EFFLUENT CHARACTERIZATION PROGRAM SAMPLING, ANALYSIS AND QA/QC PLAN

DRAFT

Project No. 0701-00-14676.001

May, 2001

EBA Engineering Consultants Ltd.

EFFLUENT CHARACTERIZATION PROGRAM
SAMPLING, ANALYSIS AND QA/QC PLAN

Prepared by:

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Submitted To:

MINNGUQ SEWING GROUP
QIKIQTARJUAQ ECONOMIC DEVELOPMENT OFFICE

Project No. 0701-00-14676.001

May, 2001

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PREAMBLE

This Sampling, Analysis and QA/QC Plan was completed for the Minnguq Tannery's Pilot Project. The objective of the Sampling, Analysis, and QA/QC Plan is to provide the methodology to for the characterization of the tannery effluent that will be generated during the pilot project. This Plan is in partial fulfilment of the Conditional Water Licence No. NWB4QIK0001 issued by the Nunavut Water Board (NWB) on November 29, 2000.

This pilot project is an eight-week study intended to determine to economic feasibility of operating the tannery on a full-time or seasonal basis. The tannery is owned by the Municipality of Qikiqtarjuaq, PO Box 88, Qikitarjuaq, Nunavut, X0A 0B0 (UTM N7496000 E457000).

Formal distributions of this Plan were made to the following person/agencies:

- Environmental Protection Service, Department of Sustainable Development
- Department of Fisheries and Oceans Canada
- Environment Canada
- Indian and Northern Affairs
- Nunavut Impact Review Board
- Nunavut Planning Commission
- Nunavut Water Board
- Minnguq Sewing Group
- Qikiqtani Inuit Association
- Stephen Shivas, Tannery Consultant

Additional copies and updates of this Plan can be obtained by contacting:

Municipality of Qikiqtarjuaq
P.O. Box 88
Qikiqtarjuaq, Nunavut X0A 0B0
Telephone: 867-927-8009
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Attn: Ms. Tia Nukiwuak

TABLE OF CONTENTS

TABLES

APPENDICES

1.0 INTRODUCTION

1.1 Objective of the Effluent Characterization Program

The overall *project objectives* of the effluent characterization program are as follows:

❶ determine the nature of the waste streams generated by the tannery pilot project;

and,

❷ identify potential disposal options and approximate costs.

The findings of this program will be a supplement to the overall feasibility of the tannery pilot project.

1.2 Data Quality Objectives

There are several major *data quality objectives* for the effluent characterization program:

- Determine the chemical composition and concentration of each effluent stream, based on the reagents used.
- Ensure that variability in sampling is minimized and samples are representative of the total population.
- Collect replicate to determine the variability, or errors, in sample collection.
- Determine the variability in effluent quality from batch to batch, once the tanning recipe is finalized.

The data generated in the effluent characterization program will be used for the following:

- Determine if the municipal sewage lagoon is a potential disposal option for any of the effluent streams by comparing the relevant parameters to the Industrial Waste Discharge Guidelines (see Section 1.4).
- Determine if the solid waste site is a potential disposal option for the sawdust and fat drippings generated in the tanning process by comparing the parameters of concern to the Industrial Waste Discharge Guidelines.
- Determine if any on-site treatment options are available for effluents that are not found to be suitable for disposal in the municipal facilities.
- Determine off-site treatment costs.

1.3 Regulatory Requirements

The applicable regulatory requirements, with respect to the management and disposal of effluent and solid waste, are summarized in Table 1 below. Spill Contingency Planning is not addressed as part of this document.

Table 1 Regulatory Framework for Tannery Effluent Management and Disposal

Regulation / Guideline	Applicability
Environmental Guideline for the General Management of Hazardous Waste	- Provides information on the proper management of hazardous waste in the North - increase awareness of hazardous waste - establish a "cradle to grave" monitoring system for hazardous waste from generation to final disposal
Environmental Guideline for Industrial Waste Discharges	Governs the allowable concentrations of a wide variety of chemical parameters for discharge of liquid process water/wastewater into municipal sewage lagoons. Specifically, describes: - standards for process effluent discharged to municipal sewage systems - Standards for solid waste/process residuals suitable for landfill
Guidelines for the Discharge of Domestic Wastewater in Nunavut (Draft Ed.3)	Commercial/industrial wastewater must be characterized before acceptance to a municipal sewage system. The purpose of the guideline is to: - protect the municipal infrastructure - protect workers who may be exposed to the waste - not upset the treatment process or affect effluent quality, and - not leave toxic residuals
Water Licence Issued by Nunavut Water Board	Establishes terms and conditions related to water use and waste disposal. Involves consultation of stakeholders and regulatory agencies, and evaluates the site-specific information of an industrial operation.

The Environmental Guideline for Industrial Waste Discharges provides users with schedules of standards (I to IV) to which the composition of industrial waste can be compared. Schedule I outlines parameters that must be met for the disposal of industrial effluent into a municipal sewage system. Schedules III and IV apply to the disposal of process residuals, or solid waste, into municipal solid waste facilities. If the waste materials (liquid and solid) are within the criteria outlined in the schedules, disposal in municipal facilities is considered acceptable. If the waste materials exceed the parameters outlined in the schedules, the materials are considered hazardous waste and must be managed in accordance with the Environmental Guideline for the General Management of Hazardous Waste. The schedules of this guideline are included in Appendix A.

The water licence may set specific industrial effluent discharge parameters that must be complied with. The water licence supersedes the requirements of the environmental guidelines.

2.0 TANNERY OPERATION

The plant is a small-scale tannery capable of tanning the skins of seal, caribou, fox, dog, etc. The tannery has a capacity at any one time to tan between fifteen and thirty skins depending upon their size. The tanning process takes four days to complete involving the use of tanning drum, driers, a stretcher and buffer. For the 8-week duration of the pilot project, the tannery will run two batches of 20 skins each week, for a total of 16 batches of 320 skins.

Ten chemical reagents in varying volumes will be used at the plant. The main chemical reagents used at the plant include salt, K2302 Solvent Scouring Agent, Soda Ash (sodium carbonate), Relugan GTW, Bascal S, Lutan FN, Chromitan FM, Neutrigan P4, Lipoderm Liquor PSE, and Sulphuric Acid. These chemicals are used in the process in small quantities, and are stored in sealed plastic containers in the chemical storage room of the tannery.

The proposed tanning procedure is included as Appendix B. The tanning process will follow this procedure, possibly with minor modifications over the course of the pilot project to improve the quality of the tanned skins.

3.0 WASTE STREAM ANALYSES

3.1 Waste Generation Summary

There will be seven liquid effluents generated by the tanning process: the scour and soak solution (A-1) and a subsequent rinse (A-2), the tanning float (B-1), a rinse following the tanning (C-1), a alkaline soak (C-2), another rinse (C-3), and then a fatliquor (neutralization) solution (C-4). The composition and volumes of the effluents is discussed further in the following section. Liquid effluent will be collected in 205L plastic drums, separated by effluent type, and the drums will be stored within a Waste Storage Facility (WSF), comprised of an earthen berm lined with a geomembrane. The WSF is located approximately four metres east of the tannery building.

Solid wastes or "process residuals" generated by the tanning process include fats skimmed from the drum during both the scour and soak and tanning stages, fat drippings from hanging the seal skins to dry following the tanning float, and sawdust.

Approximately 100 L of sawdust will be produced per week, as the skins are tumble dried in sawdust as one of the final steps in the tanning process. Sawdust will be bagged and discarded at the municipal landfill if chemical analysis results determine this is an acceptable disposal method.

3.2 Liquid Effluents

There will be seven liquid effluents generated by three main steps in the tanning procedure.

The scour and soak solution involves using an alkaline solution with a hydrocarbon-based detergent to clean and prepare the skins for tanning. The soak and scour solution effluent has been designated as A-1, and a subsequent rinse that will be a dilute version of A-1 has been designated A-2. Approximately 160 L and 30 L of effluent will be generated per batch for the A-1 and A-2 effluents, respectively. The total combined volume of the two effluents over the course of the pilot project will be approximately 4,000 L.

The tanning procedure involves the sequential addition of dry chemicals, including chrome, with limited water added. The effluent produced will be approximately 20 L in volume for each batch, or 320 L over the course of the pilot project.

The neutralization or fatliquor procedure involves several rinse steps and the addition of lipoderm (a solution of paraffin and surfactants). The first rinse (C-1) follows the tanning procedure and will likely contain residual concentrations of the chemicals added in the tanning. This is followed by an alkaline soak (C-2) comprising of soda ash and water, followed by another rinse of water only (C-3), and finally a fatliquor (neutralization) solution (C-4).

Only Effluent B, the tanning float, is expected to vary in composition due to adjustments in the tanning process. The scour and soak effluent (A) and the neutralization effluent (C) will not change in composition throughout the pilot project.

Table 2 summarizes the reagents and volumes used in each step of the tanning procedure, and the assigned effluent designation (A-1 through C4). The effluents are further discussed in Table 3, highlighting the chemicals of concern in each effluent (based on reagents), and the proposed analytical program and sampling frequency.

Table 2 Tanning Process Inputs and Effluents

Step	Process	Amount	Material	Effluent
SOAK AND SCOUR (based on 10 kg dry weight)				
1	Count dry skins into drum and record			
2	Soak	100 L 300 g 1 kg	Water K2302 Salt	A-1
3	Dunk and lay overnight, soften next morning and dump			
4	Scour #1	30 L 60 g 150 g	Water Soda Ash K2302	A-1
5	Dump and reload			
6	Rinse and dump	30 L	Water	A-2
7	Scour #2 Dump and reload	30 L 45 g 90 g	Water Soda Ash K2302	A-1
8	Hot rinse and dump	30 L	Water	A-2
9	Cold rinse and dump	30 L	Water	A-2
TANNING PROCEDURE (based on 10 kg dry weight)				
10	Pretan	3 L 500 g 400 g	Water Salt Relugan	
11	Pickle	100g 800 g	Bascal S Alum	B-1
12	Tannage	1.2 kg	Chrome	
13	Neutralize	200 g	Neutrigan	
14	Basify (repeat 4x) total water = 16 L + 3 L = 19 L	100 g 4 L	Soda ash Water	
FATLIQUOR PROCEDURE (based on 20kg wet weight)				
15	Wash	20 L	Water	C-1
16	Neutralize	800 g 8 L	Soda ash Water	C-2
17	Rinse and dump	20 L	Water	C-3
18	Fatliquor	20 L 2 kg	Water Lipoderm	C-4

Table 3 Liquid Effluents: Composition, Volumes and Proposed Chemical Analysis

Effluents	Description	Initial Mix Volume per batch (litres) *	Analytical Program	Sampling Frequency **
A-1	K2302, Salt, soda ash, water K2302 contains small concentration of xylenes, a halogenated hydrocarbon, and alcohol. Xylenes considered a contaminant. Soda ash (sodium bicarbonate) will raise pH of effluent to alkaline.	160	Xylenes Sulphate, sulphides pH, TSS BOD, COD Phenols, oil & grease	One initial batch during first month, and three final batches once recipe finalized.
A-2	Rinseate A very dilute solution of A-1, containing trace K2302, salt and/or soda ash	30	Xylenes Sulphate, sulphides pH, TSS BOD, COD Phenols, oil & grease	One initial batch during first month, and three final batches once recipe finalized.
B-1	Tanning agents Chromatin (chromium sulfate), alum (aluminum sulfate), Lutan (sodium sulfates, inorganic metal salts), Neutrigan (sodium), Relugan (alcohols & aldehydes), salt (sodium chloride), soda ash (sodium bicarbonate, sulphuric acid (sulphides, low pH)	19	ICP metals scan Sulphate, sulphides, chlorides pH, TSS BOD, COD Phenols Oil & grease	One initial batch during first month, and three final batches once recipe finalized.
C-1	Rinseate A very dilute solution of B-1, containing chromium, aluminum, sodium, chlorides, sulphides and sulphates, possibly low pH	20	ICP metals scan Sulphate, sulphides, chlorides pH, TSS BOD, COD Phenols Oil & grease	One initial batch during first month, and three final batches once recipe finalized.
C-2	Soda ash and water Alkaline water, possibly trace chemicals from previous steps	8	pH, TSS BOD, COD	One batch during first month, two final batches.
C-3	Rinseate A very dilute solution, rinse after C-2, possibly alkaline with trace chemicals	20	pH, TSS BOD, COD	One batch during first month, two final batches.
C-4	Lipoderm and water Paraffins (alkane hydrocarbons) and surfactants (likely containing sulphides)	20	pH, TSS BOD, COD Oil & grease Phosphorus Sulphides, sulphates	One initial batch during first month, and three final batches once recipe finalized.

* The skins will absorb a considerable volume of water, so the volumes of effluent produced will be less than the original liquid volume added.

** There will be two batches per week processed, or a total of 16 batches over the eight week pilot project
One QA/QC Duplicate will be collected for a different effluent stream on each of the six sampling events.

Chemical analysis results for each effluent will be compared to Schedule I: Standards for Process Effluent Discharged to Municipal Sewage Systems[6] to determine which, if any, effluents are suitable for disposal into the municipal lagoon.

