	
Antimony	Sb-T0041		<0.015	<0.015	<0.015	
Sulfur	S--T0041		2.69	2.99	3.02	6%
Selenium	Se-T0041		<0.03	<0.03	<0.03	
Silicon	Si-T0041		2.00	1.99	2.43	12%
Sr	Sr-T0041		0.086	0.099	0.102	9%
Tin	Sn-T0041		<0.02	<0.02	<0.02	
Tellurium	Te-T0041		<0.02	<0.02	<0.02	
Thallium	Tl-T0041		<0.003	<0.003	<0.003	
Titanium	Ti-T0041		<0.003	<0.003	<0.003	
V	V--T0041		<0.003	<0.003	<0.003	
Zn	Zn-T0041		0.008	0.010	0.016	37%
Zirconium	Zr-T0041		<0.003	<0.003	<0.003	
E. coli	01476013		46			
Enterococcus	01486014		12			
Coliform fecal	04502480		34			
Chlorate	pscppscp					
Chloroform						

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Field Replicates Report for CRIEMP March to Oct 1992.

		Site	Date/Time	Date/Time	Form #	
		200559	92/06/09:1125		10003290	
			92/06/09:1210		3034516	
			92/06/09:1145		3034517	
			92/06/09:1245		3034518	
Parameter	Sparcode	Result mg/L 1	Result mg/L 2=Site A	Result mg/L 3=Site B	Result mg/L 4=Site C	Relative SD limit<18% @ >5x mdc
Carbon total	C--T0910	14	14			0%
pH	41220	8	8.0	8.0	8	0%
Color true	213000		<5	<5	<5	
Color TAC	241310	3	4	4	3	16%
Color SW	10521320	<5	<5	5	<5	
Sp. Cond	111160	127	124	126	128	1%
NFR=TSS	81070	2	2	2	2	0%
FR=TDS	7H1032	76	84	78	78	4%
Turbidity	151140	0.3	0.3	0.3	0.4	15%
Hardness	107CALC		57.8	58.2	57.9	0%
HCO3 as CaCO3						
Phenol. Alk	1011211	<0.5	<0.5	<0.5	<0.5	
Total Alk.	1021210	54.1	53.7	53.7	53.8	0%
Chloride	11041330	0.6	0.6	0.7	0.6	8%
oride		<0.10	<0.10	<0.10	<0.10	
TOC	0103calc	<3	<3			
TIC	01240930	14	14			0%
TKN	0113136A	0.04	0.05	0.09	0.07	35%
Ammonia	11081351	<0.005	<0.005	0.010	<0.005	
NO3+NO2	11091350	0.09		0.10		7%
Phosphorus Ortho	11181380		<0.003	<0.003	<0.003	
Silica Reactive	11201381	4.0	4.0	4.0	4.0	0%
Sulfate	11211400	9.0	8.9	8.9	9.0	1%
Silver	Ag-T0041		<0.01	<0.01	<0.01	
All resin acids excep	xxxxP030	<0.0005	<0.0005			
Behenic acid						
Chlorodehydroabietic acid						
Dichl.deh.abietic Acid						
Isopimaric acid						
Levo Pimaric Acid						
Fatty acids except following		<0.0005	<0.0005			
Lauric acid	LAURP030	0.029	0.038			19%
Lignoceric acid	LIGNP030					
Myristic Acid	MYRIP030	0.010	0.011			7%
Oleic Acid			0.028			
Palmitric acid	PALMP030	0.015	0.021			24%
Palustric acid	PALUP030					
Stearic acid	STEAP030		0.012			
AOX	AOX-DM01	<0.01	<0.01			
Al	Al-T0041		0.06	0.04	0.06	22%
As hydride	As-T0181		<0.001	<0.001	<0.001	

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

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Field Replicates Report for CRIEMP March to

		Site	Date/Time	Date/Time	Form #
		200559	92/06/09:1125		10003290
			92/06/09:1210		3034516
			92/06/09:1145		3034517
			92/06/09:1245		3034518
		Result mg/L	Result mg/L	Result mg/L	Result mg/L
Parameter	Sparcode	1	2=Site A	3=Site B	4=Site C
B	B--T0041		0.038	0.073	0.081
Ba	Ba-T0041		0.017	0.017	0.02
Beryliium	Be-T0041		<0.001	<0.001	<0.001
Bismuth	Bi-T0041		<0.02	<0.02	<0.02
Ca	Ca-T0041		16.9	17.1	16.9
Cd	Cd-T0060		<0.0005	<0.0005	<0.0005
Co	Co-T0041		<0.003	<0.003	<0.003
Cr	Cr-T0041		0.003	0.003	0.007
Cu	Cu-T0041		0.013	0.002	0.003
Fe	Fe-T0041		0.072	0.056	0.082
Mercury	Hg-T0310		<0.00005	0.00013	
K ICP	K--T0041		0.7	<0.4	0.8
Mg	Mg-T0041		3.78	3.77	3.81
Mn	Mn-T0041		0.003	0.003	0.004
Mo	Mo-T0041		<0.004	<0.004	<0.004
Sodium	Na-T0041		1.08	1.20	1.14
Sodium	Na-D1331	1.2	1.2	1.2	1.2
Ni	Ni-T0041		<0.008	<0.008	<0.008
Pb	Pb-T0060		0.003	0.001	0.002
Phos T diss	P--D1390	0.003	<0.003	0.003	<0.003
Phos total	P--T0041				
Phos total	P--T139A	0.007	0.007	0.009	0.007
K	K--D1331	0.6	0.6	0.6	0.6
Antimony	Sb-T0041		<0.015	<0.015	<0.015
Sulfur	S--T0041		2.83	2.71	2.86
Selenium	Se-T0041		<0.03	<0.03	<0.03
Silicon	Si-T0041		2.05	2.21	2.08
Sr	Sr-T0041		0.107	0.109	0.107
Tin	Sn-T0041		<0.02	<0.02	<0.02
Tellurium	Te-T0041		<0.02	<0.02	<0.02
Thallium	Tl-T0041		<0.003	<0.003	<0.003
Titanium	Ti-T0041		<0.003	<0.003	<0.003
V	V--T0041		<0.003	<0.003	<0.003
Zn	Zn-T0041		0.009	0.007	0.010
Zirconium	Zr-T0041		<0.003	<0.003	<0.003
E. coli	01476013	3			
Enterococcus	01486014	1			
Coliform fecal	04502480				
Chlorate	pscppscp	<0.01	<0.01		
Chloroform					

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Field Replicates Report for CRIEMP March to Oct 1992.

		Site	Date/Time		Form #	
		Columbia R.	92/07/07 11:30		10003291	
		at Waneta	92/07/07 12:00		3034524	
		0200559	92/07/07 12:30		3034525	
			92/07/07 13:00		3034526	
Parameter	Sparcode	Result mg/L 1	Result mg/L 2=Site A	Result mg/L 3=Site B	Result mg/L 4=Site C	Relative SD limit<18% @ >5x mdc
Carbon total	C--T0910	13	15			10%
pH	41220		8.0	8	7.9	14%
Color true	213000		<5	<5	<5	
Color TAC	241310		2	2	3	25%
Color SW	10521320		5.00	6	<5	13%
Sp. Cond	111160		130	131	130	0%
NFR=TSS	81070		1	1	1	0%
FR=TDS	7H1032		82	82	84	1%
Turbidity	151140		0.4	0.5	0.5	12%
Hardness	107CALC		60.6	58.6	61.2	2%
HCO3 as CaCO3						
Phenol. Alk	1011211		<0.5	<0.5	<0.5	
Total Alk.	1021210		54.1	54.3	54.2	0%
Chloride	11041330		0.8	0.8	0.8	0%
luoride			0.11	0.10	0.11	5%
TOC	0103calc	<3				
TIC	01240930	13				
TKN	0113136A		0.09	0.07	0.09	14%
Ammonia	11081351		0.014	0.014	0.014	0%
NO3+NO2	11091350		0.06	0.07	0.06	9%
Phosphorus Ortho	11181380		0.003	0.004	0.005	25%
Silica Reactive	11201381		4.2	4.2	4.2	0%
Sulfate	11211400		9.3	9.2	9.3	1%
Silver	Ag-T0041		<0.01	<0.01	<0.01	
All resin acids excep	xxxxP030	<0.001	<0.0005			
Behenic acid						
Chlorodehydroabietic acid						
Dichl.deh.abietic Acid						
Isopimaric acid						
Levo Pimaric Acid			0.0005			
Fatty acids except following		<0.001				
Lauric acid	LAURP030					
Lignoceric acid	LIGNP030					
Myristic Acid	MYRIP030					
Oleic Acid						
Palmitric acid	PALMP030		0.003			
Palustric acid	PALUP030					
Stearic acid	STEAP030					
AOX	AOX-DM01	<0.01	<0.01			
Al	Al-T0041		0.04	0.04	0.04	0%
As hydride	As-T0181		<0.001	<0.001	<0.001	

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Field Replicates Report for CRIEMP March to Oct 1992.

		Site	Date/Time		Form #	
		Columbia R.	92/07/07 11:30		10003291	
		at Waneta	92/07/07 12:00		3034524	
		0200559	92/07/07 12:30		3034525	
			92/07/07 13:00		3034526	
Parameter	Sparcode	Result mg/L 1	Result mg/L 2=Site A	Result mg/L 3=Site B	Result mg/L 4=Site C	Relative SD limit<18% @ >5x mdc
B	B--T0041		0.019	0.027	0.02	17%
Ba	Ba-T0041		0.020	0.019	0.02	3%
Beryliium	Be-T0041		<0.001	<0.001	<0.001	
Bismuth	Bi-T0041		<0.02	<0.02	<0.02	
Ca	Ca-T0041		17.7	17.1	18	2%
Cd	Cd-T0060		<0.0005	<0.0005	<0.0005	
Co	Co-T0041		<0.003	<0.003	<0.003	
Cr	Cr-T0041		0.004	0.004	0.004	0%
Cu	Cu-T0041		0.005	0.004	0.003	25%
Fe	Fe-T0041		0.055	0.054	0.047	8%
Mercury	Hg-T0310		<0.00005	<0.00005		
K ICP	K--T0041		0.5	0.5	0.5	0%
Mg	Mg-T0041		3.98	3.85	4.01	2%
Mn	Mn-T0041		0.003	0.003	0.003	0%
Mo	Mo-T0041		<0.004	<0.004	<0.004	
Sodium	Na-T0041		1.24	1.22	1.26	2%
Sodium	Na-D1331		1.4	1.4	1.4	0%
Ni	Ni-T0041		0.009	<0.008		
Pb	Pb-T0060		0.005	0.007	0.006	17%
Phos T diss	P--D1390		<0.003	0.004	0.005	16%
Phos total	P--T0041					
Phos total	P--T139A		0.01	0.014	0.014	4%
K	K--D1331		0.6	0.6	0.6	0%
Antimony	Sb-T0041		<0.015	<0.015	<0.015	
Sulfur	S--T0041		3.01	2.93	3	2%
Selenium	Se-T0041		<0.03	<0.03	<0.03	
Silicon	Si-T0041		1.93	1.96	2.08	4%
Sr	Sr-T0041		0.104	0.100		3%
Tin	Sn-T0041		<0.02	<0.02	<0.02	
Tellurium	Te-T0041		<0.003	<0.003	<0.003	
Thallium	Tl-T0041		0.010	<0.003	0.005	47%
Titanium	Ti-T0041		<0.003	<0.003	<0.003	
V	V--T0041		<0.003	<0.003	<0.003	
Zn	Zn-T0041		0.011	0.013	0.011	10%
Zirconium	Zr-T0041		<0.003	<0.003	<0.003	
E. coli	01476013	1				
Enterococcus	01486014	1				
Coliform fecal	04502480					
Chlorate	pscppscp	<0.01				
Chloroform						

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

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Field Replicates Report for CRIEMP March to Oct 1992.

Site	Date/Time	Date/Time	Form #
200559	92/08/04:1145		10003292
	92/08/04:1215		3034523
	92/08/04:1245		3034522
	92/08/04:1330		3034521

Parameter	Sparcode	Result mg/L 1	Result mg/L 2=Site A	Result mg/L 3=Site B	Result mg/L 4=Site C	Relative SD limit<18% @ >5x mdc
Carbon total	C--T0910	13	13			0%
pH	41220		8.0	7.9	7.9	13%
Color true	213000		5	<5	5	0%
Color TAC	241310		5	4	4	13%
Color SW	10521320		<5	5	5	0%
Sp. Cond	111160		120	121	121	0%
NFR=TSS	81070		1	1	1	0%
FR=TDS	7H1032		76	76	74	2%
Turbidity	151140		0.3	0.3	0.2	22%
Hardness	107CALC		57.6	53.8	54.7	4%
HCO3 as CaCO3						
Phenol. Alk	1011211		<0.5	<0.5	<0.5	
Total Alk.	1021210		51.1	51.3	51.3	0%
Chloride	11041330		0.7	0.5	0.5	20%
:oride			<0.10	<0.10	<0.10	
,OC	0103calc	<3	<3			
TIC	01240930	11	11			0%
TKN	0113136A		0.09	0.07	0.14	36%
Ammonia	11081351		<0.005	0.012	0.009	20%
NO3+NO2	11091350		0.10	0.08	0.08	13%
Phosphorus Ortho	11181380		0.016	0.018	0.018	7%
Silica Reactive	11201381		3.6	3.6	3.6	0%
Sulfate	11211400		10.4	9.0	8.9	9%
Silver	Ag-T0041		<0.01	<0.01	<0.01	
All resin acids excep	xxxxP030	<0.0005	<0.0005			
Behenic acid						
Chlorodehydroabietic acid						
Dichl.deh.abietic Acid						
Isopimaric acid						
Levo Pimaric Acid						
Fatty acids except following		<0.0005	<0.0005			
Lauric acid	LAURP030					
Lignoceric acid	LIGNP030					
Myristic Acid	MYRIP030					
Oleic Acid						
Palmitric acid	PALMP030					
Palustric acid	PALUP030					
Stearic acid	STEAP030					
,OX	AOX-DM01	<0.01	<0.01			
Al	Al-T0041		0.04	0.04	0.05	13%
As hydride	As-T0181		<0.001	<0.001	<0.001	

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Field Replicates Report for CRIEMP March to Oct 1992.

