Quality Assurance and Quality Control
For
Water Sampling at FOX-C
Intermediate DEW Line Site
Ekalugad Fiord
Nunavut

PWGSC Environmental Services
Western Region

1.0 INTRODUCTION

As the custodian of most federal lands in the north, the Department of Indian Affairs and Northern Development (DIAND) has responsibility, through the Northern Contaminated Sites Program (CSP), to manage a number of contaminated properties that are no longer maintained by the original occupant. DIAND's portfolio of contaminated sites in the north originates from private sector mining, oil and gas activities and government military activity dating back over half a century, many years before the environmental impacts of such activities were adequately understood. The former FOX-C Intermediate DEW Line Site at Ekalugad Fiord, Nunavut is one of these sites.

The site will require remedial activities to remove contaminants either off site or to place contaminants into an engineered containment facility or landfill. Water sampling will be conducted throughout the remediation process for the following reasons:

1) To maintain a contractors camp at site with drinking water and waste facilities.
2) To determine potential leachate sources at site.
3) To determine concentrations of contaminants at site.

The purpose of this document is to provide a quality assurance and quality control program for the management of water sampling during the remediation process.

2.0 SAMPLE COLLECTION

Water samples will be collected during various activities. The following indicates the locations to be sampled and the frequency. A spreadsheet can be found in Appendix A that details the sampling protocol, frequency and parameters. Site maps can be found in Appendix B indicating facilities and, where possible, proposed sample locations.

2.1 Site Camp

A contractor's camp will be set up at the site to provide services and support for the remediation activities. The camp is scheduled to be at site for a period of two years with the duration of the construction season from mid June to the end of September. Sampling of water supplies will be conducted during the duration of camp operations.

2.1.1 Wastewater (Sewage)

Camp sewage will be initially directed into a temporary lagoon until construction of the larger camp lagoon is completed. At that time wastewater will be pumped over from the temporary lagoon to the camp lagoon and the temporary lagoon will be decommissioned. Both the temporary and camp lagoon have been sited so as to meet the requirements specified in the water license.

UMA Engineering Ltd. has provided documentation for the justification of the wastewater discharge criteria. This documentation can be found in Appendix C of this report. Table 1 in Appendix C is a comparison of project wastewater criteria to other Canadian and Northern Standards including NWT, Nunavut and CCME guidelines and criteria.

The total water requirement for the construction camp has been estimated at approximately 30 cubic metres (as per UMA calculations). The parameters to be analyzed within the wastewater include heavy end hydrocarbon chains as the contamination at this site historically occurred 40 plus years ago. Light end volatiles would have since dissipated. It should be noted that those hydrocarbon products used at site were diesel fuel and lubricating oils.

Wastewater will be sampled each month during the field season and prior to discharge for the following parameters:

Contaminant	Container	Storage	Sample Preparation	Holding Time
pH, TSS	250mL plastic	Cool	none	4 days
BOD	500mL plastic	Cool	none	4 days
Faecal Coliforms	250mL plastic sterilized	Cool	Na_2SO_4	48 hours

A visual inspection for oil and grease will also be performed; however, no samples will be taken or analyzed for this parameter.

2.1.2 Drinking Water

Drinking water at the site will be sampled on a weekly basis to ensure the water quality meets the Health Canada Guidelines for Canadian Drinking Water Guidelines. The sampling and analyses will be provided at the water supply source and at the distribution source prior to consumption. Bottled distilled drinking water will be supplied at the camp should there exceedances be noted in the water sampling analysis.

2.1.3 Construction Camp Waste

All liquid hydrocarbon waste which cannot be incinerated will be turned over to the Construction Contractor for proper disposal on an as required basis.

2.2 Remediation Activities

Remediation activities or site contaminants that may impact site water resources are to be mitigated by providing the following:

1) Excavation of contaminants and materials,
2) Leachate testing of barrel residuals,
3) Waste processing and rinsing,
4) Testing of landfarm runoff, and
5) Testing of landfarm monitoring wells.

All soils that are to be either landfilled or transported off site will be stored in such a manner so as not to provide surface run off to water sources. All contaminated materials (residuals in barrels etc) will be either incinerated at site or transported off site for disposal. Temporary storage will be provided for these materials to ensure no run off is entering into the surrounding environment.

Site locations for the above activities are listed in approximate areas as per site maps in Appendix B.

3.0 SAMPLING EQUIPMENT AND METHODOLOGY

Sampling equipment to be used at site will be dependent on the parameters and materials to be sampled. The following is a breakdown of the sampling equipment required for the site activities as well as the associated methodology. The *CCME Guidance Manual on Sampling, Analysis and Data Management for Contaminated Sites* will be complied with.

During all sampling episodes there is the requirement for the use of new disposable nitrile gloves for each individual sample collection to avoid the potential for cross-contamination of samples. Also dedicated water sampling equipment will be used to avoid cross-contamination within samples. All bottles required for the sampling events will be new and no bottles will be reused for sampling purposes.

Duplicate, trip and field blanks will be required for each parameter during each sampling episode as detailed in the spreadsheet in Appendix A. A blank consists of a laboratory method blank of all analytical steps but excluding the sample. It is used to determine any laboratory background contamination or contamination for the test method. A duplicate sample is a repeat analysis of a sample within the same batch including all steps of the testing method is and used as a control to assess the precision of the test method for the sample matrix. Duplicates will be provided “blind” to the laboratory. A trip blank is a sealed sample bottle containing an inert matrix that is carried to the field and returned unopened to the laboratory. Field blanks, consisting of distilled water, will be containerized in the

field using the same handling procedures as the samples. It is then re-sealed and shipped to the laboratory for analysis with the other samples. This control is used to assess possible sample contamination due to sample procedure completed in the field.

Sampling frequency for blanks, trip blanks and field blanks for each parameter can be found in Appendix A.

3.1 Wastewater

The wastewater in the lagoons will be sampled on a monthly basis during the field season.

Sampling will be completed from the same areas of the lagoon to provide consistency and contents will be placed in the appropriate analytical bottles as identified by the accredited laboratory for specific chemical analysis. GPS coordinates will be taken at the sampling location.

3.2 Drinking Water

All sampling and analyses of the drinking water at the construction camp supply source must satisfy the Health Canada Guidelines for Canadian Drinking Water Quality.

The sampling and analysis will be provided at the water source and at the distribution source prior to consumption and continued thereafter on a biweekly basis. Sampling will include the use of new bottles and the water collected will be stored in the laboratory identified bottles. A blank sample will be required every 1 in 12.