3.3 Process Residuals

Two solid waste streams will be produced: a very small amount of fats, and sawdust. The fats are generated at two sources: skimming from the tanning drum during the soak and scour, as well as a small amount of fat drippings when the skins are hung to dry following the tanning procedure). The sawdust is used for tumbling during the final, softening stage of the tanning process. The skins are painted with a 50:50 water to Lipoderm Liquor solution prior to tumbling, so the sawdust will contain a small volume of Lipoderm absorbed from the skins.

The fat skimmings and drippings may contain trace levels of xylenes and chromium, respectively. Chemical analysis of the fat process residuals will be conducted to determine if the material is suitable for landfilling or requires special handling and disposal.

The waste sawdust will be collected in bags for disposal. It is likely to contain only trace levels of the Lipoderm PSE solution as it has been diluted prior to application, and has been primarily absorbed by the skins. The sawdust will be collected in bags after every two batches of skins. Chemical analysis of the sawdust will be completed to determine if the material is suitable for landfilling. If alternate disposal methods are required, the material will be packaged in 205L drums and stored in the WSF until they can be transported for disposal.

Table 4 summarizes the process residuals and the proposed sampling analytical and frequency.

Table 4 Process Residuals: Composition, Sampling and Chemical Analysis

Waste	Possible Contaminants	Proposed Analytical	Sampling Frequency
Fats skimmed from Effluent A	Xylenes	Xylenes	Three times over course of pilot project
Fats skimmed from Effluent B	Chromium	Chromium	Three times over course of pilot project
Fat Drippings after tanning	Chromium	Chromium	Three times over course of pilot project
Sawdust from tumbling of tanned skins	Chromium	Chromium	Three times over course of pilot project

The chemical analysis results from the above testing on solid waste or process residuals will be compared to Schedules III and IV of the Environmental Guideline for Industrial Waste Discharges. The results will be used to determine if the materials are considered non-hazardous and are suitable for disposal to the municipal landfill, or if the wastes are hazardous and are subject to the Environmental Guideline for the General Management of Hazardous Waste.

4.0 SAMPLING TECHNIQUES AND RATIONALE

4.1 Human Resources

The sampling program will be carried out by Mr. Richard Cook of EBA. Mr. Cook has almost five years of experience in environmental sampling and has prepared numerous regulatory documents including QA/QC sampling plans. He was the primary author of this document. He will conduct the sampling in two visits to the tannery throughout the pilot project.

Mr. Joseph Selann is EBA's principal environmental scientist, based on Edmonton, Alberta. Mr. Selann has over 25 years of varied environmental consulting experience, a portion of which was in the water and wastewater treatment industries. Mr. Selann, in recent years, has spearheaded the development of EBA's in-house field sampling and QA/QC protocols. He will be available for on-going technical support as well as senior review of this project.

Mr. Stephen Shivas is an experienced tannery expert. He is project manager for the tannery program. Mr. Shivas has an intimate knowledge of the tanning process, including the reagents and waste streams, and has completed sampling programs in the past. EBA will review the tanning process with Mr. Shivas to ensure the sampling program and protocols will produce representative results.

4.2 Collection of Representative Samples

It is essential that samples collected are representative of the effluent produced by the tanning process. The tanning process is completed by batch, with no constant effluent stream. The Canbar drum to which the various reagents/solutions will be added to the skins is emptied by gravity feed. Since transfer of the effluent directly to 205 L drums from the Canbar drum is not possible, 20 L plastic pails will be used to transfer the effluent from the Canbar drum to the plastic 205 L drums. Sampling will be completed from the transfer pails. For sample volumes greater than 20 L (Effluents A and C) and where several pails are required, a composite sample will be prepared by combining a portion of the contents of

each pail. This will minimize any variability in the effluent as it is decanted from the Canbar drum. In the case of the tanning effluent, approximately 20 L will be generated in each batch, and the 20 L pail of effluent will be stirred with clean plastic stirrers prior to collecting a sample.

Approximately 5 L of effluent is required for chemical analysis. When sampling, clean dedicated plastic pails will be used to collect 5 L of sample from each pail used in the transfer for that batch. The 5 L aliquots will be mixed and the 5 L composite sample collected.

Samples will be collected in triplicate for the first sampling event to determine the inherent variability in sampling, and single samples (plus 10% QA/QC duplicates) will be collected on subsequent batches.

4.3 Sample Handling

This section discusses sample bottles, preservation, storage, shipment, and submission of waste samples to the laboratory.

4.3.1 Sample Bottles and Labelling

Laboratory-certified clean sample bottles are to be used for all samples. Specific bottles (bottle construction material, volume, etc.) are designated for sampling for particular parameters. The prepared bottles should be sorted by size and type, and stored in sealed in coolers or transparent plastic bags with the lids in place.

Bottles that are to be used for bacterial testing must be autoclaved (sterilized). Autoclaved bottles are provided by the laboratory.

Sample bottles are to be labelled prior to sampling and will include the following:

- Sample I.D.
- Client Name (EBA) and Project No. (14676)
- Date and Time of sampling
- Sampler's Initials.

Although permanent markers can be used to identify sample bottles, these markings can be erased with wear and may not be clearly legible. All bottles from EnviroTest

Laboratories are equipped with labels. The labels should be secured with transparent tape after labelling with a permanent marker. Replacement labels are also stored with the bottles, and can be applied over the original label only when the surface is dry, also secure these labels with transparent tape.

4.3.2 Sample Preservation

Samples should be analyzed as soon as possible, as changes in water chemistry can occur within one hour after sampling if steps are not taken to preserve samples. Because it may take several days to transport the samples from the field to the analytical laboratory, procedures are utilized to preserve the samples to conditions as close as possible to the original condition.

Two main preservation techniques are utilized:

1. Temperature Control

   Refrigeration of samples at 4°C is the most common field preservation technique. Most samples should be stored in a cool, dark cooler to prevent changes in water chemistry.

   All samples at the tannery are to be kept cool. Because sampling will be conducted shortly before transport, samples will be kept cool using ice-packs in the sample cooler.

2. Chemical Preservation

   This usually involves the acidification or alkali addition immediately following sample collection. For the parameters to be analyzed at the tannery, acidification is used, which includes the addition of very small aliquots of either sulphuric, nitric or hydrochloric acid that is provided by the laboratory.

Table 5 summarizes the sample bottles required for analysis of each waste stream, the preservatives that must be added to the samples at the time of collection, and the respective colour coding of each of the sample bottles. Bottles are colour coded according to the preservation requirements.

Table 5 Sample Containers

Parameter(s)	Container Label	Colour Code	Container Type	Preservative
Total Ammonia, Sulphate, Sulphides, Phosphorus	NUTRIENTS	Purple	500 ml Polyethylene	2 ml 1:1 H_2SO_4
pH, Total Suspended Solids (TSS), Chlorides	ROUTINE	--	500 ml Polyethylene	None
pH	ROUTINE	--	500 ml Polyethylene	None
Total Metals (As, Cu, Cr, Cd, Pb, Ni, Se, Zn)	METALS	Blue	250 ml Polyethylene (wide mouth)	5 ml 20% Nitric Acid
Biological Oxygen Demand	(BOD_5)	--	Sterile / autoclaved 1000ml Polyethylene (wide mouth)	None
Chemical Oxygen Demand	COD	Orange	175 ml amber bottle	None
Xylenes	BTEX	White	2 – 250 ml amber bottles	0.5 ml 1:1 HCl
Oil & Grease	OIL & GREASE	Yellow	1000 ml amber glass (wide mouth)	2 ml at 1:1 HCL
Phenols	PHENOLS	Orange	175 ml amber bottle	None

4.3.3 Record Keeping and Data Storage

A Chain of Custody form, also called an Analytical Request Form, must be completed and accompany each shipment of samples to the laboratory from the tannery (see the following section regarding sample storage and shipment). The Chain of Custody form is completed in triplicate; the original (white copy) is to accompany the samples to the lab. The other two copies (pink and yellow) are to be kept in the Sampling Log Book. A sample Chain of Custody form is included in Appendix C.

The Sampling Log Book is a dated journal in which the sampler records the details of each sampling event, including what samples were collected, any field measurements collected, and any observations or deviations from the standard sampling protocol (this QA/QC Sampling Plan) that were made during sampling. The Sampling Log Sheet included in Appendix D can be photocopied and comprise

a binder, or can be used as a guide when filling in a Sampling Log Book contained within a bound book.

Additional information can be useful when inquiries are made into the meaning of sample data at a later date. The sampler should record any information that may have a bearing on the analytical results, such as weather conditions (if sampling is completed outside), how long after the process the effluent was sampled, and any unusual conditions at the site. Any necessary deviations from standard procedures ***must*** be recorded.

Data storage is an important component of good quality assurance. The Sampling Log Book should be maintained at the tannery in a designated location where it will not be damaged or lost. As an additional measure, the completed Chain of Custody form should be faxed to the environmental consultant, EBA, following the shipment of each set of samples. EBA staff will review the chain of custody form and can follow up by telephone, and request information or copies of the Sampling Log Book, if required.

4.3.4 Sample Storage and Shipment

All effluent samples collected will be analyzed at the laboratory for time-sensitive parameters, and therefore it is necessary to conduct the sampling as soon as possible prior to shipment. According to Standard Methods for the Examination of Water and Wastewater, Biological Oxygen Demand (BOD) determination should be conducted within one hour after collection if possible, or within 24 hours with refrigeration at 4°C. So every effort should be made to minimize the time between collection and analysis.

Samples will be shipped from the tannery to EnviroTest Laboratories in Edmonton via First Air Cargo. Regular scheduled flights depart on Mondays and Wednesdays, which are able to transport the water samples from Qikiqtarjuaq to Edmonton within 16 hours. Laboratory personnel will pick-up the samples at the Edmonton International Airport at 10pm the same day, and will process the BOD samples immediately upon returning to the laboratory, resulting in a 17-18 hour time period between collection and analysis.

The following is the flight schedule for First Air:

Monday	Flight # 829	Departs 09:45
Wednesday	Flight # 908	Departs 10:50

Given that sampling will require up to several hours to complete (depending upon the number of samples and the experience of the sampler), it will be necessary to collect samples very early in the morning (i.e. starting at 6 a.m. or earlier). The sample cooler delivered to the airport at least 30 minutes prior to the flight. It is advisable to communicate with the First Air agent prior to the flight to notify the agent of the sample shipment and to determine if there are any anticipated delays or schedule changes. **Sample coolers must be shipped as guaranteed priority**.

Samples should be packaged in a cooler(s) to minimize the possibility of breakage. Ice packs must be placed into the cooler. Ice packs may include sealed dry-ice containers, or clean plastic sample bottles that have been filled with water and frozen.

The white copy of the chain of custody should be placed in a sealed plastic bag (i.e. Ziploc® and inserted into the cooler, or one of the coolers. The cooler(s) should be wrapped in packing tape to prevent from opening during shipment.

Sample shipment should be **hold for pick-up**, with the following receiver address:

EnviroTest Laboratories
9936 – 67 Avenue
Edmonton, Alberta T6E 0P5
Phone (780) 413-5220 or toll-free 1-800-668-9878

For any questions or concerns regarding sample collection or shipment, Mr. Richard Cook or Ms. Diep Duong of EBA can be reached at (867) 920-2287. The point of contact at EnviroTest Laboratories is Ms. Tammi Hogan, and she can be reached by calling toll-free 1-800-668-9878.

4.4 Field Quality Assurance and Quality Control

Quality Assurance (QA) is a set of operating principles that, if strictly followed during sample collection and analysis, will produce data of known and defensible quality[1]. That is, the accuracy of the analytical result can be stated with a high level of confidence. A high level of quality assurance can be achieved by applying the following principles:

- Personnel conducting water sampling, sample handling and analysis are well trained.
- Facilities and equipment are suitable, well maintained and always kept clean.
- Standard procedures are implemented for the collection and transportation of samples, based on recognized good operating practice.
- Standard analytical procedures are developed and implemented, based on recognized methods that are well suited to the samples being analyzed and the required data quality.
- Laboratory instruments are calibrated using procedures, and at a frequency, recommended by the manufacturer and recognized as good operating practice.
- Laboratory water, reagents and other supplies are of consistent high quality.
- Quality Control (QC) programs are developed and implemented based on recognized good operating practice, to assess the quality of the analytical data and provide warning of unacceptable analytical errors.
- Prompt remedial action is taken to address deficiencies identified by the QC programs.
- Analytical results and QC program results are reported internally and externally using standard procedures

Quality control (QC) is a set of specific procedures used to "measure" the quality of the data produced and correct deficiencies in sampling or analysis, as the occur. Quality control is used by the analyst and sampler to achieve standards of measurement for the three principal components of quality: precision, accuracy and reliability. The components are defined as follows:

Precision A measure of the closeness with which multiple analyses of a given sample agree with each other.

Accuracy A measure of the closeness of the analytical result to the true value.

Reliability A measure of the frequency at which the standards of precision and accuracy are achieved.

Although each component of quality can be achieved without the others, true quality can only be achieved with a combination of all three components.

Different quality control methods can be used to measure each of the components for quality and can isolate the probable source of detected errors. For this reason, a good QC program is made up of a number of recognized methods.

4.4.1 Field Blanks

Field blanks are samples of pure water that are subjected to exactly the same procedures as routine samples and then analyzed. Any measurement of the parameter of interest, above method detection limits, will indicate an analytical error, impurities in the water, or contamination of the sample during the handling process. Combined with the results of other quality control procedures, analysis of field blanks can help to identify a source of contamination.