Site	Date/Time	Date/Time	Form #
200559	92/08/04:1145		10003292
	92/08/04:1215		3034523
	92/08/04:1245		3034522
	92/08/04:1330		3034521

Parameter	Sparcode	Result mg/L 1	Result mg/L 2=Site A	Result mg/L 3=Site B	Result mg/L 4=Site C	Relative SD limit<18% @ >5x mdc
B	B--T0041		0.022	<0.008	<0.008	
Ba	Ba-T0041		0.017	0.016	0.016	4%
Beryliium	Be-T0041		<0.001	<0.001	<0.001	
Bismuth	Bi-T0041		<0.02	<0.02	<0.02	
Ca	Ca-T0041		17.1	15.9	16	4%
Cd	Cd-T0060		<0.0005	<0.0005	<0.0005	
Co	Co-T0041		<0.003	<0.003	<0.003	
Cr	Cr-T0041		<0.002	0.004	0.003	20%
Cu	Cu-T0041		0.002	0.002	0.001	35%
Fe	Fe-T0041		0.032	0.024	0.038	22%
Mercury	Hg-T0310		<0.0005	<0.0005		
K ICP	K--T0041		0.5	0.9	0.8	28%
Mg	Mg-T0041		3.62	3.42	3.46	3%
Mn	Mn-T0041		0.003	0.003	0.003	0%
Mo	Mo-T0041		<0.004	<0.004	<0.004	
Sodium	Na-T0041		1.10	0.95	0.99	8%
Sodium	Na-D1331		1.2	1.2	1.2	0%
Ni	Ni-T0041		<0.008	<0.008	<0.008	
Pb	Pb-T0060		0.002	<0.001	<0.001	
Phos T diss	P--D1390		0.016	0.019	0.018	9%
Phos total	P--T0041					
Phos total	P--T139A		0.031	0.031	0.030	2%
K	K--D1331		0.6	0.6	0.6	0%
Antimony	Sb-T0041		<0.015	<0.015	<0.015	
Sulfur	S--T0041		2.77	2.63	2.67	3%
Selenium	Se-T0041		<0.03	<0.03	<0.03	
Silicon	Si-T0041		1.73	1.56	1.67	5%
Sr	Sr-T0041		0.102	0.096	0.097	3%
Tin	Sn-T0041		<0.02	<0.02	<0.02	
Tellurium	Te-T0041		<0.02	<0.02	<0.02	
Thallium	Tl-T0041		<0.003	<0.003	<0.003	
Titanium	Ti-T0041		0.009	0.004	<0.003	54%
V	V--T0041		<0.003	<0.003	<0.003	
Zn	Zn-T0041		0.007	0.004	0.008	33%
Zirconium	Zr-T0041		<0.003	<0.003	<0.003	
E. coli	01476013	16	11			
Enterococcus	01486014	6	6			
Coliform fecal	04502480		12			
Chlorate	pscppscp	0.01	0.01			0%
Chloroform						

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Field Replicates Report for CRIEMP March to Oct 1992.

		Site	Date/Time	Form #	Form #	
		200559	92/08/31:1045		10003294	
			92/08/31:1115		3034512	
			92/08/31200		3034515	
			92/08/31:1230		3034513	
Parameter	Sparcode	Result mg/L 1	Result mg/L 2=Site A	Result mg/L 3=Site B	Result mg/L 4=Site C	Relative SD limit<18% @ >5x mdc
Carbon total	C--T0910	12	11			6%
pH	41220		7.9	8.0	7.9	13%
Color true	213000		<5	<5	<5	
Color TAC	241310		2.	2	2	0%
Color SW	10521320		<5	7	<5	
Sp. Cond	111160		119	120	121	1%
NFR=TSS	81070		2	200%	2	0%
FR=TDS	7H1032		76	70	80	7%
Turbidity	151140		0.6	0.5	0.5	11%
Hardness	107CALC		58.2	57.6	56.9	1%
HCO3 as CaCO3						
Phenol. Alk	1011211		<0.5	<0.5	<0.5	
Total Alk.	1021210		50.4	50.5	50.5	0%
Chloride	11041330		0.5	0.5	0.5	0%
'uoride			<0.10	0.10	0.10	0%
.OC	0103calc	<3	<3			
TIC	01240930	10	9			7%
TKN	0113136A		<0.04	<0.04	0.11	
Ammonia	11081351		0.024	0.017	0.017	21%
NO3+NO2	11091350		0.08	0.07	0.07	8%
Phosphorus Ortho	11181380		<0.003	<0.003	<0.003	
Silica Reactive	11201381		3.2	3.2	3.2	0%
Sulfate	11211400		9.5	9.9	9.7	2%
Silver	Ag-T0041		<0.01	<0.01	<0.01	
All resin acids excep	xxxxP030	<0.0005	<0.0005			
Behenic acid						
Chlorodehydroabietic acid						
Dichl.deh.abietic Acid						
Isopimaric acid						
Levo Pimaric Acid						
Fatty acids except following		<0.0005	<0.0005			
Lauric acid	LAURP030	0.0058				
Lignoceric acid	LIGNP030					
Myristic Acid	MYRIP030	0.0036	0.0010			
Oleic Acid						
Palmitric acid	PALMP030	0.0022				
Palustric acid	PALUP030					
Stearic acid	STEAP030					
,OX	AOX-DM01	0.01	<0.01			
Al	Al-T0041		<0.02	<0.02	<0.02	
As hydride	As-T0181		<0.001	<0.001	<0.001	

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Field Replicates Report for CRIEMP March to Oct 1992.

		Site	Date/Time	Form #	Form #	
		200559	92/08/31:1045		10003294	
			92/08/31:1115		3034512	
			92/08/31200		3034515	
			92/08/31:1230		3034513	
Parameter	Sparcode	Result mg/L 1	Result mg/L 2=Site A	Result mg/L 3=Site B	Result mg/L 4=Site C	Relative SD limit<18% @ >5x mdc
B	B--T0041		<0.008	0.070	<0.008	
Ba	Ba-T0041		0.018	0.016	0.016	7%
Beryliium	Be-T0041		<0.001	<0.001	<0.001	
Bismuth	Bi-T0041		<0.02	<0.02	<0.02	
Ca	Ca-T0041		17.4	17.2	17.0	1%
Cd	Cd-T0060		<0.0005	<0.0005	<0.0005	
Co	Co-T0041		<0.003	<0.003	<0.003	
Cr	Cr-T0041		<0.002	<0.002	<0.002	
Cu	Cu-T0041		0.003	0.001	0.002	50%
Fe	Fe-T0041		0.037	0.026	0.022	27%
Mercury	Hg-T0310		<0.00005	<0.00005		
K ICP	K--T0041		0.6	0.5	0.6	10%
Mg	Mg-T0041		3.59	3.56	3.51	1%
Mn	Mn-T0041		0.004	0.003	0.003	17%
Mo	Mo-T0041		<0.004	<0.004	<0.004	
Sodium	Na-T0041		1.10	1.16	1.04	5%
Sodium	Na-D1331		1.2	1.2	1.2	0%
Ni	Ni-T0041		<0.008	<0.008	<0.008	
Pb	Pb-T0060		0.002	0.001	0.002	35%
Phos T diss	P--D1390		<0.003	<0.003	<0.003	
Phos total	P--T0041					
Phos total	P--T139A		0.006	0.007	0.007	9%
K	K--D1331		0.6	0.6	0.6	0%
Antimony	Sb-T0041		<0.015	<0.015	<0.015	
Sulfur	S--T0041		3.05	2.97	2.98	1%
Selenium	Se-T0041		<0.03	<0.03	<0.03	
Silicon	Si-T0041		1.48	1.41	1.48	3%
Sr	Sr-T0041		0.099	0.098	0.097	1%
Tin	Sn-T0041		<0.02	<0.02	<0.02	
Tellurium	Te-T0041		<0.02	<0.02	<0.02	
Thallium	Tl-T0041		<0.003	<0.003	<0.003	
Titanium	Ti-T0041		<0.003	<0.003	<0.003	
V	V--T0041		<0.003	<0.003	<0.003	
Zn	Zn-T0041		0.016	0.007	0.008	48%
Zirconium	Zr-T0041		<0.003	<0.003	<0.003	
E. coli	01476013	<2	1			
Enterococcus	01486014	1	<2			
Coliform fecal	04502480		2			
Chlorate	pscppscp	<0.01	<0.01			
Chloroform						

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Field Replicates Report for CRIEMP March to Oct 1992.

			Date/Time		Form #	
			92/09/29:1100		10003002	
			92/09/29:1130		3034511	
			92/09/29:1200		3034510	
			92/09/29:1230		3034509	
Parameter	Sparcode	Result mg/L 1	Result mg/L 2=Site A	Result mg/L 3=Site B	Result mg/L 4=Site C	Relative SD limit<18% @ >5x mdc
Carbon total	C--T0910	14	13			5%
pH	41220		7.8	7.7	7.9	23%
Color true	213000		<5	<5	<5	
Color TAC	241310		2	2	2	0%
Color SW	10521320		<5	<5	<5	
Sp. Cond	111160		124	125	125	0%
NFR=TSS	81070		<4	<4	<4	
FR=TDS	7H1032		86	96	92	6%
Turbidity	151140		0.5	0.5	0.5	0%
Hardness	107CALC		69.9	67.0	70.5	3%
HCO3 as CaCO3			50.5	52.5	52.3	
Phenol. Alk	1011211		<0.5	<0.5	<0.5	
Total Alk.	1021210		50.5	52.5	52.3	2%
Chloride	11041330		0.8	0.8	0.8	0%
Fluoride			<0.10	<0.10	<0.10	
OC	0103calc	<3	<3			
TIC	01240930	14	13			5%
TKN	0113136A		<0.04	0.04	0.09	
Ammonia	11081351		0.005	<0.005	<0.005	
NO3+NO2	11091350		0.08	0.08	0.07	8%
Phosphorus Ortho	11181380		<0.003	0.003	0.003	
Silica Reactive	11201381		3.2	3.2	3.2	0%
Sulfate	11211400		9.8	10.0	10.1	2%
Silver	Ag-T0041		<0.01	<0.01	<0.01	
All resin acids excep	xxxxP030	<0.0005	<0.0005			
Behenic acid		0.0010				
Chlorodehydroabietic acid		0.8300				
Dichl.deh.abietic Acid		0.0010				
Isopimaric acid						
Levo Pimaric Acid						
Fatty acids except following		<0.0005	<0.0005			
Lauric acid	LAURP030	0.0009	0.0090			116%
Lignoceric acid	LIGNP030					
Myristic Acid	MYRIP030	0.0010	0.0030			71%
Oleic Acid		0.0010				
Palmitric acid	PALMP030	0.0024				
Palustric acid	PALUP030					
Stearic acid	STEAP030	0.0040				
\OX	AOX-DM01	0.01	<0.01			
Al	Al-T0041		<0.02	<0.02	<0.02	
As hydride	As-T0181		<0.001	<0.001	<0.001	

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Field Replicates Report for CRIEMP March to Oct 1992.

			Date/Time		Form #	
			92/09/29:1100		10003002	
			92/09/29:1130		3034511	
			92/09/29:1200		3034510	
			92/09/29:1230		3034509	
Parameter	Sparcode	Result mg/L 1	Result mg/L 2=Site A	Result mg/L 3=Site B	Result mg/L 4=Site C	Relative SD limit<18% @ >5x mdc
B	B--T0041		<0.008	<0.008	<0.008	
Ba	Ba-T0041		0.02	0.019	0.019	3%
Beryliium	Be-T0041		<0.001	<0.001	<0.001	
Bismuth	Bi-T0041		<0.02	<0.02	<0.02	
Ca	Ca-T0041		20.8	19.9	20.7	2%
Cd	Cd-T0060		<0.0005	<0.0005	<0.0005	
Co	Co-T0041		<0.003	<0.003	<0.003	
Cr	Cr-T0041		<0.002	<0.002	<0.002	
Cu	Cu-T0041		0.002	0.002	0.001	35%
Fe	Fe-T0041		0.027	0.025	0.022	10%
Mercury	Hg-T0310		<0.00005	<0.00005		
K ICP	K--T0041		0.8	0.8	0.7	8%
Mg	Mg-T0041		4.35	4.21	4.56	4%
Mn	Mn-T0041		0.003	0.004	0.010	67%
Mo	Mo-T0041		<0.004	<0.004	<0.004	
Sodium	Na-T0041		1.47	1.40	1.61	7%
Sodium	Na-D1331		1.3	1.3	1.3	0%
Ni	Ni-T0041		<0.008	<0.008	<0.008	
Pb	Pb-T0060		0.006	0.006	0.004	22%
Phos T diss	P--D1390		<0.003	0.003	0.004	
Phos total	P--T0041					
Phos total	P--T139A		0.008	0.010	0.009	11%
K	K--D1331		0.6	0.6	0.6	0%
Antimony	Sb-T0041		<0.015	<0.015	<0.015	
Sulfur	S--T0041		3.53	3.48	4.35	13%
Selenium	Se-T0041		<0.03	<0.03	<0.03	
Silicon	Si-T0041		1.61	1.51	1.62	4%
Sr	Sr-T0041		0.115	0.110	0.116	3%
Tin	Sn-T0041		<0.02	<0.02	<0.02	
Tellurium	Te-T0041		<0.02	<0.02	<0.02	
Thallium	Tl-T0041		<0.003	<0.003	<0.003	
Titanium	Ti-T0041		<0.003	<0.003	<0.003	
V	V--T0041		0.005	<0.003	0.003	
Zn	Zn-T0041		0.012	0.012	0.010	10%
Zirconium	Zr-T0041		<0.003	<0.003	<0.003	
E. coli	01476013	<2	2			
Enterococcus	01486014	<2	<2			
Coliform fecal	04502480		2			
Chlorate	pscppscp	<0.01	<0.01			
Chloroform						

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Field Replicates Report for CRIEMP March to Oct 1992.