Drinking water will be analysed for the following parameters:

Contaminant	Container	Storage	Sample Preparation	Holding Time
Dissolved Metals	250mL plastic	Cool	Field filtered, HNO_3 < pH 2	30 days
Total Metals	250mL plastic	Cool	HNO3 < pH 2	30 days
Mercury	125mL clear glass	Cool	$K_2Cr_2O_2/HNO_3$ < pH 2	7 days
pH, TSS	250mL plastic	Cool	none	4 days
Nitrate, Nitrite	250mL plastic	Cool	none	28 days
Faecal Coliforms	250mL plastic sterilized	Cool	Na_2SO_4	48 hours

3.3 Barrel Residues

Barrels will be sampled using disposable sampling implements. Depending on the contents of the barrel, either glass barrel thieves or PVC bailers will be used. The contents of the theives will then be deposited into the proper container for each parameter required. These residuals will be analysed and incinerated if possible. All residuals not slated for incineration will be stored in a water tight container and disposed of as hazardous materials.

The sampling implements will be disposed of in the appropriate landfill after each use.

3.4 Landfarm Runoff

The runoff or ponding at the landfarm areas and the excavation areas (if required) will be removed from those areas via pump and placed in a holding tank for subsequent sampling. The tank will be sampled after treatment, prior to release or disposal.

3.5 Landfarm Monitoring Wells

The monitoring wells will be sampled on an annual basis at the end of each field season for the following parameters:

Contaminant	Container	Storage	Sample Preparation	Holding Time
BTEX/F1	3 x 40mL clear glass septum vial	Cool	HCl < pH 2, no headspace	14 days
F2-F4	2 x 500mL amber glass	Cool	HCl < pH 2	14 days

Water levels in each of the monitoring wells will be recorded using a Solinist oil/water interface probe. The instrument will be cleaned between boreholes by field rinsing/washing using de-ionized water.

After monitoring and recording the above data, each monitoring well will be purged at least three well casing volumes or until field measurements for temperature, EC and pH have stabilized or until bailed dry. This will be completed using either PVC wattera tubing with foot valves or with disposable PVC bailers. The wells will be allowed to recharge and representative groundwater samples will be taken as near as possible to the time of shipping. Samples will be kept cool from the time of sampling to arrival at the laboratory.

3.6 Waste Processing and Rinsing

Rinsate from barrel and or tank cleaning will be treated on-site using an oil-water separator and filtration through an activated carbon filter. Following treatment, the water will be stored and sampled to ensure that it meets the discharge

requirements defined in the specification (provided in Appendix C and listed below). Once it is confirmed that the treated wastewater meets the discharge criteria, it will be released at a location a minimum 30 m from natural drainage courses and 100 m from fish bearing waters.

Discharge criteria parameters are as follows;

Contaminant	Container	Storage	Sample Preparation	Holding Time
Dissolved Metals	250mL plastic	Cool	Field filtered, HNO_3 < pH 2	30 days
Total Metals	250mL plastic	Cool	HNO3 < pH 2	30 days
Mercury	125mL clear glass	Cool	$K_2Cr_2O_2/HNO_3$ < pH 2	7 days
Oil and Grease	1L amber glass	Cool	HCl < pH 2	30 days
PCBs	1L amber glass	Cool	none	30 days
Phenols	120mL amber glass	Cool	H_2SO_4 < pH 2	30 days

4.0 SAMPLE HANDLING

All samples are to be sent to an accredited laboratory for chemical analyses and will be stored in coolers with ice to maintain the temperature below 10°C. Those samples requiring preservation will be completed as per the laboratory instructions.

4.2 Sample Identification

Samples will be given a sample number that provides no information to the laboratory as to the location of the sample. Sample numbers and their corresponding locations will be recorded in a tracking spreadsheet and in a field notebook. Samples will be labelled with only a sample number and a date sampled when sent to the laboratory. Sample locations will be recorded in the field notebook and GPS coordinates will be taken.

4.3 Transportation

Transportation of the samples will be in a ice chilled cooler to ensure the temperature of the samples does not exceed 4°C. Each chemical analysis will have holding times that they can not exceed. Transportation of the samples will be via air to the accredited laboratory for chemical analysis. Please note that some of the analytical holding times can not be met (i.e. pH and faecal coliforms). Every effort will be made to meet laboratory hold times; however, due to the remoteness of the site, hold times may be exceeded.

5.0 LABORATORY ANALYSES

Chemical analysis of samples will be conducted by Maxxam Analytics Inc. who is accredited by the Canadian Association of Environmental Analytical Laboratories (CAEAL). Proof of accreditation is provided in Appendix B.

Detection limits are predetermined by the laboratory and will be below the recommended criteria limits. Analytical methodology will be included in the laboratory chemical findings. Laboratory QA/QC procedures will be reviewed once results are received.

6.0 REFERENCES

1. Indian and Northern Affairs Canada and Northwest Territories Water Board, *Quality Assurance (QA) and Quality Control (QC) Guidelines for Use by Class "B" Licensees in Collecting Representative Water Samples in the Field and for Submission of a QA/QC Plan*, 1996.