A set of field blanks should be prepared during each sampling event under the same conditions as other samples are collected. Distilled and deionized water is to be used for most parameters; field blanks for microbiological parameters (i.e., BOD) should be prepared from Type I reagent grade water.

The samples should be preserved and submitted to the laboratory identified as "field blanks", as shown on the example Chain of Custody form in Appendix C.

4.4.2 Sample Replicates

Replicate sampling is the collection of more than one sample for a given analysis, at a given location. Replicate samples are collected, handled, and analyzed using the standard procedures applied to routine samples. Replicate sampling combined with

the results of other QC procedures can indicate sources of errors and are particularly useful in identifying problems in sampling methods.

Each effluent will be sampled initially in triplicate, to identify if there are inconsistencies in sample collection, such as proper mixing of the effluent to obtain a representative composite sample.

In addition, during each subsequent sampling event one replicate sample will be taken of a random waste stream (i.e., effluent A, B, or C), representing as many of the routine analyses as possible.

5.0 ANALYTICAL LABORATORY

The laboratory conducting the laboratory analysis is EnviroTest Laboratories of Edmonton, Alberta. ETL operates their environmental laboratory with high standard of quality and is accredited by the Canadian Association for Environmental Analytical (CAEAL) for all of the analyses required in this program. A description of the company, it's laboratory QA/QC Program, laboratory facilities, staffing, and a list of accredited parameters are provided in Appendix E.

For additional information on analytical methods, quality control and accreditation, ETL may be contacted at the following address:

EnviroTest Laboratories
9936 – 67 Avenue
Edmonton, Alberta T6E 0P5
Telephone 1-800-668-9878

Contact: Ms. Tammi Hogan

REFERENCES

1 American Public Health Association. 1989. Standard Methods for the Examination of Water and Wastewater (17th Ed.)

2 American Standards for Testing and Materials. 1993. ASTM Designation D3370-82, Standard Practices for Sampling Water.

3 Broughton, Linda (P.Eng.). 1996. Quality Assurance and Quality Control Manual: Water Quality Sampling, Canada Tungsten Inc.

4 Csuros, Maria. 1994. Environmental Sampling and Analysis for Technicians. Boca Raton, Florida, CRC Press Ltd.

5 EBA Engineering Consultants Ltd. 2000. Environmental Sampling and Analysis QA/QC Manual for the Colomac Mine.

6 Government of the Northwest Territories, Department of Resources, Wildlife and Economic Development. 1998. Environmental Guideline for General Management of Hazardous Waste.

7 Government of the Northwest Territories, Department of Resources, Wildlife and Economic Development. 1998. Environmental Guideline for Industrial Waste Discharges.

8 Hauser, Barbara. 1996. Practical Manual of Wastewater Chemistry. Chelsea, Michagan, Ann Arbor Press, Inc.

9 Indian & Northern Affairs Canada, Water Resources Division. 1996. Quality Assurance and Quality Control Guidelines (for use by Class "A" Licenses in meeting SNP requirements and for submissions of a QA/QC plan).

10 Manahan, Stanley E. 1994. Environmental Chemistry (6th Ed.) Ann Arbor, Michigan, Lewis Publishers.

11 Nunavut Water Board. 2000. Licence No. NWB4QIK0001 Issued to the Minnguq Tannery.

12 Pan American Centre for Sanitary Engineering and Environmental Sciences. 2001. Guidelines For Treating, Storing and Disposing of Tannery Wastes: Treatment and Disposal Options.

13 Pan American Centre for Sanitary Engineering and Environmental Sciences. 2001. Pollution Limits for Discharge of Tannery Effluents into Water Bodies and Sewer.

14 Queen's Printer of Ontario. 1993. Protocol for the Sampling and Analysis of Industrial / Municipal Wastewater.

15 United Nations Industrial Development Organization. 2000. Pollutants in Tannery Effluents.

\\YEL1\DATA\0701\Projects\2000\00-14676 Tannery\00-14676.001 (Regulatory)\Sampling Plan\report.doc

APPENDIX A
Schedules of Industrial Waste Discharge Guidelines

Schedule I: Standards for Process Effluent Discharged to Municipal Sewage Systems

Concentrations not to be exceeded

PARAMETER	EFFLUENT OBJECTIVE (mg/L)
Aluminum	50
Arsenic	1
Barium	5
Biochemical oxygen demand	500
Cadmium	2
Chlorides	1500
Chromium	5
Copper	5
Cyanide	2
Fluoride	10
Lead	5
Iron	50
Mercury	0.1
Nickel	5
Oil & Grease	150
pH range	6.5-10.5
Phenolic compounds	1
Phosphorus	100
Silver	5
Sulphates	1500
Sulphides	2
Suspended solids	600
Tin	5
Zinc	5

Schedule III: Standards for Solid Waste/Process Residuals Suitable for Landfill

Leachate test results not to exceed 100mg/l	
Parameter	**Parameter**
Ammonia sulphide	Maleic anhydride
Benzidine	Methylamine
Benzyl chloride	Potassium permanganate
Diethylamine	Quinoline
Ethylamine	Strychnine
Ethylenediamine	Tetrachloroethanes

Schedule IV: Standards for Solid Waste/Process Residuals Suitable for Landfill (based on Leachate quality test results)

Parameter	Concentration (mg/L)
Arsenic	2.5
Barium	100
Cadmium	0.5
Carbon Tetrachloride	0.5
Chromium	5
Cyanide(free)	20
DDT	3
Endrin	0.02
Heptachlor + Heptachlor epoxide	0.3
Lead	5
Lindane	0.4
Mercury	0.1
Methoxychlor	10
Methyl ethyl ketone	200
Metolachlor	5
PCBs	50*
Selenium	1
Silver	5
Tetrachloroethylene	3.0
Toxaphene	0.5
Trihalomethanes	10
2,4,5-TP (Silvex)	1
Zinc	500

*Based on Concentration by Mass

APPENDIX B
Proposed Tanning Procedure

SOAK AND SCOUR PROCESS 10 KG DRY SEAL SKINS **JUNE 13, 2000**

STEP #	PROCESS	%	AMOUNT	MATERIAL	TEMP F °	DRUM SPEED	TIME
1	COUNT DRY SKINS INTO DRUM AND RECORD						
2	SOAK	1000	100 L	WATER	80		
		3	300 G	K2302			
		10	1 KG	SALT		1	20
	DUNK AND LAY OVERNIGHT						
3	SOFTEN NEXT MORNING			RUN		5	20
				DUMP			
4	SCOUR # 1	300	30 L	WATER AT 110 ° FOR 95 °			
		0.6	60 G	Soda Ash			
		1.5	150 g	K2302			
	RELOAD SKINS INTO THE ABOVE			RUN		5	60
5	DUMP AND RELOAD						
6	RINSE	300	30 L	WATER	95	5	15
7	SCOUR # 2	DUMP FLOAT					
		300	30 L	WATER	95		
		.45	45 G	SODA ASH			
		.9	90 G	K2302			
				RUN		5	60
8	DUMP AND RELOAD						
	HOT RINSE	300	30 L	WATER	100 FOR 95		
				RUN		5	15
				DUMP FLOAT			
9	COLD RINSE	300	30 L	WATER	80		
				RUN		5	10
	DUMP AND LOAD SKINS INTO EMPTY DRUM						

TANNING PROCEDURE - % BASED ON DRY WEIGHT OF 10 KG

JUNE 13, 2000

STEP #	PROCESS	%	AMOUNT	MATERIAL	TEMP F °	DRUM SPEED	TIME
10	Pretan	30	3 L	Water	80		
		5	500 g	Salt Add dry			
		4	400 g	Relugan GTW		5	20 min
Test S.G. must be over 1.05 (Baume 6 ° a Salometer 27 °) if not add salt							
11	Pickle	1.0	100 g	Basoal S Add dry			
		8.0	800 g	Alum Add dry		5	40 min
Test PH The leather cross section should be about 1.5, if not run longer or add more Alum							
12	Tannage	12	1.2 kg	Chrome Add dry			
				Run		5	3 hrs
Check penetration, if not complete run longer Note: can leave overnight laying chrome.							
13	Neutralization	2	200 g	Neutrigan Add dry		5	30 min
14	Basify	1.0	100 g	Soda Ash}			
		40	4 L	Water }	80	5	
				Run 4 feeds of step 14		each	20 min
				Repeat step 14 until PH = 3.6 then run		5	30 min

If convenient dunk and lay overnight. Dump, if buffing or shaving is needed horse up overnight. Then use formula "fatliquor" for the rest of the wet processing. Leather often improves if stored a day or so at this stage being careful not to let the leather dry out while horsed up.

FATLIQUOR PROCEDURE - % BASED ON 20 KG WET WEIGHT

STEP #	PROCESS	%	AMOUNT	MATERIAL	TEMP F°	DRUM SPEED	TIME
15	WASH	100	20 L	WATER	100	5	20
DUMP, SQUEEZE, RELOAD							
16	NEUTRALIZE	1	200 G	SODA ASH &			
			8 L	WATER (dissolve)	100	5	20
REPEAT STEP 16 UNTIL PH 4.5 IN THE CROSS SECTION							
DUMP & RELOAD							
17	RINSE	100	20 L	WATER	110	5	20
DUMP & RELOAD							
18	FATILIQUOR	100	20 L	WATER }	120		
		10	2 KG	LIPODERM PSE }		5	30
NOTE: FATLIQUOR EXHAUSTION, IF INCOMPLETE RUN MORE OR ADD A LITTLE ACID DUMP, HORSE OVERNIGHT, DRY							

APPENDIX C
Example Chain of Custody Form

nviroTest

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

ANALYSIS REQUESTED:

Telephone: (780) 413-5096 Fax: (780) 437
Telephone: 1 800 668-9378 Fax: 1 800 ...
Telephone: (403) 291-3807 Fax: (403) 291
Telephone: (780) 539-6195 Fax: (780) 513
Telephone: (306) 668-6370 Fax: (306) 668
Telephone: (204) 945-5705 Fax: (204) 945
Telephone: (807) 623-6463 Fax: (807) 623

1505 - 112 Street, Grande Prairie, Albert
General Purpose Bldg. 1st ... F
745 Logan Avenue, Winnipeg, Manitoba
1851 Sutton Street, Thunder Bay, Ontario

DATE: April 19, 2001 DATE REQUIRED: 2 Weeks

SPECIAL REQUIREMENTS / REGS (CIRCLE ONE)

MISA	TIER 1	CCME
BC MELP	AB MUST	
OTHER		

SERVICE REQUESTED:

☑ REGULAR ☐ PRIORITY (...ARGE) ☐ EMERGENCY (100% SURCHARGE)

SAMPLED BY / DATE / TIME	LOCATION OF SAMPLING	SAMPLING METHOD	SAMPLE TYPE
RAC April 19/01 ...			Water
RAC April 18/01 10:20			
RAC April 18/01 10:40			
RAC April 18/01 11:00			
RAC April 18/01 11:20			
RAC April 18/01 11:40			
RAC April 18/01 12:00			
RAC April 18/01 12:05			

ESERVED

...DITIONS ... must b... proper pricing

...nd times will vary dependant on complexity of analysis & La... workload at time of submission. Please contact the Lab to confirm turnaround times.

...ardous samples submitted must be la... must include the nature of the hazard, as we... Lab can contact for further information

RELINQUISHED BY / DATE

NOTE: Shaded areas MUST be completed in full by client for sample processing to occur.

EBA Engineering
... Pook
Box 2244
... NT X1A 2...

BOTTLES SUBMITTED: 8 × 2

PHONE: (867) 920-2287
(867) 873-3324

0701-90-14671

APPENDIX D
Sampling Log Sheet

SAMPLING LOG

Date:_____

Name of Sampler:_____

Sampling start (day/time):_____

Sampling finished (day/time):_____

When did the samples leave Qikiqtarjuaq?_____

Which effluents were sampled?

_____
_____
_____
_____

Briefly describe how the sampling was completed (indoors/outdoors, sampling apparatus)

_____
_____

What QA/QC measures were employed?
(Latex gloves, field blanks, duplicates)

_____
_____

Did anything happen during sampling that may have affected the effluent sample?

_____
_____
_____
_____

APPENDIX E
Lab QA/QC and Accreditation

TABLE OF CONTENTS

APPENDICES:

1.0 COMPANY PROFILE

Enviro-Test Labs was incorporated in the Province of Alberta in 1982 as ETL Chemspec Analytical Ltd., and is owned and operated by a group of eleven managers/shareholders. Enviro-Test Labs is 100% Canadian owned and operated. Since our inception 15 years ago Enviro-Test has specialized in trace level environmental analysis and this is still our focus today. Our professional services include: complete organic and inorganic laboratory services, pesticide/herbicide analysis completed to EPA GLP standards, industrial hygiene lab services (AIHA accredited), pulp and paper lab services, toxicological assessments, dedicated Air Toxics laboratory, R&D and mobile lab services.