		Site	Date/Time		Form #	
		200559	92/10/27:1115		10003004	
			92/10/27:1145		3034507	
			92/10/27:1200		3034506	
			92/10/27:1215		3034505	
Parameter	Sparcode	Result mg/L 1	Result mg/L 2=Site A	Result mg/L 3=Site B	Result mg/l 4=Site C	Relative SD limit<18% @ >5x mdc
Carbon total	C--T0910	15	15			0%
pH	41220		7.4	7.5	7.5	14%
Color true	213000		<5	<5	<5	
Color TAC	241310		3	3	3	0%
Color SW	10521320		7	6	7	9%
Sp. Cond	111160		135	135	135	0%
NFR=TSS	81070		<4	<4	<4	
FR=TDS	7H1032		78	82	77	3%
Turbidity	151140		0.3	0.4	0.3	17%
Hardness	107CALC		65.1	67.4	75.0	7%
HCO3 as CaCO3			56.6	56.5	56.4	0%
Phenol. Alk	1011211		<0.5	<0.5	<0.5	
Total Alk.	1021210		56.6	56.5	56.4	0%
Chloride	11041330		1.0	0.9	1.0	6%
⁻luoride			<0.10	<0.10	<0.10	
ɔC	0103calc	<3	<3			
TIC	01240930	15	15			0%
TKN	0113136A		<0.04	0.07	0.07	0%
Ammonia	11081351		0.02	0.024	0.024	10%
NO3+NO2	11091350		0.07	0.06	0.07	9%
Phosphorus Ortho	11181380		<0.003	<0.003	<0.003	
Silica Reactive	11201381		3.4	3.4	3.4	0%
Sulfate	11211400		10.8	12.0	12.7	8%
Silver	Ag-T0041		<0.01	<0.01	<0.01	
All resin acids excep	xxxxP030	<0.0005	<0.0005			
Behenic acid						
Chlorodehydroabietic acid						
Dichl.deh.abietic Acid						
Isopimaric acid						
Levo Pimaric Acid						
Fatty acids except following		<0.0005	<0.0005			
Lauric acid	LAURP030					
Lignoceric acid	LIGNP030					
Myristic Acid	MYRIP030		0.0030			
Oleic Acid						
Palmitric acid	PALMP030		0.0030			
Palustric acid	PALUP030					
Stearic acid	STEAP030					
OX	AOX-DM01	0.02	0.02			0%
Al	Al-T0041		<0.02	<0.02	0.07	
As hydride	As-T0181		<0.001	<0.001	<0.001	

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

Table I

Field Replicates Report for CRIEMP March to Oct 1992.

		Site	Date/Time		Form #	
		200559	92/10/27:1115		10003004	
			92/10/27:1145		3034507	
			92/10/27:1200		3034506	
			92/10/27:1215		3034505	
Parameter	Sparcode	Result mg/L 1	Result mg/L 2=Site A	Result mg/L 3=Site B	Result mg/L 4=Site C	Relative SD limit<18% @ >5x mdc
B	B--T0041		<0.008	0.017	0.019	8%
Ba	Ba-T0041		0.020	0.021	0.025	12%
Beryliium	Be-T0041		<0.001	<0.001	<0.001	
Bismuth	Bi-T0041		<0.02	<0.02	<0.02	
Ca	Ca-T0041		19.2	19.8	21.9	7%
Cd	Cd-T0060		<0.0005	<0.0005	<0.0005	
Co	Co-T0041		<0.003	<0.003	<0.003	
Cr	Cr-T0041		<0.002	<0.002	<0.002	
Cu	Cu-T0041		0.003	0.002	0.002	25%
Fe	Fe-T0041		0.018	0.018	0.016	7%
Mercury	Hg-T0310		<0.00005	<0.00005		
K ICP	K--T0041		0.6	0.8	0.6	17%
Mg	Mg-T0041		4.2	4.37	4.93	9%
Mn	Mn-T0041		0.003	0.003	0.003	0%
Mo	Mo-T0041		<0.04	<0.004	<0.004	
Sodium	Na-T0041		10.4	1.94	2.71	93%
Sodium	Na-D1331		1.7	1.8	1.7	3%
Ni	Ni-T0041		<0.008	<0.008	<0.008	
Pb	Pb-T0060		0.003	0.002	0.002	25%
Phos T diss	P--D1390		0.004	<0.003	0.004	0%
Phos total	P--T0041					
Phos total	P--T139A		0.010	0.007	0.008	18%
K	K--D1331		0.6	0.6	0.6	0%
Antimony	Sb-T0041		<0.015	<0.015	<0.015	
Sulfur	S--T0041		4.16	3.6	3.67	8%
Selenium	Se-T0041		<0.03	<0.03	<0.03	
Silicon	Si-T0041		1.56	1.73	2.04	14%
Sr	Sr-T0041		0.106	0.106	0.111	3%
Tin	Sn-T0041		<0.02	<0.02	<0.02	
Tellurium	Te-T0041		<0.02	<0.02	<0.02	
Thallium	Tl-T0041		<0.02	<0.02	<0.02	
Titanium	Ti-T0041		<0.003	<0.003	0.005	
V	V--T0041		<0.003	<0.003	<0.003	
Zn	Zn-T0041		0.005	<0.002	<0.002	
Zirconium	Zr-T0041		<0.003	<0.003	<0.003	
E. coli	01476013	<2	1			
Enterococcus	01486014	7	7			0%
Coliform fecal	04502480		4			
Chlorate	pscppscp	0.03	0.03			0%
Chloroform						

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

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Field Replicates Report for CRIEMP March to Oct 1992.

Comments

Acceptable difference =25% for laboratory duplicates when both concentrations are > 5x mdc.

Acceptance limits for field duplicates should be larger and set by the client.

Parameter	Sparcode	MDC	5x MDC	UNITS if not mg/L
Carbon total	C--T0910	3	15	
pH	41220	n/a		pH units compared as [H+]
Color true	213000	5	25	Colour units
Color TAC	241310	1	5	TAC units
Color SW	10521320	5	25	SW units
Sp. Cond	111160			uhmos/cm
NFR=TSS	81070	1	5	
FR=TDS	7H1032	1	5	
Turbidity	151140	0.1	0.5	NTU
Hardness	107CALC			
HCO3 as CaCO3				
Phenol. Alk	1011211	0.5	2.50	
Total Alk.	1021210	0.05	0.25	
Chloride	11041330	0.50	2.50	
⁻luoride		0.10	0.50	
ɔC	0103calc	3	15	
TIC	01240930	2	10.00	
TKN	0113136A	0.04	0.20	
Ammonia	11081351	0.005	0.03	
NO3+NO2	11091350	0.02	0.10	
Phosphorus Ortho	11181380	0.003	0.015	
Silica Reactive	11201381	0.50	2.50	
Sulfate	11211400	0.01	0.05	
Silver	Ag-T0041	0.01	0.05	
All resin acids excep	xxxxP030	0.001	0.005	
Behenic acid				
Chlorodehydroabietic acid				
Dichl.deh.abietic Acid				
Isopimaric acid				
Levo Pimaric Acid				
Fatty acids except following		0.001	0.005	
Lauric acid	LAURP030			
Lignoceric acid	LIGNP030			
Myristic Acid	MYRIP030			
Oleic Acid				
Palmitric acid	PALMP030			
Palustric acid	PALUP030			
Stearic acid	STEAP030			
ɔX	AOX-DM01	0.01	0.050	
Al	Al-T0041	0.02	0.100	
As hydride	As-T0181	0.001	0.005	

ZENON ENVIRONMENTAL LABORATORIES INC (BC)

Table I

Field Replicates Report for CRIEMP March to Oct 1992.

Comments

Acceptable difference =25% for laboratory duplicates when both concentrations are > 5x mdc.

Acceptance limits for field duplicates should be larger and set by the client.

Parameter	Sparcode	MDC	5x MDC	UNITS if not mg/L	
B	B--T0041	0.008	0.040		
Ba	Ba-T0041	0.001	0.005		MDCt = 0.001
Beryliium	Be-T0041	0.001	0.005		
Bismuth	Bi-T0041	0.020	0.100		
Ca	Ca-T0041	0.01	0.050		
Cd	Cd-T0060	0.0005	0.0025		
Co	Co-T0041	0.003	0.015		
Cr	Cr-T0041	0.002	0.010		
Cu	Cu-T0041	0.001	0.005		
Fe	Fe-T0041	0.003	0.0150		MDCt = 0.05
Mercury	Hg-T0310	0.00005	0.00025		
K ICP	K--T0041	0.4	2.00		
Mg	Mg-T0041	0.02	0.1000		
Mn	Mn-T0041	0.002	0.0100		
Mo	Mo-T0041	0.004	0.0200		
Sodium	Na-T0041	0.01	0.0500		
Sodium	Na-D1331	0.5	2.5000		
Ni	Ni-T0041	0.008	0.0400		
Pb	Pb-T0060	0.001	0.0050		
Phos T diss	P--D1390	0.003	0.0150		
Phos total	P--T0041	0.003	0.0150		
Phos total	P--T139A	0.003	0.0150		
K	K--D1331	0.1	0.5000		
Antimony	Sb-T0041	0.015	0.075		
Sulfur	S--T0041	0.03	0.150		
Selenium	Se-T0041	0.03	0.150		
Silicon	Si-T0041	0.03	0.150		MDCt = 0.8
Sr	Sr-T0041	0.001	0.0050		
Tin	Sn-T0041	0.02	0.100		
Tellurium	Te-T0041	0.001	0.005		
Thallium	Tl-T0041	0.02	0.100		
Titanium	Ti-T0041	0.003	0.015		
V	V--T0041	0.003	0.0150		
Zn	Zn-T0041	0.002	0.0100		
Zirconium	Zr-T0041	0.003	0.015		MDCt = 0.01
E. coli	01476013	1	5	CFU	
Enterococcus	01486014	1	5	CFU	
Coliform fecal	04502480	2	10	CFU	
Chlorate	pscppscp	0.1	0.50		
Chloroform					

Report For ENVIRONMENT CANADA
Inland Waters Directorate Pacific and Yukon
Region Conservation and Protection
CRIEMP Sediment and Biology Monitoring Samples

by

ZENON ENVIRONMENTAL LABORATORIES INC.
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1.0 INTRODUCTION

On July 27, 1992 a total of twenty eight biota and vegetation samples were received from Norecol Consultants. The samples were received in coolers in a frozen state and immediately transferred to a freezer for storage. The samples were contained in plastic bags and bottles with identifiable markings. Analysis of select samples began upon receipt of an analysis schedule from Annette Smith of Norecol.

On September 3, 1992 a total of fourteen sediment samples were received from Bruce Ott of Norecol Consultants. Samples were received in two coolers and packed with dry ice. All samples were received frozen and immediately transferred to a freezer pending receipt of an analysis schedule. Samples were contained in 1 litre clear glass containers fitted with teflon lined plastic lids. The containers were supplied by Zenon and had been certified as Level I containers by the supplier. Final confirmation of the sampling schedule was received September 11, 1992 and analysis started the following week.

Also included are results for samples delivered by Tom Tremblay of Environment Canada. These samples were reported as being from the American portion of the project. The samples were received on October 13, 1992 in a cooler and packed with ice. Samples were transferred to a storage fridge and stored at 4°C prior to and during analysis. Three soils were also received for wet and sieving prior to testing by Graham Van Aggelen of the BCMOE Aquatic Toxicology Lab.

The report herein describes the analytical protocols in Section 2, presents the analytical results Section 3 and details the QA/QC protocols in Section 4.

2.0 ANALYTICAL METHODOLOGY

2.1 Metals

Samples were homogenized, dried (soils are air dried while biology samples are freeze dried) and subjected to a nitric perchloric ($HNO_3/HClO_4$) digestion to solubilize the solid matter and remove most of the organics by oxidation and volatilization. The sample was then introduced into an Inductively Coupled Argon Plasma(ICAP) where the atomic emission signal corresponding to each excited element was measured and compared to those of external standards for quantification.

Arsenic and selenium were run by ICAP- hydride generation thus allowing for the improved detection limits. Samples were digested as above and then introduced into an automated system where mixing with concentrated acid (HCl), sodium borohydride ($NaBH_4$) and potassium iodide (KI) occurred. Arsenate and selanate species are converted to gaseous arsine and selenium hydride allowing for their separation from the aqueous solution. The hydrides are swept into the ICAP for excitation and subsequent quantification.