2. Public Works and Government Services Canada, *DEW Line Clean Up Project FOX-C: Ekalugad Fiord*, May 2005.

3. Public Works and Government Services Canada, *DEW Line Site Restoration FOX-C: Ekalugad Fiord*, March 2005.

APPENDIX A

CHEMICAL ANALYSIS SPREADSHEET

Material	Sampling Frequency and Location	Duplicate		Trip blank		Field blank	
		Frequency	Min. per batch	Frequency	Min. per trip	Frequency	Min. per trip
Wastewater (Sewage)							
Oil & Greases	Monthly during field season	1/12	NA	1/12	1	1/12	1
pH	Monthly during field season	1/12	NA	NA	NA	NA	NA
TSS	Monthly during field season	1/12	NA	NA	NA	NA	NA
BOD	Monthly during field season	1/12	NA	NA	NA	NA	NA
Fecal coliforms	Monthly during field season	NA	NA	NA	NA	NA	NA
Drinking water							
Copper	weekly	1/12	NA	1/12	1	1/12	1
Iron	weekly	1/12	---	1/12	1	1/12	1
Lead	weekly	1/12	---	1/12	1	1/12	1
Manganese	weekly	1/12	NA	1/12	1	1/12	1
Mercury	weekly	1/12	NA	1/12	NA	1/12	NA
Cadmium	weekly	1/12	NA	1/12	1	1/12	1
Chromium	weekly	1/12	NA	1/12	NA	1/12	NA
Zinc	weekly	1/12	NA	1/12	NA	1/12	NA
pH	weekly	1/12	NA	1/12	NA	1/12	NA
Total Suspended Solids	weekly	1/12	NA	NA	NA	NA	NA
Nitrate	weekly	1/12	NA	1/12	NA	1/12	NA
Nitrite	weekly	1/12	NA	1/12	NA	1/12	NA
Faecal Coliforms	weekly	NA	NA	NA	NA	NA	NA
Waste processing - Retention tank (including solvent rinsate)							
pH	When Tank is full and after treatment	1/12	NA	NA	NA	NA	NA
Oil & Greases	When Tank is full and after treatment	1/12	---	1/12	1	1/12	1
As	When Tank is full and after treatment	1/12	NA	1/12	1	1/12	1
Cr, Co, Cu, Pb, Ni, Zn	When Tank is full and after treatment	1/12	NA	1/12	1	1/12	1
Hg	When Tank is full and after treatment	1/12	NA	1/12	1	1/12	1
BTEX	When Tank is full and after treatment	1/12	---	1/12	1	1/12	1
Chlorinated phenols	When Tank is full and after treatment	1/12	---	1/12	1	1/12	1
PCBs	When Tank is full and after treatment	1/12	NA	1/12	1	1/12	1
CCME TPH F1	When Tank is full and after treatment	1/12	---	1/12	1	1/12	1
CCME TPH F2-F4	When Tank is full and after treatment	1/12	---	1/12	1	1/12	1
Ponded water (includes water from landfill facilities and resulting from excavation areas)							
pH	When Tank is full and after treatment	1/12	NA	NA	NA	NA	NA
Oil & Greases	When Tank is full and after treatment	1/12	---	1/12	1	1/12	1
As	When Tank is full and after treatment	1/12	NA	1/12	1	1/12	1
Cd, Cr, Co, Cu, Pb, Ni, Zn	When Tank is full and after treatment	1/12	NA	1/12	1	1/12	1
BTEX	When Tank is full and after treatment	1/12	---	1/12	1	1/12	1
Chlorinated phenols	When Tank is full and after treatment	1/12	---	1/12	1	1/12	1
PCBs	When Tank is full and after treatment	1/12	NA	1/12	1	1/12	1
Testing of landfarm runoff							
CCME TPH F1	As required, prior to discharge	1/12	---	1/12	1	1/12	1
CCME TPH F2-F4	As required, prior to discharge	1/12	---	1/12	1	1/12	1

pH	As required, prior to discharge	1/12	NA	NA	NA	NA	NA
BTEX	As required, prior to discharge	1/12	---	1/12	1	1/12	1
Testing of landfarm monitoring wells							
CCME TPH F1	Annually at the end of each field season	1/12	---	1/12	1	1/12	1
CCME TPH F2-F4	Annually at the end of each field season	1/12	---	1/12	1	1/12	1
pH	Annually at the end of each field season	1/12	NA	NA	NA	NA	NA
BTEX	Annually at the end of each field season	1/12	---	1/12	1	1/12	1
Testing of landfill monitoring wells							
PCBs	Annually at the end of each field season	1/12	NA	1/12	1	1/12	1
Metals	Annually at the end of each field season	1/12	NA	1/12	1	1/12	1
CCME TPH F1	Annually at the end of each field season	1/12	---	1/12	1	1/12	1
CCME TPH F2-F4	Annually at the end of each field season	1/12	---	1/12	1	1/12	1
pH	Annually at the end of each field season	1/12	NA	NA	NA	NA	NA
BTEX	Annually at the end of each field season	1/12	---	1/12	1	1/12	1
Oil & Grease	Annually at the end of each field season	1/12	---	1/12	1	1/12	1
Explosive vapour testing for tanks and barrels with unknown contents							
%LEL, presence/absence	1 measurement per barrel	NA	NA				
Air monitoring - building demolition							
Particulates	Accumulation over 48 hours during demolition	NA	NA				
Asbestos	For Type 2 and 3, 1 per day	NA	NA				
Landfill development							
Air Monitoring - Particulates	Accumulation over 48 hours during construction						
Compaction to 95 % max dried density	As required	NA	NA				
Seive analysis for above	1 per 1,000 cubic meter	NA	NA				

Glossary	
Duplicate	Repeat analysis of a sample within the same batch; including all steps of the testing method. This control is used to assess the precision of the test method for the sample matrix.
Trip blank	A trip blank is a sealed sample bottle containing an inert matrix. It is carried to the field and returned to the laboratory for analysis. Those bottles are sealed in the laboratory prior to the field trip and are returned un-opened to the laboratory. This control helps to identify any possible sample contamination during shipping and handling from the laboratory to the field and back to the laboratory.
Field Blank	A field blank is a sealed sample bottle containing an inert matrix. It is carried to the field and opened under the same condition and for the same length of time as regular sample during sampling. It is then re-sealed and shipped to the laboratory with other samples for analysis. This control is used to assess possible sample contamination due to the sampling procedure used in the field.
Frequency	Controls are analyzed in a fixed frequency as required by our laboratory accreditation program. This frequency is expressed as 1/n for one control for every n samples.
Batch	A batch consist of one series of sample extraction, preparation and analysis at one specific time. A batch can consist of 1 sample or may consist of a large number of samples.
Trip	For the purpuse of quality control, a trip is defined as a sampling event. A sampling event can last as little as one day and as long as months.
NA = Not applicable	
NAV = Information not available at this time	

APPENDIX B

LABORATORY ACCREDITATION

CAEAL Directory of Laboratories

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Home | List all | Search PT Directory | Search Accreditation Directory

Membership Number: 2340
Laboratory Name: Maxxam Analytics Inc.
Parent Institution:
Address: 6740 Campobello Road Mississauga, Ontario L5N 2L8
Contact: Ms. JoAnn DiSensi
Phone: (905) 817-5727 Ext.
Fax: (905) 817-5775
Email: joann.disensi@maxxamanalytics.com

Showing PT Directory

Registered Tests

Parameter	Method
Matrix: Oil	
Total PCB	GC/ECD - EXTRACTION
Matrix: Soil	
Benzene	GC/MS - PURGE AND TRAP
Benzene	GC/MS/FID - HEADSPACE
Benzene	GC/PID/FID - HEADSPACE
Ethylbenzene	GC/MS - PURGE AND TRAP
Ethylbenzene	GC/MS/FID - HEADSPACE
Ethylbenzene	GC/PID/FID - HEADSPACE
F1: C6-C10	GC/MS/FID - HEADSPACE
F1: C6-C10	GC/PID/FID - HEADSPACE
F2: C10-C16	GC/FID - EXTRACTION
F3: C16-C34	GC/FID - EXTRACTION
F4: C34-C50	GC/FID - EXTRACTION
m/p-xylene	GC/MS - PURGE AND TRAP
m/p-xylene	GC/MS/FID - HEADSPACE
m/p-xylene	GC/PID/FID - HEADSPACE
o-xylene	GC/MS - PURGE AND TRAP
o-xylene	GC/MS/FID - HEADSPACE
o-xylene	GC/PID/FID - HEADSPACE
Toluene	GC/MS - PURGE AND TRAP
Toluene	GC/MS/FID - HEADSPACE
Toluene	GC/PID/FID - HEADSPACE
Matrix: Soil/Sediment	
Antimony	AA - DIGESTION
Antimony	ICP/MS
Arsenic	AA - DIGESTION
Arsenic	ICP/MS
Benzo (a) anthracene	GC/MS - EXTRACTION
Benzo (a) anthracene	GC/MS - EXTRACTION
Benzo (a) pyrene	GC/MS - EXTRACTION
Benzo (a) pyrene	GC/MS - EXTRACTION