Our mission statement is as follows: *"Enviro-Test is dedicated to providing accurate and precise analytical data combined with communication and understanding with the client. Together we work towards these goals in a corporate culture that encourages personal and professional growth as well as a spirit of teamwork amongst all of our staff"*

This mission statement is used on a continual basis within our company to define our short and long term goals and to help develop the shared vision for our company. Enviro-Test has always strived to be a laboratory dedicated to providing a high quality analytical service as well as a high level of communication and innovation. Our commitment to innovation and continuous improvement is illustrated by the following points:

- first private laboratory on the Prairie Provinces to utilize in-house GC/MS capability for target and non-target analysis of organics,
- first, and still only, private laboratory on the Prairie Provinces to utilize in-house high resolution GC/MS capability for the analysis of dioxins/furans,
- first laboratory in Western Canada to offer laboratory quality trace organic analyses in a mobile laboratory environment,
- first private laboratory in Western Canada to be accredited by the American Industrial Hygiene Association,

- first private laboratory in Western Canada to utilize automated LC/MS and LC/MS/MS for the analysis of water soluble and thermally labile compounds,
- first private laboratory in Western Canada to offer summa canister analysis for monitoring organics in ambient air samples.

This commitment to technical excellence in order to meet our clients' changing needs will not vary within our company. Over the past few years we have taken several steps to increase the geographical area that we service. Now that we are firmly established in Alberta, Saskatchewan, Manitoba, and Western Ontario, we will continue to develop our labs to meet the specific client needs of each region. We will continue to offer a high level of service and quality to our clients at competitive prices.

2.0 LABORATORY QUALIFICATIONS AND SERVICES

2.1. Regionally Based Laboratories

Enviro-Test Laboratories is the only company that operates full service environmental soil and water laboratories in all three prairie provinces. ETL operates 4 full service laboratories in all three prairie provinces (Calgary, Edmonton, Saskatoon, and Winnipeg). We also operate two branch laboratories in Grande Prairie, AB and Thunder Bay, ON. ETL employs 200 people in 120,000 sq. ft of lab space.

2.2. Legal Sampling

Enviro-Test Laboratories, Edmonton, and Winnipeg, are the only laboratories recognized by the respective Provincial Crown Prosecutor's office to accept environmental samples that could lead to legal prosecutions. Enviro-Test has developed a very strict protocol on the handling of court case samples, to ensure that the evidence given by our technicians and chemists will stand up in court. Enviro-Test developed a Standard Operating Procedure that was reviewed by the Alberta Crown Prosecutor's office that was followed in several successful court appearances by ETL employees.

2.3. Quality Control

ETL is also one of the very few Canadian laboratories that has been successfully audited by independent US auditors to meet the GLP compliance required to supply analytical data for US EPA product registration. Our QA department has developed the expertise to perform audits for the environmental and operations laboratories of our corporate clients.

As outlined in our covering letter Enviro-Test Laboratories has a very well established quality assurance program with the highest number of accredited tests of any Canadian Laboratory. Enviro-test Laboratories is routinely audited by Canadian & US major clients.

2.4. Sample Turnaround

ETL's most significant improvement in the past year has been our ability to consistently meet turnaround time targets. We have set reasonable turnaround time goals with our major clients than have a committed operations laboratory that ensures they are met. Our **client support group** monitors work flow on a daily basis and provides the close client communications.

ETL has found that 10-20% of our work volume is required on a priority basis. Our regional labs are usually the only lab able to meet same day or next day turn-around times. Our clients have reported to us that our ability to provide this service when required has been extremely valuable and has resulted in some significant cost savings to them.

By establishing regionally based laboratories we have been able to work with each of the local clients and regulatory bodies to ensure the specific needs are well addressed. We have trained the managers and professionals at the regional laboratories to provide the necessary project consultation and data interpretation that has proven to be a valuable support service to our local clients.

2.5. Technical Expertise

ETL employs the largest number of professional support staff of any facility in Canada. These people, who have many years experience in environmental and other analytical, are a valuable support service to our clients to assist in data interpretation, project development and problem solving. A customer support specialist is assigned to ensure that all concerns and questions are well addressed.

2.6 Equipment and Facilities

Enviro-Test operates four full-service laboratories that could complete most of the common environmental analytical requirements. Enviro-Test has internal backups for all major instrumentation required including ICP, AA, and GC/MS. In the event of some extreme situation that required external backup, most tests of interest can also be completed in any of our branch lab facilities, although we do not foresee any circumstance that would require this level of backup capability.

2.7 Sample bottles

Enviro-Test Labs provide all bottles, preservatives and coolers required. All sample bottles utilized by Enviro-Test are purchased as certified clean bottles from a supplier who has passed an audit by Enviro-Test senior management. All lids color coded for the parameters required. Prior to the onset of any major the project a Project Manager is assigned to contact the individual users to review the sample bottles, the coding, the safe handling of the preservatives, holding time issues, proper packaging of the samples, proper completion of the Chain of Custody, and set-up meetings with users to discuss any other requirements.

3.0 QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

Enviro-Test Laboratories' QA/QC program is based on the U.S. EPA FIFRA Good Laboratory Practice (GLP) regulations and CAN/CSA Z753 (ISO Guide 25, specific to environmental testing). You are invited to review this program and our QA manual at any time. Enviro-Test has always encouraged clients to audit laboratories for major projects.

The QA/QC section of Enviro-Test Laboratories consists of a Quality Assurance Manager with a support group of eight Quality Control Supervisors/Coordinators who are committed to QA/QC on a full time basis. The QA Manager coordinates and manages all aspects of the QA/QC program.

Following are the list of standard QA practises.

- Standard Operating Procedures (SOPs) for all methods and procedures.
- NIST traceable calibration standards.
- Method detection limits and precision and accuracy data.
- Maintenance and calibration records.
- Sample tracking procedures.
- Quality control analysis program (10-20%).
- Quality control charting.
- Quality control review and sign-off.
- Interlaboratory check sample program.
- Training seminars, external and internal.
- Personnel training records.
- Facility audits.

3.1 Quality Objectives

Our Quality Assurance program is designed to meet a series of objectives within ETL. Each objective has a corresponding section in the QA Manual that provides more detail on the objective and the system in place to meet the objective.

3.2 Accreditation/Certification

Enviro-Test is accredited or certified by the Canadian Association of Environmental Analytical Laboratories (CAEAL) for most of the parameters of interest for this project. A complete listing of all accreditation/certification information is attached.

3.3 Sample Shipment and Handling

Immediately upon arrival in the laboratory, the samples go through the following "triage" process. If the sample does not conform to the descriptive information provided or if testing, sampling, or other information is not fully specified the log-in coordinator CS specialist will contact the user for further clarification.

3.4 Chain of Custody

Enviro-Test will provide Chain of Custody forms (a duplicate form) to be used with all sample submissions.

3.5 Data Reporting

Final test reports shall be reviewed and signed by the appropriate Division Manager/Supervisor (or designate). No data shall be released without authorization. Any data given verbally over the phone shall be recorded on a *Verbal Communication of Result Form*.

The Customer Service Group will be responsible for ensuring that procedures for sending test results by mail, facsimile, or other electronic means meet client requirements for confidentiality. Authorization, in writing, is required for issuing to a third party. Enviro-Test is well aware of the requirements for client confidentiality as we have been involved in sensitive environmental issues since our inception 15 years ago. You can be assured that this confidentiality is guaranteed.

4.0 ADDITIONAL SERVICES/ VALUE ADDITION

Following are some of the other services that we feel would be of value. A copy of all our analytical services are listed in the attached 1998 User Guide.

4.1 Mobile Laboratory Services

Enviro-Test has proven capability in providing lab quality results in a mobile laboratory setting. The tests completed in the field can range from simple UST related parameters to complex analysis by GC/MS. With our experience in the field we are able to plan a field program and anticipate problems that may arise. We are also able to develop a field specific QA/QC program that will meet the constraints of producing high quality data and still meet the extreme turnaround requirements of a mobile job. These mobile units are most useful in remediation settings and can produce substantial savings not only in analytical costs but also in overall site costs by allowing the contractor to more accurately delineate the area of contamination. This may be of interest for projects where the time constraints make submission to a laboratory unsuitable. By utilizing the onsite laboratories in these situations user's can shorten the time needed for the overall project and thereby reduce the overall project cost. Please note that these units are designed to yield lab quality results that will not require confirmation prior to decision making. Screening techniques are available if required.

4.2 Toxicity Identification Evaluation Studies

Enviro-Test has a wide range of experience in Toxicity Identification Evaluation (TIE) studies. These studies combine toxicity testing screens with fractionation and finally with analyte identification. These studies must be directed by an experienced chemist in order to yield useable results. Dr. D.A. Birkholz is a Ph.D. toxicologist who manages all T.I.E. studies within Enviro-Test and has the necessary background in analytical chemistry and environmental toxicology to provide the proper guidance for these complicated projects. This type of project may have limited applications for this contract however in complex remediation situations it may be an alternative to costly , and in some cases misleading, target compound analysis.

4.3 Air Monitoring and Industrial Hygiene Related Analyses

Enviro-Test is an A.I.H.A. accredited laboratory with the Industrial Hygiene section being managed by a Certified Industrial Hygienist (American Board of Industrial Hygiene). This section provides a wide range of organic and inorganic related analysis in situations related to worker health. As well, Enviro-Test has a fully dedicated Air Toxics Laboratory and can provide stack and ambient air related analysis.

4.4 Information Seminars

Enviro-Test Laboratories provides seminar services to major clients and industries. These are customized to meet the needs of those who are involved in various projects. The senior managers put on short presentations on topics such as:

- Petroleum Hydrocarbons - applications of various analytical methods.
- Sampling and continuity
- Regulatory changes - CCME/Alberta Tier I
- Toxicity Identification Evaluations

4.5 Training and Support

Enviro-Test Labs has provided training programs to many of our clients in assisting them to upgrade on-site operational labs to provide routine fast TAT parameters. This can include any of the following services:

1. On-site training by an experienced analyst.
2. Laboratory audit by our Quality Assurance department. ETL has trained ISO and CAEAL/SCC certified assessors on staff.
3. Training of laboratory technicians at ETL.
4. Provision of required analytical method and QC SOPs.

5.0 STAFF QUALIFICATIONS AND EXPERIENCE

The table on the following page summarizes the key staff. Summary Resumes for most of the senior staff are attached in **Appendix 2.** All analysts must demonstrate proficiency before completing any analysis for clients. As well there are backups for all analysts who have also completed the demonstration of proficiency process.

SENIOR STAFF

Staff	Title	Duties
Dennis Erickson	President/CEO	Oversees management of Enviro-Test Laboratories corporate. + 20 years experience.
Brandon Greene	Corporate Agronomist	Oversees the agricultural soil, feed and plant tissues testing services.
Larry Serbin, CIH	Manager of Industrial Hygiene & Air Toxics	Manages the industrial hygiene & air toxics programs + 18 years experience.
Richard Clara	Thunder Bay Lab Manager	Oversee all aspects of day to day operations of the Thunder Bay operation.
Gordon Nelson	Edmonton Lab Manager; Corporate Vice President	Oversee all aspects of the day to day operation of the Edmonton facility. Oversee the functions of the various ETL locations. + 15 years experience
Roy Jones	Edmonton Inorganic Lab Manager	Oversees all aspects of the ETL Edmonton inorganic dept. day to day operation. Review all inorganic reports/data prior to release. + 18 years experience
Dr. Deib Birkholz	Director Research and Development	Responsible for corporate research & development and providing consultative & problem solving services to our clients + 20 years experience
Doug Johnson	ETL Edmonton Trace Organics Manager	Oversees all aspects of the operation of organics in ETL Edmonton. Will review all data for PAHs & VOCs.
Beth Weitzel	Corporate QA Manager	Oversees and manages the QA program for ETL. Reviews concerns brought to her by regional QA supervisors and coordinators. + 15 years experience
Wanda Young	Winnipeg Lab Manager	Oversee all aspects of the day to day operation of the Winnipeg facility. + 18 years
Don LaBerge	Calgary Lab Director	Oversee all aspects of the day to day operation of the Calgary facility. + 20 years experience
Nick Pidskalny	Saskatchewan Lab Manager	Oversee all aspects of the day to day operation of the Saskatchewan facility.
Erv Callin	Director Environmental Services	Oversees all environmental programs and manages client support and liaison. + 20 years experience
Gary Bruns	Manager, Pesticide Residues	Oversees all aspects of pesticide residue analysis for ETL. + 20 years experience

APPENDIX 1

EQUIPMENT AND FACILITIES

1. Mass Spectrometers

- Hewlett Packard 5972 Series II MS with a 7673 autosampler and UNIX data system. This equipment is used for high sensitivity selected ion work.
- One Hewlett Packard 5972 series II MS with a 7673 autosampler and 486 computer system.
- Hewlett Packard 5988A Research Grade Gas Chromatograph/Mass Spectrometer system. Autosampler, MS Chem station with colour computer. This instrument is dedicated to volatiles and is equipped with a Tekmar 7000 automated headspace system.
- A Hewlett Packard 5970 MS connected to a Nutech Desorption System used for volatile organic air analysis.
- Hewlett Packard Gas Chromatograph/Mass Selective Detector 5970 series with a Tekmar LSC 2000 Purge and Trap unit and a 2016 automatic liquid sampler. This also has a series 3000 model 319 Unix workstation and 59944A Chemstation Unix 'A' software including Target 1 software.
- Gas Chromatograph/Mass Spectrometer - Finnigan-Mat Incos 50 GC/MS/DS system, autosampler, chemical ionization, negative chemicalionization, 50,000 compound NBS library.
- Four Gas Chromatograph/Mass Selective Detectors, Hewlett Packard 5971A, with 7673A autosamplers used for high sensitivity, selected ion work.
- Four Gas Chromatograph/Mass Selective detectors (GC/MSD) Hewlett- Packard 5970 series two with 7673A autosamplers used for high sensitivity selected ion work.
- Two Gas Chromatograph/Mass Spectrometers - 5993-C Hewlett-Packard with 31,000 compound NBS library and full data system, floor model.
- Hewlett Packard 5985 Research Grade Gas Chromatograph/Mass Spectrometer system with autosampler chemical ionization and negative chemical ionization. NBS Library.
- Two Varian Saturn 2000 Ion Trap GC/MS units; one with MS/MS capability.