Mercury was analysed by first oxidizing organomercury compounds using a $H_2SO_4/KMnO_4/K_2S_2O_8$ digestion. After digestion excess permanganate was reduced with hydroxylamine hydrochloride followed by reduction with stannous chloride. Elemental mercury is then purged from the solution and swept into a UV monitor possessing a mercury lamp. The absorbance of mercury is measured at 253.7 nm and is measured against reference standards.

2.2 Extractable Organic Halides

The organic halogen content of sediment sample is measured after extraction of the organohalides into an appropriate organic solvent. A representative five gram sample of the solid is placed in a 15 mL centrifuge tube with 1 mL of deionized water and 5 mL of ethyl acetate and capped tightly with a teflon lined cap. The sample is shaken vigorously for one minute. Then the sample is sonicated in a sonic bath for 15 minutes. The suspension is allowed to settle for 10 minutes then the upper ethyl acetate layer is transferred to a clean 15 mL centrifuge tube with a disposable pipette. The tube is then capped and centrifuged at 1000 g for 5 minutes. The ethyl acetate layer is then transferred to a clean centrifuge tube for analysis.

The organic halogen content is measured using a Dohrmann Model MC 3. Twenty five uL of the extract is injected directly into the pyrolyses tube at a rate of 1 uL/second. A ten minute integration cycle is used to estimate the concentration. If readings exceed the working range the analysis is repeated using the diluted extract. Please note that the solid to solvent ratio was modified to lower the detection limit.

2.3 Total Kjeldahl Nitrogen

The dried and homogenized soil sample was digested in a hot block with a mixture of sulphuric acid, mercuric oxide and potassium sulphate. This converted the free ammonia and organic nitrogen compounds to ammonium bisulfate. The digestate was then analyzed for Kjeldahl nitrogen using an automated colourimetric method. An emerald green colour of the ammonium salicylate complex was formed by the reaction of ammonia, sodium salicylate, sodium nitroprusside and sodium hypochlorite in a buffered alkaline medium at a pH of 12.8-13.0. The ammonia salicylate complex was read at 660 nm. Detection limit for this method is 2.0 ug/g.

2.4 Acid Volatile Sulphides

Also referred to as acid-insoluble sulfides which were determined according to EPA SW846 Method 9030A. Sulfides were separated from the sediments by the addition of hydrochloric acid and vigorous stirring. Tin (II) was present to prevent the oxidation of sulphide to sulfur by metal ions or dissolved oxygen present in the system. The mixture was distilled at 100°C under a stream of nitrogen allowing for the collection of H_2S in gas scrubbing bottles containing zinc acetate. Precipitated zinc sulphide was redissolved with an excess known amount of iodine with the excess being titrated with sodium thiosulphate.

2.5 Total Organic Carbon (LECO Method)

An induction furnace and an oxygen atmosphere was used to combust the sample to CO and CO_2. A catalytic furnace then converts all the CO to CO_2. The resulting CO_2 together with oxygen displaces fluid in a burette before and after absorption in a KOH solution. The differnce in burette readings was proportional to the total carbon content. Another portion of the sample was ashed and treated as above with inorganic carbon being the final result. Total organic carbon was obtained from the difference of the two analyses.

2.6 Moisture

A homogeneous portion of the soil was dried to constant mass at 105°C. The loss in mass has been expressed as a percentage of the original sample and is defined as percent moisture.

2.7 Wet and Dry Sieving

Approximately 5 g of sample was dried overnight at 105°C then sieved through 100 mesh. Sample was submitted for Solid Phase Microtox testing.

The remainder of the sample was wet sieved through 50 mesh until 300 mL of the sample was collected or entire sample had been consumed. Samples were submitted for Hyallela Azteca testing.

3.0 ANALYTICAL RESULTS

The analytical data for the samples are presented in Appendix A-C.

Elevated levels of heavy metals were found in several samples throughout the study. Common metals found were cadmium, cobalt, chromium, lead, and zinc that are of concern from a bioconcentration or bioaccumulation perspective.

Detectable levels of extractable organic halides were observed more frequently in samples displaying acid volatile sulphide.

Please note that all results are dry weight basis except for the acid volatile sulphide which are treated as received (ie. results are reported as wet weight basis for this parameter).

4.0 QUALITY CONTROL / QUALITY ASSURANCE (QA/QC)

A complete QA/QC programme was employed by ZENON for this programme. ZENON participates in many internal and external studies that allows current methodologies to be continually evaluated and improved. Measures that were specifically used in this study are described below and results are summarized in Appendix D and E.

4.1 Method Blanks

A method blank is an analysis incorporating all aspects of the analysis, excluding the sample. Its value is to identify the presence of glassware, reagent or instrumentation induced contamination. In this study method blanks were processed with each group of samples. Please note that all samples are blank corrected.

4.2 Duplicate Data

Duplicate samples were carried through the analytical train as an indication of sample homogeneity. Duplicates for the Biota and Vegetation samples were quite good, however, much higher percent differences were observed for the sediments. Both duplicates processed for the sediments showed large differences for tin and zirconium while others such as chromium showed elevated differences on a individual basis. Samples were split and carried through the analytical procedure separately.

4.3 Spiked Samples

Samples were spiked for several of the parameters of interest and recoveries are based upon recovery of the spike once dilution correction has been applied. Overall recoveries were quite good for both types of samples. High recoveries were observed for aluminum and potassium in sample 18972, however, the spike was quite low when compared to sample concentration. Low recovery of the arsenic spike on sample 20278 is also due to relative amount of spike added when compared to level of arsenic in the sample.

4.4 Standard Reference Materials

Standard reference materials(SRM's) are actual samples available in different matrices that have been extensively analysed by several laboratories and have certified concentration values for the compounds analysed. The analysis of SRM's gives a measure of the accuracy of the method when applied to that matrix. Poor recoveries are generally observed for some metals, such as chromium and potassium, in sediments since the acid digestion does not completely decompose the matrix.

APPENDIX A

ANALYTICAL RESULTS FOR BIOLOGY SAMPLES

ANALYTICAL REPORT
Form 03035797

ZENON

Parameter	MDC	Unit	Zenon ID : 92018963	92018964	92018965
Moisture	0.1	%(W/W)	89.2	87.0	87.4
Silver	1	ug/g	< 1	< 1	< 1
Aluminum	2	ug/g	183	429	388
Arsenic	0.2	ug/g	2.8	0.9	2.8
Barium	0.1	ug/g	1030	669	859
Beryllium	0.1	ug/g	0.1	< 0.1	< 0.1
Bismuth	2	ug/g	< 2	< 2	< 2
Calcium	1	ug/g	33100	29400	44700
Cadmium	0.1	ug/g	3.6	1.1	13.3
Cobalt	0.3	ug/g	1.1	1.1	1.0
Chromium	0.2	ug/g	4.5	13.8	6.3
Copper	0.1	ug/g	6.1	14.8	64.2
Iron	0.3	ug/g	2610	3760	4590
Mercury	0.05	ug/g	< 0.05	< 0.05	0.08
Potassium	40	ug/g	1120	1280	989
Magnesium	2	ug/g	1190	1250	1360
Manganese	0.2	ug/g	4770	4780	5330
Molybdenum	0.4	ug/g	0.9	< 0.4	0.8
Sodium	1	ug/g	2710	2090	2150
Nickel	0.8	ug/g	1.0	3.0	1.6
Phosphorus	4	ug/g	27800	24900	30900
Lead	2	ug/g	4	2	251
Sulphur	3	ug/g	6560	6480	6070
Antimony	1.5	ug/g	< 1.5	< 1.5	< 1.5
Selenium	0.5	ug/g	2.7	2.2	2.8
Tin	2	ug/g	< 2	< 2	< 2
Strontium	0.1	ug/g	138	250	229
Tellurium	2	ug/g	< 2	< 2	< 2
Titanium	0.3	ug/g	6.8	21.7	19.5
Thallium	0.3	ug/g	< 0.3	< 0.3	< 0.3
Vanadium	0.3	ug/g	< 0.3	0.5	0.6
Zinc	0.2	ug/g	214	256	962
Zirconium	0.3	ug/g	1.8	1.6	1.9
		Sample State :	Biota	Biota	Biota
		Sampled on :	92/07/17 00:00	92/07/18 00:00	92/07/14 00:00

Sample 92018963 comment : CLAMS-KOOTENAY RIVER GLADE : SAMPLED BY NORECOL
Sample 92018964 comment : CLAMS-CELGAR PERIPHYTON STN : SAMPLED BY NORECOL
Sample 92018965 comment : CLAMS-WANETA COMPOSITE : SAMPLED BY NORECOL

Project ID: CRIEMP BIOTA STUDY

ALL RESULTS ARE DRY WEIGHT BASIS

ANALYTICAL REPORT
Form 03035798

ZENON

Parameter	MDC	Unit	Zenon ID : 92018972	92018973
Moisture	0.1	%(W/W)	84.7	87.0
Silver	1	ug/g	< 1	< 1
Aluminum	2	ug/g	417	543
Arsenic	0.2	ug/g	1.0	0.2
Barium	0.1	ug/g	110	45.7
Beryllium	0.1	ug/g	< 0.1	< 0.1
Bismuth	2	ug/g	< 2	< 2
Calcium	1	ug/g	84700	24000
Cadmium	0.1	ug/g	6.3	1.1
Cobalt	0.3	ug/g	1.4	0.4
Chromium	0.2	ug/g	1.8	1.8
Copper	0.1	ug/g	27.6	6.8
Iron	0.3	ug/g	679	764
Mercury	0.05	ug/g	0.11	< 0.05
Potassium	40	ug/g	12000	16900
Magnesium	2	ug/g	2290	2230
Manganese	0.2	ug/g	381	78.3
Molybdenum	0.4	ug/g	0.9	< 0.4
Sodium	1	ug/g	583	424
Nickel	0.8	ug/g	1.9	4.9
Phosphorus	4	ug/g	1610	1210
Lead	2	ug/g	38	3
Sulphur	3	ug/g	1850	2530
Antimony	1.5	ug/g	2.0	< 1.5
Selenium	0.5	ug/g	< 0.5	< 0.5
Tin	2	ug/g	< 2	< 2
Strontium	0.1	ug/g	241	111
Tellurium	2	ug/g	< 2	< 2
Titanium	0.3	ug/g	25.0	56.7
Thallium	0.3	ug/g	6.8	< 0.3
Vanadium	0.3	ug/g	1.1	1.3
Zinc	0.2	ug/g	218	32.5
Zirconium	0.3	ug/g	0.4	< 0.3
		Sample State :	Biota	Biota
		Sampled on :	92/07/14 00:00	92/07/18 00:00

Sample 92018972 comment : MACROPHYTES;WANETA : SAMPLED BY NORECOL
Sample 92018973 comment : MACROPHYTES;CELGAR PERIPHYTON STN : SAMPLED BY NORECOL

Project ID: CRIEMP BIOTA STUDY ALL RESULTS ARE DRY WEIGHT BASIS

ANALYTICAL REPORT
Form 03035799

ZENON

Parameter	MDC	Unit	Zenon ID : 92018966	92018967	92018968	92018969	92018970	92018971
Moisture	0.1	%(W/W)	72.6	72.6	70.4	70.0	70.3	71.5
Silver	1	ug/g	< 1	< 1	< 1	< 1	< 1	< 1
Aluminum	2	ug/g	17	12	18	11	12	16
Arsenic	0.2	ug/g	3.2	2.4	2.1	1.7	2.2	2.1
Barium	0.1	ug/g	5.2	3.3	2.7	1.9	2.3	4.8
Beryllium	0.1	ug/g	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Bismuth	2	ug/g	< 2	< 2	< 2	< 2	< 2	< 2
Calcium	1	ug/g	836	692	1000	1020	1230	922
Cadmium	0.1	ug/g	0.30	0.31	0.34	0.65	0.73	0.38
Cobalt	0.3	ug/g	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Chromium	0.2	ug/g	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Copper	0.1	ug/g	25.6	21.2	20.7	33.6	40.9	27.7
Iron	0.3	ug/g	117	88.0	102	103	123	124
Mercury	0.05	ug/g	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Potassium	40	ug/g	7230	5750	6110	6510	7400	7310
Magnesium	2	ug/g	752	642	705	810	983	848
Manganese	0.2	ug/g	22.2	13.2	13.4	11.7	14.6	19.4
Molybdenum	0.4	ug/g	1.3	1.0	1.0	1.9	2.0	1.2
Sodium	1	ug/g	2390	1950	2050	2260	2620	2520
Nickel	0.8	ug/g	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
Phosphorus	4	ug/g	7450	6160	7180	8150	9340	8000
Lead	2	ug/g	5	4	6	20	25	6
Sulphur	3	ug/g	6140	4920	5590	5940	6370	5940
Antimony	1.5	ug/g	< 1.5	< 1.5	2.3	2.9	3.4	< 1.5
Selenium	0.5	ug/g	2.7	2.6	1.8	1.3	1.5	2.6
Tin	2	ug/g	< 2	< 2	< 2	2	3	2
Strontium	0.1	ug/g	4.5	3.7	6.5	5.0	6.0	4.8
Tellurium	2	ug/g	< 2	< 2	< 2	< 2	< 2	< 2
Titanium	0.3	ug/g	1.1	0.8	1.2	0.7	0.7	0.9
Thallium	0.3	ug/g	< 0.3	0.3	< 0.3	0.3	< 0.3	1.2
Vanadium	0.3	ug/g	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	0.3
Zinc	0.2	ug/g	135	105	136	181	217	128
Zirconium	0.3	ug/g	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
		Sample State :	Biota	Biota	Biota	Biota	Biota	Biota
		Sampled on :	92/07/16 00:00	92/07/16 00:00	92/07/17 00:00	92/07/15 00:00	92/07/15 00:00	92/07/19 00:00