Benzo (b) fluoranthene	GC/MS - EXTRACTION
Benzo (b) fluoranthene	GC/MS - EXTRACTION
Benzo (g,h,i) perylene	GC/MS - EXTRACTION
Benzo (g,h,i) perylene	GC/MS - EXTRACTION
Benzo (k) fluoranthene	GC/MS - EXTRACTION
Benzo (k) fluoranthene	GC/MS - EXTRACTION
Beryllium	ICP/MS
Cadmium	AA - DIGESTION
Cadmium	ICP/MS
Chromium	ICP/MS
Cobalt	ICP/MS
Copper	ICP - DIGESTION
Copper	ICP/MS
Fluoranthene	GC/MS - EXTRACTION
Fluoranthene	GC/MS - EXTRACTION
Indeno (1,2,3 - cd) pyrene	GC/MS - EXTRACTION
Indeno (1,2,3 - cd) pyrene	GC/MS - EXTRACTION
Lead	AA - DIGESTION
Lead	ICP/MS
Mercury	COLD VAPOUR AA - DIGESTION
Nickel	ICP/MS
Phenanthrene	GC/MS - EXTRACTION
Phenanthrene	GC/MS - EXTRACTION
Pyrene	GC/MS - EXTRACTION
Pyrene	GC/MS - EXTRACTION
Zinc	ICP - DIGESTION
Zinc	ICP/MS
Matrix: Water (Inorganic)	
Alkalinity (pH 4.5)	COLORIMETRIC
Alkalinity (pH 4.5)	TITRIMETRIC
Ammonia	AUTO COLOR
Ammonia	COLORIMETRIC
BOD (5 day)	D.O. METER
Bromide	ION CHROMATOGRAPHY
Chloride	COLORIMETRIC
Chloride	ION CHROMATOGRAPHY
COD	REFLUX - COLORIMETRIC
Conductivity (25ÝC)	CONDUCTIVITY METER
Cyanide (SAD)	COLOR - DISTILLATION
Dissolved Aluminum	ICP/MS
Dissolved Aluminum (High)	ICP
Dissolved Barium	ICP
Dissolved Barium	ICP/MS
Dissolved Beryllium	ICP
Dissolved Beryllium	ICP/MS
Dissolved Boron	ICP
Dissolved Boron	ICP/MS
Dissolved Cadmium	AA GRAPHITE
Dissolved Cadmium	ICP/MS
Dissolved Calcium	ICP
Dissolved Calcium	ICP/MS
Dissolved Chromium	ICP
Dissolved Chromium	ICP/MS
Dissolved Cobalt	ICP
Dissolved Cobalt	ICP/MS
Dissolved Copper	ICP
Dissolved Copper	ICP/MS
Dissolved Iron	ICP
Dissolved Iron	ICP/MS
Dissolved Lead	AA GRAPHITE
Dissolved Lead	ICP/MS
Dissolved Lead (High)	ICP
Dissolved Magnesium	ICP
Dissolved Magnesium	ICP/MS
Dissolved Manganese	ICP
Dissolved Manganese	ICP/MS
Dissolved Molybdenum	ICP

Dissolved Molybdenum	ICP/MS
Dissolved Nickel	ICP/MS
Dissolved Nickel (High)	ICP
Dissolved Silver	AA GRAPHITE
Dissolved Silver	ICP/MS
Dissolved Strontium	ICP
Dissolved Strontium	ICP/MS
Dissolved Thallium	AA GRAPHITE
Dissolved Thallium	ICP/MS
Dissolved Tin	ICP/MS
Dissolved Titanium	ICP
Dissolved Titanium	ICP/MS
Dissolved Uranium	ICP/MS
Dissolved Vanadium	ICP
Dissolved Vanadium	ICP/MS
Dissolved Zinc	ICP
Dissolved Zinc	ICP/MS
DOC	IR - COMBUSTION
Fluoride	AUTO TITRIMETRIC
Fluoride	ION CHROMATOGRAPHY
Hardness (as CaCO3)	ICP
Hardness (as CaCO3)	ICP/MS
Mercury	COLD VAPOUR AA - DIGESTION
Nitrate	ION CHROMATOGRAPHY
Nitrate plus Nitrite	AUTO COLOR
Nitrate plus Nitrite	CALCULATED
Nitrite	COLORIMETRIC
Nitrite	ION CHROMATOGRAPHY
pH	pH METER
Phosphate	COLORIMETRIC
Phosphate	COLORIMETRIC
Phosphate	ION CHROMATOGRAPHY
Potassium	ICP
Potassium	ICP/MS
Sodium	ICP
Sodium	ICP/MS
Sulfate	COLORIMETRIC
Sulfate	ION CHROMATOGRAPHY
Total Antimony	AA GRAPHITE
Total Antimony	ICP/MS
Total Arsenic	AA GRAPHITE
Total Arsenic	ICP/MS
Total Kjeldahl Nitrogen	AUTO COLOR - DIGESTION
Total Kjeldahl Nitrogen	COLORIMETRIC
Total Phosphorus	COLORIMETRIC
Total Phosphorus	COLORIMETRIC - DIGESTION
Total Selenium	AA GRAPHITE
Total Selenium	ICP/MS
Total Suspended Solids	GRAVIMETRIC
Turbidity	NEPHELOMETRY
Matrix: Water (Microbiology)	
Escherichia coli (E. coli)	MEMBRANE FILTRATION
Escherichia coli (E. coli)	MEMBRANE FILTRATION (DC-AGAR)
Fecal Coliforms	MEMBRANE FILTRATION
Heterotrophic Plate Count (HPC)	POUR PLATE
Total Coliforms	MEMBRANE FILTRATION
Total Coliforms	MEMBRANE FILTRATION (DC-AGAR)
Matrix: Water (Organic)	
1,1-dichloroethylene	GC/MS - PURGE AND TRAP
1,2-dichlorobenzene	GC/MS - PURGE AND TRAP
1,2-dichloroethane	GC/MS - PURGE AND TRAP
1,4-dichlorobenzene	GC/MS - PURGE AND TRAP
2,3,4,6-tetrachlorophenol	GC/MS - EXTRACTION
2,4-dichlorophenol	GC/MS - EXTRACTION
2,4-dichlorophenoxyacetic acid	GC/MS - EXTRACTION
2,4,5-trichlorophenoxyacetic acid	GC/MS - EXTRACTION
2,4,6-trichlorophenol	GC/MS - EXTRACTION