2. Gas Chromatographs

- Nine Hewlett-Packard 5890 GC systems. Equipped with FID, PID and/or ECD detectors, autosamplers, data systems, and two purge and trap systems with automatic samplers.
- One Hewlett - Packard 5840 GC system equipped with FID.
- One Hewlett - Packard 5790A GC system equipped with FID
- Two Varian 3500 Capillary GC systems equipped with ECD and/or FID detectors, Varian GC Star Data System
- One Varian 3600 with dual FID and dual autosamplers
- One Varian Model 3400, FID, ECD, Dual Capillary, Vista 401 integrator and autosampler
- One Varian Model 3400 with FID and autosampler
- Two Varian Model 6000 GC systems equipped with ECD, NPD and/or FID, autosamplers and Vista 402 data systems
- Varian Model 4600B with Vista 402 data system. GC equipped for Gas analysis by FID and TCD
- Varian Model 3700, FID, ECD, NPD, Capillary and Packed, Vista 401 integrator
- One Shimadzu GC-14A equipped with FID, TCD and a Shimadzu C-R4ax chromatrix integrator

3. Liquid Chromatograph Systems

- One PE Sciex API 2000 LC/MS/MS Triple Quadrupole Mass Spectrometer with a Turbo Ionspray interface. The system is equipped with a PE series 200 micor LC pump and autosampler.
- One Sciex APE III Plus LC/MS/MS Triple Quadrupole Mass Spectrometer with Turbo Ionspray and Heated Nebulizer interfaces. This system is equipped with a Varian gradient HPLC system and Waters refrigerated Autosampler. A Waters post-column pump can also be used for addition of modifiers.
- One Sciex API 150 EX LC/MS Single Quadrupole Mass Spectrometer with Turbo Ionspray and Heated Nebulizer interfaces. The system is equipped with a Varian Gradient HPLC system and Waters refrigerated autosampler.

3. Liquid Chromatograph Systems

- One Finnigan SSQ710 LC/MS with TSP (thermospray) interface with discharge ionization and positive/negative CI. This system is equipped with a refrigerated Waters electronic autosampler. The ULTRIX 30 operating system controls the HPLC, post column pump, autosampler and the eluent valve switch. The LC/MS routinely operates int he automated mode allowing for good sample throughput and precision. We have had over 3 years of experience operating the LC/MS and found it to be very reliable when operated in the selected ion mode using eluent switching.
- Varian Vista 5500 - HPLC Ternary system with model UV-200 detector and oven control. Shimadzu RF 5000u scanning Spectrofluorophotometer
- Two Varian Vista 5000 - HPLC Ternary systems with model UV-100 detector and oven control
- Two Waters 510 Gradient - HPLC system with oven control and a Kratos Spectroflow 980 programmable fluorescence detector Waters 470 fluorescence detectors and a Waters 848 UV detector. Waters post column pumping system included to complete specific pesticide analysis. The system is connected to a Varian Star Data System.
- An Automated Waters 600E Gradient system with in line Waters model 450 UV detector connected to a Varian integrator
- Waters 600E Gradient system with in line Waters 484UV detector and a Waters 470 fluorescence detector automated with a Waters 715 Ultra WISP
- Three Waters 712 WISP auto samplers
- Beckman system Gold LC system
- Dionex DX-100 conductivity and analytical pumping system including autosampler and a Spectra Physics 4400 Integrator
- Waters 590 LC connected to 430 conductivity detector and the Waters 740 data system
- Varian Star Workstation
- Hewlett-Packard - 3392A integrator

4. Purge and Trap Equipment

- Three Tekmar LSC 2000 Purge and Trap samplers, GC/MS, FID/PID on HP 5890 GCs. Each system is automated with either a Tekmar 2016 sampler or a Tekmar 2050 autosampler
- One Tekmar LSC 2000 Purge and Trap connected to a Dynatech PTA-30 Purge and trap 5970 Mass Spectrometer.
- Tekmar Purge and Trap Autosampler ALS 2050
- Four Varian Genesis Headspace systems connected to three Varian 3400 PID/FID and a Varian 6000 PID/FID
- One Tekmar 7000 Headspace system connected to a HP 5988A GC/MS system
- One S.P.M.E. automated autosampler

5. ICP and Atomic Absorption Spectrometers

Seven ICP spectrometers

- Two Perkin Elmer 6000 ICP Mass spectrometer for trace metals
- One Perkin Elmer Optimal 3000 ICP spectrometer with ultrasonic nebulizer

Eighteen Atomic Absorption Spectrometers including:

- One Varian Spectra 400 Atomic Absorption Spectrophotometer equipped with a graphite tube atomizer and a hydride / cold vapour generation system
- One Varian 600Z Atomic Absorption Spectrometer with Zeeman background correction and graphite furnace
- One Varian Spectra AA 600 Atomic Absorption Spectrometer
- One Varian Spectra AA250 Atomic Absorption Spectrometer with graphite tube atomizer
- Two Varian 1275 Atomic Absorption Spectrometers
- One Perkin Elmer 2380 Atomic Absorption Spectrometer

6. Analyzers

- Dionex 100 Ion chromatograph with conductivity detector
- Two Dionex QIC ion chromatographs and one Waters 712 WISP ion chromatograph

6. Analyzers

- Seven technicon continuous flow systems with auto distillation and dialysis
- Three Lachat Flow Injection Analyzers
- Cobas Fara discrete analyzer
- Questron HP & LP
- Shimadzu TOC 5050 total organic carbon analyzer
- Buck Scientific Mercury Analyzer
- Pharmacia 130 Mercury Analyzer
- Leco CHN Analyzer
- Bauck/Simpson Titrator
- Phenol and Cyanide autoanalyzer system
- Two Mettler Titrators
- Spectronic 1001 Plus UV/Vis Spectrophotometer
- Perkin Elmer 681 Infrared Spectrophotometer
- Abbott ABA-101 Bichromaric Analyzer
- Uranium Analyzer

7. Mobile Lab Equipment

- One 35 foot Mobile Laboratory equipped with two gas chromatographs and computerized integration. A self contained unit equipped with two generators, solvent waste system, purging system, fumehood and lab benching. The unit is made for customization.
- One twenty-six foot Mobile Laboratory equipped with two gas chromatographs and computerized integration. One Varian 3500 with FID/ ECD Detectors, and an 8100 Autosampler. One Varian 3400 with PID/FID Detectors and a semi-automated headspace apparatus. The mobile laboratory is a self contained unit equipped with two generators and a solvent waste system, purging system, fumehood, lab benching, portable phone and fax machine.
- One Raised Roof Van equipped with gas chromatograph and computerized integration. A Varian 3400 with gas chromatograph PID/FID detectors and a semi automated headspace apparatus. The van is a self
  contained unit equipped with its own lab benching, generator, waste system, purging system and portable telephone.

7. **Mobile Lab Equipment**

- One portable Sentex Scentograph gas chromatograph equipped with argon ionization detector. Designed for field BTEX analysis

8. **Three AOX analyzers,** Mitsubishi TOX-10

9. **Automated GPC system** with fraction collector, valve controller and a Waters LC pump, T10/35

10. **Balances**

- One micro 6 place balance
- Seventeen analytical 4 & 5 place balances
- Fourteen top loading 2 place balances
- Five top loading 1 place balances

11. **Computing Facilities**

- Edmonton(South)
  Novell Netware 3.11 (100 users) network consisting:
  - server ETL-1(Pentium 75MHZ, 64MB RAM, 6.5 GB HD storage)
  - server ETL-2(486DX 66MHZ , 64 MB RAM, 2 GB HD storage)
  - 90+ PC workstations(Pentium, 486DX, 386DX)
- Edmonton(Downtown)
  Novell Netware 3.12 (10 users) network containing:
  - server ETL-3(486DX 33MHZ, 16 MB RAM, 1 GB HD storage)
  - 6 PC workstations (486DX, 386DX)
- The satellite locations (Edmonton(Downtown), Calgary) are connected to main server (ETL-1) through ISDN lines.

12. **Sample Storage**

- Five 8'× 10' walk in coolers, temperature controlled and monitored daily, with alarm systems. One cooler is in the Calgary location
- Three 8'× 16' walk in freezers, temperature controlled and monitored daily, with alarm systems
- Two 10'× 28' walk in freezers, temperature controlled and monitored daily, with alarm systems

13. Other Equipment

- Eleven rotary evaporator systems
- Four muffle furnaces
- Six distillation racks (soxhlet)
- Four centrifuge systems, including two refrigerated high speed models
- Three vacuum desiccators
- Three Turbo-Vap evaporator systems
- Three sample refrigerators
- Five sample freezers
- Three ultrasonic baths and an ultrasonic dismembrator, Braun Sonic 2000
- Nine 1600 cfm stainless steel 6' fumehoods
- Questron Microwave Digestor
- CEM Microwave digester
- CEM Microwave extraction unit
- Dissolved oxygen meter
- Three Bouyoucos Dispension units
- Drying facilities for 3000 samples
- Tecator Digestion Units
- Turbidimeter
- Leachate extractor and filter
- Soil dryer
- BOD incubator
- Parr Bomb calorimeter
- Enrauf Noinus Diffractus 582 X-Ray Diffractometer
- Beckman LS-100 Liquid Scintillation Counter
- Canberra Series 100 Multichannel Gama Spectrometer
- Virtis Cansul 12 Lyophilizer

SECURITY

- The laboratory has an on-line security system for instant police and fire response
- All GLP raw data and final reports are stored in a locked secure area with limited access

Main Laboratory and Head Office
9936 - 67 Avenue
Edmonton, Alberta
T6E 0P5

Phone: (403) 413-5227
Fax: (403) 437-2311

Toll free number 1-800-668-9878
Emergency number (403) 988-4072

Downtown Laboratory
2nd Floor, 10158 - 103 Street
Edmonton, Alberta
T5J 0X6

Phone: (403) 413-5265
Fax: (403) 424-4602

Calgary Laboratory
Bay 2, 1313 - 44th Avenue N.E.
Calgary, Alberta
T2E 6L5

Phone: (403) 291-9897
Fax: (403) 291-0298

Saskatoon Laboratory
General Purpose Building
124 Veterinary Road
Saskatoon, Saskatchewan
S7N 5E3

Phone: (306) 668-8370
Fax: (306) 668-8383
Toll Free: 1-800-667-soil (7645)

Winnipeg Laboratory
745 Logan Avenue
Winnipeg, Manitoba
R3E 3L5

Phone: (204) 945-3705
Fax: (204) 945-0763

Thunder Bay Laboratory
1081 Barton Street
Thunder Bay Ontario
P7B 5N3

Phone: (807) 623-6463
Fax: (807) 623-7598

Drop-off depots

Lloydminster AB
Dosco
Glen Nelson Industrial Park
5210 62 Street
T8V 2E4

Phone: (403) 875-6131
Fax: (403) 875-2111

Bonnyville AB
BMW Monarch
5520 50 Avenue
T9N 2K8

Phone: (403) 826-7318
Fax: (403) 826-4310

Provost AB
Dosco
PO Box 658
T0B 3S0

Phone: (403) 753-2269
Fax: (403) 753-2824

APPENDIX 2

SENIOR STAFF

DENNIS ERICKSON
President and Chief Executive Officer

Mr. Erickson founded Enviro-Test Laboratories in 1982. He has provided leadership and expertise in Environmental analytical chemistry to industry and government for over ten years. Mr. Erickson is an analytical chemist with over twenty years experience in organic residue chemistry. His specialty in GC/MS, GC and HPLC has been the driving force in the establishment of a major Canadian laboratory dedicated to trace residue organic analysis.

He has developed an expert analytical team consisting of senior managers that have many years of hands-on experience in the fields of environmental analysis, pesticide residue analysis, toxicological analysis and evaluations, industrial hygiene analysis, and quality assurance/quality control.

BETH WEITZEL
Quality Assurance Manager

Ms. Weitzel is a trace organic chemist with specialization in both quality assurance and environmental analysis. Since 1987, Beth has held the full-time position of Quality Assurance Manager answering directly to the Company President. She is responsible for overseeing all aspects of the QA/QC program including implementation of new policies such as EPA Good Laboratory Practices and Responsible Care®, as well as monitoring existing programs. Her specific duties include laboratory audits, employee training, standard operating procedures, quality control (QC) sample preparation, daily QC data reviews and QC charting.