Sample 92018966 comment : CADDIS FLIES;KOOTENAY RIVER GLADE GLADE : SAMPLED BY ENV CANADA
Sample 92018967 comment : CADDIS FLIES;KOOTENAY RIVER GLADE GLADE : SAMPLED BY NORECOL
Sample 92018968 comment : CADDIS FLIES;CELGAR : SAMPLED BY NORECOL
Sample 92018969 comment : CADDIS FLIES;WANETA : SAMPLED BY ENV CANADA
Sample 92018970 comment : CADDIS FLIES;WANETA : SAMPLED BY NORECOL
Sample 92018971 comment : CADDIS FLIES GROHMAN NARROWS : SAMPLED BY NORECOL

Project ID: CRIEMP BIOTA STUDY ALL RESULTS ARE DRY WEIGHT BASIS

APPENDIX B

ANALYTICAL RESULTS FOR SEDIMENT SAMPLES

ANALYTICAL REPORT
Form 03035782

ZENON

Parameter	MDC	Unit	Zenon ID : 92021065	92021066	92021067	92021068	92021069
Carbon Total	500	ug/g	26800	6800	5600	2900	7700
Moisture	0.1	%(W/W)	71.8	31.0	29.3	27.0	40.5
Sulfide Total		None	— (1)	— (2)	— (3)	— (4)	— (5)
Carbon Total Organic	500	ug/g	26000	5920	4670	1970	6000
Carbon Tot Inorganic	500	ug/g	825	880	930	930	1700
Nitrogen Kjel.Tot(N)	30	ug/g	2130	346	284	140	< 30
Silver	1	ug/g	1	< 1	< 1	17	< 1
Aluminum	2	ug/g	19600	7850	7270	11300	7140
Arsenic	0.2	ug/g	11	2.2	2.0	55	1.3
Barium	0.1	ug/g	162	68.2	64.8	1540	78.1
Beryllium	0.1	ug/g	0.9	0.4	0.4	0.6	0.3
Bismuth	2	ug/g	< 2	< 2	< 2	15	< 2
Calcium	1	ug/g	7030	5460	5730	33000	5670
Cadmium	0.1	ug/g	4.5	0.73	0.48	6.0	0.34
Cobalt	0.3	ug/g	8.5	4.8	4.6	32.9	4.4
Chromium	0.2	ug/g	28.6	25.1	22.1	55.9	43.9
Copper	0.1	ug/g	28.1	10.3	8.3	2520	27.0
Iron	0.3	ug/g	21300	15800	14900	86700	12500
Mercury	0.05	ug/g	0.06	< 0.05	< 0.05	0.49	0.08
Potassium	40	ug/g	4250	1750	1610	2050	1670
Magnesium	2	ug/g	7230	4230	3960	3910	3770
Manganese	0.2	ug/g	316	201	200	1720	203
Molybdenum	0.4	ug/g	< 0.4	< 0.4	< 0.4	13.1	< 0.4
Sodium	1	ug/g	424	299	300	1280	364
Nickel	0.8	ug/g	19.6	14.2	11.4	24.3	13.8
Phosphorus	4	ug/g	1160	1040	1220	2430	1000
Lead	2	ug/g	176	30	15	546	12
Sulphur	3	ug/g	2740	438	336	3030	352
Antimony	1.5	ug/g	1.6	< 1.5	< 1.5	8.9	< 1.5
Selenium	1	ug/g	< 1	< 1	< 1	< 1	< 1
Tin	2	ug/g	4	< 2	3	5	3
Strontium	0.1	ug/g	54.8	47.6	46.8	170	54.5
Tellurium	2	ug/g	< 2	< 2	< 2	< 2	< 2
Titanium	0.3	ug/g	1190	1060	1080	380	1010
		Sample State :	Soil	Soil	Soil	Soil	Soil
		Sampled on :	92/09/03 00:00	92/09/02 00:00	92/09/02 16:15	92/09/02 11:30	92/09/01 00:00

Sample 92021065 comment : U/S NELSON - KOOTENAY LAKE - WEST ARM : SAMPLED BT ENV. CANADA
Sample 92021066 comment : III-1 U/S CHINA CREEK : SAMPLED BY NORECOL
Sample 92021067 comment : III-3 LOWER BIRCH BANK : SAMPLED BY NORECOL
Sample 92021068 comment : IV-2 D/S BEAVER CREEK : SAMPLED BY NORECOL
Sample 92021069 comment : II-3 ROBSON NEC : SAMPLED BY NORECOL

Project ID: CRIEMP SEDIMENT STUDY ALL RESULTS ARE DRY WEIGHT BASIS

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ANALYTICAL REPORT
Form 03035782

ZENON

Parameter	MDC	Unit	Zenon ID : 92021065	92021066	92021067	92021068	92021069
Thallium	0.3	ug/g	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Vanadium	0.3	ug/g	34.2	33.9	32.8	50.4	28.2
Zinc	0.2	ug/g	539	103	90.2	6520	96.8
Zirconium	0.3	ug/g	6.8	2.2	1.3	11.9	2.4
Extractbl Org Halide	2.5	ug/g	4.1	6.2	< 2.5	< 2.5	2.7
		Sample State :	Soil	Soil	Soil	Soil	Soil
		Sampled on :	92/09/03 00:00	92/09/02 00:00	92/09/02 16:15	92/09/02 11:30	92/09/01 00:00

Sample 92021065 comment : U/S NELSON - KOOTENAY LAKE - WEST ARM : SAMPLED BT ENV. CANADA
Sample 92021066 comment : III-1 U/S CHINA CREEK : SAMPLED BY NORECOL
Sample 92021067 comment : III-3 LOWER BIRCH BANK : SAMPLED BY NORECOL
Sample 92021068 comment : IV-2 D/S BEAVER CREEK : SAMPLED BY NORECOL
Sample 92021069 comment : II-3 ROBSON NEC : SAMPLED BY NORECOL

Project ID: CRIEMP SEDIMENT STUDY ALL RESULTS ARE DRY WEIGHT BASIS

Result comments and/or text results :

(1) Text results for sample 92021065 sparcode 0125CLSP follow :

60. ug/g ACID-SOLUBLE SULFIDE; WET WEIGHT BASIS.

(2) Text results for sample 92021066 sparcode 0125CLSP follow :

15. ug/g ACID-SOLUBLE SULFIDE; WET WEIGHT BASIS.

(3) Text results for sample 92021067 sparcode 0125CLSP follow :

12. ug/g ACID-SOLUBLE SULFIDE; WET WEIGHT BASIS.

(4) Text results for sample 92021068 sparcode 0125CLSP follow :

21. ug/g ACID-SOLUBLE SULFIDE; WET WEIGHT BASIS.

(5) Text results for sample 92021069 sparcode 0125CLSP follow :

9. ug/g ACID-SOLUBLE SULFIDE; WET WEIGHT BASIS.

ANALYTICAL REPORT
Form 03035785

ZENON

Parameter	MDC	Unit	Zenon ID : 92020281	92020282	92020283	92020284	92020285	92020286
Carbon Total	500	ug/g	23500	17300	25700	25000	12100	—
Moisture	0.1	%(W/W)	67.4	67.3	65.8	62.3	49.3	—
Sulfide Total		None	— (1)	— (2)	— (3)	— (4)	— (5)	—
Carbon Total Organic	500	ug/g	22300	15800	23800	23500	10900	—
Carbon Tot Inorganic	500	ug/g	1200	1500	1900	1500	1200	—
Nitrogen Kjel.Tot(N)	30	ug/g	1320	1260	1230	1360	444	—
Silver	1	ug/g	< 1	< 1	< 1	< 1	< 1	—
Aluminum	2	ug/g	35500	37800	40800	36900	8900	—
Arsenic	0.2	ug/g	8.7	8.8	11	11	1.6	—
Barium	0.1	ug/g	366	381	407	376	91.0	—
Beryllium	0.1	ug/g	1.4	1.5	1.5	1.4	0.4	—
Bismuth	2	ug/g	< 2	< 2	< 2	< 2	< 2	—
Calcium	1	ug/g	7380	7750	7520	7310	5610	—
Cadmium	0.1	ug/g	0.93	1.2	1.3	1.0	0.28	—
Cobalt	0.3	ug/g	16.1	17.4	18.3	18.4	6.0	—
Chromium	0.2	ug/g	23.0	30.3	30.8	49.6	42.2	—
Copper	0.1	ug/g	48.5	48.9	52.4	52.3	11.3	—
Iron	0.3	ug/g	39600	43100	46600	45900	14300	—
Mercury	0.05	ug/g	0.06	0.05	0.06	0.08	< 0.05	—
Potassium	40	ug/g	11000	10600	12000	10200	2170	—
Magnesium	2	ug/g	10600	11500	11700	11400	4980	—
Manganese	0.2	ug/g	675	744	902	885	214	—
Molybdenum	0.4	ug/g	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	—
Sodium	1	ug/g	1100	1110	1190	970	377	—
Nickel	0.8	ug/g	46.0	50.1	53.0	53.2	18.8	—
Phosphorus	4	ug/g	1520	1630	1440	1440	1010	—
Lead	2	ug/g	70	66	80	81	8	—
Sulphur	3	µg/g	389	386	424	420	763	—
Antimony	1.5	ug/g	< 1.5	1.8	1.6	< 1.5	< 1.5	—
Selenium	1	ug/g	< 1	< 1	< 1	< 1	< 1	—
Tin	2	ug/g	3	4	5	14	2	—
Strontium	0.1	ug/g	87.0	92.3	92.6	85.8	59.0	—
Tellurium	2	ug/g	< 2	< 2	< 2	< 2	< 2	—
		Sample State :	Soil	Soil	Soil	Soil	Soil	Soil
		Sampled on :	92/09/01 00:00	92/09/01 00:00	92/09/01 00:00	92/09/01 00:00	92/09/01 00:00	92/09/01 00:00

Sample 92020281 comment : I-1 ARROW L. SEDIMENT : SAMPLED BY NORECOL
Sample 92020282 comment : I-1 ARROW L. SEDIMENT : SAMPLED BY NORECOL
Sample 92020283 comment : I-1A ARROW L. SEDIMENT : SAMPLED BY ENV. CANADA
Sample 92020284 comment : I-1B ARROW L. SEDIMENT : SAMPLED BY ENV. CANADA
Sample 92020285 comment : II-2 COLUMBIA - D/S CELGAR : SAMPLED BY NORECOL
Sample 92020286 comment : II-3 COLUMBIA - ROBSON : SAMPLED BY NORECOL

Project ID: CRIEMP SEDIMENT STUDY ALL RESULTS ARE DRY WEIGHT BASIS

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ANALYTICAL REPORT
Form 03035785

Parameter	MDC	Unit	Zenon ID : 92020281	92020282	92020283	92020284	92020285	92020286
Titanium	0.3	ug/g	2050	2160	2010	1820	1270	---
Thallium	0.3	ug/g	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	---
Vanadium	0.3	ug/g	62.0	66.1	63.9	60.3	31.5	---
Zinc	0.2	ug/g	155	145	161	161	57.9	---
Zirconium	0.3	ug/g	4.3	5.5	5.8	8.4	1.6	---
Extractbl Org Halide	2.5	ug/g	< 2.5	< 2.5	< 2.5	< 2.5	< 2.5	---
		Sample State :	Soil	Soil	Soil	Soil	Soil	Soil
		Sampled on :	92/09/01 00:00	92/09/01 00:00	92/09/01 00:00	92/09/01 00:00	92/09/01 00:00	92/09/01 00:00

Sample 92020281 comment : I-1 ARROW L. SEDIMENT : SAMPLED BY NORECOL
Sample 92020282 comment : I-1 ARROW L. SEDIMENT : SAMPLED BY NORECOL
Sample 92020283 comment : I-1A ARROW L. SEDIMENT : SAMPLED BY ENV. CANADA
Sample 92020284 comment : I-1B ARROW L. SEDIMENT : SAMPLED BY ENV. CANADA
Sample 92020285 comment : II-2 COLUMBIA - D/S CELGAR : SAMPLED BY NORECOL
Sample 92020286 comment : II-3 COLUMBIA - ROBSON : SAMPLED BY NORECOL

Project ID: CRIEMP SEDIMENT STUDY ALL RESULTS ARE DRY WEIGHT BASIS

Result comments and/or text results :

(1) Text results for sample 92020281 sparcode 0125CLSP follow :

<6. ug/g ACID-SOLUBLE SULFIDE; WET WEIGHT BASIS.

(2) Text results for sample 92020282 sparcode 0125CLSP follow :

<6. ug/g ACID-SOLUBLE SULFIDE; WET WEIGHT BASIS.

(3) Text results for sample 92020283 sparcode 0125CLSP follow :

<6. ug/g ACID-SOLUBLE SULFIDE; WET WEIGHT BASIS.

(4) Text results for sample 92020284 sparcode 0125CLSP follow :

<6. ug/g ACID-SOLUBLE SULFIDE; WET WEIGHT BASIS.

(5) Text results for sample 92020285 sparcode 0125CLSP follow :

9 ug/g ACID-SOLUBLE SULFIDE; WET WEIGHT BASIS.