A -BHC	GC/ECD - EXTRACTION
a - Chlordane	GC/ECD - EXTRACTION
Aldicarb	GC/MS - EXTRACTION
Aldicarb	HPLC - EXTRACTION
Aldrin	GC/ECD - EXTRACTION
Atrazine	GC/MS - EXTRACTION
Azinphos-methyl	HPLC - EXTRACTION
Bendiocarb	GC/MS - EXTRACTION
Bendiocarb	HPLC - EXTRACTION
Benzene	GC/FID/PID - HEADSPACE
Benzene	GC/MS - PURGE AND TRAP
Benzene	GC/MS/FID - HEADSPACE
Benzo (a) anthracene	GC/MS - EXTRACTION
Benzo (a) anthracene	GC/MS - EXTRACTION
Benzo (a) pyrene	GC/MS - EXTRACTION
Benzo (a) pyrene	GC/MS - EXTRACTION
Benzo (b) fluoranthene	GC/MS - EXTRACTION
Benzo (b) fluoranthene	GC/MS - EXTRACTION
Benzo (g,h,i) perylene	GC/MS - EXTRACTION
Benzo (g,h,i) perylene	GC/MS - EXTRACTION
Benzo (k) fluoranthene	GC/MS - EXTRACTION
Benzo (k) fluoranthene	GC/MS - EXTRACTION
Bromodichloromethane	GC/MS - PURGE AND TRAP
Bromoform	GC/MS - PURGE AND TRAP
Bromoxynil	GC/MS - EXTRACTION
Carbaryl	GC/MS - EXTRACTION
Carbaryl	HPLC - EXTRACTION
Carbofuran	GC/MS - EXTRACTION
Carbofuran	HPLC - EXTRACTION
Carbon Tetrachloride	GC/MS - PURGE AND TRAP
Chlorobenzene	GC/MS - PURGE AND TRAP
Chlorodibromomethane	GC/MS - PURGE AND TRAP
Chloroform	GC/MS - PURGE AND TRAP
Chlorpyrifos (ethyl)	GC/MS - EXTRACTION
Cyanazine	GC/MS - EXTRACTION
Diazinon	GC/MS - EXTRACTION
Dicamba	GC/MS - EXTRACTION
Dichloromethane	GC/MS - PURGE AND TRAP
Diclofop-methyl (as free acid)	GC/MS - EXTRACTION
Dieldrin	GC/ECD - EXTRACTION
Dimethoate	GC/MS - EXTRACTION
Dinoseb	GC/MS - EXTRACTION
Diuron	HPLC - EXTRACTION
Endosulfan I	GC/ECD - EXTRACTION
Endosulfan II	GC/ECD - EXTRACTION
Endrin	GC/ECD - EXTRACTION
Ethylbenzene	GC/FID/PID - HEADSPACE
Ethylbenzene	GC/MS - PURGE AND TRAP
Ethylbenzene	GC/MS/FID - HEADSPACE
Fluoranthene	GC/MS - EXTRACTION
Fluoranthene	GC/MS - EXTRACTION
g - Chlordane	GC/ECD - EXTRACTION
Glyphosate	HPLC - DERIVATIZATION
Heptachlor	GC/ECD - EXTRACTION
Heptachlor Epoxide	GC/ECD - EXTRACTION
Heptachlor Epoxide	GC/MS - EXTRACTION
Indeno (1,2,3 - cd) pyrene	GC/MS - EXTRACTION
Indeno (1,2,3 - cd) pyrene	GC/MS - EXTRACTION
Lindane (gamma-BHC)	GC/ECD - EXTRACTION
Lindane (gamma-BHC)	GC/MS - EXTRACTION
m/p-xylene	GC/FID/PID - HEADSPACE
m/p-xylene	GC/MS - PURGE AND TRAP
m/p-xylene	GC/MS/FID - HEADSPACE
Malathion	GC/MS - EXTRACTION
Metolachlor	GC/MS - EXTRACTION
Metribuzin	GC/MS - EXTRACTION
Mirex	GC/ECD - EXTRACTION

o,p' - DDT	GC/ECD - EXTRACTION
o,p' - DDT	GC/MS - EXTRACTION
o-xylene	GC/FID/PID - HEADSPACE
o-xylene	GC/MS - PURGE AND TRAP
o-xylene	GC/MS/FID - HEADSPACE
p,p' - DDT	GC/ECD - EXTRACTION
p,p' - DDT	GC/MS - EXTRACTION
p,p' Methoxychlor	GC/ECD - EXTRACTION
Parathion (ethyl)	GC/MS - EXTRACTION
Pentachlorophenol	GC/MS - EXTRACTION
Phenanthrene	GC/MS - EXTRACTION
Phenanthrene	GC/MS - EXTRACTION
Phorate	GC/MS - EXTRACTION
Picloram	GC/MS - EXTRACTION
Pyrene	GC/MS - EXTRACTION
Pyrene	GC/MS - EXTRACTION
Simazine	GC/MS - EXTRACTION
Terbufos	GC/MS - EXTRACTION
Tetrachloroethylene	GC/MS - PURGE AND TRAP
Toluene	GC/FID/PID - HEADSPACE
Toluene	GC/MS - PURGE AND TRAP
Toluene	GC/MS/FID - HEADSPACE
Total PCB	GC/ECD - EXTRACTION
Total PCB	GC/ECD - EXTRACTION
Total PCB	GC/MS - EXTRACTION
Trichloroethylene	GC/MS - PURGE AND TRAP
Trifluralin	GC/MS - EXTRACTION