GORDON W. NELSON
Vice President
Laboratory Manager

Mr. Nelson has been with Enviro-Test for over ten years and is Laboratory Manager. Prior to this he was the Manager of the Industrial Chemicals Section at Enviro-Test Laboratories for five years. During his time with Enviro-Test, Mr. Nelson has been involved in most areas of organic environmental analysis including: the analysis for PCBs, volatile and extractable priority pollutants as well as other target and non-target GC/MS analyses, and the analysis of volatile aromatics related to underground storage tank situations. Mr. Nelson is specifically involved in method development with respect to improvement of extraction and sample preparation techniques in order to improve sample throughput and turnaround while meeting all QA/QC criteria. He also is involved in the development and implementation of LIMS techniques to improve data handling efficiency. Mr. Nelson's areas of expertise include the operation and optimization of most analytical instrumentation with emphasis on mass spectral systems.

DOUGLAS JOHNSON
Manager, Trace Organics Division

Mr. Johnson is responsible for managing the Industrial Chemicals division at Enviro-Test Laboratories. This section includes the analysis of PCBs, volatile and semi-volatile priority pollutants as well as other target and non-target GC/MS analyses. He is involved in the assessment of new technologies and the integration of these technologies into a training format for employees through seminars, standard operating procedures and personal guidance. The development, assessment and validation of the "best available technology" to be used in both the laboratory and the field fall into Mr. Johnson's area of expertise. Mr. Johnson has extensive experience with both environmental and pulp & paper chemistries in both hands-on and supervisory capacities.

RON MINKS
Manager, ETL Calgary

Mr. Minks has more than eight years experience in the analysis of environmental samples for EPA 500 and 600 series, SW-846 EPA 8000 Series, ASTM, NIOSH, and various MOE Methods. He was previously employed at Western Research where he was involved in the analysis of volatile and extractable organics for emissions licensing of waste incinerators. Parameters extracted and analyzed for included polychlorinated biphenyls (by congener), polychlorinated benzenes, polychlorinated phenols (by congener), target PAHs, and hazardous substance list for volatile organics. He is experienced with GC/MS, GC with ECD, FID, PID, FPD, NPD, and TCD, as well as the extraction and cleanup of various environmental matrices. Mr. Minks maintains the day to day operation of the Petroleum Contamination Section at Enviro-Test Labs.

DETLEF (DEIB) BIRKHOLZ
Executive Vice-President
Manager, Pulp and Paper Division
Research and Development Division, Director

Dr. Birkholz is responsible for the management of the Pulp and Paper Division, the Dioxin testing facility and the Research and Development Division. The Pulp and Paper Division provides analytical and biological services to the Pulp and Paper industry. His specific research interests include: combined chemical fractionation/bioassay for the isolation and identification of toxic chemicals in complex environmental samples (i.e. toxicity identification evaluations); the use of biomarkers and chemical analyses to assess aquatic organism exposure to and effects of industrial discharges; and developing analytical protocols for the isolation and identification of hazardous substances in complex industrial samples and/or hazardous wastes and the interrelationships between chemical analyses of biological samples and effects on aquatic organisms.

KEN PLUMB
Technical Service Manager

Mr. Plumb has an extensive background in analytical instrumentation. He has over ten years of experience in working with a wide range of instrumentation, including nine years of experience with Varian Instrument Group. Mr. Plumb has the responsibility for instrument maintenance, repair, and analyst training. Mr. Plumb also oversees the operation and procedural changes with the Laboratory Information Management System. In addition, he assists in new method development and installation of new technologies at Enviro-Test.

SCOTT R. LAIRD
Sales Manager

Mr. Laird is responsible for business development and marketing analytical and professional services to the environmental community. He has a background in sales and marketing and will teach courses related to advertising, sales and marketing. He has six years of experience working in the environmental market place with helping to design analytical programs based both on legislative requirements and specific site contaminants. He has a working knowledge of Provincial and Federal Legislation as it pertains to the measurement of contaminants in the environment. He presently is an active member in the Environmental Services Association and sits on the Board of Directors with the CPANS Airs & Waste Management Association, Edmonton, AB chapter.

ERV CALLIN
Director, Environmental Services

Mr. Callin has over 20 years experience as a manager in environmental laboratory analysis. He spent 10 years with Alberta Environment. In his position as manager of Research Services with Chemistry at the Alberta Environmental Centre, he edited the Methods Manual that is still referred to in License Requirements for Alberta industry. For the past seven years until 1993 he was manager of environmental services with Norwest Labs. While at Norwest, he developed the trace inorganic analyses and consulted with clients on major environmental projects. He is very familiar with the environmental analyses to assist clients to meet their regulatory requirements. He is an active member of Laboratory Associations and industry/government committees that review analytical procedures. He is a past president of WEALA and he is presently co-chairman of the AWAC Validation Committee.

ROY JONES
Manager
Inorganics Analytical Division

Previous to joining Enviro-Test Laboratories, Mr. Roy Jones was the lab manager of the laboratory at Chem Security Special Waste Treatment Centre in Swan Hills where he managed a team of laboratory technicians and chemists that used a variety of complex instrumentation including ICP spectroscopy, ion chromatography, and mass spectroscopy. Mr. Jones is very familiar with the special sample preparation procedures and instrumentation required for soil and waste analyses. Prior to joining Chem Security, Mr. Jones was a lab manager at Norwest Labs

LARRY SERBIN
Manager, Industrial Hygiene/Air Toxic Division

Mr. Serbin is a Certified Industrial Hygienist with specialization in chemical aspects of industrial hygiene monitoring and is a Registered Occupational Hygienist with the Canadian Registration Board of Occupational Hygienists. He is responsible for managing the industrial hygiene and air monitoring services at Enviro-Test Laboratories. Mr. Serbin has over twenty years of experience in industry hygiene analytical chemistry. This includes eleven years at Laboratory Services, Alberta Occupational Health and Safety as laboratory supervisor and ten years at Enviro-Test Laboratories as manager of industrial hygiene services.

GARY BRUNS
Manager, Pesticide Residue Division

Mr. Bruns is a Pesticide Residue Chemist with over twenty years of experience in the residue analysis field. He has had extensive hands-on experience with clean-up of complex matrices, GLC, LC/MS, GC/MS and HPLC techniques. Interpretation of data, method development, maintaining GLP (Good Laboratory Practice) compliance and maintaining sample throughput is part of Mr. Bruns' responsibilities.

SUSAN NELSON
Project Supervisor
Pesticide Residue Division

Mrs. Nelson is responsible for supervising the pesticide residue section at Enviro-Test Laboratories. This section includes the analysis of pesticides, herbicides and fungicides in several types of matrices. This section is also required to perform data interpretation and method development while maintaining GLP (Good Laboratory Practice.) Mrs. Nelson is specially involved in method development of new compounds, supervising and maintaining sample throughput, and writing the final GLP reports. She has had extensive experience in operating and optimizing many analytical instruments such as HPLC, GC/ECD, GC/FID, GC/MS, and LC/MS.

RON TAUBER
Project Supervisor,
Pesticide Residue Division

Mr. Tauber has eleven years experience in the agricultural chemical section at Enviro-Test Laboratories. He has gained extensive experience in the HPLC, GC/MSD and LC/MS area. Interpretation of data, method development, validation of methods and supervision of GLP (Good Laboratory Practice) studies and reports are also part of Mr. Tauber's responsibilities. Mr. Tauber's strengths lie in the management and organization of laboratory analysts and technicians involved in GLP studies.

and was responsible for the laboratory analyses of environmental and agricultural analyses of water, soils and feeds. Mr. Jones, with over 10 years experience in lab supervision/management, brings an expertise that will ensure an efficient laboratory operation.

LLOYD HODGINS
Associate - Environmental Reclamation
Mr. Hodgins was the Manager of Environmental Services for Enviro-Test Laboratories - Saskatoon from May 1994 to December 1995. From 1991 - 1994 he served in positions of assistant Director and the QA/QC Manager of the original Plains Innovative Laboratory Services ™ (formerly Saskatchewan Soil Testing Laboratory). He has consulted on a number of international projects in Asia and Africa since 1980. These projects involved the reclamation of Agriculture and Forest Soils.

Prior to that he served as a senior technologist with Alberta Agriculture. He has extensive experience in laboratory technology, operation and procurement. Mr. Hodgins was instrumental in developing the Environmental Services Division of PILS both in terms of methodology and overall process development.

Mr. Hodgins has vast experience in both inorganic and organic chemistry and is involved in the assessment of new technologies and the interpretation of these technologies for the benefit of the laboratory's clientele, especially those in the oil/gas and mining sector.

NICK PIDSKALNY
Laboratory Manager, Enviro-Test, Saskatoon
Mr. Pidskalny received his B.Sc. from the University of Waterloo Ontario (1978) with a focus on physics and chemistry. He continued his education for two years at the University of Calgary to enhance his educational background with specific engineering courses.

Nick has worked in a laboratory setting for 14 years with 12 of those as a Mass spectroscopist at the University of Saskatchewan. Nick has co-authored scientific and technical papers on various mass spectrometry related topics, and remains an active technical consultant in mass spectrometry. Nick holds several certificates of merit and training in aspects of laboratory methodology, operations and safety. Nick joined Enviro-Test Laboratories, Saskatoon in April, 1995.

WANDA YOUNG
Laboratory Manager, Enviro-test, Winnipeg
Ms. Young has over 20 years experience in all areas of organic/inorganic environmental analyses. She is responsible for the day to day operations of the laboratory and is accountable for the effective and efficient delivery of high quality analytical, microbiological and environmental consulting services through a team of chemists and technologists. Her experience includes: development and implementation of hazardous waste protocols under the Dangerous Goods Handling and Transportation Act, development and implementation of methodology for the

testing of aquatic organisms, research development in bioremediation technology, method development: for trihalomethanes, isocyanates in air, polyaromatic hydrocarbon in air accelerants in fire debris, pesticides and PCB in fish, sediment and method development for pesticides and herbicides in water.

DON LABERGE

Laboratory Director, Enviro-Test, Calgary

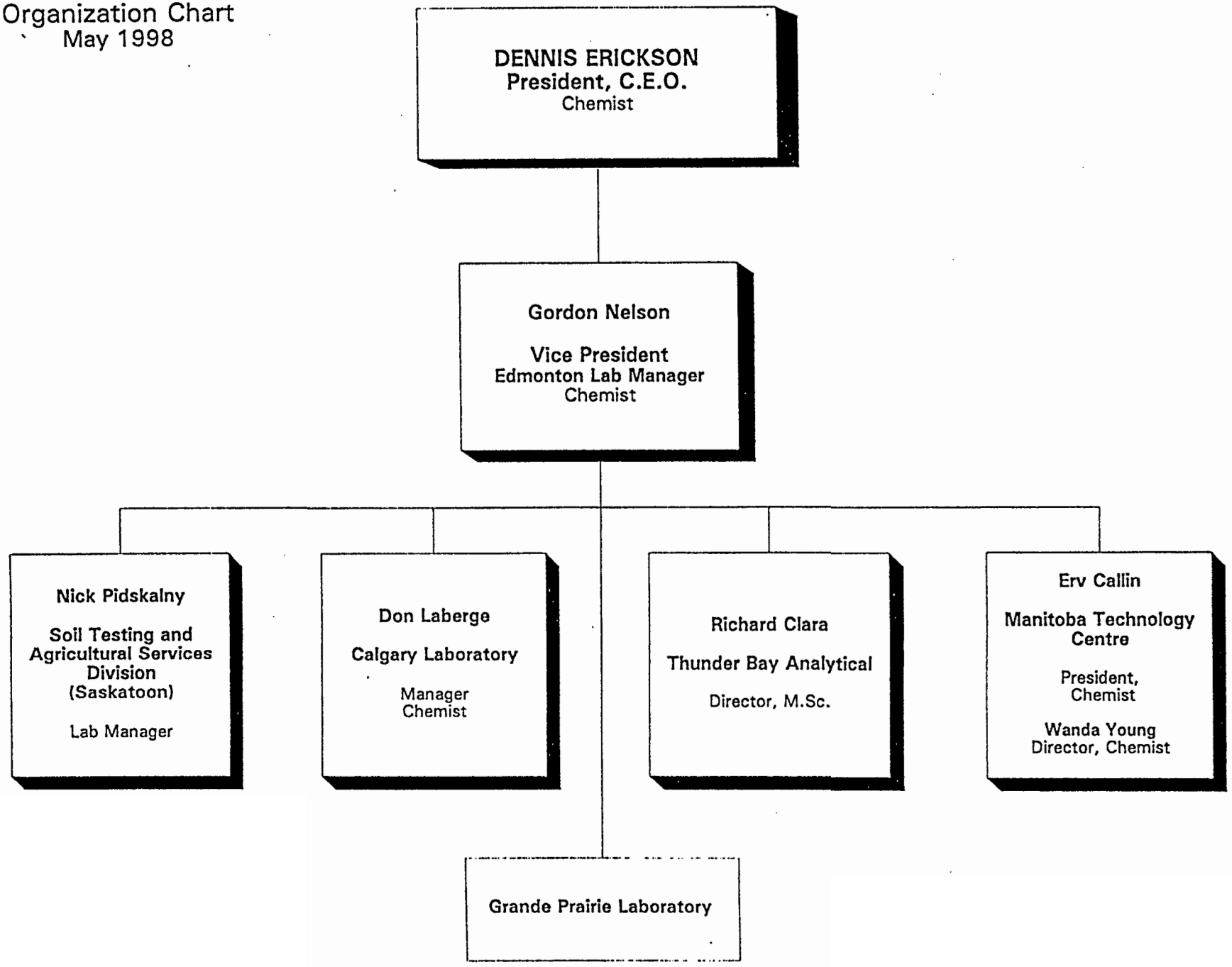
Mr. LaBerge has over 20 years of lab management experience. Prior to joining Enviro-Test he was employed by Chemex Labs Alberta Inc. for 23 years as Manager of the Environmental Division. His responsibilities included managing a staff of seventy-five scientists, chemists and technicians. He had responsibilities for overseeing laboratory operations, quality assurance and computer systems development. Mr. LaBerge has a wealth of expertise in surface, ground and waste water analyses introducing innovative analytical procedures to improve the quality of lower detection limits. He is active in laboratory associations having served as past-president and has been a member of the Board of Directors of the Canadian Association for Environmental Analytical Laboratories since 1989. He has also served on a number of industry/government committees to establish regulatory guidelines and protocols. He is currently the Director of Calgary Operations for Enviro-Test in Calgary and has the responsibility of operations and marketing in Calgary.