ANALYTICAL REPORT
Form 03035783

ZENON

Parameter	MDC	Unit	Zenon ID : 92020287	92020288
Carbon Total	500	ug/g	15300	13700
Moisture	0.1	%(W/W)	54.0	54.7
Sulfide Total		None	— (1)	— (2)
Carbon Total Organic	500	ug/g	13700	12500
Carbon Tot Inorganic	500	ug/g	1600	1200
Nitrogen Kjel.Tot(N)	30	ug/g	1350	439
Silver	1	ug/g	4	4
Aluminum	2	ug/g	13400	13800
Arsenic	0.2	ug/g	18	18
Barium	0.1	ug/g	633	609
Beryllium	0.1	ug/g	0.7	0.7
Bismuth	2	ug/g	< 2	< 2
Calcium	1	ug/g	14000	13800
Cadmium	0.1	ug/g	9.8	10.7
Cobalt	0.3	ug/g	9.0	9.2
Chromium	0.2	ug/g	53.1	56.3
Copper	0.1	ug/g	471	486
Iron	0.3	ug/g	32600	32900
Mercury	0.05	ug/g	1.39	1.65
Potassium	40	ug/g	2950	3040
Magnesium	2	ug/g	5370	5480
Manganese	0.2	ug/g	397	404
Molybdenum	0.4	ug/g	2.0	1.9
Sodium	1	ug/g	566	565
Nickel	0.8	ug/g	18.9	19.4
Phosphorus	4	ug/g	1460	1330
Lead	2	ug/g	532	566
Sulphur	3	ug/g	3350	3160
Antimony	1.5	ug/g	2.6	2.8
Selenium	1	ug/g	1	1
Tin	2	ug/g	5	< 2
Strontium	0.1	ug/g	85.3	86.6
Tellurium	2	ug/g	< 2	< 2
Titanium	0.3	ug/g	847	685
Thallium	0.3	ug/g	< 0.3	< 0.3
Vanadium	0.3	ug/g	45.9	46.3
Zinc	0.2	ug/g	1990	2080
Zirconium	0.3	ug/g	6.1	6.1
		Sample State :	Soil	Soil
		Sampled on :	92/09/02 00:00	92/09/02 00:00

Sample 92020287 comment : IV-3 COLUMBIA - COMINCO GRAVEL PIT : SAMPLED BY NORECOL
Sample 92020288 comment : IV-3 COLUMBIA - COMINCO GRAVEL PIT : SAMPLED BY NORECOL

Project ID: CRIEMP SEDIMENT STUDY ALL RESULTS ARE DRY WEIGHT BASIS

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ANALYTICAL REPORT
Form 03035783

		Zenon ID :	92020287	92020288
Parameter	**MDC**	**Unit**		
Extractbl Org Halide	2.5	ug/g	< 2.5	3.9
		Sample State :	Soil	Soil
		Sampled on :	92/09/02 00:00	92/09/02 00:00

Sample 92020287 comment : IV-3 COLUMBIA - COMINCO GRAVEL PIT : SAMPLED BY NORECOL
Sample 92020288 comment : IV-3 COLUMBIA - COMINCO GRAVEL PIT : SAMPLED BY NORECOL

Project ID: CRIEMP SEDIMENT STUDY ALL RESULTS ARE DRY WEIGHT BASIS

Result comments and/or text results :

(1) Text results for sample 92020287 sparcode 0125CLSP follow :

```
60. ug/g  ACID-SOLUBLE SULFIDE; WET WEIGHT BASIS.
```

(2) Text results for sample 92020288 sparcode 0125CLSP follow :

```
110 ug/g  ACID-SOLUBLE SULFIDE; WET WEIGHT BASIS.
```

ANALYTICAL REPORT
Form 03035784

Parameter	MDC	Unit	Zenon ID : 92020278	92020280
Carbon Total	500	ug/g	16900	15200
Moisture	0.1	%(W/W)	40.2	55.4
Sulfide Total		None	— (1)	— (2)
Carbon Total Organic	500	ug/g	15700	13900
Carbon Tot Inorganic	500	ug/g	1200	1300
Nitrogen Kjel.Tot(N)	30	ug/g	684	542
Silver	1	ug/g	2	4
Aluminum	2	ug/g	18400	13100
Arsenic	0.2	ug/g	26	18
Barium	0.1	ug/g	377	611
Beryllium	0.1	ug/g	0.6	0.7
Bismuth	2	ug/g	< 2	< 2
Calcium	1	ug/g	11000	13600
Cadmium	0.1	ug/g	7.1	9.0
Cobalt	0.3	ug/g	10.8	8.7
Chromium	0.2	ug/g	41.9	45.8
Copper	0.1	ug/g	209	442
Iron	0.3	ug/g	29100	31200
Mercury	0.05	ug/g	0.68	1.39
Potassium	40	ug/g	2660	2880
Magnesium	2	ug/g	7710	5180
Manganese	0.2	ug/g	402	386
Molybdenum	0.4	ug/g	1.2	1.9
Sodium	1	ug/g	574	565
Nickel	0.8	ug/g	32.3	18.1
Phosphorus	4	ug/g	1880	1360
Lead	2	ug/g	576	508
Sulphur	3	ug/g	2440	3210
Antimony	1.5	ug/g	3.0	1.9
Selenium	1	ug/g	1	< 1
Tin	2	ug/g	4	4
Strontium	0.1	ug/g	95.1	83.0
Tellurium	2	ug/g	< 2	< 2
Titanium	0.3	ug/g	1500	715
Thallium	0.3	ug/g	< 0.3	1.4
Vanadium	0.3	ug/g	52.9	45.4
Zinc	0.2	ug/g	1130	1900
Zirconium	0.3	ug/g	7.6	4.8
		Sample State :	Soil	Soil
		Sampled on :	92/09/02 00:00	92/09/02 00:00

Sample 92020278 comment : IV-1 COLUMBIA - D/S COMINCO : SAMPLED BY NORECOL
Sample 92020280 comment : IV-3 COLUMBIA - COMINCO GRAVEL PIT : SAMPLED BY NORECOL

Project ID: CRIEMP SEDIMENT STUDY ALL RESULTS ARE DRY WEIGHT BASIS

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ANALYTICAL REPORT
Form 03035784

		Zenon ID :	92020278	92020280
Parameter	**MDC**	**Unit**		
Extractbl Org Halide	2.5	ug/g	2.6	< 2.5
		Sample State :	Soil	Soil
		Sampled on :	92/09/02 00:00	92/09/02 00:00

Sample 92020278 comment : IV-1 COLUMBIA - D/S COMINCO : SAMPLED BY NORECOL
Sample 92020280 comment : IV-3 COLUMBIA - COMINCO GRAVEL PIT : SAMPLED BY NORECOL

Project ID: CRIEMP SEDIMENT STUDY ALL RESULTS ARE DRY WEIGHT BASIS

Result comments and/or text results :

(1) Text results for sample 92020278 sparcode 0125CLSP follow :

70. ug/g ACID-SOLUBLE SULFIDE; WET WEIGHT BASIS.

(2) Text results for sample 92020280 sparcode 0125CLSP follow :

110 ug/g ACID-SOLUBLE SULFIDE; WET WEIGHT BASIS.

APPENDIX C

ANALYTICAL RESULTS FOR SPLIT SAMPLES FROM AMERICAN STUDY

CRIEMP Sediment Monitoring Programme - American Split Samples

		CLIENT ID:	Auxil Gage 2A	3A Goodeve Crk	Five Mile Crk	Onion Crk B TE Split	Colville R. Beach
		ZENON ID:	92024194	92024195	92024196	92024197	92024198
Parameter	**MDC**	**Units**					
Moisture	0.1	%(w/w)	21	23.7	29.9	43.4	7
Carbon Total	500	ug/g	—	—	—	—	—
Carbon Total Inorganic	500	ug/g	—	—	—	—	—
Carbon Total Organic	500	ug/g	—	—	—	—	—
Metals							
Silver	1	ug/g	28	15	<	6	<
Aluminum	2	"	15500	13600	17800	14300	13900
Arsenic	0.2	"	52	31	4	19	2.5
Barium	0.1	"	1720	1300	289	919	134
Beryllium	0.1	"	1	0.8	0.8	0.8	0.6
Bismuth	2	"	<	<	<	<	<
Calcium	1	"	58500	50800	14100	31300	11400
Cadmium	0.1	"	6.9	6.1	1.4	5.4	0.49
Cobalt	0.3	"	48.2	16	7.2	12.8	5.4
Chromium	0.2	"	80.9	53.5	23.2	55.3	28.6
Copper	0.1	"	2560	1380	90.7	656	34.2
Iron	0.3	"	112000	68300	18400	51800	28300
Mercury	0.05	"	0.4	0.61	0.11	0.72	<
Potassium	40	"	2760	2530	3360	2700	2490
Magnesium	2	"	5220	14900	7040	8900	4480
Manganese	0.2	"	2200	1220	378	878	345
Molybdenum	0.4	"	19.7	8	<	3.9	<
Sodium, Total	1	"	2310	1060	605	878	624
Nickel	0.8	"	20.9	19.1	16.7	17.6	13.1
Phosphorus, Total	4	"	4200	1300	1120	1470	1140
Lead	2	"	513	398	76	323	24
Sulphur, Total	3	"	2460	2250	308	2500	131
Antimony	1.5	"	4.7	3.4	<	1.7	2
Selenium	1	"	<	<	<	<	<
Tin	0.1	"	<	3	<	<	<
Strontium	2	"	261	121	76	96.3	70.9
Tellurium	2	"	<	<	<	<	<
Titanium	0.3	"	573	565	1820	778	1950
Thallium	0.3	"	3.2	2.7	0.8	1	0.7
Vanadium	0.3	"	53.3	52.8	56.3	49.3	60.5
Zinc	0.2	"	7390	4260	432	2800	176
Zirconium	0.3	"	6.9	3.4	2	0.9	2.3
		DATE SAMPLED:	92/10/05	92/10/03	92/10/06	92/10/06	92/10/08
		TIME SAMPLED:	15:30	12:30	12:15	12:15	

NOTES: ug/g = microgram per gram = parts per million
MDC = Minimum Detectable Concentration
< = Less than MDC
Solid Results Are Dry Weight Basis
Results are blank corrected

CRIEMP Sediment Monitoring Programme - American Split Samples

		CLIENT ID:	#3A Goodeve Crk	Five Mile Crk	Bosbora	China Bend A
		ZENON ID:	92024199	92024200	92024201	92024202
Parameter	**MDC**	**Units**				
Moisture	0.1	%(w/w)	20.3	34	41.3	45.2
Carbon Total	500	ug/g	8700	5200	23300	19700
Carbon Total Inorganic	500	ug/g	6400	1700	7100	6400
Carbon Total Organic	500	ug/g	2300	3500	16200	13300
Metals						
Silver	1	ug/g	—	—	—	—
Aluminum	2	"	—	—	—	—
Arsenic	0.2	"	—	—	—	—
Barium	0.1	"	—	—	—	—
Beryllium	0.1	"	—	—	—	—
Bismuth	2	"	—	—	—	—
Calcium	1	"	—	—	—	—
Cadmium	0.1	"	—	—	—	—
Cobalt	0.3	"	—	—	—	—
Chromium	0.2	"	—	—	—	—
Copper	0.1	"	—	—	—	—
Iron	0.3	"	—	—	—	—
Mercury	0.05	"	—	—	—	—
Potassium	40	"	—	—	—	—
Magnesium	2	"	—	—	—	—
Manganese	0.2	"	—	—	—	—
Molybdenum	0.4	"	—	—	—	—
Sodium, Total	1	"	—	—	—	—
Nickel	0.8	"	—	—	—	—
Phosphorus, Total	4	"	—	—	—	—
Lead	2	"	—	—	—	—
Sulphur, Total	3	"	—	—	—	—
Antimony	1.5	"	—	—	—	—
Selenium	1	"	—	—	—	—
Tin	0.1	"	—	—	—	—
Strontium	2	"	—	—	—	—
Tellurium	2	"	—	—	—	—
Titanium	0.3	"	—	—	—	—
Thallium	0.3	"	—	—	—	—
Vanadium	0.3	"	—	—	—	—
Zinc	0.2	"	—	—	—	—
Zirconium	0.3	"	—	—	—	—
		DATE SAMPLED:	92/10/03	92/10/06	92/10/07	92/10/07
		TIME SAMPLED:	12:30	12:15	12:50	10:10

NOTES: ug/g = microgram per gram = parts per million
MDC = Minimum Detectable Concentration
< = Less than MDC
Solid Results Are Dry Weight Basis
Results are blank corrected

APPENDIX D

QA/QC RESULTS FOR BIOLOGY SAMPLES

QA/QC Report for the CRIEMP Vegetation and Biota Monitoring Programme

		ZENON ID:	Method Blank	Duplicate 1A	Duplicate 1B	Percent Difference
Parameter	**MDC**	**Units**				
Metals				18968 A	18968 B	
Silver	1	ug/g	<	<	<	0%
Aluminum	2	"	<	19.3	18.3	5%
Arsenic	0.2	"	<	<	<	0%
Barium	0.1	"	<	2.94	2.72	8%
Beryllium	0.1	"	<	<	<	0%
Bismuth	2	"	<	<	<	0%
Calcium	1	"	9.7	1070	1000	7%
Cadmium	0.1	"	<	0.312	0.339	-8%
Cobalt	0.3	"	<	<	<	0%
Chromium	0.2	"	0.82	<	<	0%
Copper	0.1	"	0.225	22.1	20.7	7%
Iron	0.3	"	1.68	109	102	7%
Mercury	0.05	"	<	0.084*	0.084*	0%
Potassium	40	"	<	6340	6110	4%
Magnesium	2	"	<	757	705	7%
Manganese	0.2	"	<	14.3	13.4	6%
Molybdenum	0.4	"	<	1.05	0.955	9%
Sodium, Total	1	"	17.4	2160	2050	5%
Nickel	0.8	"	<	<	<	0%
Phosphorus, Total	4	"	<	7700	7180	7%
Lead	2	"	<	5.85	5.59	5%
Sulphur, Total	3	"	8.67	5770	5590	3%
Antimony	1.5	"	<	1.81	2.28	-23%
Selenium	0.5	"	<	1.8	1.71	5%
Tin	0.1	"	<	<	<	0%
Strontium	2	"	<	6.94	6.51	6%
Tellurium	2	"	<	<	<	0%
Titanium	0.3	"	<	1.16	1.22	-5%
Thallium	0.3	"	<	<	<	0%
Vanadium	0.3	"	<	<	<	0%
Zinc	0.2	"	0.51	145	136	6%
Zirconium	0.3	"	<	<	<	0%