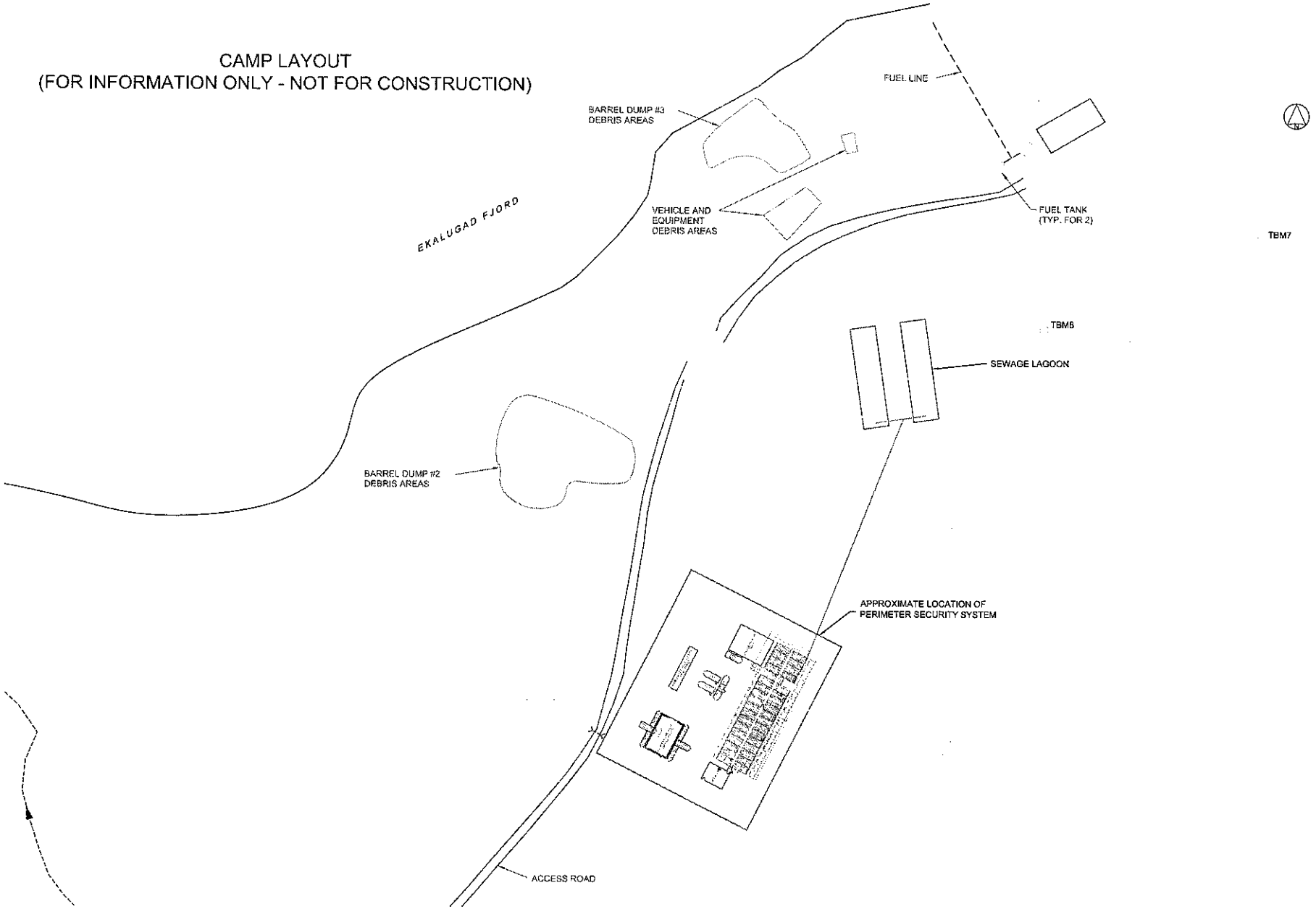
Appendix B - Laboratory Methodologies
Standard Operating Procedures

Parameter	SOP
Phenols	ONT SOP 0113
PCB	ONT SOP 0615
Total Metals	ONT SOP 0624
Mercury	ONT SOP 0112
AOX	US EPA method 9020
Oil & Grease	ONT SOP 0098
Faecal Coliform	ONT SOP 0635
BOD	ONT SOP 0068
Glycol	ONT SOP 0857
Dissolved Metals	ONT SOP 0624
Nitrate+Nitrite	ONT SOP 0100
pH	ONT SOP 0067

APPENDIX C

SITE MAPS

CAMP LAYOUT
(FOR INFORMATION ONLY - NOT FOR CONSTRUCTION)



APPENDIX D

WASTE WATER DISCHARGE INFORMATION

UMA | AECOM

UMA Engineering Ltd.
17007 107 Avenue
Edmonton, Alberta T5S 1G3
T 780.486.7000 F 780.486.7070 www.uma.aecom.com

May 30, 2006

File Name: 2977-301-05-02

Mr. Brad Thompson, P.Eng.
Senior Project Engineer, Western Region
Public Works and Government Services Canada
Telus Tower North
5th Floor, 10025 – Jasper Avenue
Edmonton, AB T5J 1S6

VIA EMAIL: Brad.Thompson@pwgsc.gc.ca

Dear Mr. Thompson:

Re: Restoration of FOX-C and CAM-F Intermediate DEW Line Sites
Application for a Water License from the Nunavut Water Board (NWB)
Response to NWB Outstanding Issues for the Water License Applications

UMA Engineering Ltd. (UMA) has been retained to provide services to support the application for Water Use Licenses for the environmental restoration at the CAM-F, Sarcpa Lake and FOX-C, Ekalugad Fiord Intermediate DEW Line sites. The Nunavut Water Board (NWB) has submitted a letter, dated May 26, 2006, outlining outstanding issues for these water license applications. The purpose of this letter is to provide a response to the NWB issues. This response letter is structured to follow the format of the NWB letter.

RESPONSES RELATIVE TO BOTH APPLICATIONS (1BR-SAR & 1BR-EKA)

1. Justificiation of the Wastewater Discharge Criteria:

a. The Environment Canada reference document: "An Approach for Assessing and Managing Wastewater Effluent Quality for Federal Facilities" (2000) has been pulled from circulation; however, this does not affect the wastewater discharge criteria, as there are other guidelines to back up each parameter (see response to 1 d).

b. The Wastewater Discharge Criteria parameters are the same for both the 1982 and 1992. The guideline comparison table (see response to 1 d) has been updated to reference the 1992 Guidelines.

c. Attached to this letter are the specification pages with the corresponding Wastewater Discharge Criteria from the current DND Clean Up Sites (FOX-5, FOX-M and DYE-M).

d. I have updated and attached Table 1 – Comparison of Project Wastewater Criteria to other Canadian and Northern Standards – to show that each parameter has a match to an existing environmental guideline.