ORGANIZATIONAL CHART

Enviro-Test Laboratories

Organization Chart
May 1998

Locations



Enviro-Test Laboratories

Organization Chart

May 1998

Corporate Management

DENNIS ERICKSON
President, C.E.O.

Chemist

GORDON NELSON
Vice President

Edmonton Lab Manager

Chemist

Dr. Detlef Birkholz
Executive Vice President

Chemist, Toxicologist

- Research and Development
- International Development

Beth Weitzel

Quality Assurance/ Quality Control Division

Corporate Manager
Chemist

Erv Callin

Director, Environmental Services

Chemist

- Manitoba Technology Centre

Roy Jones

Corporate Inorganics

Chemist

- Grande Prairie Lab

Don Laberge

Executive Vice President

Chemist

- Calgary Lab

Gary Bruns
Vice President

Agricultural Chemical Services

Director
Chemist

Ken Plumb
Vice President

Technical Services

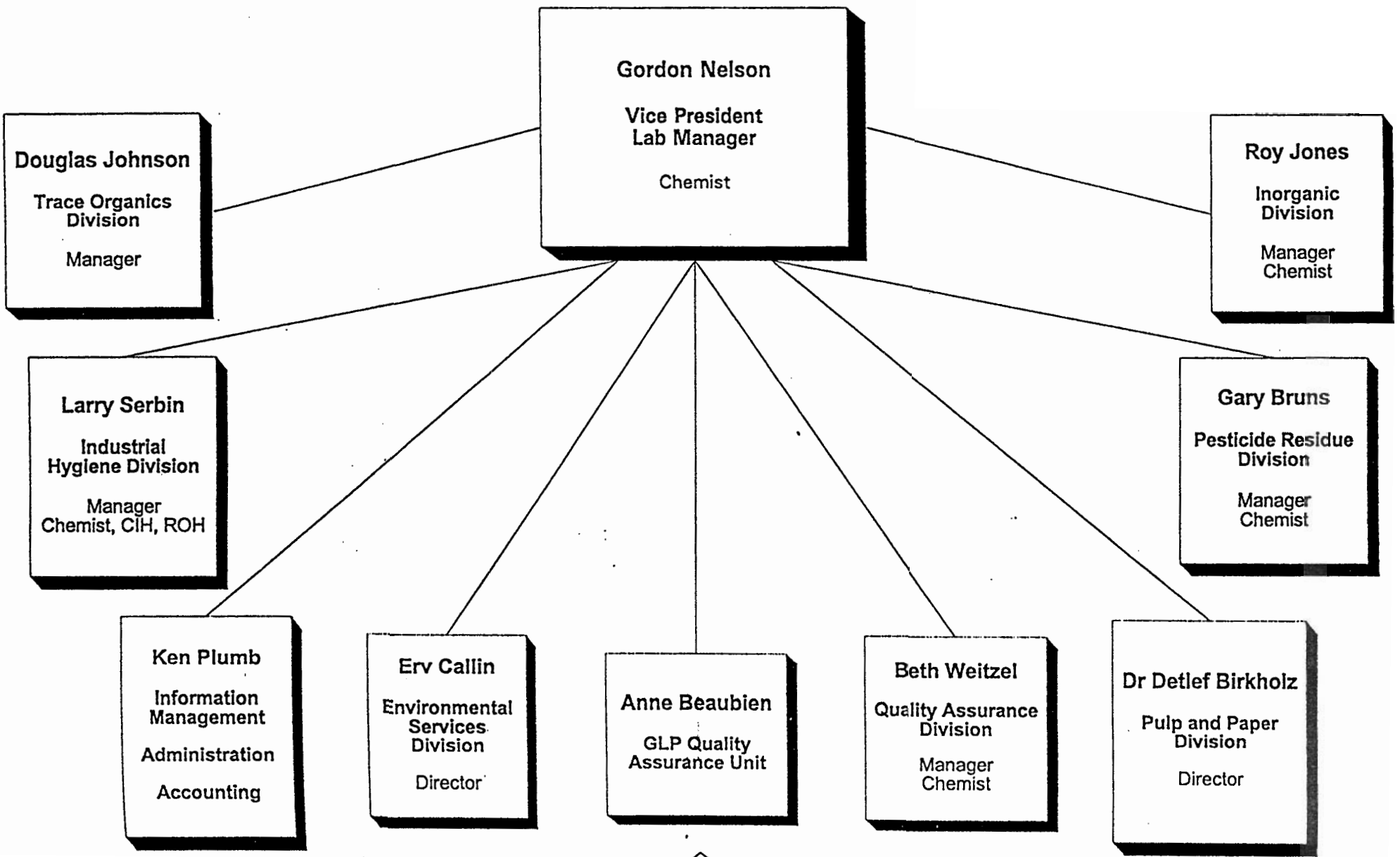
Manager

- Accounting and Finance
- Administration/ Human Resources
- Information Management Sy...

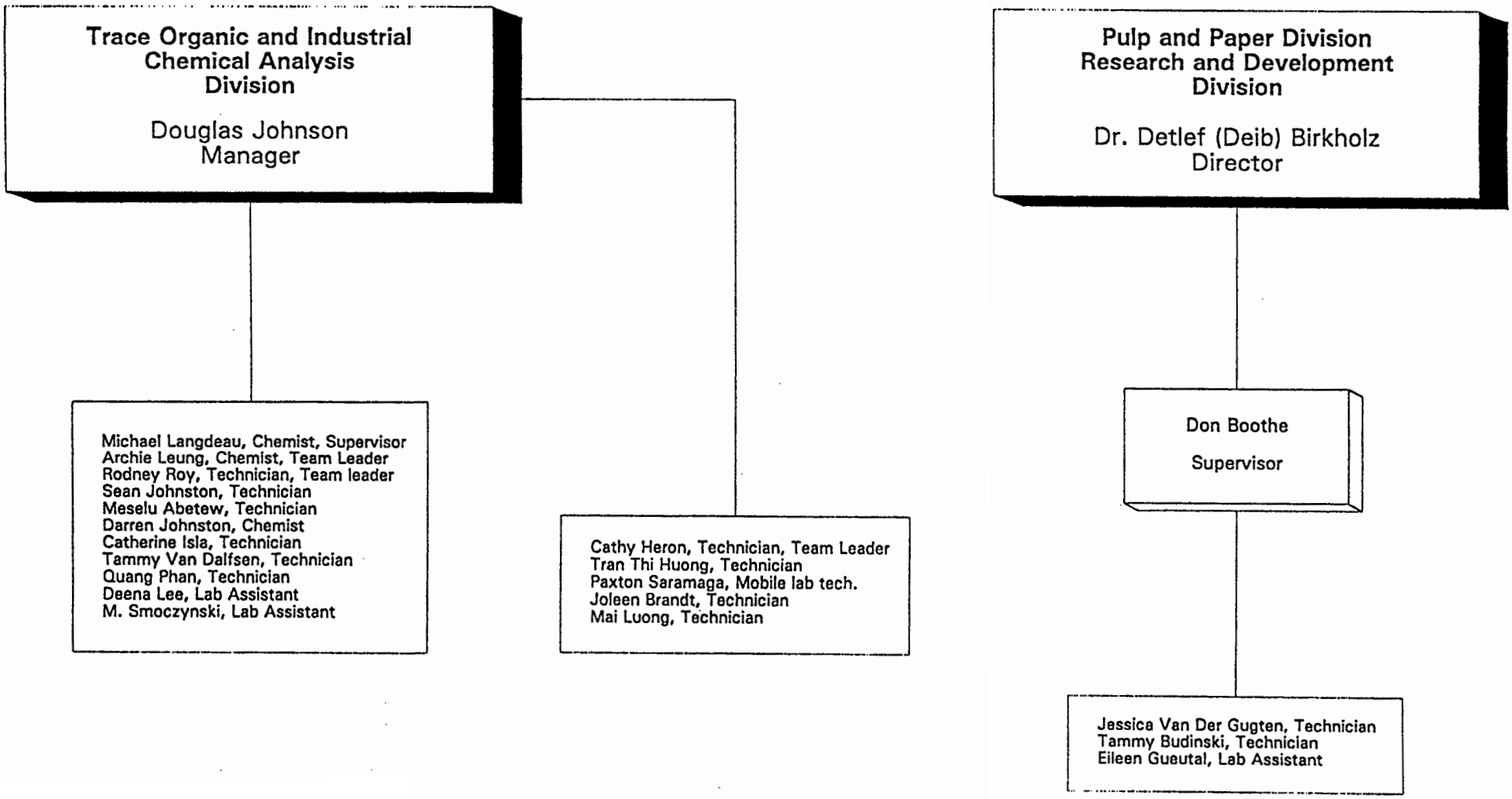
Enviro-Test Laboratories

Edmonton (Head Office)

May 1998



Enviro-Test Laboratories
Edmonton
May 1998



APPENDIX 3

QUALITY ASSURANCE,
NOTICES AND CERTIFICATES OF ACCREDITATION

NOTICES AND CERTIFICATES OF ACCREDITATION

DEC/98

The American Industrial Hygiene Association

is proud to acknowledge that

ETL Chemspec Analytical, Ltd.

Edmonton, Alberta, CANADA

Laboratory ID# 11663

has fulfilled the requirements for Industrial Hygiene Laboratory Accreditation and has earned distinguished recognition as an

AIHA IH Accredited Laboratory

Originally Accredited January 1, 1989, current certificate effective January 1, 1998 until January 1, 2001, subject to continued compliance with AIHA accreditation criteria.

D. Jeff Burton, CIH, PE, CSP
President, American Industrial Hygiene Association

February 4, 1998
Preparation Date

Mark A. Puskar, Ph.D.
Chair, Analytical Accreditation Board

379
Certificate Number

William M. Walsh, CIH
Chair, IH Laboratory Accreditation Committee

CERTIFICATE OF ACCREDITATION

CERTIFICAT D'ACCRÉDITATION

ENVIRO-TEST LABORATORIES

9936-67th Avenue, Edmonton, Alberta

having been assessed by the Canadian Association for Environmental Analytical Laboratories (CAEAL) Inc., under the authority of the Standards Council of Canada (SCC), and found to comply with the requirements of the ISO/IEC Guide 25, the conditions established by the SCC and the CAEAL proficiency testing program, is hereby recognized as an

ACCREDITED ENVIRONMENTAL LABORATORY

for specific tests or types of tests listed in the scope of accreditation approved by the Standards Council of Canada.

ayant été soumis à une évaluation par l'Association canadienne des laboratoires d'analyse environnementale (ACLAE) Inc., sous l'autorité du Conseil canadien des normes (CCN), et ayant été trouvé conforme aux prescriptions du Guide ISO/CEI 25, aux conditions établies par le CCN et au programme d'essais d'aptitude de l'ACLAE, est de fait reconnu comme

LABORATOIRE DE L'ENVIRONNEMENT ACCRÉDITÉ

pour des essais ou types d'essais déterminés inscrits dans la portée d'accréditation approuvée par le Conseil canadien des normes.

Accredited Laboratory No.
No de laboratoire accrédité : 52

Issued on
Émis ce : 1996-05-08

Expiry date
Date d'expiration : 2000-02-07

Richard Lafontaine
President, SCC / Président, CCN

Assessment performed according to the *General Requirements for the Accreditation of Calibration and Testing Laboratories*, CAN-P-4 (ISO/IEC Guide 25), *Requirements for the Competence of Environmental Analytical Laboratories*, CAN/CSA-Z753 and the *Conditions for the Accreditation of Calibration and Testing Laboratories*, CAN-P-1515.
The scope of accreditation is available from the accredited laboratory or SCC.

Évaluation effectuée conformément aux *Prescriptions générales concernant la compétence des laboratoires d'étalonnage et d'essais*, CAN-P-4 (Guide ISO/CEI 25), aux *Exigences visant les compétences des laboratoires de l'environnement*, CAN/CSA-Z753 et aux *Conditions d'accréditation des laboratoires d'étalonnage et d'essais*, CAN-P-1515.
La portée d'accréditation est disponible auprès du laboratoire accrédité ou du CCN.