NOTES: ug/g = microgram per gram = parts per million
MDC = Minimum Detectable Concentration
< = Less than MDC
Solid Results Are Dry Weight Basis
Results are blank corrected
* = Duplicate Performed on Sample 92018965

QA/QC Report for the CRIEMP Vegetation and Biota Monitoring Programme

		ZENON ID:	Duplicate 2A	Duplicate 2B	Percent Difference
Parameter	**MDC**	**Units**			
Metals			**18973 A**	**18973 B**	
Silver	1	ug/g	<	<	0%
Aluminum	2	"	543	490	10%
Arsenic	0.2	"	<	<	0%
Barium	0.1	"	45.7	43.5	5%
Beryllium	0.1	"	<	<	0%
Bismuth	2	"	<	<	0%
Calcium	1	"	24000	22500	6%
Cadmium	0.1	"	1.11	1.41	-24%
Cobalt	0.3	"	0.443	0.57	-25%
Chromium	0.2	"	2.64	2.69	-2%
Copper	0.1	"	1.82	1.87	-3%
Iron	0.3	"	764	791	-3%
Mercury	0.05	"	<	<	0%
Potassium	40	"	16900	16700	1%
Magnesium	2	"	2230	2180	2%
Manganese	0.2	"	78.3	76.4	2%
Molybdenum	0.4	"	<	<	0%
Sodium, Total	1	"	424	420	1%
Nickel	0.8	"	4.92	5.64	-14%
Phosphorus, Total	4	"	<	<	0%
Lead	2	"	2.50	2.39	4%
Sulphur, Total	3	"	2530	2570	-2%
Antimony	1.5	"	<	<	0%
Selenium	0.5	"	<	<	0%
Tin	0.1	"	<	<	0%
Strontium	2	"	111	105	6%
Tellurium	2	"	<	<	0%
Titanium	0.3	"	56.7	54.5	4%
Thallium	0.3	"	<	<	0%
Vanadium	0.3	"	1.31	1.33	-2%
Zinc	0.2	"	32.5	33	-2%
Zirconium	0.3	"	<	<	0%

NOTES: ug/g = microgram per gram = parts per million
MDC = Minimum Detectable Concentration
< = Less than MDC
Solid Results Are Dry Weight Basis
Results are blank corrected
* = Duplicate Performed on Sample 92018965

Parameter	MDC	Units	ZENON ID: SRM NBS 1577A	Certified Value	Percent Recovery
Metals					
Silver	1	ug/g	<	NA	NA
Aluminum	2	"	1.41	NA	NA
Arsenic	0.2	"		0.047±0.006	
Barium	0.1	"	0.0859	NA	NA
Beryllium	0.1	"	<	NA	NA
Bismuth	2	"	<	NA	NA
Calcium	1	"	89.9	NA	NA
Cadmium	0.1	"	0.24	0.44±0.06	55%
Cobalt	0.3	"	0.22	0.21±0.05	105%
Chromium	0.2	"	0.953	NA	NA
Copper	0.1	"	106	158±7	67%
Iron	0.3	"	127	194±20	65%
Mercury	0.05	"	<	0.004±0.002	NA
Potassium	40	"	7240	9996±70	72%
Magnesium	2	"	413	600±15	69%
Manganese	0.2	"	6.78	9.9±0.8	68%
Molybdenum	0.4	"	2.34	3.5±0.5	67%
Sodium, Total	1	"	1680	2430±130	69%
Nickel	0.8	"	0.488	NA	NA
Phosphorus, Total	4	"	0.814	2800±400	0%
Lead	2	"	0.0212	0.135±0.015	16%
Sulphur, Total	3	"	5650	7800±100	72%
Antimony	1.5	"	0.63	NA	NA
Selenium	0.5	"	0.8	0.71±0.07	113%
Tin	0.1	"	1.43	NA	NA
Strontium	2	"	0.118	0.138±0.003	86%
Tellurium	2	"	<	NA	NA
Titanium	0.3	"	0.133	NA	NA
Thallium	0.3	"	0.266	NA	NA
Vanadium	0.3	"	0.0007	NA	NA
Zinc	0.2	"	84.2	123±8	68%
Zirconium	0.3	"	0.32	NA	NA

NOTES: ug/g = microgram per gram = parts per million
MDC = Minimum Detectable Concentration
< = Less than MDC
Solid Results Are Dry Weight Basis
Results are blank corrected
* = Duplicate Performed on Sample 92018965

Parameter	MDC	Units	ZENON ID: SRM NBS 1571	Certified Value	Percent Recovery
Metals					
Silver	1	ug/g	<	NA	NA
Aluminum	2	"	169	NA	NA
Arsenic	0.2	"	12.9	10±2	129%
Barium	0.1	"	32.1	NA	NA
Beryllium	0.1	"	<	0.027±0.01	NA
Bismuth	2	"	0.837	NA	NA
Calcium	1	"	18400	20900±300	88%
Cadmium	0.1	"	0.0884	0.11±0.01	80%
Cobalt	0.3	"	0.27	NA	NA
Chromium	0.2	"	2.48	2.6±0.3	95%
Copper	0.1	"	9.78	12±1	82%
Iron	0.3	"	211	300±20	70%
Mercury	0.05	"	0.133	0.155±0.015	89%
Potassium	40	"	10900	14700±300	74%
Magnesium	2	"	4950	6200±200	80%
Manganese	0.2	"	73.4	91±4	80%
Molybdenum	0.4	"	<	0.3±0.1	NA
Sodium, Total	1	"	77.3	82±6	94%
Nickel	0.8	"	0.932	1.3±0.2	72%
Phosphorus, Total	4	"	1700	2100±100	81%
Lead	2	"	38.1	45±3	85%
Sulphur, Total	3	"	1670	NA	NA
Antimony	1.5	"	2.58	2.9±0.3	89%
Selenium	0.5	"	<	0.08±0.01	NA
Tin	0.1	"	1.13	NA	NA
Strontium	2	"	28.3	37±1	76%
Tellurium	2	"	0.133	NA	NA
Titanium	0.3	"	5.91	NA	NA
Thallium	0.3	"	<	NA	NA
Vanadium	0.3	"	7.14	NA	NA
Zinc	0.2	"	22	25±3	88%
Zirconium	0.3	"	0.396	NA	NA

NOTES: ug/g = microgram per gram = parts per million
MDC = Minimum Detectable Concentration
< = Less than MDC
Solid Results Are Dry Weight Basis
Results are blank corrected
* = Duplicate Performed on Sample 92018965

		ZENON ID:	Sample 18972	Sample Spiked	Spike Level	Spike Recovery
Parameter	**MDC**	**Units**				
Metals						
Silver	1	ug/g	<	4.6	5	92%
Aluminum	2	"	453	502	30	163%
Arsenic	0.2	"	1	5.6	5	92%
Barium	0.1	"	117	231	100	114%
Beryllium	0.1	"	<	0.6	0.5	120%
Bismuth	2	"	<	10	10	100%
Calcium	1	"	82200	89000	5000	136%
Cadmium	0.1	"	7.3	8.6	1	130%
Cobalt	0.3	"	1.5	2.4	1	90%
Chromium	0.2	"	2.1	3.8	2	85%
Copper	0.1	"	31.3	34	5	54%
Iron	0.3	"	869	913	50	88%
Mercury	0.05	"	0.11	0.56	0.5	90%
Potassium	40	"	14100	14500	200	200%
Magnesium	2	"	2380	2540	200	80%
Manganese	0.2	"	390	498	100	108%
Molybdenum	0.4	"	0.8	1.6	1	80%
Sodium, Total	1	"	742	810	50	136%
Nickel	0.8	"	2.3	4.8	2.5	100%
Phosphorus, Total	4	"	1840	2900	1000	106%
Lead	2	"	38	65	25	108%
Sulphur, Total	3	"	1990	3014	1000	102%
Antimony	1.5	"	1.5	10	10	85%
Selenium	0.5	"	0.88	9.7	10	88%
Tin	0.1	"	<	11	10	11%
Strontium	2	"	254	283	30	97%
Tellurium	2	"	<	10	10	100%
Titanium	0.3	"	27	29	NA	NA
Thallium	0.3	"	7.4	17.4	10	100%
Vanadium	0.3	"	1.4	2.5	1	110%
Zinc	0.2	"	267	374	100	107%
Zirconium	0.3	"	0.4	2.7	3	77%

NOTES: ug/g = microgram per gram = parts per million
MDC = Minimum Detectable Concentration
< = Less than MDC
Solid Results Are Dry Weight Basis
Results are blank corrected
* = Duplicate Performed on Sample 92018965

APPENDIX E

QA/QC RESULTS FOR SEDIMENT SAMPLES

QA/QC Report for the CRIEMP Sediment Monitoring Programme

		ZENON ID:	Method Blank #1	Zenon Sample ID	Duplicate 1A	Duplicate 1B	Percen Diff
Parameter	**MDC**	**Units**					
Moisture	0.1	%(w/w)	<	92021069	40.5	40.5	0%
Carbon Total	500	ug/g	<	92021065	26200	27400	-4%
Carbon Total Inorganic	500	ug/g	<	92021069	1600	1800	-12%
Carbon Total Organic	500	ug/g	<		24600	25600	-4%
Sulfide Total	6	ug/g	<	92020285	9	10	-11%
Total Kjeldahl Nitrogen	30	ug/g	<	92020285	444	477	-7%
Extractable Organic Halides	2.5	ug/g	<	91020288	2.7	2.6	4%
Metals							
Silver	1	ug/g	<	92020281	<	<	0%
Aluminum	2	"	2.25	"	35500	34500	3%
Arsenic	0.2	"	<	"	8.8	8.6	2%
Barium	0.1	"	0.161	"	366	350	4%
Beryllium	0.1	"	<	"	1.38	1.35	2%
Bismuth	2	"	<	"	<	<	0%
Calcium	1	"	36.3	"	7380	7440	-1%
Cadmium	0.1	"	<	"	0.929	0.853	9%
Cobalt	0.3	"	<	"	16.1	16.7	-4%
Chromium	0.2	"	0.392	"	23	41.1	-56%
Copper	0.1	"	0.328	"	48.5	47.5	2%
Iron	0.3	"	4.92	"	39600	40600	-2%
Mercury	0.05	"	<	"	0.06	0.05	18%
Potassium	40	"	<	"	11000	9590	14%
Magnesium	2	"	5.41	"	10600	10900	-3%
Manganese	0.2	"	<	"	675	693	-3%
Molybdenum	0.4	"	<	"	<	<	0%
Sodium, Total	1	"	38.8	"	1100	972	12%
Nickel	0.8	"	<	"	46	48.6	-5%
Phosphorus, Total	4	"	4.27	"	1520	1580	-4%
Lead	2	"	<	"	69.8	67.4	3%
Sulphur, Total	3	"	9.07	"	389	379	3%
Antimony	1.5	"	<	"	<	<	0%
Selenium	1	"	<	"	<	<	0%
Tin	0.1	"	<	"	2.95	4.40	-39%
Strontium	2	"	<	"	87	84.9	2%
Tellurium	2	"	<	"	<	<	0%
Titanium	0.3	"	<	"	2050	1970	4%
Thallium	0.3	"	<	"	<	<	0%
Vanadium	0.3	"	<	"	62	61.2	1%
Zinc	0.2	"	1.06	"	155	147	5%
Zirconium	0.3	"	<	"	4.27	6.95	-48%

NOTES: ug/g = microgram per gram = parts per million
MDC = Minimum Detectable Concentration
< = Less than MDC
Solid Results Are Dry Weight Basis
Results are blank corrected
* = CANMET SRM STSD 2