2. PWGSC to respond to QA/QC plan issues.

RESPONSES RELATIVE TO APPLICATION 1BR-SAR

3. PWGSC to provide response for the fuel storage facility based on communications with the Contractor.

RESPONSES RELATIVE TO APPLICATION 1BR-EKA

1. The total requirement for water, including camp and construction activities, is estimated at 30 cubic metres per day.

2. The volume of solid waste that will be generated by the camp is estimated at 150 kg per day. All combustible waste will be incinerated and the ash/residual will be disposed of in the on-site non-hazardous waste landfill.

3. It is not expected that there will be any hazardous waste generated from the camp and laboratory. Any hazardous waste generated from construction, camp or laboratory will be containerized appropriately and shipped off-site for disposal at a licensed hazardous waste disposal facility.

4. PWGSC to provide response for the fuel storage areas based on communications with the Contractor.

5. PWGSC / INAC to forward Landfarm Questionnaire Response.

6. PWGSC to provide response for wastewater storage based on communications with the Contractor.

OTHER ISSUES

Total Petroleum Hydrocarbons (TPH) and BTEX constituents have not been included in the Wastewater Discharge Criteria for CAM-F, FOX-C or any of the DND DEW Line Sites.

The hydrocarbon contamination at the FOX-C and CAM-F sites are typically the result of diesel fuel and/or lubricating oil spills. These hydrocarbon products consist of heavy end hydrocarbon chains, rather than the lighter end, such as the BTEX constituents, and are not very soluble in water. In addition, the hydrocarbon contamination at these sites occurred during the operational timeframe (from the mid-1950's to the mid-1960's) before the sites were closed. As such, there would be little, if any, BTEX present in the soils, as they are easily volatilized. Therefore, the most meaningful and practical parameter to monitor in the wastewater would be oil and grease. Previously, we have monitored this by the presence/absence of a visible sheen. On occasion, the water has been sampled for oil and grease. The visible sheen is an indication of phase-separated hydrocarbons and can easily be dealt with by skimming the surface or filtering the wastewater with a hydrophobic, sorbent boom or blanket.

For the PCB concentration in wastewater, we propose a criterion of 1 ppm (mg/L), which is derived from the Chlorobiphenyls Regulations (1991). Section 5 (2 b) from this regulation states that: "the concentration that may be released is 5 ppm by weight of the liquid in respect of an application to a road surface". We have chosen the criteria of 1.0 mg/L to provide a slightly more conservative value than CEPA requires.

For the zinc concentration in wastewater, we propose to lower the criteria from 1 mg/L to 0.5 mg/L to match the 1992 NWT Guidelines for Municipal Wastewater Discharge.

CLOSURE

We trust this meets your current requirements. If you require additional information or clarification, please call me on my direct line at (780) 486-7624.

Respectfully Submitted,

UMA Engineering Ltd.

Barry Fedorak, P.Eng.
Senior Project Engineer
barry.fedorak@uma.aecom.com

BWF:js

cc: Jared Buchko, PWGSC - via email: jared.buchko@pwgsc.gc.ca

Encl: Table 1 - Comparison of Project Wastewater Criteria to other Canadian and Northern Standards
Wastewater Discharge Criteria for FOX-5, FOX-M and DYE-M
Water Quality Results from the Site Clean Up at PIN-3, Lady Franklin Point

Table 1: Comparison of Project Wastewater Criteria to other Canadian and Northern Standards

Parameter	Construction Wastewater Discharge Criteria (µg/L)	NWT Guideline, 1992 (µg/L)	Nunavut Effluent Guidelines, Sept. 2002 (µg/L)	CCME Interim Irrigation Criteria, 1991 (µg/L)	Chlorobiphenols Regulations (1991)
pH	6 - 9 (unitless)	N.G.	N.G.	6.5 - 9.0 (unitless)	N.G.
Oils and Grease	5000	5000 / none visible	N.G.	N.G.	N.G.
Arsenic (total)	100	50	500	100	N.G.
Cadmium (dissolved)	10	5	1.7	10	N.G.
Chromium (dissolved)	100	100	890 (trivalent)	100	N.G.
Cobalt (dissolved)	50	100	N.G.	50	N.G.
Copper (dissolved)	200	200	N.G.	200 - 1000	N.G.
Lead (dissolved)	50	50	N.G.	200	N.G.
Mercury (dissolved)	0.6	0.6	10	N.G.	N.G.
Nickel (dissolved)	200	300	N.G.	200	N.G.
PCB (total)	1000	N.G.	N.G.	N.G.	5000
Zinc (dissolved)	500	500	3000	N.G.	N.G.
[1] Guideline numbers derived from Table 4.2					
[2] Guideline numbers derived from Table 6.2 "Fresh Water Maximum Concentration"					

Parameter	Maximum Allowable Level
pH	6 to 9
Oil and Grease	5 mg/L & None Visible
Arsenic (total)	100 µg/L
Cadmium (dissolved)	10 µg/L
Chromium (total)	100 µg/L
Cobalt (dissolved)	50 µg/L
Copper (dissolved)	200 µg/L
Lead (dissolved)	50 µg/L
Mercury (total)	0.6 µg/L
Nickel (dissolved)	200 µg/L
PCB: discharge to barren area	50 µg/L
PCB: discharge to vegetated area	5 µg/L
Phenols	20 µg/L
Zinc (total)	1,000 µg/L

.2 Dispose of any liquid effluent not conforming to these guidelines as hazardous material in accordance with Section 02090 - Hazardous Waste Material.

5 Sewage Disposal Requirements

.1 An existing sewage lagoon services the Hamlet of Qikiqtarjuaq. The Contractor is required to use this sewage lagoon for disposal of all sewage related to this contract, unless capacity or other issues disallow use.

.2 Comply with the requirements of this section, unless written application has been made to and written permission has been received from the Hamlet. Provide proof of same to Engineer.

.3 If capacity or other issues disallow use of Hamlet's sewage lagoon, discharge sewage into two temporary lagoons within the DND reserve. Provide the necessary piping to ensure the lagoons can be operated independently.

.4 Size each of the two temporary lagoons to provide capacity for 45 days of wastewater storage or one-half the duration of the construction season, whichever is less. The maximum fluid depth shall not exceed one metre.

.5 Locate the temporary lagoon area:

.1 A minimum of 100 m from the construction camp, Engineer's Office, and/or other temporary facilities.
.2 A minimum of 100 m from drainage paths.
.3 A minimum of 450 metres from water bodies supporting aquatic life.
.4 Downwind of the construction camp based on the prevailing wind direction.
.5 Within the DND reserve.

.2 Submit one complete copy of all submittals and agency approvals to the Engineer.

4 Wastewater Discharge Criteria

.1 Wash water, meltwater collection, rinse water resulting from the cleaning of fuel tanks and pipelines, and/or any other liquid effluent stream shall be released onto the ground at a location that is a minimum of 30 metres from natural drainage courses, and shall conform to the following guidelines:

Parameter	Maximum Allowable Level
pH	6 to 9
Oil and Grease	None Visible
Arsenic (total)	100 µg/L
Cadmium (dissolved)	10 µg/L
Chromium (total)	100 µg/L
Cobalt (dissolved)	50 µg/L
Copper (dissolved)	200 µg/L
Lead (dissolved)	50 µg/L
Mercury (total)	0.6 µg/L
Nickel (dissolved)	200 µg/L
PCB: discharge to barren area	50 µg/L
PCB: discharge to vegetated area	5 µg/L
Phenols	20 µg/L
Zinc (total)	1,000 µg/L

.2 Dispose of any liquid effluent not conforming to these guidelines as hazardous material in accordance with Section 02090 - Hazardous Waste Material.

5 Sewage Disposal Requirements

.1 An existing sewage lagoon services the Hamlet of Hall Beach. The use of this lagoon is subject to the Contractor receiving approval from the Hamlet.

.2 Comply with the requirements of this section, unless written application has been made to and written permission has been received from the Hamlet. Provide proof of same to Engineer.

.3 Comply with the requirements of the Land Use Permit, the Water License and the Public Health Act (Nunavut).

.4 If an existing sewage lagoon is not available discharge sewage into two temporary lagoon areas constructed within the DND reserve. Provide the necessary piping to

Parameter	Maximum Allowable Concentration
pH	6 to 9
Oil and Grease	5 mg/L and None Visible
Arsenic (total)	100 µg/L
Cadmium (dissolved)	10 µg/L
Chromium (total)	100 µg/L
Cobalt (dissolved)	50 µg/L
Copper (dissolved)	200 µg/L
Lead (dissolved)	50 µg/L
Mercury (total)	0.6 µg/L
Nickel (dissolved)	200 µg/L
PCB: discharge to barren area	50 µg/L
PCB: discharge to vegetated area	5 µg/L
Phenols	20 µg/L
Zinc (total)	1,000 µg/L

.2 Dispose of any liquid effluent not conforming to these guidelines as hazardous material in accordance with Section 02090 - Hazardous Waste Material.

5 Sewage Disposal Requirements

.1 Comply with the requirements of the Land Use Permit, the Water License and the Public Health Act (Nunavut).

.2 For each camp location, discharge sewage into two temporary lagoon areas constructed within the DND reserve. Provide the necessary piping to ensure the lagoons can be operated independently.

.3 Size each of the lagoons to provide capacity for 45 days of wastewater storage or one half the duration of the construction season, whichever is less. The maximum fluid depth shall not exceed one metre.

.4 Locate the temporary lagoon area:

.1 A minimum of 100 m from the construction camp, Engineer's Office, and/or other temporary facilities.
.2 A minimum of 100 m from drainage paths.
.3 A minimum of 450 metres from water bodies supporting aquatic life.
.4 Downwind of the construction camp based on the prevailing wind direction.
.5 Within the DND reserve.

.5 Treat all sewage to meet the following Minimum Sewage Discharge Criteria:

Parameter	Maximum Average Concentration
Oil and Grease	None Visible
pH	6 to 9
BODs	120 mg/L
Total Suspended Solids	180 mg/L
Faecal Coliforms	10 000 CFU/dL

Table 2: Summary of 2003 Water Quality Results at PIN-3

Parameter	pH	Oil & Grease	Total Arsenic	Dissolved Cadmium	Total Chromium	Dissolved Cobalt	Dissolved Copper	Dissolved Lead	Total Mercury	Dissolved Nickel	Total Zinc	PCBs	Phenols
Units	pH	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	ug/L	ug/L
MAC[1]	6.0 - 9.0	No visible sheen	0.1	0.01	0.1	0.05	0.2	0.05	0.6	0.2	1	5 or 50	20
Beach POL Pad (12408631 E, 7596518 N)													
30/06/2003	8.22	None visible	<0.003	<0.001	<0.005	<0.003	0.006	<0.010	<0.4	<0.005	0.018	<3.0	<1.0
Sewage Outfall													
06/07/2003	7.21	None visible	0.004	<0.001	<0.005	<0.003	0.005	<0.010	<0.4	<0.005	0.036	<3.0	<1.0
West Module Train Holding Pond - North (12409012 E, 7598256 N)													
08/07/2003	7.48	None visible	<0.003	<0.001	<0.005	<0.003	0.005	<0.010	<0.4	<0.005	0.014	<3.0	<1.0
West Module Train Holding Pond - South (12409012 E, 7598256 N)													
08/07/2003	7.25	None visible	<0.003	<0.001	<0.005	<0.003	<0.005	<0.010	<0.4	<0.005	<0.010	<3.0	<1.0
Field Blank													
08/07/2003	6.59	None visible	<0.003	<0.001	<0.005	<0.003	<0.005	<0.010	<0.4	<0.005	<0.010	<3.0	<1.0
Travel Blank													
08/07/2003	5.40	None visible	<0.003	<0.001	<0.005	<0.003	<0.005	<0.010	<0.4	<0.005	<0.010	<3.0	<1.0
East Module Train Holding Pond - North (12409240 E, 7598259 N)													
10/07/2003	7.48	None visible	<0.003	<0.001	<0.005	<0.003	0.007	<0.010	<0.4	<0.005	0.025	<3.0	<1.0
East Module Train Holding Pond - North (12409240 E, 7598259 N)													
10/07/2003	7.92	None visible	<0.003	<0.001	<0.005	<0.003	0.006	<0.010	<0.4	<0.005	<0.010	<3.0	<1.0
7/10/2003*	8.01	None visible	<0.003	<0.001	<0.005	<0.003	0.008	<0.010	<0.4	<0.005	0.010	<3.0	<1.0
Beach POL Pad Excavation #1 (12408653 E, 7596461 N)													
05/08/2003	8.01	None visible	0.004	<0.001	0.005	<0.003	0.006	<0.010	<0.4	<0.005	<0.010	<3.0	1.0
Beach POL Pad Excavation #2 (12408630 E, 7596450 N)													
05/08/2003	7.95	None visible	0.005	<0.001	<0.005	<0.003	0.007	<0.010	<0.4	<0.005	0.010	<3.0	1.9
Hanger Excavation (12408221 E, 7597322 N)													
05/08/2003	8.06	None visible	<0.003	<0.001	<0.005	<0.003	0.006	<0.010	<0.4	<0.005	0.040	<3.0	<1.0

NOTE: [1] Target Maximum Acceptable Concentrations as proposed in the Monitoring Plan
5.4 Exceeds Guideline Criteria
* Duplicate Sample