AUDITS

DEC/98

ENVIRO-TEST LABORATORIES (EDMONTON) - AUDITS . . . cont'd

Client/Organization	Audit Objectives/Parameters/Standard	Frequency/ Date (Year)
BHP Diamond Mines	Site assessment / environmental parameters / BHP contract lab specifications	1997
Syncrude	Site assessment / specific inorganic & organic parameters	1997, 1996
Kimberly Clark	Site assessment / pulp mill parameters	1997
SC Johnson	Facility Inspection / EPA FIFRA GLP regulations	1996
Zeneca	Inspection of study-specific data / EPA FIFRA GLP regulations and specific study protocols	1996
Stone Consolidated	Site assessment / pulp mill parameters	1996
Methanex	Responsible Care® audit	1996
BASF / Grayson Research	Inspection of study-specific data / EPA FIFRA GLP regulations and specific study protocols	1995
Elf Atochem N.A. Inc.	Facility Inspection / EPA FIFRA GLP regulations	1995
Sherritt	Analytical lab supplier survey	1995
James River-Marathon	Site assessment / specific pulp mill parameters	1995

ENVIRO-TEST LABORATORIES (EDMONTON) - AUDITS

Client/Organization	Audit Objectives/Parameters/Standard	Frequency/ Date (Year)
Standards Council of Canada (SCC) / Canadian Association for Environmental Analytical Laboratories (CAEAL)	Surveillance audit to maintain accreditation status for specific environmental tests / CAN/CSA Z-753 (ISO Guide 25)	Bi-annually
American Industrial Hygiene Association (AIHA)	Surveillance audit to maintain accreditation status for specific tests (solvents, asbestos, silica, metals on filters) / AIHA accreditation requirements	Tri-annually
Imperial Oil Limited	Assessment of operational and quality assurance systems / Environmental Analytical Services Contract Requirements	1998
Alberta Power	Contract lab services audit / environmental parameters	1998, 1996
Rhone Poulenc/Pacific Rim Consulting	Facility Inspection / EPA FIFRA GLP regulations	1998, 1997
Placer Dome	Site assessment / metals analysis	1997
Weyerhaeuser Canada Ltd.	Site assessment / pulp mill parameters	1997, 1995, 1994
Weldwood of Canada Ltd.	Site assessment / pulp mill parameters	1997, 1996, 1995
Dow Chemical Canada Inc.	Responsible Care® audit	1997, 1996, 1995

ENVIRO-TEST LABORATORIES (EDMONTON) - AUDITS cont'd

Client/Organization	Audit Objectives/Parameters/Standard	Frequency/ Date (Year)
E.I. Du Pont De Nemours (USA)	Facility Inspection / EPA FIFRA GLP regulations	1989, 1990, 1991, 1993, 1994
Monsanto Agricultural Co.	Facility Inspection / EPA FIFRA GLP regulations	1993
Radian Corporation / Novacor	Contract lab audit / Contract Laboratory Program (CLP) criteria	1993
Ciba Geigy Corporation	Facility Inspection / EPA FIFRA GLP regulations	1992
Browning-Ferris Industries (BFI)	Contract lab assessment / groundwater monitoring and waste analysis parameters	1992
Rohm & Haas (USA)	Facility Inspection / EPA FIFRA GLP regulations	1991

ENVIRO-TEST LABORATORIES (CALGARY) - AUDITS

Client/Organization	Audit Objectives/Parameters/Standard	Frequency/ Date (Year)
Standards Council of Canada (SCC) / Canadian Association for Environmental Analytical Laboratories (CAEAL)	Surveillance audit to maintain accreditation status for specific environmental tests / CAN/CSA Z-753 (ISO Guide 25)	Biannually

ENVIRO-TEST LABORATORIES (GRANDE PRAIRIE) - AUDITS

Client/Organization	Audit Objectives/Parameters/Standard	Frequency/ Date (Year)
Weyerhaeuser Canada Ltd.	Site assessment / pulp mill parameters	1998, 1997

ENVIRO-TEST LABORATORIES (SASKATOON) - AUDITS

Client/Organization	Audit Objectives/Parameters/Standard	Frequency/ Date (Year)
Standards Council of Canada (SCC) / Canadian Association for Environmental Analytical Laboratories (CAEAL)	Surveillance audit to maintain accreditation status for specific environmental tests / CAN/CSA Z-753 (ISO Guide 25)	Biannually
Canadian Food Inspection Agency (CFIA)	Surveillance audit to maintain accreditation status / fertilizer and animal feed testing	Bi-annually

ENVIRO-TEST LABORATORIES (WINNIPEG) - AUDITS

Client/Organization	Audit Objectives/Parameters/Standard	Frequency/ Date (Year)
Standards Council of Canada (SCC) / Canadian Association for Environmental Analytical Laboratories (CAEAL)	Surveillance audit to maintain accreditation status for specific environmental tests / CAN/CSA Z-753 (ISO Guide 25)	Bi-annually
American Industrial Hygiene Association (AIHA)	Surveillance audit to maintain accreditation status for specific tests (solvents, asbestos, metals on filters, and bulk asbestos) / AIHA accreditation requirements	Tri-annually
Standards Council of Canada (SCC) / Canadian Food Inspection Agency (CFIA)	Accreditation audit for specific microbiological tests in food / ISO Guide 25 (as interpreted by Eurachem)	1998
Browning-Ferris Industries (BFI)	Contract lab assessment / landfill site monitoring and well water analysis	1998

ENVIRO-TEST LABORATORIES (THUNDER BAY) - AUDITS

Client/Organization	Audit Objectives/Parameters/Standard	Frequency/ Date (Year)
Standards Council of Canada (SCC) / Canadian Association for Environmental Analytical Laboratories (CAEAL)	Accreditation audit / environmental tests / CAN/CSA Z-753 (ISO Guide 25)	1998
Abitibi-Consolidated	Site assessment / TP, VOA	1998
Kimberly Clark Corporation	Site assessment / environmental tests	1997
Placer Dome Canada	Site assessment / environmental tests	1997
Dow Chemical	Site assessment / product testing	1997

INTERLAB CHECK SAMPLE PARTICIPATION

DEC/98

ENVIRO-TEST LABORATORIES (EDMONTON) PERFORMANCE EVALUATION PROGRAMS

Program	Analysis	Frequency
Canadian Association for Environmental Analytical Laboratories (CAEAL)	(water) PAHs, BTEX, THMs, routines, metals, nutrients, solids, BOD, CN; (soil) metals, PAHs; (oil) PCBs; (filter) metals	Semi-annually
American Industrial Hygiene Association (AIHA): NIOSH-PAT	solvents, asbestos, silica, metals on filters	Quarterly
Alberta Water Analysts Committee (AWAC)	Metals, nutrients, major ions, and demand parameters	Quarterly
PHH Environmental	Filter sample exchange for fibre counting	Semi-annually
National Water Research Institute (NWRI)	Major ions, nutrients, and metals	Semi-annually
Association of the Chemical Profession of Ontario (ACPO)	hexavalent chromium, sulfate, TDI, formaldehyde, solvents in air, lead in blood	Quarterly
Quebec Centre of Toxicology	Lead in urine	Bimonthly
Centre of Disease Control (CDC)	Lead in blood	Semi-annually
Ryerson Polytechnic University	Fibre counting	Semi-annually

ENVIRO-TEST LABORATORIES (CALGARY) PERFORMANCE EVALUATION PROGRAMS

Program	Analysis	Frequency
Canadian Association for Environmental Analytical Laboratories (CAEAL)	(water) BTEX, routines, metals, nutrients, solids; (soil) metals; (filter) metals	Semi-annually

ENVIRO-TEST LABORATORIES (SASKATOON) PERFORMANCE EVALUATION PROGRAMS

Program	Analysis	Frequency
Canadian Association for Environmental Analytical Laboratories (CAEAL)	(water) routines, solids; (soil) metals	Semi-annually
Association of American Feed Control Officials (AAFCO)	Feed testing	Monthly
Magruder Fertilizer Check Sample Program	Fertilizer analysis	Monthly
North American Proficiency Testing Program (NAPT)	Soil testing	Quarterly
National Forage Testing Association	Feed testing	Bimonthly

ENVIRO-TEST LABORATORIES (WINNIPEG) PERFORMANCE EVALUATION PROGRAMS

Program	Analysis	Frequency
American Industrial Hygiene Association (AIHA): NIOSH - ELPAT	Lead in paint chips	Quarterly
American Industrial Hygiene Association (AIHA): NIOSH - EMPAT	Fungal Identification	Three per year
American Industrial Hygiene Association (AIHA): NIOSH - PAT	Metals on filters, asbestos, solvent	Quarterly
American Industrial Hygiene Association (AIHA) - NIOSH - Bulk	Asbestos - bulk	Quarterly
Alberta Water Analysts Committee (AWAC)	BOD, TOC, COD, oil & grease	Semi-annually
Canadian Association for Environmental Analytical Laboratories (CAEAL)	(water) PAHs, BTEX, THMs, OC pesticides, and PCBs, routines, metals, nutrients, solids, reactive silica, BOD, CN, trout LC50, daphnia LC50, microtox EC50, fecal and total coliforms; (soil) metals, PAHs; (oil) PCBs; (filter) metals, anions	Semi-annually
Canadian Certified Preference Materials Project	Mineral analysis (gold, silver, copper, cobalt, nickel, lead, zinc) in rock	Semi-annually

ENVIRO-TEST LABORATORIES (WINNIPEG) PERFORMANCE EVALUATION PROGRAMS . . . cont'd

Program	Analysis	Frequency
Canadian Food Inspection - Freshwater Institute	Mercury in fish	Annually
Canadian Food Inspection Agency	Salmonella sp, coliforms, HPC, listeria sp., E.coli, staphococcus aureus, and yeasts and molds in a variety of matrices (milk powder, evaporated milk, eggs, cheese, butter, feed, and meat.)	Two to four food types per month
Centre of Disease Control	Fluoride in water	Monthly
Food & Drug Administration (FDA)	Serotyping for Salmonella, coliforms, Ecoli	Annually
National Performance Audit Program	Air high volume filters	Annually
National Water Research Institute	Major Ions, trace metals, mercury in water	Annually
Quebec Centre of Toxicology	Pb in blood, Hg in urine & blood	Bimonthly
Western Canada Microtox Users Committee	Microbial toxicity	Semi-annually
U.S. Environmental Protection Agency (EPA)	Pesticides, herbicides, PAH in water	Annually

ENVIRO-TEST LABORATORIES (THUNDER BAY) PERFORMANCE EVALUATION PROGRAMS

Program	Analysis	Frequency
Canadian Association for Environmental Analytical Laboratories (CAEAL)	(water) routines, metals, nutrients, solids, BOD, CN, total coliforms, fecal coliforms.	Semi-annually
Alberta Water Analysts Committee (AWAC)	Metals, nutrients, major Ions, and demand parameters	Quarterly
Kimberly Clark Corporation	BOD, TSS, COD, pH, TP, ammonia	Monthly

QUALITY ASSURANCE

DEC/98

INTRALABORATORY QUALITY CONTROL

Enviro-Test Laboratories' QA/QC program is based on the U.S. EPA FIFRA Good Laboratory Practice (GLP) regulations and CAN/CSA Z753 (ISO Guide 25, specific to environmental testing). The following is a list of standard practices employed on an every day basis in the laboratory.

1. The QA/QC section of Enviro-Test Laboratories consists of a Quality Assurance Manager with a support group of seven full-time QA Supervisors/QC Coordinators. The QA Manager coordinates and manages all aspects of the QA/QC program.

2. Standard Operating Procedures (SOPs) are written for all analytical methodology, operation and maintenance of all lab equipment and instrumentation, safety procedures, general laboratory procedures, and quality assurance protocols. Copies of SOPs are readily available to all staff and periodic SOP reviews are scheduled.

3. NIST (National Institute of Standards and Technology) traceable calibration standards are used for all analyses, when available. Other commercially available standards are checked for purity using U.S. EPA protocols. A calibration standard inventory is maintained and all standard preparations are documented.

4. Precision, accuracy, and method detection limit studies are performed to validate analytical methods.

5. Maintenance and calibration records are kept for all major equipment and instrumentation. Records include balance calibrations, water system maintenance, temperature monitoring of coolers, freezers, and drying ovens, thermometer and weight calibrations, pipette calibrations and instrument maintenance.

6. Sample tracking procedures are in place to document sample custody from time of receipt to final analysis. Complete chain of custody documentation ensures that all data is legally defensible.

INTRALABORATORY QUALITY CONTROL (CONT'D)

7. A 10 - 20% program of quality control analyses is maintained for every batch of samples. Quality control samples include calibration and verification standards, standard reference materials, matrix spikes, duplicates, method and reagent blanks, transportation and storage blanks and glassware proofs.

8. Quality control charting is established for all routine analytical tests ensuring that a process is in place for determining whether the analytical system is in control.

9. Prior to issuing a final report, each project file is thoroughly reviewed by the analyst and project manager to ensure completeness of sample chain of custody documentation, verification of sample history information and analytical requirements, acceptability of QC data and validity of sample results.

10. Participation in interlaboratory check sample programs is extensive. (Refer to the Performance Evaluation Program section for a complete listing.)

11. Training seminars are scheduled bimonthly and include both in-house as well as outside guest speakers. Seminar topics include training in such areas as QA/QC, safety, instrumentation and method development. All new employees must complete a set of initial training requirements within 3 months. Daily training is provided to technicians and analysts by experienced senior staff at the bench-level on a day-to-day basis.

12. Personnel records are maintained for training, analyst proficiency, curriculum vitae, job descriptions and confidentiality agreements.

13. Facility audits within each division of the laboratory are performed annually by the QA/QC department to evaluate the laboratory's quality assurance program.