QA/QC Report for the CRIEMP Sediment Monitoring Programme

		ZENON ID:	Zenon Sample ID	Duplicate 2A	Duplicate 2B	Percent Difference
Parameter	**MDC**	**Units**				
Moisture	0.1	%(w/w)	NA	NA	NA	NA
Carbon Total	500	ug/g	NA	NA	NA	NA
Carbon Total Inorganic	500	ug/g	NA	NA	NA	NA
Carbon Total Organic	500	ug/g	NA	NA	NA	NA
Sulfide Total	6	ug/g	NA	NA	NA	NA
Total Kjeldahl Nitrogen	30	ug/g	NA	NA	NA	NA
Extractable Organic Halides	2.5	ug/g	NA	NA	NA	NA
Metals						
Silver	1	ug/g	92021068	16.7	14	18%
Aluminum	2	"	"	11300	11000	3%
Arsenic	0.2	"	"	55	46.8	16%
Barium	0.1	"	"	1540	1580	-3%
Beryllium	0.1	"	"	0.594	0.535	10%
Bismuth	2	"	"	14.5	9.90	38%
Calcium	1	"	"	33000	33100	0%
Cadmium	0.1	"	"	6.04	5.32	13%
Cobalt	0.3	"	"	32.9	34	-3%
Chromium	0.2	"	"	55.9	57.4	-3%
Copper	0.1	"	"	2520	2540	-1%
Iron	0.3	"	"	86700	86100	1%
Mercury	0.05	"	92021067	<	<	0%
Potassium	40	"	92021068	2050	1980	3%
Magnesium	2	"	"	3910	3780	3%
Manganese	0.2	"	"	1720	1760	-2%
Molybdenum	0.4	"	"	13.1	14	-7%
Sodium, Total	1	"	"	1280	1270	1%
Nickel	0.8	"	"	24.3	22.5	8%
Phosphorus, Total	4	"	"	2430	2300	5%
Lead	2	"	"	546	578	-6%
Sulphur, Total	3	"	"	3030	3120	-3%
Antimony	1.5	"	"	8.90	17.5	-65%
Selenium	1	"	"	<	<	0%
Tin	0.1	"	"	4.72	7.99	-51%
Strontium	2	"	"	170	173	-2%
Tellurium	2	"	"	<	<	0%
Titanium	0.3	"	"	380	341	11%
Thallium	0.3	"	"	<	<	0%
Vanadium	0.3	"	"	50.4	40.5	22%
Zinc	0.2	"	"	6520	6720	-3%
Zirconium	0.3	"	"	11.9	17.2	-36%

NOTES: ug/g = microgram per gram = parts per million
MDC = Minimum Detectable Concentration
< = Less than MDC
Solid Results Are Dry Weight Basis
Results are blank corrected
* = CANMET SRM STSD 2

QA/QC Report for the CRIEMP Sediment Monitoring Programme

Parameter	MDC	Units	ZENON ID: NBS 2704	Certified Value	Percent Recovery
Moisture	0.1	%(w/w)	NA	NA	NA
Carbon Total	500	ug/g	NA	NA	NA
Carbon Total Inorganic	500	ug/g	NA	NA	NA
Carbon Total Organic	500	ug/g	NA	NA	NA
Sulfide Total	6	ug/g	NA	NA	NA
Total Kjeldahl Nitrogen	30	ug/g	NA	NA	NA
Extractable Organic Halides	2.5	ug/g	NA	NA	NA
Metals					
Silver	1	ug/g	0.519	NA	NA
Aluminum	2	"	35100	61000±1600	58%
Arsenic	0.2	"	18.6	23.4±0.8	80%
Barium	0.1	"	170	414±12	41%
Beryllium	0.1	"	1.1	NA	NA
Bismuth	2	"	<	NA	NA
Calcium	1	"	21500	26000±300	83%
Cadmium	0.1	"	3.15	3.45±22	91%
Cobalt	0.3	"	10.8	14±0.6	77%
Chromium	0.2	"	23.2	135±5	17%
Copper	0.1	"	88.8	98.6±5	90%
Iron	0.3	"	33300	41100±1000	81%
Mercury	0.05	"	1.5	1.47 ± 0.07	102%
Potassium	40	"	8850	20000±400	44%
Magnesium	2	"	10100	12000±200	84%
Manganese	0.2	"	468	555±19	84%
Molybdenum	0.4	"	2.57	NA	NA
Sodium, Total	1	"	498	5470±140	9%
Nickel	0.8	"	34	44.1±3	77%
Phosphorus, Total	4	"	851	998±28	85%
Lead	2	"	142	161±17	88%
Sulphur, Total	3	"	3310	3970±40	83%
Antimony	1.5	"	3.84	3.79±.15	101%
Selenium	1	"	0.765	1.12±0.05	67%
Tin	0.1	"	4.86	9.5	51%
Strontium	2	"	68	130	52%
Tellurium	2	"	0.833	NA	NA
Titanium	0.3	"	394	NA	NA
Thallium	0.3	"	<	NA	NA
Vanadium	0.3	"	51.4	95±4	54%
Zinc	0.2	"	380	43±128	87%
Zirconium	0.3	"	11	300	3%

NOTES: ug/g = microgram per gram = parts per million
MDC = Minimum Detectable Concentration
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Results are blank corrected
• = CANMET SRM STSD 2

QA/QC Report for the CRIEMP Sediment Monitoring Programme

Parameter	MDC	Units	ZENON ID: Zenon Sample ID	Sample Conc.	Sample Spiked	Spike Level	Spike Recovery
Moisture	0.1	%(w/w)	NA	NA	NA	NA	NA
Carbon Total	500	ug/g	NA	NA	NA	NA	NA
Carbon Total Inorganic	500	ug/g	NA	NA	NA	NA	NA
Carbon Total Organic	500	ug/g	NA	NA	NA	NA	NA
Sulfide Total	6	ug/g	92020285	10	21	20	105%
Total Kjeldahl Nitrogen	30	ug/g	92020285	444	510	100	66%
Extractable Organic Halides	2.5	ug/g	92020288	3.9	20.1	18.6	87%
Metals							
Silver	1	ug/g	92020278	NA	NA	NA	NA
Aluminum	2	"	"	15690	57800	40000	105%
Arsenic	0.2	"	"	23	25.5	4	63%
Barium	0.1	"	"	280	657	400	94%
Beryllium	0.1	"	"	NA	NA	NA	NA
Bismuth	2	"	"	NA	NA	NA	NA
Calcium	1	"	"	9442	50230	40000	102%
Cadmium	0.1	"	"	7.13	11	4	96%
Cobalt	0.3	"	"	9.7	43	40	83%
Chromium	0.2	"	"	35.6	83.2	40	119%
Copper	0.1	"	"	221	229	40	19%
Iron	0.3	"	"	26420	67990	40000	104%
Mercury	0.05	"	"	0.68	1.12	0.5	88%
Potassium	40	"	"	1970	9754	8000	97%
Magnesium	2	"	"	6490	27060	20000	103%
Manganese	0.2	"	"	335	3962	4000	91%
Molybdenum	0.4	"	"	NA	NA	NA	NA
Sodium, Total	1	"	"	248	1055	800	101%
Nickel	0.8	"	"	32.9	363	400	82%
Phosphorus, Total	4	"	"	NA	NA	NA	NA
Lead	2	"	"	606	923	400	79%
Sulphur, Total	3	"	"	NA	NA	NA	NA
Antimony	1.5	"	"	2.8	6.44	4	91%
Selenium	1	"	"	1.33	1.88	0.8	69%
Tin	0.1	"	"	NA	NA	NA	NA
Strontium	2	"	"	57.2	97	40	100%
Tellurium	2	"	"	NA	NA	NA	NA
Titanium	0.3	"	"	892	2831	2000	97%
Thallium	0.3	"	"	1.57	11.2	8	120%
Vanadium	0.3	"	"	30.3	97.2	80	84%
Zinc	0.2	"	"	1120	1430	400	78%
Zirconium	0.3	"	"	NA	NA	NA	NA

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MDC = Minimum Detectable Concentration
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APPENDIX F

NORECOL ENVIRONMENTAL CONSULTANTS

SAMPLE TRANSMITTAL

FORMS

TRANSMITTAL FORM

FROM: NORECOL
TO: ZENON

DATE: JULY 20/92
(2 COOLERS)

INSTRUCTIONS: STORE FROZEN PENDING INSTRUCTION FROM Annette Smith. KEEP ALL CLAM SHELLS FOR I

1) CADDIS FLIES; LOC: KOOTENAY RIVER, GLADE
DATE: JULY 16/92; ASSAY: METALS; ~~FROM~~ SAMPLER: ENVIRONMENT CANADA. SAMPLE 609 (18966)

~~2) KEEP SHELLS~~

2) CLAMS; [KEEP SHELLS FOR ID]; LOC: KEENLEYSIDE; JULY 16/92; ASSAY: METALS; SAMPLER: NEC

3) CADDISFLIES; LOC: KOOTENAY RIVER, GLADE; JULY 16/92; ASSAY: METALS; SAMPLER: NEC (18967)

4) CLAMS; LOC: KEENLEYSIDE; JULY 16/92; ASSAY: METALS; SAMPLER: NEC

5) CLAMS; LOC: KOOTENAY RIVER, GLADE; JULY 17/92; ASSAY: METALS; SAMPLER: NEC (18963)

7) CLAMS; LOC: WANETA (= ACROSS FM GRAVEL PIT) JULY 14/92; ASSAY: METALS; SAMPLER: NEC

8) PERIPHYTON; LOC: CELGAR PER. STM.; JULY 18/92; ASSAY: BIOMASS; SAMPLER: NEC

9) PERIPHYTON; LOC: CELGAR; JULY 18/92; ASSAY: Chlorophyll a; SAMPLER: NEC.

10) CLAMS; LOC: BIRCHBANK; JULY 14/92; ASSAY: METALS

DRAFT

TRANSMITTAL FORM

TO: ZENON

(11) CLAMS; LOC: CELGAR PERIPHYTON STATION; JULY 8/
ASSAY: METALS; SAMPLER: NEC (18964)

(12) PERIPHYTON (VARIOUS); LOCS: II-1 (BIOMASS)
II-1 (Chl a)
WANETA - (BAY ACROSS FROM GRAVEL PIT)
BIOMASS

13) CLAMS; LOC: KOOTENAY (LOWER); JULY 16/92;
ASSAY: METALS; SAMPLER: NEC

14) CLAMS; LOC: KOOTENAY (LOWER); JULY 16/92;
ASSAY: METALS; SAMPLER: NEC

15) MACROPHYTES; LOC: ROBSON WEST; JULY 14/92;
ASSAY: METALS; SAMPLER: NEC

16) MACROPHYTES; LOC: KEENLEYSIDE; JULY 16/92;
ASSAY: METALS; SAMPLER: NEC

17) MACROPHYTES; LOC: KOOTENAY (LOWER); JULY 16/92;
ASSAY: METALS; SAMPLER: NEC

18) MACROPHYTES; LOC: KEENLEYSIDE; JULY 16/92;
ASSAY: METALS; SAMPLER: NEC

19) MACROPHYTES; LOC: KOOTENAY (LOWER); JULY 16/92;
ASSAY: METALS; SAMPLER: NEC

(20) MACROPHYTES; LOC: WANETA (BAY ACROSS FROM COMINCO GRAVEL PIT); JULY 14/92; ASSAY: METAL;
SAMPLER: NEC (18972)

(21) MACROPHYTES; LOC: CELGAR PERIPHYTON STN;
JULY 18/92; ASSAY: METALS (18973)

TO: ZGNON

22) CLAMS; LOC: WANETA; ~~[illegible]~~ (BAY ARROW FROM KOMINCO GRAVEL PIT); JULY 14/9
ASSAY: METALS; SAMPLER: NEC

23) ~~CLAMS~~ CADDISFLIES; LOC: ROBSON WEST; JULY 17/9
ASSAY: METALS; SAMPLER: NEC

24) CADDISFLIES; LOC: CELGAR; JULY 17/92;
ASSAY: METALS; SAMPLER: NEC (18968)

25) CADDISFLIES; LOC: WANETA; JULY 15/92;
ASSAY: METALS; SAMPLER: ENVIRONMENT CANADA (18969)

26) CADDISFLIES; LOC: WANETA; JULY 15/92; ASSAY:
METALS; SAMPLER: NEC (18970)

27) CLAMS; LOC: ROBSON WEST; JULY 14/92; ASSAY: METALS
SAMPLER: NEC (18965)

28) Grohman Narrow Caddis Flies

Note: ① #7 & 22 are to be composited into one sample. (18971)

NORECOL
SAMPLE ANALYSIS

TRANSMITTAL FORM

TO: Zenon

File: 1-379-01.0

Date: Sept 3 22

ATTENTION: Shawn Heier

PROJECT: CRIEMP

FROM: NORECOL ENVIRONMENTAL CONSULTANTS LTD.
Suite 700, 1090 West Pender Street
Vancouver, B.C.
V6E 2N7 (PH: 682-2291; FAX: 682-8323)

BILLING INSTRUCTIONS: to CRIEMP

ATTENTION: Terry Baturin

Submit copy of data to Norecol

(list for 2 coolers 1 of 2 total # sample)

SAMPLES COLLECTED BY: Annette Smith / Bruce Ott Date: Sept 1- 2/

	Sample ID	Description	Analyses to be Completed
20281	I-1 NEC	Arrow L. Sediment ✓	CRIEMP - Metals, Acid
20282	I-1 NEC	✓	Vol. Sulphides, Tot. Kjel. N
20283	I-1A EC	✓	
20284	I-1B EC	✓	Note: bottle broke; transfered to ne
20285	II-2	Columbia - d/s Calgar ✓	
20286	II-3	" - Robson ✓	
21066	III-1	" u/s China Cr. ✓	
	III-2	" Birchbank ✓	
21067	III-3	" Lower Birchbank ✓	
20278	IV-1	" d/s Cominco ✓	
21068	IV-2	" d/s Beaver Cr. ✓	
20280	IV-3 NEC	" Cominco gravel pit ✓	
20287	IV-3 NEC	" "	
20288	IV-3 NEC	" "	

Blanks, Reference or Duplicates Results Required (See sample ID list): YES [ ] NO [ ]

Please include the following information on the invoice: Number of Samples Analysed
Date Submitted
Unit Price of Sample Analysis

DATA ANALYSIS CATEGORY: RUSH [ ] REGULAR

Date Results Required:

(For Norecol Use)

Date Data Received: Signed:

Notes: