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CHARACTERIZATION OF CONTAMINATED SITES AT CFS-ALERT AND CFS-EUREKA, NUNAVUT

Final Report

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EXECUTIVE SUMMARY

The present report contains site characterization data from multiple contaminated sites at CFS-Alert and CFS-Eureka, Nunavut, to complete information and provide an update of 8 Wing's Econet database. Located on Ellesmere Island, CFS-Alert and CFS-Eureka are two of Canada's northernmost military sites. This investigation was conducted by personnel of National Research Council's Biotechnology Research Institute (BRI).

The scope and objectives of the investigation were to:

- Review the historical data for the 45 contaminated sites located at CFS-Alert and CFS-Eureka;
- Identify any missing data required to complete the entry of each site in the Econet database;
- Perform site reconnaissance;
- Complete data collection and characterization for the missing water, sediment and soil parameters;
- Classify each site according to the national classification system for contaminated sites (FCSAP);
- Update the Econet database;
- Update the Geographic Information System (GIS) documentation of the completed CFS-Alert sites;
- Enter the data into Econet for the new sites at both CFS-Alert and CFS-Eureka.

Historical data used for the purposes of this investigation was obtained from past reviews assembled by the Environmental Sciences Group (ESG) of the Royal Military College of Canada, from 1999 to 2002.

Background

Two teams, each composed of two BRI staff members, visited CFS-Alert during the summer of 2006. The first team visited CFS-Alert between June 21st and July 8th, with an interim visit to CFS-Eureka between June 29th and June 30th. The second team visited CFS-Alert between July 3rd and July 22nd. Field work was completed to obtain more information regarding the contamination present at the sites (location, depth, concentration, and nature). The collected information was used to classify the sites, according to the Federal Contaminated Sites Action Plan (FCSAP) for contaminated site classification, and ultimately update the Econet database. Each sampling point was also georeferenced, to permit updating of the sites' GIS documentation. All of the sample points from 2006 were added to the sampling locations from 1999 and 2000, recorded in the preexisting GIS database compiled by ESG. All assessment criteria were selected based on site usage characteristics and discussions with 8 Wing.

In total, 45 sites were investigated, including buildings and their surroundings and areas where contamination had previously been recorded and other areas of suspected contamination. Of these 45 sites, 41 were found to be contaminated.

Approach to the Investigation

SOILS

In terms of soils, comparison criteria for the assessment of petroleum hydrocarbon contaminated soils at CFS-Alert and CFS-Eureka are based on the Canadian Council of Ministers of the Environment (CCME) Canada-Wide standards for petroleum hydrocarbons in soil and subsoil, 2001. The results of the inorganic elements, glycol, phenol and PCB analyses were interpreted using CCME environmental soil quality guidelines, 1999. For the CCME guidelines established after 2004, the guidelines for coarse soils will be used in this report, as they are more conservative and therefore better represent the typical soil type found at CFS-Alert and CFS-Eureka. Arsenic concentrations frequently exceeded CCME soil criterion for industrial sites at CFS-Alert and CFS-Eureka. This is most likely the result of high background concentrations of arsenic in the soil of Ellesmere Island. High concentrations of arsenic were detected in otherwise non-contaminated soil. Furthermore, no known anthropogenic source of arsenic is present at CFS-Alert or CFS-Eureka.

WATER

Water samples collected from the Alert Inlet (Alert), Slidre Fjord (Eureka) and in Dumbell Bay (Alert) were compared to the CCME Marine Quality Guidelines for the Protection of Aquatic Life. Water samples collected from standing water pools, the sewage lagoon, sewage outfall, grey water outfall and drainage channels were compared to CCME Freshwater Quality Guidelines for the Protection of Aquatic Life.

SEDIMENT

In terms of sediment, the Canadian Sediment Quality Guidelines (CSQGs), from the CCME, were used. Here the guidelines have identified two numerical levels: the lesser level is termed the "Interim Sediment Quality Guideline" (ISQG) value and the greater level is called the Probable Effect Level (PEL) value. Sediment chemical concentrations below ISQG values are not expected to be associated with any adverse biological effects, while concentrations above PEL values are frequently associated with adverse biological

effects. Chemical concentrations between the ISQG and PEL values represent the range in which effects are occasionally observed.

Due to the high number of fuel spills that have occurred at the different locations, various fuel constituents have been screened, such as the monocyclic aromatic hydrocarbons benzene, toluene, ethylbenzene and xylenes (BTEX), polycyclic aromatic hydrocarbons (PAHs) and volatile organic compounds (VOCs). Samples were also analyzed for a suite of inorganic elements, including arsenic, barium, cadmium, chromium, cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, tin and zinc. Water and sediment samples were also analyzed for polychlorinated biphenyls (PCBs) and phenols, in addition to total petroleum hydrocarbons (TPHs) and metals. Some soil samples were also tested for PCBs and phenols. A total of 195 soil samples, including 40 samples from different depths and 15 duplicate pairs were collected. Additionally, 27 surface water samples and 9 sediment samples were collected and analyzed.

Results of the 2006 Field Visit

At the Main Station Landfill, 3 of 4 surface water samples were found to contain copper, lead and zinc in concentrations that exceeded the CCME criteria. Copper concentrations ranged from 7 mg/L to 24 mg/L, lead concentrations ranged from 4 mg/L to 14 mg/L and zinc concentrations ranged from 60 mg/L to 160 mg/L. One (1) water sample also exceeded the criteria for arsenic (6 mg/L) and nickel (37 mg/L). This sample was taken from the drainage channel just before it reaches Dumbell Bay, indicating a risk that arsenic and nickel from the landfill may be migrating into Dumbell Bay. No soil samples were taken from wthin the Main Station Landfill.

The presence of arsenic at or above CCME criteria was detected in numerous samples taken from various sites around CFS-Alert. There is no anthropogenic source of arsenic at CFS-Alert, indicating that the natural background concentration of arsenic is at or above the CCME criteria in localized areas.

At the Sewage Outfall, the contaminant of greatest concern was copper, which exceeded the guidelines in all but 1 of the samples. The mean copper concentration for the 4 soil samples was 500 mg/kg, ranging from 19 mg/kg to 1,100 mg/kg. A sediment sample, tested only for metals, exceeded the criterion for arsenic, with a concentration of 9 mg/kg. The copper concentration in this sample was 91 mg/kg. In addition to exceeding the copper criterion, the surface water samples contained high levels of lead; 1 µg/L and 14 µg/L, respectively, where the guideline is 1-7 µg/L.

Like the Main Station Landfill, the area of the New Fuel Spill of 1999 represents a natural drainage area that empties into Alert Inlet, approximately 0.4 km downgradient. Here, several contaminants were found to be present above the CCME guidelines: one (1) showed toluene at 20 mg/kg, ethylbenzene at 41 mg/kg, total xylene at 170 mg/kg, fraction 1 hydrocarbons at 7,200 mg/kg, BTEX at 7,000 mg/kg and fraction 2 hydrocarbons at 29,000 mg/kg. A duplicate sample had the same contaminants, but at lower concentrations, yet still remained above the guideline concentrations.

The Sewage Lagoon is a high-risk area due to the fact that sewage from the lagoon is dumped directly into Slidre Fjord. In addition to 4 sediment samples, in which contamination was observed, 2 water samples were tested for metals. Several exceeded the criteria, with all of the highest concentrations being found in sample 06SW0142, collected from the east side of the lagoon. These contaminants included arsenic (41 ug/L), cadmium (2 ug/L), copper (381 ug/L), lead (182 ug/L), nickel (418 ug/L), selenium (1 ug/L) and zinc (1060 ug/L). This sample also exceeded the Environment Canada Discharge Criteria for chromium and cobalt (68 mg/L and 185 mg/L, respectively) where the established criteria are 10 mg/L and 50 mg/L, respectively.

BRI recommends the installation of a permanent sewage treatment facility at both CFS-Alert and CFS-Eureka to properly treat sewage before it is released into the environment. This would result in the protection of this fragile environment from the

introduction of potentially detrimental bacterial contaminants such as coliforms and fecal coliforms.

Conclusion

The results obtained from the summer 2006 sampling campaign showed that the largest volumes of contaminated soil at both CFS-Alert and CFS-Eureka was from petroleum hydrocarbons. Contamination from inorganic elements was also exists, but in fewer sites.

Subsequent analyses are recommeded during the next field visit, including 22 delineations and 18 assessments at Alert and 5 delineations and 3 assessments at Eureka. Sites were classified according to the FCSAP Contaminated Site Classification and the following sites have been identified as those of highest concern :

CFS-Alert

- Oxidator Building
- Diesel Pipeline
- Main Station Landfill
- Station Day Tank Area
- Baker's Dozen
- New Fuel Spill of 1999
- Sewage Outfall
- MSE-17 Vehicle Maintenance Building
- Burner Project Site (Old Haz Mat Storage Site)

CFS-Eureka

- North Airstrip Apron
- Sewage Lagoon
- Barrel Dump

BRI recommends the completion of additional assessment and delineation work at the 12 sites listed above. Eventually, remediation of the remaining contaminated areas will have to be performed; this includes the treatment of contaminated soils in situ or after

excavation. The team at BRI can provide additional remediation strategy recommendations following more detailed evaluation. This would include microbiological testing of samples obtained from the next campaign for the evaluation of treatment options.

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1 INTRODUCTION

This report was prepared by the Biotechnology Research Institute (BRI) and presents the results of field studies for the characterization of multiple contaminated sites situated at CFS-Alert and CFS-Eureka, Nunavut, with the objective of updating the Econet database. The purpose of the field study was to collect the necessary hydrogeological and physicochemical data required to update the Econet database.

1.1 Scope and Objectives

The actual work of the present mandate included the following field activities: 1) Review of the historical data for the 57 sites located at CFS-Alert and CFS-Eureka; 2) Identification of missing data required to complete entry of each site in the Econet database; 3) Site reconnaissance; 4) Data collection and characterization of the missing water, sediment and soil parameters; 5) Classification of each site according to the national classification system for contaminated sites (FCSAP); 6) Updating the Econet database; 7) Updating of the geographic information system (GIS) documentation of the completed CFS-Alert sites; 8) Entry of data into Econet for the new sites at both CFS-Alert and CFS-Eureka.

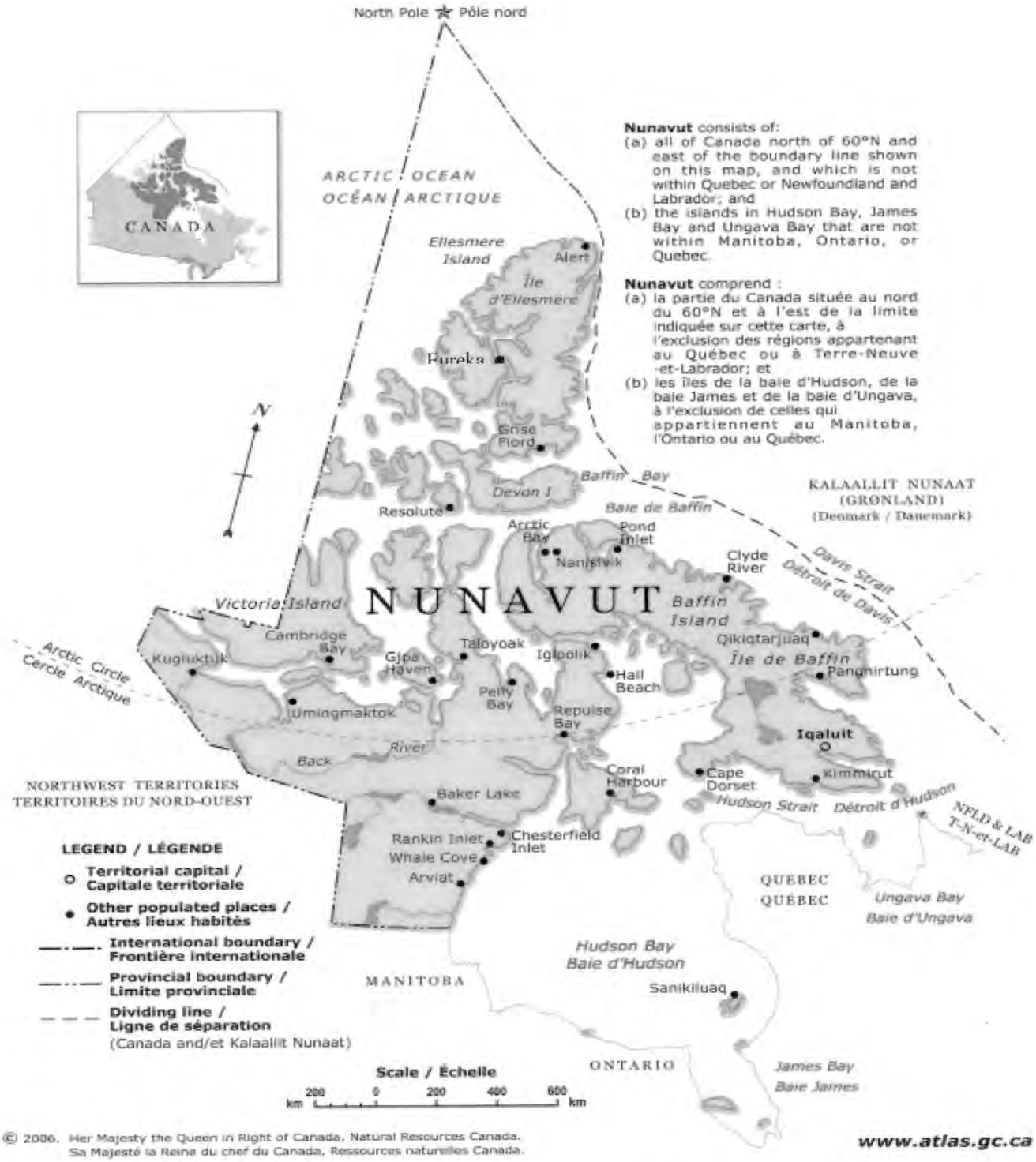

Figure 1. Map of Nunavut, showing Eureka and Alert on Ellesmere Island (Map from www.atlas.gc.ca).

2 METHODOLOGY

2.1 Review of Existing Reports

A review of existing reports and previous studies was carried out to evaluate the extent and type of contamination at each site and to assist in the planning of additional required characterization work. Sources of information included:

- Dumoulin, A. and Pier, D. Environmental Sciences Group, Royal Military College, Delineation of hydrocarbon contaminated soil 1999, Eureka, January 2000.
- Environmental Sciences Group, Royal Military College, CFS Alert environmental management system manual, Issued September 2002, December 2002.
- Pier, D. Environmental Sciences Group, Royal Military College, An environmental study of DND facilities, Eureka, April 1999.
- Pier, D. Environmental Sciences Group, Royal Military College, Delineation of hydrocarbon contaminated soil, CFS-Alert, April 1999.
- Pier, D. Environmental Sciences Group, Royal Military College, environmental study of station facilities, 1999, CFS-Alert, February 2000.
- Royal Military College, The Environmental Sciences Group and Canadian Forces Station Alert: A summary of environmental projects 1998-2002, CFS-Alert, June 2003.
- Thomassin-Lacroix, E. Environmental Sciences Group, Royal Military College, Baseline environmental report August 2000, CFS-Alert, March 2001.

2.2 Assessment Criteria

2.2.1 Soil Criteria

Criteria for the remediation of petroleum hydrocarbon contamination at CFS-Alert and CFS-Eureka are based on the Canadian Council of Ministers of the Environment (CCME) Canada-Wide standards for petroleum hydrocarbons in soil and subsoil endorsed in 2001. The standard is grounded in the science of risk assessment and has been established in the context of land use categories.

The results of the inorganic elements, glycol, phenol and PCB analyses of all soil samples from Alert and Eureka were interpreted using CCME environmental soil quality guidelines, 1999. For the guidelines established after 2004, there was a distinction based on the type of soil (coarse/fine) under investigation. The guidelines for coarse soils will be used in this report, as they are more conservative and better represent the typical soil type found at CFS-Alert and CFS-Eureka.

In this report, petroleum hydrocarbons, inorganic elements and other contaminant concentrations obtained during the 2006 sampling campaign will be compared to CCME industrial generic levels. The CCME industrial land use category is assigned to a site where the primary activity involves the production, manufacture or storage of materials and where public access is restricted. Children are not permitted continuous access or occupancy on industrial sites. This land use category corresponds to the activities presently occurring at CFS-Alert and CFS-Eureka. However, it is important to note that it is the intended future land use that governs the decision as to the level of remediation performed at the site. The type of land use found adjacent to the contaminated site may also influence the remediation criteria levels to be followed. Due to these factors, the choice of assigning a site to the industrial land use category can be the subject of discussion with interested stakeholders.

No background soil samples were collected during the 2006 sampling campaign, therefore metal concentrations are compared to the mean inorganic element concentrations detected in thirteen background soil samples from Ellesmere Island collected by the Environmental Sciences Group (ESG) in 1999. These background concentrations are presented in Table I.

Table I . Mean inorganic element concentrations detected in background soil samples, ESG, 1999.

Element	Cu	Ni	Co	Cd	Pb	Zn	Cr	As
Mean (mg/kg)	19	31	11	0.5	11	68	38	7.9
Standard deviation (mg/kg)	3.9	13	3.8	-	2.3	9.3	8.2	2.6

Arsenic concentrations frequently exceeded CCME soil criterion for industrial sites at CFS-Alert and CFS-Eureka. This is probably the result of high background concentrations of this element in the soil of Ellesmere Island. Furthermore, no significant anthropogenic source of arsenic is present at CFS-Alert and CFS-Eureka.
Background soil samples will be collected during the sampling campaign of 2007 to evaluate more precisely the background concentrations of inorganic elements and to compare these samples with those obtained by ESG in 1999.

2.2.2 Water Criterion

Water samples collected from the Alert Inlet (Alert), Slidre Fjord (Eureka) and in Dumbell Bay (Alert) were compared to the CCME Marine Quality Guidelines for the Protection of Aquatic Life. Water samples collected from isolated standing water pools, Sewage Lagoons, Sewage Outfall, Grey Water Outfall and drainage channels were compared to CCME Freshwater Quality Guidelines for the Protection of Aquatic Life.

The Sewage Outfall and the Main Station Landfill at Alert, the New Grey Water Outfall and the Sewage Lagoon at Eureka were compared to both CCME and Environment Canada Effluent Quality and Wastewater Treatment at Federal Establishments guidelines (EC 1976).

2.2.3 Sediment Criterion

Canadian Sediment Quality Guidelines (CSQGs) are nationally endorsed, science-based benchmarks for evaluating the potential of adverse biological effects in aquatic systems. Freshwater and marine CSQGs have been developed and published for a number of contaminants of concern in sediments (CCME 2002).

For each parameter of interest, the CCME guidelines have identified two numerical levels: the lesser level is termed the "Interim Sediment Quality Guideline" (ISQG) value and the greater level is termed the Probable Effect Level (PEL) value. Sediment chemical concentrations below ISQG values are not expected to be associated with any adverse biological effects, while concentrations above PEL values are frequently associated with adverse biological effects. Chemical concentrations between the ISQG and PEL values represent the range in which effects are occasionally observed.

Sediment samples collected from Alert Inlet (Alert), Slidre Fjord (Eureka) and Dumbell Bay (Alert) were compared to the guidelines developed for marine sediment. Moreover, the sediment from Lower Dumbell Lake (Alert), Sewage Lagoon (Eureka) and New Grey Water Outfall (Eureka) were compared to the guidelines for freshwater sediment as well.

2.3 Site Visits

Two teams composed of 2 BRI staff members visited CFS-Alert during the summer of 2006. The first team visited CFS-Alert between June 21st and July 8th, with an interim visit to CFS-Eureka between June 29th and June 30th. The second team visited CFS-Alert between July 3rd and July 22nd.

2.4 Sample Identification

The sample identification scheme followed the following format: 06XX0000. The first 2 numbers represent the year of the sampling campaign ie. 2006, the 2 letters represent the site identification abbreviation and the last 4 numbers represent the sample identification. A list of the sites visited during the 2006 BRI sampling campaign with the

Property Record Identification Number (PRIN), the site name and the site identification abbreviation is presented in Table II.

Table II. Sites visited during the 2006 BRI sampling campaign.

	PRIN	Name	Abbreviation
ALERT	S-148	Battery Dump	BD
	S-349	Oxidator Building (Back of building)	OX
	S-351	12 Pack Site (Lower POL)	TW
	S-352	Runoff Collection Basin	RB
	S-10193	Airstrip Tank Farm	AF
	S-10194	Apron Refueling Area	AP
	S-10194	Deicing Area	DICE
	S-10195	MSE -17 Vehicle Maintenance Building	VM
	S-10196	Burn Pit	BP
	S-10197	Main Station Landfill	MS
	S-10199	CE-140 MCE Building Fire Hall	FH
	S-10200	B-145 Cat House	CH
	S-10201	1 CEU GP Hut	CE
	S-10202	Cold Storage Dog House GP Hut	CS
	S-10203	Curling Club/Gym Complex	GY
	S-10204	50 Line GP Huts Drainage	GP
	S-10205	Dump #3	D3
	S-10206	TX Site	TX
	S-10207	Airstrip Building HIL-124	HI
	S-10208	Airstrip Building FH-128	AS
	S-10209	Airstrip DREP building & Barrel Cache	DB
	S-10210	Airstrip Diesel Pipeline	DP
	S-10211	Airstrip Hurricane Building	HB
	S-10212	Airstrip Met Shack	ME
	S-10213	Main Station POL Pallet Line	SP
	S-10214	Main Station Day Tank Area	DT
	S-10215	Main Station HAPS	HA
	S-10216	Baker's Dozen	KZ
	S-10217	Building 113, Heated Vehicle Storage	HV
	S-10218	Burner Project Site	BU
	S-10219	New Fuel Line Spill 1999	NF
	S-10522	AES Weather Station Remains-GA	WS
	S-10523	Operations Building	OP
	S-10524	Sewage Outfall	SO
	S-10529	Lower Dumbell Lake	LL
EUREKA	S-150	Battery Dump	BD
	S-10185	HADCS Vehicle Maintenance Garage	HD
	S-10186	East Airstrip Landfill	EL
	S-10187	Sewage Lagoon	SW
	S-10190	Main Camp "The Fort"	MC
	S-10191	West Airstrip Landfill	WL
	S-10192	Polar Continental Shelf Facilities	PC
	S-10525	Barrel Dump	BL
	S-10526	New Grey Water Outfall	SO FOR SOIL/WO FOR WATER
	S-10527	North Airstrip Apron	NA
	S-10528	South Airstrip Dump	SL

2.5 Soil and Sediment Sampling

Assessment work was performed at almost every site based on a review of the existing reports and visual observations. The objective of the assessment work, based on deterministic random sampling, was to target contaminated zones in order to obtain more information regarding the contamination present at the sites (location, depth, concentration, nature). This information is necessary for updating the Econet database. Delineation work, based on sampling from a grid, was performed at 2 sites during the 2006 sampling campaign; the Oxidator building (PRIN S-349) and the deicing area, located in the Apron Refueling area (PRIN S-10194). The objective of the work at these 2 sites was to delineate the extent of contamination and the volume of soil impacted.

Bodycote Materials Testing of Pointe-Claire, Montreal and Maxxam Analytique Inc. of Saint-Laurent, supplied all sample containers. The sample label was firmly attached to the side of the container, and the following information was legibly and indelibly written on the label:

- Project name;
- Sample identification;
- Sampling date;
- Tests required;
- Preservatives added;
- Sample collector's initials.

All petroleum hydrocarbon (F1 to F4) analyses were carried out by laboratories affiliated with Maxxam Analytique Inc. Maxxam Analytique Inc. has CCME accreditation for this analysis. The majority of the remaining analyses were performed by Bodycote Materials Testing of Pointe-Claire or other affiliated laboratories.

For the majority of soil/sediment samples, a hole was dug with a shovel washed with water and Alconox® soap between each sample. For some soil samples, a backhoe was used to make a trench prior to sampling. Samples for organic and inorganic element

analyses were collected using glass sample jars with a Teflon coated cap and dedicated gloves. For petroleum hydrocarbon (F1 to F4) analyses, a 250 mL jar was completely filled with soil to avoid contaminant volatilization.

Visual observations and descriptions of odours were noted for each sample in the field logs. Samples were stored in coolers at 4°C before and during shipping whenever possible. A total of 168 soil samples and 3 sediment samples were collected at Alert and a total of 29 soil samples and 6 sediment samples were collected at Eureka during the 2006 campaign.

Additionally, in the compiled analyses results tables, several samples bear the notation "Soil (Drainage sed.)." It must be noted that this was due to an error that occurred when the purchase orders for the laboratories were filled out: these samples were collected in different drainage pathways and they should have been considered as soils collected on land.[1]

2.6 Water Sampling

Bodycote Materials Testing of Pointe-Claire, Montreal and Maxxam Analytique Inc. of Saint-Laurent, supplied all sample containers. A total of 22 water samples were collected at Alert and 5 water samples were collected at Eureka during the 2006 campaign.

All petroleum hydrocarbon (F1 to F4) analyses were carried out by laboratories affiliated with Maxxam Analytique Inc., which has CCME accreditation for this type of analysis. The majority of the remaining analyses were performed by Bodycote Materials Testing of Pointe-Claire or other affiliated laboratories. Water samples were taken 1 day prior to shipping. Samples were stored in coolers at 4°C before and during shipping whenever possible.

[1] According to Trenton Military Base personnel.

2.7 Surveying of Each Sample Point

The geo-referencing of each new sample point was performed during the 2006 sampling campaign. The geo-referencing will permit the updating of GIS documentation for the CFS-Alert sites and to plot the new sampling sites for CFS-Eureka.

A post-processing differential CMT-Alto-G12 GPS was used to perform the survey. Differential GPS involves the use of a stationary receiver (base station) that continuously records satellite measurements at a fixed and known location. The data was collected using the global geodetic reference system WGS84. This system was established and is maintained by the U.S. Department of Defense to facilitate positioning and navigation worldwide[2], and has an accuracy of approximately 1 m.

2.8 Contaminated Site Classification

Each site was evaluated using the ''FCSAP Contaminated Site Classification Guidance''[3] form provided by 8 Wing CFB (Canadian Forces Base) Trenton and was developed by Environment Canada. Like the CCME National System of Classification of contaminated sites, this tool was created in order to help evaluate contaminated sites and the actual or possible negative effects on the environment or the health of the population. A copy of the guide and the evaluation of each site is included in appendix B.

2.9 Photographic Documentation of Sample Sites

Photographs of each site were taken during the 2006 sampling campaign to facilitate site documentation. Please refer to Appendix A for a selection of photos from the site visits.

[2] Modern Geodetic Reference Frames For Precise Satellite Positioning And Navigation (Kouba et al. 1994)
[3] This document does not supercede the CCME National Classification System (NCS) for Contaminated Sites (Report CCME EPC-CS39E), March 1992.

Figure 2. Location of Ellesmere Island, Nunavut, Canada (Map from www.maps.com).

Figure 3. Aerial view of CFS-Alert with Dumbell Bay in the foreground (BRI, 2006).

3.1 CFS-Alert Sites

3.1.1 S-148 Battery Dump

3.1.1.1 Location and Site Description

The Battery Dump site is located southwest of the AES Hydrogen Building between Lower Water Road and Line Road and remains an operational site (Figure 4). The battery dump "has been used for the disposal of various types of batteries, including vehicle and potassium hydroxide batteries, and to a lesser extent, other types of debris such as wooden pallets, etectrical wire, metal and cargo strapping", (ESG 2000). The area is surrounded by a circular rope fence and the debris was covered with gravel in 2004. At the time of the field investigation, battery debris and asbestos were exposed. (Photograph 1, Appendix A).

The ESG noted in their 1999 report that the substrate consists of native clay and silts with some shale stone and supports sparse vegetation composed principally of grasses. The site is situated on the side of a north-south slope above Alert Inlet.

3.1.1.2 Potential Receptors and Valued Ecological Components

The principal receptor of this site is Alert Inlet, located just down the slope. No drainage channels were observed at the time of our visit and no contamination had been detected outside the fence until the 2006 visit by BRI. The battery dump supports sparse vegetation and pools of standing water. This suggests that animal life is probably present on the site even though no evidence of their presence was observed. Humans activities are sporadic in this area.

3.1.1.3 Summary of Previous Investigations[4]

Four (4) soil samples were collected in 1999 by ESG staff and were analyzed for inorganic elements. One sample contained 670 mg/kg lead and therefore exceeded Tier II of the DEW line assessment criterion.

Forty-seven (47) soil samples were analyzed in 2000 and five of them had concentrations in excess of the DEW line assessment criteria, (Table III). Three (3) samples exceeded the criterion for zinc, 2 for lead and 1 for arsenic. The contamination was observed up to a depth of 0.75 m. The extent of contamination was defined for three small zones and was estimated to cover approximately 240 m^2 and have a volume of 130 m^3. No contamination was detected outside of the rope fence.

Table III. (S-148) Previous contaminated samples.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
99-11176	0	LEAD (PB)	500	670
00-11039/40	0-10	ARSENIC (AS)	30	32
00-11052	0-10	ZINC (ZN)	500	11,672
00-11064	0-10	LEAD (PB)	500	553
00-11103	0-10	LEAD (PB)	500	3,811
00-11154	0-10	ZINC (ZN)	500	3,193
00-11155	40-50	ZINC (ZN)	500	8,824

3.1.1.4 Nature and Extent of Contamination

In total, five soil samples were collected at the site during the summer of 2006. Four (4) sub-surface soil samples (ranging from 30 – 50 cm in depth) were collected in the contaminated area defined by ESG in 2000, and only 1 sample (06BD0026) had zinc concentrations above CCME criterion for industrial sites (Table IV). Another soil sample (06BD0029) was collected at the surface and no inorganic element concentrations were above CCME criteria. Arsenic concentrations at this site were above CCME guidelines

[4] All comments in the section ''Summary of Previous investigations'' for all the evaluated sites, were derivedfrom the previous ESG reports (1998/1999/2000).

for 3 soil samples. No known anthropogenic sources of arcsenic are found at CFS-Alert. Additional background soil samples should be taken during the summer 2007 sampling campaign to confirm this.

3.1.1.5 Recommendations

Because the contaminated soil is contained within the bermed area, an assessment of the area surrounding the berm should be performed during the next sampling campaign to evaluate if migration of the contaminants is occurring. This includes the collection of approximately 6 subsurface and surface soil samples for metals. Two (2) surface water samples from the drainage pathway downstream of the dump should be collected and evaluated for metals to confirm if there has been any contaminant migration toward Alert Inlet. The 2006 results should be compared to the background concentrations.

Table IV. (S-148) Battery Dump results.

	PARAMETERS	SOIL			Battery Dump (S-148) SOIL				
		UNITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	06BD0025 35-45 cm 06/24/06	06BD0026 30-40 cm 06/24/06	06BD0027 50 cm 06/24/06	06BD0028 Dup. of 0027 50 cm 06/24/06	06BD0029 15 cm 06/24/06
METALS	Arsenic (As)	mg/kg	12	0.27	14	6	13	14	9
	Barium (Ba)	mg/kg	2,000	5	19	17	24	20	15
	Cadmium (Cd)	mg/kg	22	0.22	<0.5	1.8	<0.5	<0.5	<0.5
	Chromium (Cr)	mg/kg	87	3	9	13	7	6	19
	Cobalt (Co)	mg/kg	300	1.9	12	12	9	8	11
	Copper (Cu)	mg/kg	91	2.1	20	52	7	9	24
	Lead (Pb)	mg/kg	600	1.2	19	400	15	13	68
	Manganese (Mn)	mg/kg	---	1.1	560	410	540	460	430
	Molybdenum (Mo)	mg/kg	40	1.4	<2	3	<2	<2	<2
	Nickel (Ni)	mg/kg	50	0.6	31	33	16	15	34
	Selenium (Se)	mg/kg	3.9	0.5	NA	NA	NA	NA	NA
	Silver (Ag)	mg/kg	40	0.4	<2	<2	<2	<2	<2
	Tin (Sn)	mg/kg	300	0.8	<5	6	<5	<5	<5
	Zinc (Zn)	mg/kg	360	2.5	190	7,900	30	23	52

ND Not detected
NA Not available
Higher than the criteria

Figure 4. (S-148) Battery dump map.

3.1.2 S-349 Oxidator Building

3.1.2.1 Location and Site Description

The Oxidator Building is located within the main station area southeast of the HAPS building and northwest of the water treatment plant (Figures 5-7). The Oxidator Building was the previous location of the station's power plant and now houses the waste incinerator. Battery neutralization is also done inside and outside the building (Photograph 2, Appendix A). Batteries are first dismantled and washed with hot water. The battery casing is incinerated and the water is neutralized with a sulfuric acid solution for 12 hours. After that, the water is filtered, the filter is incinerated and the water is analyzed for zinc. All of the ash produced by incineration is then disposed of in an engineered landfill. The soil on the site is composed of native silts and clays. The topography of the site is generally flat with a steep embankment sloping downward toward pools of standing water and drainage ditches located to the southeast of the building. A drainage ditch also runs along the northwest side of the building.

3.1.2.2 Potential Receptors and Valued Ecological Components

The drainage on the site eventually makes its way down the slope towards the Baker's Dozen and finally to the Collection Basin. Therefore, the drainage ditches can facilitate contamination from the site by migrating toward the Collection Basin. Evidence of animal life was observed at the Collection Basin. For example, feces and animal tracks were observed at the time of our visit to this site. Furthermore, the Oxidator Building site supported sparse vegetation and small animals (birds and field mice). Human activities are not officially present outside of the building in this area but remain possible due to the proximity to the accomodations building (HAPS).

3.1.2.3 Summary of Previous Investigations

In 1998, delineation of the site behind and north of the building was done by ESG to

determine inorganic elements, TPH, PAH and BTEX concentrations. The volume of soil contaminated with TPH above 2,500 mg/kg was estimated to be 360 m^3. Approximately 50 m^3 of soil with the highest TPH concentrations was excavated for a bioremediation project. Recommendations for additional sampling around the entire building were made.

In 1999, ESG collected 42 delineation surface soil samples on a 12 m x 6 m grid. A test pit was also dug on the south side of the building and a sample was collected at a depth of 50 cm. Twenty-nine (29) soil samples were analyzed for inorganic elements and 10 of them contained zinc, copper and/or lead at levels exceeding DEW line assessment criteria. Zinc was the most common inorganic element. Twenty-two (22) soil samples were analyzed for TPH and 10 of them had concentrations above 2500 mg/kg. Fuel oil was most commonly the source.
PAHs were tested for in sub-surace soil samples and only and naphthalene was found to exceed the CCME criterion of 0.6 mg/kg.
No TPH, PCBs or glycol were detected in the water sample collected in the pool of standing water located below the oxidator building. The pH of the sample was 6.9.

In 2000, ESG collected 49 delineation samples including 8 depth samples mostly from the north, east and south sides of the building. Fourteen (14) soil samples were analyzed for inorganic elements and one of them (Sample 00-10105, collected from a depth of 30 cm) was above the tier II DEW line asessment criteria for zinc and copper. Thirty-four (34) soil samples were analyzed for TPH and 4 of them had concentrations above 2,500 mg/kg (00-10104/105/106/133). The highest concentration was 23,000 mg/kg, collected from a depth of 30 cm. Two (2) different contaminated areas were defined in 2000; 1 at the east end of the building and the other along Canso Lane.

3.1.2.4 Nature and Extent of Contamination

In 2006, 22 delineation surface soil samples, including 3 drainage soil samples, 1 duplicate pair, and 2 depth soil samples were collected. Four (4) surface water samples from the standing water pools were also collected. Nineteen (19) soil samples were analyzed for inorganic elements and 14 of them exceeded CCME guidelines for industrial soil for at least 1 element (Table VI). Zinc was the major inorganic element exceeding criteria on the site. Indeed, 14 soil samples contained zinc concentrations above criteria. Sample 06OX0057, collected in a standing water pool at the south of the building, contained 8,360 mg/L zinc, the maximum concentration detected at the Oxidator Building. Two (2) samples contained nickel at concentrations exceeding the CCME guidelines. Arsenic concentrations were were slightly above the CCME criteria for industrial soil in 2 soil samples.

Twenty-one (21) soil samples were analyzed for petroleum hydrocarbons (F1 to F4) and 18 of them exceeded CCME guidelines for industrial soil. Of these, only 1 sample (06OX0051) did not exceed the guideline for fraction 2 (diesel). Six (6) of them exceeded guidelines for the volatile fraction 1 (gasoline), including 2 samples (06OX0039/59) containing BTEX. Ten (10) samples analyzed for petroleum hydrocarbons were above the guidelines for fuel oil (fraction 3) and 6 of them also contained heavy oil fractions above the 3,300 mg/kg criteria (fraction 4), (Table V). The results suggest that the samples could have been contaminated from different sources.

All four water samples obtained from the three pools of standing water located along Canso Lane were analyzed for metals. Several depressions containing a pink coloration, measuring between 15 and 25 cm in diameter, were observed in the pool of standing water during the investigation (Photograph 3, Appendix A). This coloration is due to the presence of a pH indicator previously used in the battery neutralization procees. Of the 14 different elements analyzed for, 5 exceeded the applicable criteria in the 4 water samples, including arsenic (with a maximum concentration of 12 µg/L), cadmium (maximum concentration of 32 µg/L), copper (maximum concentration of 40 µg/L), lead (maximum concentration of 90 µg/L) and zinc (maximum concentration of 13,000 µg/L). It is worthy to note that freshwater sample 06OX0073 had the highest concentration for all of these elements, except for copper. This sample also exceeded the guidelines for

Table V. (S-349) Previous contaminated samples.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
98-12080/81	0	TPH	2,500	9,600
98-12082	0	TPH	2,500	6,200
98-12088	0	TPH	2,500	8,300
98-12089	0	TPH	2,500	4,000
98-12121	30	TPH	2,500	3,000
98-12122/23	35	TPH	2,500	12,000
98-12124	45	TPH	2,500	15,000
98-12125	40	TPH	2,500	22,000
98-12126	40	TPH	2,500	6,200
98-12127/28	40	TPH	2,500	18,000
98-12129	40	TPH	2,500	20,000
98-12130	35	TPH	2,500	8,000
99-12882	0	TPH	2,500	2,800
99-12883	0	TPH	2,500	3,800
99-12884	0	TPH	2,500	8,500
99-12896	50	TPH	2,500	7,700
99-12890/91	0	ZINC (ZC)	500	860
99/12892	0	ZINC (ZC)	500	520
99-12893	0	ZINC (ZC)	500	500
99-12895	0	ZINC (ZC)	500	1,600
99-12898	0	TPH	2,500	15,000
99-12899	0	ZINC (ZC)	500	10,000
	0	COPPER (CU)	100	180
	0	LEAD (PB)	500	1,600
99-12900/01	0	TPH	2,500	9,100
99-12905	0	TPH	2,500	4,400
99-12906	0	TPH	2,500	11,000
99-12908	0	TPH	2,500	7,100
	0	ZINC (ZC)	500	890
99-11784	0	ZINC (ZC)	500	730
	0	ZINC (ZC)	500	650

3.1.2.5 Recommendation

Delineation (approximately 20 samples) must be performed under and around the building to evaluate the extent of TPH, PAH and metal contamination. The majority of the samples should be collected at the exterior of the previously discovered contaminated zone to delineate the extent of the contaminated area for eventual excavation or treatment. Contamination is also suspected under the building because a liquid with a strong petroleum hydrocarbon odour was dripping down from the floor of the building at the time of our visit. In light of this, BRI suggests changing the floor of the building or installing an impermeable barrier under the building to collect the spill. Sub-surface soil samples should also be taken to evaluate the vertical extent of the contamination. Surface water samples should be collected from the drainage ditches and analyzed for petroleum hydrocarbons, metals and PAHs.

Oxydator builiding - back of building (S-349) 1/2												
Soil (Drainage sed.) 06OX0050 0-10 cm 07/03/06	Soil 06OX0051 0-10cm 07/03/06	Soil 06OX0042 0-10 cm 07/03/06	Soil 06OX0041 Dup. of 0042 0-10 cm 07/03/06	Soil 06OX0043 0-10 cm 07/03/06	Soil 06OX0044 0-10cm 07/03/06	Soil 06OX0045 0-10cm 07/03/06	Soil 06OX0046 50 cm 07/03/06	Soil (Drainage sed.) 06OX0052 0-10cm 07/03/06	Soil 06OX0053 0-10 cm 07/03/06	Soil (Drainage sed.) 06OX0054 0-10 cm 07/03/06	Soil 06OX0055 0-10 cm 07/03/06	Soil 06OX0056 0-10 cm 07/03/06
9.1	7.2	9.6	10.5	9.6	NA	NA	13	11	10.3	13.7	7.3	8.6
20	155	43	38	33	NA	NA	15	24	14	32	22	16
1	1	2	3	5	NA	NA	<1	<1	<1	1	<1	<1
26	25	37	41	51	NA	NA	28	30	30	32	27	24
10	11	13	15	11	NA	NA	15	14	14	21	12	11
22	24	39	44	57	NA	NA	26	32	27	47	22	19
33	26	37	44	149	NA	NA	14	25	19	24	15	18
489	448	468	512	380	NA	NA	491	496	495	514	448	521
<2	<2	<2	<2	5	NA	NA	<2	<2	<2	<2	<2	<2
34	35	49	60	39	NA	NA	50	44	49	50	42	36
0.7	0.7	0.8	1.2	0.6	NA	NA	0.7	<0.5	0.7	0.5	0.6	0.6
<2	<2	<2	<2	<2	NA	NA	<2	<2	<2	<2	<2	<2
<5	<5	<5	<5	5	NA	NA	<5	<5	<5	<5	<5	<5
299	464	1,980	2,790	1,940	NA	NA	82	118	913	255	85	166
ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND
ND	ND	0.03	ND	0.04	ND	ND	NA	ND	ND	ND	ND	ND
ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND	ND	ND
ND	ND	0.1	0.12	0.05	ND	2	NA	ND	ND	ND	ND	ND
ND	ND	0.1	0.12	ND	ND	1.8	NA	ND	ND	ND	ND	ND
ND	ND	0.2	0.24	0.05	ND	3.8	NA	ND	ND	ND	ND	ND
ND	ND	19	22	44	360	1,600	NA	940	ND	ND	170	88
ND	ND	19	21	44	360	1,600	NA	940	ND	ND	170	88
ND	26	2,600	6,400	9,200	8,400	27,000	NA	7,600	ND	680	9,000	2,900
140	1,800	9,200	13,000	83,000	29,000	5,300	NA	2,000	360	880	920	970
47	1,200	4,800	6,800	35,000	14,000	1,800	NA	450	170	120	140	220

f soil when they were sent for analysis.

		Oxydator builiding - back of building (S-349) 2/2									
L		Soil (Drainage sed.)	Soil	Soil	Soil	Soil	Soil	Freshwater	Freshwater	Freshwater	Freshwater
AL ES)	DETECTION LIMIT	06OX0057	06OX0039	06OX0040	06OX0058	06OX0059	06OX0060	06OX0073	06OX0074	06OX0075 Dup. of 0074	06OX0076
		0-10 cm	0-10 cm	0-10 cm	0-10 cm	40 cm	0-10 cm	Surf. Water	Surf. Water	Surf. Water	Surf. Water
		07/03/06	07/03/06	07/03/06	07/04/06	07/04/06	07/04/06	07/05/06	07/05/06	07/05/06	07/05/06
	0.27	9.2	9	10.6	NA	8	9.9	12	8	5	5
	5	13	61	20	NA	15	15	70	30	20	20
	0.22	8	2	3	NA	<1	6	32	3	2	2
	3	27	51	37	NA	26	27	12	8	5	5
	1.9	10	12	15	NA	12	8	24	6	4	4
	2.1	41	35	50	NA	25	27	28	40	35	17
	1.2	56	34	37	NA	12	70	90	75	51	13
	1.1	405	443	440	NA	426	368	669	165	110	125
	1.4	<2	<2	<2	NA	<2	<2	8	5	5	3
	0.6	41	38	49	NA	40	32	40	16	11	8
	0.5	1.9	1.1	1.3	NA	<0.5	1.4	3	1	1	<1
	0.4	<2	<2	<2	NA	<2	<2	<1	<1	<10	<1
	0.8	<5	<5	5	NA	<5	10	2	3	1	<1
	2.5	8,360	945	2,500	NA	61	6,150	13,000	12,300	7,990	7,520
	---	NA	NA	NA	NA	NA	NA	8.2	9.1	NA	7.7
	0.02	ND	0.7	ND	ND	ND	ND	NA	NA	NA	NA
	0.02	0.03	16	0.08	ND	0.4	ND	NA	NA	NA	NA
	0.02	0.04	27	0.06	ND	0.4	ND	NA	NA	NA	NA
	0.02	0.22	110	0.69	ND	3.4	ND	NA	NA	NA	NA
	0.04	0.27	150	0.48	ND	2.7	ND	NA	NA	NA	NA
	0.04	0.49	260	1.2	ND	6.1	ND	NA	NA	NA	NA
	10	150	4,700	230	13	670	ND	NA	NA	NA	NA
	10	150	4,400	230	13	670	ND	NA	NA	NA	NA
	10	2,600	51,000	16,000	3,000	12,000	920	NA	NA	NA	NA
	10	310	1000	7,900	1,100	460	840	NA	NA	NA	NA
	10	41	130	3,600	230	17	170	NA	NA	NA	NA

Figure 5. (S-349) Oxidator Building map 1.

Figure 6. (S-349) Oxidator Building map 2.

Figure 7. (S-349) Oxidator Building map 3.

3.1.3 S-351 12 Pack Site (Lower POL)

3.1.3.1 Location and Site Description

The 12 Pack Site (Lower POL (petroleum oil and lubricants) Pad is located south of the airstrip, above Dumbell Bay and immediately southwest of the Barrel Cache (Figure 8). It consists of a gravel pad that previously supported POL facilities (12 small fuel tanks). The native soils in this area consist primarily of silts and clay with some rocks and boulders. The POL pad was constructed from gravel created by crushing native shale and slate and is lined with a geomembrane.

Since 2005, the gravel pad has supported a biopile. The contaminated soils originated from one of the pipeline spillage events. An area was excavated, measuring roughly 30 m x 20 m and about 1.5 m in depth. The biopile was present during our investigation. The current treatment for this biopile is the occasional application of fertilizer and mixing of the soil. In 2006, a grain-size analysis was done on the soil of the biopile and the soil texture was determined to be a coarse grained soil (median grain size >75μm). The constructed biopile will be considered separately from the 12 Pack Site POL by DND.

3.1.3.2 Potential Receptors and Valued Ecological Components

Dumbell Bay is the main potential receptor, located less than 400 m south and downslope of the area, (Photograph 4, Appendix A). One drainage channel is present on the west side of the pad going toward to the bay. Indicators of wildlife, such as animals' feces and sparse plants were observed on this site. Human presence appeared to be short and infrequent, only during the biopile mixing.

3.1.3.3 Summary of Previous Investigations

In 1998, the site was delineated to determine the extent of the hydrocarbon contaminated soil. ESG had concluded that the hydrocarbon contamination was limited to the

immediate area of the gravel support pad and that subsurface migration of the hydrocarbons was probably not occurring. Four (4) of the 58 samples analyzed contained TPH exceeding the criterion, the highest concentration (98-12409) being 26,000 mg/kg, which is 10.4 times the recommended limit (Table VIII).

In 1999, eleven (11) soil samples were collected in 5 trenches dug to the level of the permafrost between the 12 Pack and the Dumbell Bay. In addition, a surface water sample was taken directly from a test pit. No evidence of hydrocarbon contamination was found and the analyses did not detect any TPH, PAHs or BTEX.

In 2000, 17 samples taken from inside and outside the bermed area were analyzed for inorganic elements and TPH. Only one sub-surface sample located inside the berm (10902) contained TPH concentrations over the criterion. None of the outside samples contained contaminants over the guidelines. In addition, no inorganic elements exceeded the limits.

Table VIII. (S-351) Previous contaminated samples.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
98-12110	30	TPH	2,500	4,100
98-12409	50	TPH	2,500	26,000
98-12410/11	110	TPH	2,500	7,200
00-10902	40-50	TPH	2,500	4,100

3.1.3.4 Nature and Extent of Contamination

ESG had recommended in 2000 to continue monitoring downslope from the gravel pad. During the 2006 investigation, 2 soil samples were collected downslope from the pad in order to verify the potential horizontal migration of the contamination toward the bay (Table IX). Laboratory analysis confirmed that there has been no horizontal migration.

Eight samples were taken from the biopile in 2006, and 3 of the samples demonstrated concentrations of hydrocarbon fraction 2 above the industrial guidelines (Table X).

3.1.3.5 Recommendation

12 Pack site : No more characterization work will be necessary at this site. The contamination inside the berm is isolated and should not require any action.

Biopile : Approximately 5 more soil samples should be collected in the biopile in order to analyze the petroleum hydrocarbon concentrations. The biopile should continue to be mixed and sampled regularly to verify proper functioning of the bioremediation treatment plan.. Once the soil no longer exceeds any guidelines, it could be used for other purposes, such as an inoclum for the bioremediation of future contaminated soils in biopiles as an active biodegrading population has already been established in the current biopile.

Table IX. (S-351) 12 Pack Site (Lower POL) results.

					12 Pack Site (Lower POL) (S-351)	
		SOIL			SOIL	
	PARAMETERS	UNITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	06TW0007 40 cm 24/06/06	06TW0008 40 cm 24/06/06
PETROLEUM HYDROCARBONS	Benzene	mg/kg	0.03	0.02	ND	ND
	Toluene	mg/kg	0.37	0.02	ND	ND
	Ethylbenzene	mg/kg	0.08	0.02	ND	ND
	o-Xylene	mg/kg	—	0.02	ND	ND
	p+m-Xylene	mg/kg	—	0.04	ND	ND
	Total Xylene	mg/kg	11	0.04	ND	ND
	F1 (C6-C10 Hydrocarbons)	mg/kg	310	10	ND	ND
	F1 (C6-C10) -BTEX	mg/kg	310	10	ND	ND
	F2 (C10-C16 Hydrocarbons)	mg/kg	760	10	ND	ND
	F3 (C16-C34 Hydrocarbons)	mg/kg	1,700	10	ND	ND
	F4(C34-C50 Hydrocarbons)	mg/kg	3,300	10	ND	ND

ND Not detected
NA Not available
Higher than the criteria

soil originating from a fuel line spill at the Diesel pipeline area.

SOIL		BIOPILE							
NDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	SOIL							
		A25198-01R/2766-A1 27/06/06	A25204-01R/2766-A2 27/06/06	A25205-01R/2766-B1 27/06/06	A25206-01R/2766-B2 27/06/06	A25207-01R/2766-C1 27/06/06	A25208-01R/2766-D1 27/06/06	A25209-01R/2766-D2 27/06/06	A25210-01R/2766-D3 27/06/06
0.03	0.02	ND	ND	ND	ND	ND	ND	ND	ND
0.37	0.02	ND	ND	ND	ND	ND	ND	ND	ND
0.08	0.02	ND	ND	ND	ND	ND	ND	ND	ND
---	0.02	ND	ND	ND	ND	ND	ND	ND	ND
---	0.04	ND	ND	ND	ND	ND	ND	ND	ND
11	0.04	ND	ND	ND	ND	ND	ND	ND	ND
310	10	18	22	22	24	27	32	20	20
310	10	18	22	22	24	27	32	20	20
760	10	680	1,000	500	810	790	550	740	720
1,700	10	37	46	26	36	38	29	36	41
3,300	10	ND	ND	ND	ND	ND	ND	ND	ND

Figure 8. (S-351) 12 Pack Site POL Pad map.

3.1.4 S-352 Runoff Collection Basin

3.1.4.1 Location and Site Description

The Collection Basin is located west and downslope from the Main Station Area, where Herc Drive meets DOE Road (Figure 9). This is a low-lying area in which significant summer snow melt accumulates, (Photograph 5, Appendix A).

The substrate here contains mostly clay, and a silt mixture is found in less disturbed areas around the site. During the summer months when the soil becomes saturated – and in some places submerged – the soil takes on the quality of fresh cement. Upslope of the collection basin is the Baker's Dozen, where 13 fuel tanks were previously located. Any contamination on this site would likely have migrated downslope to the Collection Basin. Additional contributors to contamination in this area include the power plant and the Oxidator Building.

3.1.4.2 Potential Receptors and Valued Ecological Components

Little vegetation was noted on the site, but sparse vegetation located around the edges of the site consisted of foxtail grass. The presence of different forms of wildlife were noted and this is probably due to the water source. Additionally, Upper Dumbell lake, from where the water for the base is pumped, is less than 1 km away to the south. No human activities were present on-site.

3.1.4.3 Summary of Previous Investigations

In 1998, 61 delineation samples, including 6 duplicate pairs and 21 depth samples were collected in or near the Collection Basin, on an 18 m x 18 m grid. Two (2) of the samples were analyzed for metals and PCBs, but metals concentrations were comparable to background levels and no PCBs were detected (Table XI). All of the delineation samples were analyzed for TPH and the mean concentration was 1,100 mg/kg, with a maximum concentration of 14,000 mg/kg seen in sample 98-12367 (Table XI). This sample was

taken from the slope near the former POL Tank Farm. Five (5) samples exceeded the 2,500 mg/kg criterion and all of these were collected on the northeast end of the delineation grid, near the tank farm area. One (1) water sample was also collected and tested for TPH. No TPH was found above detection limits. The delineation suggested that the spread of contamination was restricted to a 25 m x 25 m area on the west side of Herc Drive.

In 1999, 5 soil samples were collected and analyzed for TPH. Only 1 exceeded the guideline of 2,500 mg/kg (99-11779).

Table XI. (S-352) Previous contaminated samples.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
98-12067	0	TPH	2,500	6,700
98-12353	30	TPH	2,500	3,800
98-12357	10	TPH	2,500	7,300
98-12366	10	TPH	2,500	13,000
98-12367	30	TPH	2,500	14,000
99-11779	30	TPH	2,500	>2,500

3.1.4.4 Nature and Extent of Contamination

In the summer of 2006, 3 soil (drainage) and 2 freshwater samples were collected in the Collection Basin. These were analyzed for TPH and metals (Table XII). The only sample to exceed any criteria for metals was 06RB0192, which contained 463 mg/kg of zinc. This sample also contained 2,800 mg/kg of fraction 2 hydrocarbons in addition to 1,700 mg/kg fraction 3 hydrocarbons. Sample 06RB0195 also surpassed the fraction 2 hydrocarbon criterion with 930 mg/kg. The 2 freshwater samples were collected from 2 different pools of standing water. Despite the different locations, both samples were similar in the contaminants found. Both samples exceeded the criteria for cadmium, copper, lead, selenium and zinc. Notably, all of the concentrations were higher in sample

06RB0300, obtained from the more northern pool of standing water, closer to the drainage channel (Photograph 6, Appendix A).

3.1.4.5 Recommendations

Delineation should be performed during the next field visit in 4 differents small areas to determine the extent of contamination (figure 9). This should include the collection of approximately 16 more soil samples to be analyzed for metals and TPH. Surface soil samples should also be analyzed for PAHs in each area to determine whether there is any contamination. Additionally, 1 surface water sample should be collected in the drainage pathway going towards the Upper Dumbell lake during the next field visit.

Table XII. (S-352) Runoff Collection Basin results.

	PARAMETERS	WATER				SOIL			Runoff Collection Basin (S-352)				
									FRESHWATER		SOIL (Drainage sed.)		
		UNITS	GUIDELINES AQUATIC LIFE		DETECTION LIMIT	UNITS	INDUSTRIAL GUIDELINES	DETECTION LIMIT	06RB0300 Surf. Water 18/07/2006	06RB0301 Surf. Water 18/07/2006	06RB0190 0-10 cm 14/07/2006	06RB0192 0-10 cm 14/07/2006	06RB0195 0-10 cm 14/07/2006
			FRESH	MARINE			(Coarse)						
METALS	Arsenic (As)	ug/L	5	12.5	0.0001	mg/kg	12	0.27	4	3	10.9	6.9	8.6
	Barium (Ba)	ug/L	---	---	0.001	mg/kg	2,000	5	40	50	22	16	13
	Cadmium (Cd)	ug/L	0.017	0.12	0.0001	mg/kg	22	0.22	2	1	<1	<1	<1
	Chromium (Cr)	ug/L	---	---	0.0007	mg/kg	87	3	14	11	31	27	26
	Cobalt (Co)	ug/L	---	---	0.0006	mg/kg	300	1.9	13	11	13	12	11
	Copper (Cu)	ug/L	2-4	2-4	0.0012	mg/kg	91	2.1	17	13	26	24	20
	Lead (Pb)	ug/L	1-7	---	0.0011	mg/kg	600	1.2	8	3	21	23	14
	Manganese (Mn)	ug/L	---	---	0.0003	mg/kg	---	1.1	426	295	486	443	443
	Molybdenum (Mo)	ug/L	73	---	0.0078	mg/kg	40	1.4	4	5	<2	<2	<2
	Nickel (Ni)	ug/L	25-150	---	0.0005	mg/kg	50	0.6	18	11	43	40	39
	Selenium (Se)	ug/L	1	---	0.0006	mg/kg	3.9	0.5	2	1	NA	NA	NA
	Silver (Ag)	ug/L	---	---	0.0008	mg/kg	40	0.4	<0.3	<0.3	<2	<2	<2
	Tin (Sn)	ug/L	---	---	0.011	mg/kg	300	0.8	NA	NA	<5	<5	<5
	Zinc (Zn)	ug/L	30	---	0.006	mg/kg	360	2.5	5,210	3,090	103	463	59
PETROLEUM HYDROCARBONS	Benzene	ug/L	370	110	0.03	mg/kg	0.03	0.02	NA	NA	NA	NA	NA
	Toluene	ug/L	2	215	0.03	mg/kg	0.37	0.02	NA	NA	NA	NA	NA
	Ethylbenzene	ug/L	90	25	0.02	mg/kg	0.08	0.02	NA	NA	NA	NA	NA
	o-Xylene	ug/L	---	---	0.02	mg/kg	---	0.02	NA	NA	NA	NA	NA
	p+m-Xylene	ug/L	---	---	0.05	mg/kg	---	0.04	NA	NA	NA	NA	NA
	Total Xylene	ug/L	---	---	0.05	mg/kg	11	0.04	NA	NA	NA	NA	NA
	F1 (C6-C10 Hydrocarbons)	ug/L	---	---	100	mg/kg	310	10	NA	NA	ND	37	ND
	F1 (C6-C10) -BTEX	ug/L	---	---	100	mg/kg	310	10	NA	NA	ND	37	ND
	F2 (C10-C16 Hydrocarbons)	ug/L	---	---	100	mg/kg	760	10	ND	ND	42	2,800	930
	F3 (C16-C34 Hydrocarbons)	ug/L	---	---	100	mg/kg	1,700	10	ND	ND	1,100	1,700	850
	F4(C34-C50 Hydrocarbons)	ug/L	---	---	100	mg/kg	3,300	10	ND	ND	210	380	320

ND Not detected
NA Not available
Higher than the criteria

Soil (Drainage sed.) refers to samples which were taken from a drainage ditch but were mislabeled as sediment instead of soil when they were sent for analysis.

Figure 9. (S-352) Runoff Collectin Basin map.

3.1.5 S-10193 Airstrip Tank Farm

3.1.5.1 Location and Site Description

The Airstrip Tank Farm is located on the west and south side of the airstrip, behind the pumphouse and the dispensing shed (Figure 10). On-site are four 50,000 gallon tanks, erected in 1995, and two 100,000 gallon tanks, erected in 1978. The tanks are aligned in a row parallel to the airstrip and were placed on membrane-lined gravel pads with berms that have been stabilized with geogrid material. During our investigation, some spill recovery kits were noted on site within the bermed area enclosing the 100,000 gallon tanks. However, no visual contamination, such as iridescence or odours were present in the standing water in the berm. The tanks are refilled each spring and provide a full years-worth of diesel fuel. The fuel is pumped from these tanks to the station fuel tank farm. The site remains active.

Topographically, the site is relatively flat, with a small slope on the north side of the 100,000 gallon tank area, which also features a pool of standing water. One (1) drainage pathway also originates from the same area as the pool, heading towards Dumbell Bay. There is also a slope on the southern edge of the site, which heads south toward Dumbell Bay.

3.1.5.2 Potential Receptors and Valued Ecological Components

The sparse vegetation on site consisted of mostly grasses, with animal sightings being Artic hares. One (1) pool of standing water was also present on site, with a drainage channel going toward Dumbell Bay, located roughly 400 m to the south. Human activities are present on site around the main building.

3.1.5.3 Summary of Previous Investigations

In 1999, 26 soil samples, including 2 duplicate pairs and 2 depth samples were collected from around the fuel tank farm and analyzed for metals, TPH, PAHs, VOCs and BTEX (Table XIII). Sampling concentrated on visibly stained areas, drainage depressions and

paths leading away from the tank farm. Eleven (11) soil samples, including 1 duplicate pair, were analyzed for metals. Only 1 showed contamination above the applicable criteria; sample 99-12687, taken from next to one of the 50,000 gallon tanks, contained lead at 4,400 mg/kg, which exceeds the Tier II criterion. All other concentrations of metals were comparable to background levels. Eight (8) samples were tested for TPH and only 3 had detectable levels, with only 1 exceeding the criteria, that being 99-12687, the same sample with a high concentration of lead. This sample contained 38,000 mg/kg TPH, in addition to 52 mg/kg naphthalene and ethylbenzene and xylenes exceeding the CCME criteria. One (1) surface water sample was also taken from the pool of standing water, and analyzed for TPH, but the amount did not surpass the applicable criterion. The pH of the water was measured at 7.6.

In 2000, soil samples were collected outside the bermed area. None of the samples showed TPH or metal contamination. Therefore, ESG concluded that the berm adequately contains any contamination within the bermed area, preventing migration. The contaminated area also appeared to be small and isolated.

Table XIII. (S-10193) Previous contaminated soil samples.

Samples	Depth (cm)	Contaminant	Criterion	Concentration mg/kg)
99-12687	0	CADMIUM (CD)	5	13
99-12687	0	LEAD (PB)	500	4,400
99-12687	0	TPH	2,500	38,000
99-12687	0	NAPHTHALENE	0.6	52
99-12687	0	ETHYLBENZENE	0.2	3.1
99-12687	0	P+M+XYLENE	1.0	11
99-12687	0	O-XYLENE	1.0	9

3.1.5.4 Nature and Extent of Contamination

A total of 4 samples were collected in the summer of 2006. This included 1 duplicate pair of soil samples, a drainage soil sample (06AF0158) (Photograph 7, Appendix A), and a freshwater sample. These were tested for metals and TPH (Table XIV).

Contaminant concentrations remained below the applicable criteria, except for arsenic in all the soil samples. However, these concentrations are comparable to the background concentrations. Nickel was also detected above background concentrations, but remained below the criterion for all the soil samples. Finally, manganese was elevated for all the soil samples but no guidelines currently exist. No TPH parameters exceeded the guideline but they were detected in considerable concentrations in 2 samples; 06AF0157 contained fraction 3 and 4 and sample 06AF0158 contained fraction 3. No metals were found in the surface water and TPH was not analyzed.

3.1.5.5 Recommendations

An assessment should be performed on this site during the next field visit. This would include the collection and analysis of approximately 4 more soil samples, paying special attention to the drainage ditch to confirm if any contamination is migrating toward the Dumbell Bay. These samples should be tested for metals, TPH and BTEX. No more work is necessary around sample 99-12687, where high concentrations of petroleum hydrocarbons were found because it is contained within the berm. The 2006 results should be compared to the background concentrations to confirm that no contamination is present at the site. Closure of the site should be possible if no contamination is found during the next sampling campagn.

Table XIV. (S-10193) Airstrip Tank Farm results.

									Airstrip Tank Farm (S-10193)			
		WATER			SOIL				Freshwater	Soil		Soil (Drainage sed.)
	PARAMETERS	UNITS	GUIDELINES AQUATIC LIFE		DETECTION LIMIT	UNITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	06AF0082	06AF0157	06AF0159 Dup. of 0157	06AF0158
			FRESH	MARINE					Surface	0-10 cm	0-10 cm	0-10 cm
									07/06/06	07/09/06	07/09/06	07/09/06
METALS	Arsenic (As)	ug/L	5	12.5	0.0001	mg/kg	12	0.27	0.004	13.2	15.7	19.7
	Barium (Ba)	ug/L	---	---	0.001	mg/kg	2,000	5	0.03	19	18	38
	Cadmium (Cd)	ug/L	0.017	0.12	0.0001	mg/kg	22	0.22	<0.001	<1	<1	<1
	Chromium (Cr)	ug/L	---	---	0.0007	mg/kg	87	3	0.011	27	27	38
	Cobalt (Co)	ug/L	---	---	0.0006	mg/kg	300	1.9	0.005	12	14	18
	Copper (Cu)	ug/L	2-4	2-4	0.0012	mg/kg	91	2.1	0.01	22	26	31
	Lead (Pb)	ug/L	1-7	---	0.0011	mg/kg	600	1.2	0.011	24	16	24
	Manganese (Mn)	ug/L	---	---	0.0003	mg/kg	---	1.1	0.123	519	556	713
	Molybdenum (Mo)	ug/L	73	---	0.0078	mg/kg	40	1.4	0.001	<2	<2	<2
	Nickel (Ni)	ug/L	25-150	---	0.0005	mg/kg	50	0.6	0.015	37	41	49
	Selenium (Se)	ug/L	1	---	0.0006	mg/kg	4	0.5	<0.001	NA	NA	NA
	Silver (Ag)	ug/L	---	---	0.0008	mg/kg	40	0.4	<0.001	<2	<2	<2
	Tin (Sn)	ug/L	---	---	0.011	mg/kg	300	0.8	<0.001	<5	<5	<5
	Zinc (Zn)	ug/L	30	---	0.006	mg/kg	360	2.5	0.1	65	59	82
PETROLEUM HYDROCARBONS	Benzene	ug/L	370	110	0.03	mg/kg	0.030	0.02	NA	ND	ND	ND
	Toluene	ug/L	2	215	0.03	mg/kg	0.37	0.02	NA	ND	ND	ND
	Ethylbenzene	ug/L	90	25	0.02	mg/kg	0.082	0.02	NA	ND	ND	ND
	o-Xylene	ug/L	---	---	0.02	mg/kg	---	0.02	NA	ND	ND	ND
	p+m-Xylene	ug/L	---	---	0.05	mg/kg	---	0.04	NA	ND	ND	ND
	Total Xylene	ug/L	---	---	0.05	mg/kg	11	0.04	NA	ND	ND	ND
	F1 (C6-C10 Hydrocarbons)	ug/L	---	---	100	mg/kg	310	10	NA	ND	ND	ND
	F1 (C6-C10) -BTEX	ug/L	---	---	100	mg/kg	310	10	NA	ND	ND	ND
	F2 (C10-C16 Hydrocarbons)	ug/L	---	---	100	mg/kg	760	10	NA	ND	82	28
	F3 (C16-C34 Hydrocarbons)	ug/L	---	---	100	mg/kg	1,700	10	NA	100	17	190
	F4(C34-C50 Hydrocarbons)	ug/L	---	---	100	mg/kg	3,300	10	NA	270	ND	14

ND Not detected
NA Not available
Higher than the criteria

Soil (Drainage sed.) refers to samples which were taken from a drainage ditch but were mislabeled as sediment instead of soil when they were sent for analysis.

Figure 10. (S-10193) Airstrip Tank Farm map.

3.1.6 S-10194 Apron Refueling Area including the Deicing Area

3.1.6.1 Location and Site Description

- The Apron Refueling Area is situated on the south side of the western part of the runway (Figures 11-12). The area includes the airstrip refueling shed and is located in the northwestern region of the site. The POL pump house, located to the southeast, is also included on this site. "Fuel stored in the large fuel tanks south of the pump house is pumped through a pipeline from the tanks to the pumphouse and finally up the slope to the refuelling shed where it is pumped through a nozzle hose to the aircraft." (ESG 1999) (Photograph 8, Appendix A). The substrate here consists of a finer gravel than seen in most areas of the site.

- The Deicing Area is divided into 2 areas at the western end of the runway. The first area is in front of the refueling building and the second is on the complete west side of the end of the runway, in the small area in a semi-circular shape, (Photograph 9, Appendix A). Like the refueling area, the substrate consists of fine gravel and on the runway the land is flat. The runway is usually leveled out every year, although no additional material seems to be added in this process. In the deicing area, type 1 ethylene glycol is used to deice airplanes.

3.1.6.2 Potential Receptors and Valued Ecological Components

- Apron Refueling Area ; Dumbell bay, located less than 0.5 km south of the site, is the principal receptor, although no drainage channels were observed. Sparse vegetation and 2 Arctic hares were observed during the 2006 field study. Human activity is infrequent and normally occurs during plane refueling or inside the building.

- Deicing Area ; One (1) principal drainage channel was present on-site, starting at the end of the runway and going toward Dumbell bay located less than 1 km away from

the area, (Photograph 10, Appendix A). No human activities are usually present on-site except during the deicing and the refueling of planes. No signs of wildlife or vegetation were noted.

3.1.6.3 Summary of Previous Investigations

- At the Apron Refueling Area, 17 soil samples were taken in 1999 and analyzed for inorganic elements, PCBs, TPH, PAHS, BTEX, VOCs and glycol (Table XV). TPH, arsenic and zinc were the main contaminants of concern.

  Eleven (11) soil samples, including 2 sub-surface samples, were analyzed for TPH. Three (3) of them demonstrated concentrations superior to the applicable criterion for TPH.

  One (1) of the 7 samples analyzed for metals had results superior to the Tier II zinc guidelines (500 mg/kg). The sub-surface soil sample (99-11703) located southeast and downslope of the refueling shed contained 1,000 mg/kg zinc. All other parameters analyzed were not detected. One (1) sample obtained from south of the refueling building contained glycol but the result did not exceed the criteria.

Table XV. (S-10194) Previous contaminated soil samples.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
99-11703	50	ZINC (ZN)	500	1,000
99-12718	0	TPH	2,500	4,200
99-11197	0	TPH	2,500	3,700
99-11199	0	TPH	2,500	3,400

- Deicing ; No previous sampling or investigations were performed for this site.

3.1.6.4 Nature and Extent of Contamination

- Apron Refueling Area ; In 2006, 5 soil samples were taken at this site, including one duplicate, and 4 of them were evaluated for TPH and metals (Table XVI). The first contaminated sample (06AP0130) was taken in a trench dug where sample 99-11703

was collected in 1999, southeast and downslope of the refueling shed. This sample contained a low concentration of TPH (F1-F2) and xylene. In a second sample (06AP0131) taken at a depth of 60 cm in the same trench, fraction 2 was also detected, and the concentration equalled the guidelines (760 mg/kg),. No other contaminants exceeded the guidelines at the apron refueling area but nickel had a high concentration in the 3 samples collected in the trench under the pipeline.

- Deicing Area ; Delineation was performed in 2006, which included the collection of 20 soil samples. All of the samples were collected on the runway and were collected from a depth of 0-10 cm because the foreman did not authorize digging any deeper. Of these, 17 were analyzed for glycols and 3 for TPH (Tables XVII-XIX). None of the samples exceeded the applicable criteria for either glycols or TPH. However, 2 samples (06DICE12/15) contained high concentrations of propylene glycol, at 1,900 and 1,200 mg/kg, respectively, but there is currently no criteria set for this propylene glycol. Petroleum hydrocarbon fraction 2 (diesel) was found at 290 mg/kg in sample 06DICE25, collected just beside the refueling shed. Additionally, one freshwater sample, collected in the drainage pathway (just before it crosses Lancaster Drive) was tested for glycols and none was detected. The BRI staff tried to sample the groundwater where the trench had been dug but no groundwater was present, even after 24 hours.

3.1.6.5 Recommendation

- Apron Refueling Area ; During the next sampling campaign, delineation of this area is proposed to determine the extent of contamination. Approximately 10 samples should be analyzed for TPH and BTEX. More depth samples should be taken in a test pit located perpendicular to, and south of, the trench dug during the summer of 2006, on both sides of the pipeline.

- Deicing Area ; BRI suggests delineation of the north area of the runway near the samples that were found to contain glycol in 2006 (06DICE12/15). Approximately

6 subsurface soil samples should be taken adjacent to the runway for glycol analysis to evaluate the vertical migration of the glycol. Three (3) additional soil samples should be collected north of the refueling shed to evaluate if glycol contamination is present in this area. One surface soil sample from the drainage channel on the left side of the runway and one surface water should be collected for glycol analysis. Two (2) groundwater samples should also be collected for glycol anlaysis.

Table XVI. (S-10194) Apron refueling area results.

	PARAMETERS	SOIL			Apron Refueling Area (S-10194) SOIL			
		UNITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	06AP0130 0-10 cm 07/07/06	06AP0131 60 cm 07/07/06	06AP0152 0-10 cm 07/09/06	06AP0132 Dup. of 0131 60 cm 07/07/06
METALS	Arsenic (As)	mg/kg	12	0.27	7.5	8.3	10.8	7.2
	Barium (Ba)	mg/kg	2,000	5	18	19	15	19
	Cadmium (Cd)	mg/kg	22	0.22	<1	<1	<1	<1
	Chromium (Cr)	mg/kg	87	3	29	29	21	29
	Cobalt (Co)	mg/kg	300	1.9	10	11	9	10
	Copper (Cu)	mg/kg	91	2.1	22	24	17	23
	Lead (Pb)	mg/kg	600	1.2	13	13	13	12
	Manganese (Mn)	mg/kg	---	1.1	345	413	410	381
	Molybdenum (Mo)	mg/kg	40	1.4	<2	<2	<2	<2
	Nickel (Ni)	mg/kg	50	0.6	39	41	24	40
	Selenium (Se)	mg/kg	3.9	0.5	NA	NA	NA	NA
	Silver (Ag)	mg/kg	40	0.4	<2	<2	<2	<2
	Tin (Sn)	mg/kg	300	0.8	<5	<5	<5	<5
	Zinc (Zn)	mg/kg	360	2.5	69	71	43	70
PETROLEUM HYDROCARBONS	Benzene	mg/kg	0.030	0.02	ND	ND	ND	ND
	Toluene	mg/kg	0.37	0.02	0.15	0.08	0.05	ND
	Ethylbenzene	mg/kg	0.082	0.02	ND	ND	ND	ND
	o-Xylene	mg/kg	---	0.02	7	1	0.44	ND
	p+m-Xylene	mg/kg	---	0.04	7.1	1	0.47	ND
	Total Xylene	mg/kg	11	0.04	14	2	0.91	ND
	F1 (C6-C10 Hydrocarbons)	mg/kg	310	10	370	77	51	20
	F1 (C6-C10) -BTEX	mg/kg	310	10	360	75	50	20
	F2 (C10-C16 Hydrocarbons)	mg/kg	760	10	1,100	760	71	330
	F3 (C16-C34 Hydrocarbons)	mg/kg	1,700	10	20	35	29	32
	F4(C34-C50 Hydrocarbons)	mg/kg	3,300	10	ND	ND	ND	330

ND Not detected
NA Not available
Higher than the criteria

	DeicingArea at the Apron refueling area (S-10194)								
	SOIL								
DETECTION LIMIT	06DICE01 0-10 cm 07/10/06	06DICE02 0-10 cm 07/10/06	06DICE04 0-10 cm 07/10/06	06DICE05 0-10 cm 07/10/06	06DICE07 0-10 cm 07/10/06	06DICE09 0-10 cm 07/10/06	06DICE11 0-10 cm 07/10/06	06DICE12 0-10 cm 07/10/06	06DICE13 0-10 cm 07/10/06
<8	<8.0	<8.0	<8.0	<8.0	<8.0	<8.0	<40	<80	<8
<4	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<20	<80	<8
<16	<16	<16	<16	<16	<16	<16	<80	<160	<16
<60	<60	<60	<60	<60	<60	<60	<300	<600	<60
<8	<8.0	<8.0	<8.0	<8.0	<8.0	<8.0	730	1,900	<8

	DeicingArea at the Apron refueling area (S-10194)								
	SOIL								FRESHWATER
DETECTION LIMIT	06DICE15 0-10 cm 07/10/06	06DICE17 0-10 cm 07/10/06	06DICE19 10 cm 07/10/06	06DICE20 0-10 cm 07/10/06	06DICE21 80 cm 07/10/06	06DICE23 0-10 cm 07/10/06	06DICE31 0-10 cm 07/10/06	06DICE32 0-10 cm 07/10/06	06DICE38 Surf. Water 07/10/06
<8	<40	<8.0	<8.0	<8.0	<8.0	<8.0	<8.0	<8.0	<1.0
<4	<20	<8.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<1.0
<16	<80	<16	<16	<16	<16	<16	<16	<16	<2.0
<60	<300	<60	<60	<60	<60	<60	<60	<60	<10
<8	1,200	<8.0	<8.0	<8.0	<8.0	<8.0	<8.0	<8.0	<1.0

	Deicing Area (S-10194)		
	SOIL		
DETECTION LIMIT	06DICE25 0-10 cm 07/10/06	06DICE26 0-10 cm 07/10/06	06DICE27 15 cm 07/10/06
0.02	ND	ND	ND
0.02	ND	ND	ND
0.02	ND	ND	ND
0.02	ND	ND	ND
0.04	ND	ND	ND
0.04	ND	ND	ND
10	ND	ND	ND
10	ND	ND	ND
10	290	44	ND
10	ND	ND	ND
10	ND	ND	ND

Figure 11. (S-10194) Apron refuelling area map 1.

Figure 12. (S-10194) Apron refuelling area map 2.

3.1.7 S-10195 MSE-17 Vehicle Maintenance Building

3.1.7.1 Location and Site Description

The MSE-17 Vehicle Maintenance Building is located northwest of the Construction Engineering Building/Fire Hall (CE-140) and southeast of the Heated Vehicle Storage Building (Bldg 113) (Figure 13). The west side of the building complex is used for vehicle maintenance and offices are located midway along the building. A supply storage area is located at the east end of the building. The Vehicle Maintenance Building was constructed on beams that create an empty space between the ground and the building. Around the maintenance garage, coarse gravel prevails, with some fine material found in low spots. Several batteries were stored on a pallet on the northwest side of the building. In the summer of 2006, to the southwest of the building, a channel ran southwest following a small slope that goes in the same direction.

3.1.7.2 Potential Receptors and Valued Ecological Components

No evidence of animal life or vegetation was observed around the site. Human activity on this site is present only within building. One (1) drainage canal is located around the building and could facilitate the transport of contaminants toward standing water and eventually into a lake or inlet (Photograph 11, Appendix A).

3.1.7.3 Summary of Previous Investigations

In 1999, ESG staff collected 22 soil samples from around the maintenance building. The potential sources of contamination were waste oil, batteries, diesel fuel, glycol and other liquids. Of the 22 samples taken, 19 were analyzed for TPH, 14 for metals and 3 for PAHs (Tables XX-XXI). Sixty-three percent (63%) had TPH concentrations above 2,500 mg/kg, 35% demonstrated metals concentrations exceeding Tier II criteria and 33.3% exceeded the CCME criterion for naphthalene. No glycol or pesticides were found in the samples analyzed for these parameters. In summary, the principal

contaminants were TPH, zinc, copper and lead. ESG recommended additional sampling and that the mechanics adopt practices to eliminate contamination events.

Table XX. (S-10195) Previous contaminated water samples.

Samples	Depth (cm)	Contaminant	Criterion (µg/L)	Concentration (µg/L)
99-12501W	0	ETHYLBENZENE	90	4.6
	0	NAPHTHALENE	1.1	13.0
	0	TOLUENE	2	10.7

Table XXI. (S-10195) Previous contaminated soil samples.

Samples	Depth (cm)	Contaminant	Criterion	Concentration
99-12751	0	NAPHTHALENE	0.60	0.94
99-12750/51	0	COPPER (CU)	100	170
	0	ZINC (ZN)	500	960
99-12752	0	ZINC (ZN)	500	3,300
99-12753	0	TPH	2,500	7,100
99-12754	0	TPH	2,500	9,800
99-12755	0	ZINC (ZN)	500	710
99-12756	0	O-XYLENES	1,000	1,600
	0	NAPHTHALENE	0.60	1.9
	0	TPH	2,500	9,400
99-12762	0	TPH	2,500	4,700
	0	CADMIUM (CD)	5	7.8
99-12764	0	TPH	2,500	63,000
	0	CADMIUM (CD)	5	5.9
99-12765	0	TPH	2,500	19,000
	0	XYLENES	1,000	4,200
99-12766	0	TPH	2,500	11,000
99-12773	0	TPH	2,500	4,900
99-12774	25	TPH	2,500	12,000

3.1.7.4 Nature and Extent of Contamination

Four (4) soil samples were taken during the 2006 campaign. One (1) of them, sample 06VM0121 was a duplicate of 06VM0119. All the samples were taken at depths between

0-20 cm. No PAH concentrations were higher than the CCME criterion for Industrial sites, even though fractions 2 and 3 were detected in all of the samples (Table XXII). Metals were found in 3 different samples; arsenic was detected in 2 samples, but only slightly over the guideline concentrations, which was representative of the site's natural background concentrations. Copper was found in samples 06VM0118 and 06VM0121; both were surface soils and 1 was taken inside an interior drain. A moderate concentration of zinc was found inside the drain as well. A military technician advised BRI staff that the drain was broken. The major contamination around the Vehicle Maintenance Building is TPH fractions 2 and 3, which were present in all the samples and displayed high concentrations: between 14.5 and 40 times higher than the CCME guidelines. Fraction 2 was also present in all the samples, between 1.4 and 7.1 times higher than the guidelines. Toluene, ethylbenzene and F4 hydrocarbons were also present in 7 samples. The fuel odour of samples 06VM0117 and 06VM0119 was strong and detectable in the field. No other evidence of contamination was observed at the time of the site visit.

3.1.7.5 Recommendation

Delineation is recommended for this site to delimit the extent of contamination in 4 areas (Figure 13). Approximately 20 samples should be taken for TPH and metals analysis. Even though no PAH contamination was detected in 2006, the samples should be evaluated 1 more time to confirm that no PAH contamination exits in this area. Two (2) surface and 2 depth samples, in areas where odour was previously detected, should be collected and tested for PAHs. Deeper samples should also be collected in order to evaluate the vertical migration. Additionally, 1 surface water and 1 soil sample should be taken at the bottom of the channel to evaluate contaminant migration and analysed for metals, PAH, TPH and BTEX.

One (1) more soil sample will have to be collected under the building, precisely where the inside drain is located and where TPH contamination was detected (06VM0118). The drain was said to be broken. If contamination is found under the building, the drain will have to be changed or a collection system will have to be installed under the building to contain any spills.

Table XXII. (S-10195) Vehicle Maintenance Building results.

	PARAMETERS	SOIL			MSE 17 - Vehicle Maint Bldg (S-10195) SOIL			
		UNITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	06VM0117 15-20 cm 07/06/06	06VM0118 0-10 cm* 07/06/06	06VM0119 15 cm 07/06/06	06VM0121 Dup. of 0119 15 cm 07/06/06
METALS	Arsenic (As)	mg/kg	12	0.27	12.1	13.1	9.3	9.9
	Barium (Ba)	mg/kg	2,000	5	57	57	52	57
	Cadmium (Cd)	mg/kg	22	0.22	3	5	9	7
	Chromium (Cr)	mg/kg	87	3	33	56	38	44
	Cobalt (Co)	mg/kg	300	1.9	10	10	10	10
	Copper (Cu)	mg/kg	91	2.1	38	101	82	124
	Lead (Pb)	mg/kg	600	1.2	115	61	141	143
	Manganese (Mn)	mg/kg	---	1.1	519	448	431	420
	Molybdenum (Mo)	mg/kg	40	1.4	<2	6	3	3
	Nickel (Ni)	mg/kg	50	0.6	36	43	38	38
	Selenium (Se)	mg/kg	3.9	0.5	NA	NA	NA	NA
	Silver (Ag)	mg/kg	40	0.4	<2	<2	<2	<2
	Tin (Sn)	mg/kg	300	0.8	12	6	<5	<5
	Zinc (Zn)	mg/kg	360	2.5	265	400	266	268
PETROLEUM HYDROCARBONS	Benzene	mg/kg	0.03	0.02	ND	ND	ND	ND
	Toluene	mg/kg	0.37	0.02	ND	0.06	0.9	0.7
	Ethylbenzene	mg/kg	0.08	0.02	ND	0.58	ND	0.3
	o-Xylene	mg/kg	---	0.02	1.2	3.4	15	6.6
	p+m-Xylene	mg/kg	---	0.04	ND	2.6	6.2	4.7
	Total Xylene	mg/kg	11	0.04	1.2	6	21	11
	F1 (C6-C10 Hydrocarbons)	mg/kg	310	10	1,300	450	2,200	580
	F1 (C6-C10) -BTEX	mg/kg	310	10	1,300	440	2,200	570
	F2 (C10-C16 Hydrocarbons)	mg/kg	760	10	13,000	11,000	31,000	32,000
	F3 (C16-C34 Hydrocarbons)	mg/kg	1,700	10	26,000	68,000	51,000	51,000
	F4(C34-C50 Hydrocarbons)	mg/kg	3,300	10	1,800	3,900	5,400	6,400
PAH	Naphthalene	mg/kg	22	0.008	5.3	5.1	13.4	3.6
	2-methylnaphthalene	mg/kg	---	0.005	4.4	3.9	25.8	8.1
	1-methylnaphthalene	mg/kg	---	0.005	9.4	5.1	29.8	14.1
	1,3-Dimethylnaphthalene	mg/kg	---	0.005	14.7	15.9	55.8	39.7
	Acenaphthylene	mg/kg	---	0.004	<0.8	<0.9	1.4	0.9
	Acenaphthene	mg/kg	---	0.004	<0.8	1.2	2.3	1.9
	2,3,5-trimethylnaphthalene	mg/kg	---	0.007	3.9	3.5	8.6	7.7
	Fluorene	mg/kg	---	0.007	0.9	0.9	2.8	2.1
	Phenanthrene	mg/kg	50	0.010	<0.8	<0.9	2.2	1.5
	Anthracene	mg/kg	---	0.004	<0.8	<0.9	<1.0	<0.9
	Fluoranthene	mg/kg	---	0.008	<0.8	<0.9	<1.0	<0.9
	Pyrene	mg/kg	100	0.008	<0.8	<0.9	<1.0	<0.9
	Benzo(c)Phenanthrene	mg/kg	---	0.008	<0.8	<0.9	<1.0	<0.9
	Benzo(a)Anthracene	mg/kg	10	0.007	<0.8	<0.9	<1.0	<0.9
	Chrysene	mg/kg	---	0.008	<0.8	<0.9	<1.0	<0.9
	7,12-dimethylbenzo(a)anthracene	mg/kg	---	0.005	<0.8	<0.9	<1.0	<0.9
	Benzo(b,j,k)fluoranthene	mg/kg	10	0.008	<0.8	<0.9	<1.0	<0.9
	Benzo(a)pyrene	mg/kg	0.7	0.008	<0.8	<0.9	<1.0	<0.9
	3-methylcholanthrene	mg/kg	---	0.022	<0.8	<0.9	<1.0	<0.9
	Indeno(1,2,3-cd)pyrene	mg/kg	10	0.008	<0.8	<0.9	<1.0	<0.9
	Dibenzo(a,h)anthracene	mg/kg	10	0.008	<0.8	<0.9	<1.0	<0.9
	Benzo(g,h,i)perylene	mg/kg	---	0.008	<0.8	<0.9	<1.0	<0.9
	Dibenzo (a,l) pyrene	mg/kg	---	0.008	<0.8	<0.9	<1.0	<0.9
	Dibenzo (a,i) pyrene	mg/kg	---	0.007	<0.8	<0.9	<1.0	<0.9
	Dibenzo (a,h) pyrene	mg/kg	---	0.008	<0.8	<0.9	<1.0	<0.9

ND Not detected
NA Not available

Higher than the criteria
The criteria is lower than the detection limit

* The sample comes from a drain in the building.

Figure 13. (S-10195) MSE-17 Vehicle Maintenance Building map.

3.1.8 S-10196 Burn Pit

3.1.8.1 Location and Site Description

The Burn Pit area is found at the junction of the Tower way and the road going to the Main Station Landfill (Figure 14). The site was previously used for burning the "combustible waste generated by the station, including paper and thin plastics, wood and styrofoam, [...] before being disposed of in the main station landfill." (ESG 1999). Fuel was used to ignite the garbage pile.

The site is located about 170 m north of the operations buildings and covers an area of approximately 30 m by 25 m. It is characterized by flat land with a downward slope at the east side in the direction of Dumbell Bay (Photograph 12, Appendix A). The distance between the site and Dumbell Bay is approximately 500 m. At the time of the site visit, the majority of the berm was destroyed; only the northeast part remained. There were no other existing pits. We suspect that the site had been leveled with the berm soil. The burn pit has become an inactive site. The soil is a light grey silt and clay mix with lots of gravel.

3.1.8.2 Potential Receptors and Valued Ecological Components

The principle concern of the burn pit area is the possible contamination of Dumbell Bay, approximately 500 m downslope. However, no drainage channels were observed at the time of the investigation. No vegetation or other signs of wildlife were evident in the area and there were no human activities on-site.

3.1.8.3 Summary of Previous Investigations

Several soil samples and 1 water sample were collected in 1999, in and around the burn pit. The site was still active at the time and strong hydrocarbon odours were detected. The surface water sample was collected in a drainage pathway leading northeast away from the burn pit. Glycol, metals and TPH had negatives results (Tables XXIII-XXIV). Toluene and napthalene exceed the CCME guidelines for the protection of Aquatic Life.

Ehtylbenzene exceeded the CCME drinking water criterion. The water had a pH of 6.5. Soil samples were analyzed for inorganic elements, PCBs, TPH and pesticides. No pesticides, TPH or PCBs were found in the 10 soil samples. In terms of inorganic elements, copper, lead and arsenic were detected in samples 99-12729, 99-12730 and the duplicate samples 99-12731 and 99-12735. Arsenic was only found in the depth sample (90-100 cm) taken in the northern corner of the burn pit and is equivalent to the guideline. The arsenic result (30 mg/kg) should not be considered as an abnormally high concentration considering the soil background is naturally elevated in the Alert area. In addition, zinc concentrations in the 3 surface samples collected directly inside the pit exceeded average levels in background soil samples, although none exceeded the criterion. Copper was 5 times higher than the criterion in the surface sample located southwest of the area, north of the berm.

Table XXIII. (S-10196) Previous contaminated soil samples.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
99-12729	0	COPPER (CU)	100	520
99-12730/31	0	COPPER (CU)	100	140
	0	LEAD (PB)	500	640
99-11735	90	ARSENIC (AS)	30	30

Table XXIV. (S-10196) Previous contaminated water samples.

Samples	Depth (cm)	Contaminant	Criterion (ug/L)	Concentration (ug/L)
99-12501W	Drainage water	NAPHTHALENE	1.1	13.0
	Drainage water	TOLUENE	2	10.7

3.1.8.4 Nature and Extent of Contamination

During the summer 2006, 4 soil samples were collected and analyzed for metals, PAH, TPH and VOCs (Table XXV). A trench (1.0 m depth) was dug south of the previous berm to evaluate the vertical migration and a composite sample was taken at 60 cm (06BP0127). For all of the soil analyses, only 2 metals (arsenic and nickel) exceeded the industrial guidelines. All 4 samples exceeded the arsenic guideline by a factor of 2, and

1 depth sample (06BP0127) surpassed the nickel parameter of 3 mg/kg. The other metals (Cr/Co/Cu/Pb/Zn) were present in the soil at background concentrations. A well-point was installed, but after 24 hours no ground water was present in the area and it was removed. No surface water was collected.

3.1.8.5 Recommendations

Next summer, an assessment must be performed for the burn pit area. Approximately 5 soil samples should be collected and analyzed for metals only. The sample collected in the middle of the old burn pile area should be deeper than the ballast. A water sample in the drainage channel should also be collected to confirm any PAH, metals and VOC contamination. Excavation should be possible in 2007 if the contaminated area is delineated. If no more contamination is found during the next investigation, site closure could be possible.

Table XXV. (S-10196) Burn Pit results.

	PARAMETERS	SOIL			Burn Pit (S-10196)			
		UNITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	SOIL			
					06BP0127 0-10 cm 07/07/06	06BP0128 50 cm 07/07/06	06BP0129 40 cm 07/07/06	06BP0147 40 cm 07/09/06
METALS	Arsenic (As)	mg/kg	12	0.27	23.6	24.8	24.5	21.4
	Barium (Ba)	mg/kg	2,000	5	15	12	17	15
	Cadmium (Cd)	mg/kg	22	0.22	<1	<1	<1	<1
	Chromium (Cr)	mg/kg	87	3	31	29	31	30
	Cobalt (Co)	mg/kg	300	1.9	21	16	17	14
	Copper (Cu)	mg/kg	91	2.1	36	29	29	26
	Lead (Pb)	mg/kg	600	1.2	17	17	19	16
	Manganese (Mn)	mg/kg	—	1.1	456	537	515	514
	Molybdenum (Mo)	mg/kg	40	1.4	<2	<2	<2	<2
	Nickel (Ni)	mg/kg	50	0.6	53	48	49	47
	Selenium (Se)	mg/kg	3.9	0.5	NA	NA	NA	NA
	Silver (Ag)	mg/kg	40	0.4	<2	<2	<2	<2
	Tin (Sn)	mg/kg	300	0.8	<5	<5	<5	<5
	Zinc (Zn)	mg/kg	360	2.5	75	68	74	71
PAH	Naphthalene	mg/kg	22	0.008	NA	<0.1	<0.1	<0.1
	2-methylnaphthalene	mg/kg	—	0.005	NA	<0.1	<0.1	<0.1
	1-methylnaphthalene	mg/kg	—	0.005	NA	<0.1	<0.1	<0.1
	1,3-Dimethylnaphthalene	mg/kg	—	0.005	NA	<0.1	<0.1	<0.1
	Acenaphthylene	mg/kg	—	0.004	NA	<0.1	<0.1	<0.1
	Acenaphthene	mg/kg	—	0.004	NA	<0.1	<0.1	<0.1
	2,3,5-trimethylnaphthalene	mg/kg	—	0.007	NA	<0.1	<0.1	<0.1
	Fluorene	mg/kg	—	0.007	NA	<0.1	<0.1	<0.1
	Phenanthrene	mg/kg	50	0.010	NA	<0.1	<0.1	<0.1
	Anthracene	mg/kg	—	0.004	NA	<0.1	<0.1	<0.1
	Fluoranthene	mg/kg	—	0.008	NA	<0.1	<0.1	<0.1
	Pyrene	mg/kg	100	0.008	NA	<0.1	<0.1	<0.1
	Benzo(c)Phenanthrene	mg/kg	—	0.008	NA	<0.1	<0.1	<0.1
	Benzo(a)Anthracene	mg/kg	10	0.007	NA	<0.1	<0.1	<0.1
	Chrysene	mg/kg	—	0.008	NA	<0.1	<0.1	<0.1
	7,12-dimethylbenzo(a)anthracene	mg/kg	—	0.005	NA	<0.1	<0.1	<0.1
	Benzo(b,j,k)fluoranthene	mg/kg	10	0.008	NA	<0.1	<0.1	<0.1
	Benzo(a)pyrene	mg/kg	0.7	0.008	NA	<0.1	<0.1	<0.1
	3-methylcholanthrene	mg/kg	—	0.022	NA	<0.1	<0.1	<0.1
	Indeno(1,2,3-cd)pyrene	mg/kg	10	0.008	NA	<0.1	<0.1	<0.1
	Dibenzo(a,h)anthracene	mg/kg	10	0.008	NA	<0.1	<0.1	<0.1
	Benzo(g,h,i)perylene	mg/kg	—	0.008	NA	<0.1	<0.1	<0.1
	Dibenzo (a,l) pyrene	mg/kg	—	0.008	NA	<0.1	<0.1	<0.1
	Dibenzo (a,i) pyrene	mg/kg	—	0.007	NA	<0.1	<0.1	<0.1
	Dibenzo (a,h) pyrene	mg/kg	—	0.008	NA	<0.1	<0.1	<0.1
VOC	Vinyl chloride	mg/kg	—	0.04	NA	<0.4	<0.4	<0.4
	1,1-Dichloroethene	mg/kg	50	0.04	NA	<0.1	<0.1	<0.1
	Dichloromethane	mg/kg	50	20	NA	<0.1	<0.1	<0.1
	1,2-Dichloroethene (trans)	mg/kg	50	0.03	NA	<0.1	<0.1	<0.1
	1,1-Dichloroethane	mg/kg	50	0.03	NA	<0.1	<0.1	<0.1
	1,2-Dichloroethene (cis)	mg/kg	50	0.03	NA	<0.1	<0.1	<0.1
	Chloroform	mg/kg	50	0.03	NA	<0.1	<0.1	<0.1
	1,1,1-Trichloroethane	mg/kg	50	0.03	NA	<0.1	<0.1	<0.1
	Carbon tetrachloride	mg/kg	50	0.03	NA	<0.1	<0.1	<0.1
	Benzene	mg/kg	5	0.04	NA	<0.1	<0.1	<0.1
	1,2-Dichloroethane	mg/kg	50	0.03	NA	<0.1	<0.1	<0.1
	Trichloroethene	mg/kg	0.01	0.05	NA	<0.1	<0.1	<0.1
	1,2-Dichloropropane	mg/kg	50	0.04	NA	<0.1	<0.1	<0.1
	Bromodichloromethane	mg/kg	—	0.04	NA	<0.1	<0.1	<0.1
	1,3-Dichloropropene (trans)	mg/kg	50	0.05	NA	<0.1	<0.1	<0.1
	1,3-Dichloropropene (cis)	mg/kg	50	0.03	NA	<0.1	<0.1	<0.1
	Toluene	mg/kg	0.8	0.05	NA	<0.1	<0.1	<0.1
	1,1,2-Trichloroethane	mg/kg	50	0.04	NA	<0.1	<0.1	<0.1
	Tetrachloroethene	mg/kg	0.6	0.08	NA	<0.1	<0.1	<0.1
	Dibromochloromethane	mg/kg	—	0.09	NA	<0.1	<0.1	<0.1
	Chlorobenzene	mg/kg	10	0.03	NA	<0.1	<0.1	<0.1
	Ethylbenzene	mg/kg	20	0.03	NA	<0.1	<0.1	<0.1
	Bromoform	mg/kg	—	0.07	NA	<0.1	<0.1	<0.1
	1,1,2,2-Tetrachloroethane	mg/kg	50	0.04	NA	<0.1	<0.1	<0.1
	1,3-Dichlorobenzene	mg/kg	10	0.04	NA	<0.1	<0.1	<0.1
	1,4-Dichlorobenzene	mg/kg	10	0.03	NA	<0.1	<0.1	<0.1
	1,2-Dichlorobenzene	mg/kg	10	0.02	NA	<0.1	<0.1	<0.1
	o-xylene	mg/kg	—	0.04	NA	<0.1	<0.1	<0.1
	m+p-xylene	mg/kg	—	0.03	NA	<0.1	<0.1	<0.1
BTEX	Benzene	mg/kg	0.03	0.02	ND	NA	ND	ND

Figure 14. (S-10196) Burn Pit map.

3.1.9 S-10197 Main Station Landfill

3.1.9.1 Location and Site Description

The Main Station Landfill has been a waste disposal site since 1980 and is still active. It is located 400 m north of the Operations Building on the side of a north-facing slope above Dumbell Bay and the gravel-crushing operation is immediately to the east. The landfill itself is approximately 100 m x 75 m and "contains a mixture of potentially hazardous and non-hazardous materials, including crushed POL tanks and barrels, batteries, blasting caps, construction waste, furniture and domestic debris." (ESG 2000). The oldest part of the landfill is located at the south end and the debris here has been covered over in gravel. The newer, northern end has been left exposed and has been pushed over the edge of the filled space (Photograph 13, Appendix A).

A drainage channel flows from the landfill area through a culvert, which then divides into 2 separate channels (on the east and west sides of the site) which individually enter Dumbell Bay, (Photograph 14 and 15, Appendix A).

The soil in the toe of the landfill is comprised of native clay and silt, saturated with water. Nearer the toe is a clayey, gravelly soil containing ash from burned garbage.

3.1.9.2 Potential Receptors and Valued Ecological Components

The drainage channel flowing from the landfill site is of concern due to probable water contamination in Dumbell Bay. Due to this possibility, the contamination entering into Dumbell Bay is of concern. Signs of Arctic hares, birds and wolves have been noted in the area. Also, grasses grow sparsely at the toe of the landfill and the slope past the culvert is well vegetated with several grasses. No regular human activities are present in this area.

3.1.9.3 Summary of Previous Investigations

Site assessment was completed in 1998 in order to determine if contaminants were migrating away from the landfill. This involved the collection of 24 soil, 1 plant and 3 surface water samples, which were analyzed for metals, PCBs and TPH (Table XXVI). The main contaminant was discovered to be zinc, which exceeded Tier II guidelines in 1 sample and surpassed background concentrations in several others, including the plant sample. Soil copper concentrations also exceeded background levels and both zinc and copper were detected in all 3 water samples collected from the drainage channels flowing from the landfill. However, considering the nature of the landfill, contamination was deemed to be quite low. The water's pH was 7.2 to 7.9.

Four (4) more samples were collected in 1999; 2 soil and 2 surface water, when an iridescent green liquid was discovered in the pool of standing water found at the base of the landfill. The green liquid was found to originate from an orange powder that the ESG originally discovered, which turned green when mixed with water. The same bright green liquid was observed in the drainage channel. The ESG eventually discovered that the substance was a sea dye marker called uranine ($C_{20}H_{10}Na_2O_5$), which belongs to the xanthene family of chemicals. Airline pilots would use uranine packets in the case of an airplane going down in the water, where it would be thrown into water to leave a coloured trace for search and rescue purposes. Once the packets expired, military personnel discarded them in the main station landfill. The team concluded that no testing of the markers had been performed in this area. Analysis of soil sample 99-12503, which consisted of soil and the green sea dye from the top of the landfill revealed zinc at 21,000 mg/kg, copper at 410 mg/kg and cadmium at 6.2 mg/kg, which all exceeded Tier II criterion. A similar powder found in the landfill turned purple upon adding water and was also considered a sea dye marker. The sample analyzed at this point (99-12502), contained zinc at 400 mg/kg.

A water sample (99-12504W) collected from the large pool at the base of the landfill and across from the culvert contained copper at 0.008 µg/L and zinc at 0.138 µg/L. Although these concentrations did not exceed the Environment Canada Effluent Quality

Guidelines, they both exceeded the CCME Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life. No other metals were detected in the water samples.

In 2000, 88 soil samples, including 9 depth samples, were collected from the toe of the landfill in an effort to detect any contamination that may have migrated east from the landfill towards Dumbell Bay. Thirty-three (33) soil samples were analyzed for TPH, metals and PCBs and none of them exceeded the applicable criteria (Table XXVII). However, 5 groundwater samples, 00-11421/422/423/426/430, exceeded the CCME Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life in at least 1 of 8 different tested substances. Groudwater sample 00-11421, collected in monitoring well 1, was found to contain all of the tested inorganic elements above the guideline concentrations. Four (4) of these exceeded the Environment Canada Discharge Criteria, and 2 samples surpassed the MOEE Non-Potable Water Criteria for at least 4 different metals. Eight (8) sediment samples were also tested for metals and 6 of these exceeded the applicable criteria for copper and also had high concentrations of zinc. No PCBs were detected and TPH was detected in only 1 sediment sample (00-11407), significantly below the 2,500 mg/kg criterion. Furthermore, no contamination was found in the toe of the landfill. Patterns of contamination show that contaminants from the landfill were leaching into the groundwater and also into the Dumbell Bay, suggested by high copper concentrations in 6 sediment samples taken from the area.

Table XXVI. (S-10197) Previous contaminated SOIL samples.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
98-12345	0	ZINC (ZN)	500	550
99-12503	0	COPPER (CU)	100	410
	0	CADMIUM (CD)	500	21,000
	0	ZINC (ZN)	5	6.2

Table XXVII. (S-10197) Previous contaminated SEDIMENT samples.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
00-11402	0	COPPER (CU)	100	367.8
00-11403	0	COPPER (CU)	100	175.3
00-11406	0	COPPER (CU)	100	565.9
00-11407	0	COPPER (CU)	100	337.7
00-11409	0	COPPER (CU)	100	330
00-11410	0	COPPER (CU)	100	322

3.1.9.4 Nature and Extent of Contamination

In 2006, a total of 5 samples were collected from the area of the Main Station Landfill. Of these, 4 were surface water samples, which were analyzed for metals (Table XXVIII). The previous monitoring well points installed by the ESG were malfunctioning and could not be used in the current investigation. Contaminants were similar to the 1998 results; 3 of the 4 water samples contained copper, lead and zinc in concentrations which exceeded the guideline criteria. Copper ranged from 7 µg/L to 24 µg/L, lead ranged from 4 µg/L to 14 µg/L and zinc ranged from 60 µg/L to 160 µg/L. Sample 06MS0082 also exceeded the criterion for arsenic (6 µg/L) and nickel (37 µg/L). This sample was taken from the drainage channel just before it reaches Dumbell Bay. It could not be determined whether cadmium levels surpassed the criterion as the result was less specific than the criterion. The fifth sample was a sediment sample (06MS0030), taken from the edge of Dumbell Bay, close to the drainage channel, and was tested for metals. According to the Marine Guidelines for the Protection of Aquatic Life, none of the guidelines were exceeded, although notable amounts of copper and zinc were detected.

3.1.9.5 Recommendations

Further delineation is required for this site. An additional 10 sediment samples should be collected in Dumbell Bay, where the 2 main drainage pathways discharge, and evaluated for inorganic elements. Approximately 8 groundwater samples or surface water samples (if the snow is still melting) should be collected at the downward slope of the area near the Dumbell Bay, to localize where contamination enters the bay.

Table XXVIII. (S-10197) Main Station Landfill results.

	PARAMETERS	WATER				MARINE SEDIMENT				Main station landfill (S-10197) FRESHWATER				SEDIMENT
		UNITS	GUIDELINES AQUATIC LIFE		EC Discharge Criteria	DETECTION LIMIT	UNITS	GUIDELINES AQUATIC LIFE		DETECTION LIMIT	06MS0082 Surf. Water 07/05/06	06MS0083 Surf. Water 07/05/06	06MS0084 Surf. Water 07/05/06	06MS0085 Surf. Water 07/05/06	06MS0030 Surf. Sed. 06/26/06
			FRESH	MARINE				(3) ISQG	(4) PEL						
METALS	Arsenic (As)	ug/L	5	12.5	100	0.0001	mg/kg	7.24	41.6	0.27	6	<1	2	2	6
	Barium (Ba)	ug/L	—	—	—	0.001	mg/kg	—	—	5	40	<10	10	10	12
	Cadmium (Cd)	ug/L	0.017	0.12	10	0.0001	mg/kg	0.7	4.2	0.22	<1	<1	<1	<1	<0.5
	Chromium (Cr)	ug/L	—	—	10	0.0007	mg/kg	52.3	160	3	23	2	5	5	22
	Cobalt (Co)	ug/L	—	—	50	0.0006	mg/kg	—	—	1.9	9	<1	3	2	8
	Copper (Cu)	ug/L	2-4	2-4	200	0.0012	mg/kg	18.7	108	2.1	24	<1	11	7	11
	Lead (Pb)	ug/L	1-7	—	50	0.0011	mg/kg	30.2	112	1.2	14	<1	5	4	<5
	Manganese (Mn)	ug/L	—	—	—	0.0003	mg/kg	—	—	1.1	247	<5	89	82	440
	Molybdenum (Mo)	ug/L	73	—	—	0.0078	mg/kg	—	—	1.4	1	<1	<1	1	<2
	Nickel (Ni)	ug/L	25-150	—	200	0.0005	mg/kg	—	—	0.6	37	<1	9	8	34
	Selenium (Se)	ug/L	1	—	—	0.0006	mg/kg	—	—	0.5	<1	<1	<1	<1	NA
	Silver (Ag)	ug/L	—	—	—	0.0008	mg/kg	—	—	0.4	<1	<1	<1	<1	<2
	Tin (Sn)	ug/L	—	—	—	0.011	mg/kg	—	—	0.8	<1	<1	<1	<1	<5
	Zinc (Zn)	ug/L	30	—	1000	0.006	mg/kg	124	271	2.5	60	<10	160	90	69

ND Not detected
NA Not available

Higher than the criteria
The criteria is lower than the detection limit.

MARINE SEDIMENT (3) Following the Interim Marine Sediment Quality Guideline (ISQG) of the Canadian Sediment Quality Guidelines for the Protection of Aquatic Life of the Canadian Council of Ministers of the Environment. (2002)

MARINE SEDIMENT (4) Following the Probable Effect Level (PEL) of the Canadian Sediment Guidelines for the Protection of Aquatic Life of the Canadian Council of Ministers of the Environment. (2002)

Figure 15. (S-10197) Main Station Landfill map.

3.1.10 S-10199 CE-140 MCE Building Fire Hall

3.1.10.1 Location and Site Description

The main construction engineering building (CE-140 MCE Building Fire Hall) is located on the left side of the DOE road, behind and south of the vehicle maintenance garage (MSE-17) and north of the supply and traffic building (Figure 16). It contains the Fire Hall and trash compactor/crusher in addition to the CE offices and facilities. These buildings are surrounded by coarse gravel fill. A moderate slope is located at the east and southeast side of the area downslope of DOE road. Furthermore, a small slope is present in the southwest corner of the same building, going down toward the southwest. One stained area was identified northwest of the building, on the west side of the garage door, where 7 wood boxes (1 m x 1 m) were temporarily stored (Photograph 16, Appendix A).

3.1.10.2 Potential Receptors and Valued Ecological Components

No signs of animals were evident in the area throughout the investigation. However, workers confirmed the frequent presence of Arctic foxes searching for scraps in the garbage crusher. A few areas with vegetation were present in this area. During the summer of 2006, a standing pool of water was located in the north side of the fire hall building, which could theoretically attract animals. No drainage channels were identified on this site. Human activities are frequent in the building and outside when garbage is transported to the crusher.

3.1.10.3 Summary of Previous Investigations

During the 1999 investigation, ESG retrieved 11 surface soil samples for analysis. Five (5) soils were analyzed for TPH and two of them (field duplicate pair 99-12780/81) had concentrations above the criterion (2,500 mg/kg) (Table XXIX). One (1) of the 7 soil samples evaluated contained metals exceeding the guidelines; sample 99-12784 was retrieved from a dark 3 m x 3 m stain in front of the main door of the trash compacter

building. It contained copper above the Tier II guideline as well as lead in high concentrations, but 20 mg/kg under the Tier II guideline. Zinc concentrations in most of the soil samples were elevated compared to background levels, but none exceeded the Tier II criterion. PAHs and VOCs were analyzed for in one sample but none was detected.

Table XXIX. (S-10199) Previous contaminated samples.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
99-12780/81	0	TPH	2500	3500
99-12784	0	COPPER (CU)	50	120

3.1.10.4 Nature and Extent of Contamination

During the 2006 sampling campaign, a total of 5 soil samples were taken from around the buildings (including one duplicate). Only 2 parameters surpassed the CCME industrial soil guidelines; arsenic and fraction 2 hydrocarbons (Table XXX).

TPH fraction 2 was present in 2 samples (06FH0182 and 06FH0184) (Photograph 17, Appendix A) at approximately two times the criterion. The first was collected at the same place as the 1999 samples (99-12780/81) to confirm the previously measured concentrations. The other (06FH0184), was retrieved from behind the CE/Fire Hall building where the fuel shut-off valve and the water sewer oil pipeline are located. PAH analysis should have been performed on samples 06FH0182 and 06FH0184, in order to confirm that none is present. When the staff dug in the area, they observed that the soil was greasy and they perceived the odour of light oil.

Three (3) of 5 samples exceeded the arsenic guidelines but the results are not significantly elevated (12 mg/kg). High background arsenic concentrations on Ellesmere Island are most likely responsible for this observation. Additional background soil samples should be taken during the summer 2007 fieldwork to confirm this hypothesis.

Surface sample 06FH0185 was collected from the northwest side of the building on the west side of the garadge door, where 7 wooden boxes (1 m x1 m) were temporarily stored, because a stain was noticed during our visit, as previously mentioned in paragraph 3.1.10.1. The results of the metals analyses did not exceed the guidelines.

3.1.10.5 Recommendation

Delineation is recommended for this site to define the extent of contamination in the 2 main areas. One (1) area comprises the east side of the building, around contaminated sample 06FH0182, and the other area is where the contaminated sample 06FH0184 is located. In total, roughly 14 surface and depth samples should be collected in these areas in order to evaluate the migration of TPH in the contaminated area. PAHs should also be evaluated in the 2 areas by way of 1 surface soil sample and 1 depth sample. Finally, 1 sample should be taken in front of the main door of the trash compacter to confirm any contamination from metals.

Table XXX. . (S-10199) CE-140 MCE Building Fire Hall results

					CE-140 MCE Building Fire Hall (S-10199)				
		SOIL			SOIL				
	PARAMETERS	UNITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	06FH0182 35 cm 12/07/06	06FH0183 20 cm 12/07/06	06FH0185 0-10 cm 12/07/06	06FH0186 Dup. of 0184 35 cm 12/07/06	06FH0184 35 cm 12/07/06
METALS	Arsenic (As)	mg/kg	12	0.27	12.7	16.7	12.4	NA	NA
	Barium (Ba)	mg/kg	2,000	5	16	13	31	NA	NA
	Cadmium (Cd)	mg/kg	22	0.22	<1	<1	<1	NA	NA
	Chromium (Cr)	mg/kg	87	3	21	25	26	NA	NA
	Cobalt (Co)	mg/kg	300	1.9	9	11	9	NA	NA
	Copper (Cu)	mg/kg	91	2.1	15	18	33	NA	NA
	Lead (Pb)	mg/kg	600	1.2	14	15	23	NA	NA
	Manganese (Mn)	mg/kg	---	1.1	482	500	492	NA	NA
	Molybdenum (Mo)	mg/kg	40	1.4	<2	<2	<2	NA	NA
	Nickel (Ni)	mg/kg	50	0.6	27	37	26	NA	NA
	Selenium (Se)	mg/kg	3.9	0.5	NA	NA	NA	NA	NA
	Silver (Ag)	mg/kg	40	0.4	<2	<2	<2	NA	NA
	Tin (Sn)	mg/kg	300	0.8	<5	<5	<5	NA	NA
	Zinc (Zn)	mg/kg	360	2.5	48	54	211	NA	NA
PETROLEUM HYDROCARBONS	Benzene	mg/kg	0.03	0.02	NA	NA	NA	NA	NA
	Toluene	mg/kg	0.37	0.02	NA	NA	NA	NA	NA
	Ethylbenzene	mg/kg	0.08	0.02	NA	NA	NA	NA	NA
	o-Xylene	mg/kg	---	0.02	NA	NA	NA	NA	NA
	p+m-Xylene	mg/kg	---	0.04	NA	NA	NA	NA	NA
	Total Xylene	mg/kg	11	0.04	NA	NA	NA	NA	NA
	F1 (C6-C10 Hydrocarbons)	mg/kg	310	10	28	NA	NA	ND	ND
	F1 (C6-C10) -BTEX	mg/kg	310	10	28	NA	NA	ND	ND
	F2 (C10-C16 Hydrocarbons)	mg/kg	760	10	1,200	NA	NA	600	1,400
	F3 (C16-C34 Hydrocarbons)	mg/kg	1,700	10	350	NA	NA	60	60
	F4(C34-C50 Hydrocarbons)	mg/kg	3,300	10	33	NA	NA	ND	ND

ND Not detected
NA Not available
Higher than the criteria

Figure 16. (S-10199) CE-140 MCE Building Fire Hall map.

3.1.11 S-10200 B-145 Cat House

3.1.11.1 Location and Site Description

The Main Power Plant, also known as the Cat House, is situated south of the Traffic and Supply Building and north of the Alternate Power Plant Building (B-146), on the west side of DOE road (Figure 17). The power for the station is furnished by 4 diesel-powered generators inside the Cat House. In 1998, 1999 and also during the current investigation, several stained areas were observed around the building. In 1998 the black stain was in the back of the building (south side) where the exhaust fan is located and in 1999, it was found running along the west side of the building near the metal pallet and the exhaust stacks. During our visit, the same stained areas were present (Photograph 18, Appendix A). On the west side of the building, 2 pallets with several barrels were stored; the larger pallet contained drums of chemical products on metal supports and the smaller pallet contained fuel drums standing on wood pallets. The metal support had a recovery receptacle to collect any drum leaks. During the summer of 2006, station staff noticed visual contamination in the receptacle. (Photograph 19, Appendix A) An abrupt slope is present on the southwest side, approximately 10-15 m from the building (Photograph 20, Appendix A). In 1999, ESG staff had observed a ditch located to the east of the Cat House containing melt water that was actively draining to the south and ultimately into the Baker's Dozen area. The substrate of this site is a gravel-like coarse shale.

3.1.11.2 Potential Receptors and Valued Ecological Components

No evidence of animal life or vegetation was observed on-site during the field work. In addition, no drainage channel was active in 2006. Human activities are primarily inside the building.

3.1.11.3 Summary of Previous Investigations

In 1998, 1 single soil sample (98-12402) was taken by the ESG, from a black stain below

the exhaust fan. None of the analyses (PCBs, PAHs, TPH and BTEX) exceeded their respective criteria, although zinc (410 mg/kg) and TPH (530 mg/kg) concentrations were significantly elevated relative to background levels.

In 1999, they took additional samples to determine if TPH and zinc exceeded the criteria in any other locations. Eighteen (18) soil samples were collected, including 2 duplicate pairs. The main contaminants found were TPH, copper and zinc (Table XXXI). Nine (9) soils were analyzed for inorganic elements. Two (2) samples exceed the CCME guidelines for industrial coarse soil; copper concentrations were 4 times the limit for sample 99-12794 and zinc was 3 times the limit for sample 99-12803. Of the 5 samples analyzed for TPH, 3 had concentrations over the ,2500 mg/kg criterion. In descending order, sample 99-12798 contained 16,000 mg/kg (100% lubricating oil and grease), sample 99-12794 contained 15,000 mg/kg (100% lubricating oil and grease) and sample 99-12804 contained 4,300 mg/kg TPH as fuel oil. Several samples were also analyzed for PAHs, BTEX, PCBs and glycol, none of of which were detected.

Table XXXI. (S-10200) Previous contaminated samples.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
99-12794	0	COPPER (CU)	100	430
	0	TPH	2,500	15,000
99-12798	0	TPH	2,500	16,000
99-12803	0	ZINC (ZN)	500	1,400
99-12804	0	TPH	2,500	4,300

3.1.11.4 Nature and Extent of Contamination

In the summer of 2006, 4 samples were collected in the Cat House area. All of the samples exceeded the guidelines for at least 1 parameter (Table XXXII). Two (2) samples collected on the west side of the building had metals present. Arsenic was present in both of these samples, but at low concentrations relative to background levels. In 1 stained soil area, nickel was found at 58 mg/kg. Additionally, sample 06CH0110 was

near the maximum allowable concentration for nickel. Hydrocarbons (C10- C34) were found in 3 surface samples, between 3 and 6 times above the guidelines. Fraction 4 was elevated in sample 06CH0110 taken beside the pallets, but did not exceed the CCME criterion.

3.1.11.5 Recommendation

Delineation of the 4 stained areas around the Cat House is suggested. Approximately 16 soil surface and deeper samples (approximately 4 samples from each area) should be taken. TPH will be analyzed for in the area where samples 06CH0108/110/112 were collected and inorganic elements will be analyzed for where samples 06CH0110/111 were collected in 2006. In addition, deeper samples should be collected to evaluate the extent of the contamination.

Additionally, ESG recommended in 1999 that absorbent pads should be placed in the bottom of the metal pallets in order to prevent possible contamination.

Table XXXII. (S-10200) B-145 Cat House results.

	PARAMETERS	SOIL			B-145 Cat House (S-10200) SOIL			
		UNITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	06CH0108 0-10 cm 07/05/06	06CH0110 0-10 cm 07/05/06	06CH0111 0-10 cm 07/05/06	06CH0112 0-10 cm 07/05/06
METALS	Arsenic (As)	mg/kg	12	0.27	0	17.7	20.1	9.9
	Barium (Ba)	mg/kg	2,000	5	16	15	18	17
	Cadmium (Cd)	mg/kg	22	0.22	<1	<1	<1	<1
	Chromium (Cr)	mg/kg	87	3	24	27	31	23
	Cobalt (Co)	mg/kg	300	1.9	10	17	21	10
	Copper (Cu)	mg/kg	91	2.1	42	25	30	16
	Lead (Pb)	mg/kg	600	1.2	13	16	18	14
	Manganese (Mn)	mg/kg	---	1.1	494	543	622	523
	Molybdenum (Mo)	mg/kg	40	1.4	<2	<2	<2	<2
	Nickel (Ni)	mg/kg	50	0.6	30	49	58	32
	Selenium (Se)	mg/kg	3.9	0.5	NA	NA	NA	NA
	Silver (Ag)	mg/kg	40	0.4	<2	<2	<2	<2
	Tin (Sn)	mg/kg	300	0.8	<5	<5	<5	<5
	Zinc (Zn)	mg/kg	360	2.5	84	78	85	56
PETROLEUM HYDROCARBONS	Benzene	mg/kg	0.03	0.02	ND	ND	ND	ND
	Toluene	mg/kg	0.37	0.02	ND	ND	ND	ND
	Ethylbenzene	mg/kg	0.08	0.02	ND	ND	ND	ND
	o-Xylene	mg/kg	---	0.02	ND	ND	ND	ND
	p+m-Xylene	mg/kg	---	0.04	ND	ND	ND	ND
	Total Xylene	mg/kg	11	0.04	ND	ND	ND	ND
	F1 (C6-C10 Hydrocarbons)	mg/kg	310	10	ND	ND	ND	260
	F1 (C6-C10) -BTEX	mg/kg	310	10	ND	ND	ND	260
	F2 (C10-C16 Hydrocarbons)	mg/kg	760	10	2,500	ND	ND	4,800
	F3 (C16-C34 Hydrocarbons)	mg/kg	1,700	10	850	6,400	ND	69
	F4(C34-C50 Hydrocarbons)	mg/kg	3,300	10	ND	2,700	ND	ND

ND Not detected
NA Not available
Higher than the criteria

Figure 17. (S-10200) Building B-145, Cat House area map.

3.1.12 S-10201 1 CEU GP Hut

3.1.12.1 Location and Site Description

The 1 CEU GP Hut was one of the original buildings constructed in the 1950s. It was "[o]riginially used by construction engineers as offices and a warehouse, [...] room of construction equipment, and houses the Canadian Wildlife Services and Environmental Sciences Group laboratories." (ESG 2000). This site is located just southwest of the HAPS building and north of the Cat House (Figure 18). The building had already been demolished at the time of the site visit and the area was covered with gravel and only a small number of barrels were being stored on-site. In July of 2006, 2 drainage channels were active on the site; 1 at the east end of the area and the other at the south end. The site topography is flat.

3.1.12.2 Potential Receptors and Valued Ecological Components

No evidence of animal life was observed on the site. However, two drainage channels are located around the building and permit the transport of any contamination toward the inlet (Photograph 21, Appendix A). No regular human activities are present around this site due to its inactive state, although human presence may occur occasionally when barrels are transported to the area for storage.

3.1.12.3 Summary of Previous Investigations

In 1999, ESG staff collected 9 soil samples at the 3 entrances of the building and in adjacent drainage ditches. Two (2) soil samples exceeded the 2,500 mg/kg criterion for TPH, including sample 99-12828, which contained 20,000 mg/kg (Table XXXIII). Two (2) samples contained copper at concentrations exceeding the Tier II criterion and 1 had lead concentrations above the Tier I DEW line assessment criterion. One (1) sample was analyzed for PCBs and 1 for pesticides, and both samples returned negative results.

In 2000, 51 soil samples including 5 depth samples were collected and analyzed for inorganic elements and TPH. No concentrations above the applicable criterion were detected. The conclusion was that the contamination found in the previous study was limited to small areas and that no further action was required.

Table XXXIII. (S-10201) Previous contaminated samples.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
99-12825	0	COPPER (CU)	100	180
99-12828	0	TPH	2,500	20,000
	0	COPPER (CU)	100	180
99-12832	0	TPH	2,500	5,100
00-10062	0-10	LEAD (PB)	500	530

3.1.12.4 Nature and Extent of Contamination

Three (3) soil samples were collected during the summer of 2006, 2 in the drainage ditches and 1 in the middle of the site where several barrels were stored. No petroleum hydrocarbon (F1 to F4) concentrations were above the CCME criteria for industrial sites (Table XXXIV). Inorganic element concentrations exceeded CCME criterion for arsenic in 1 soil sample collected in the drainage canal (06CE0148). Visual inspection of the site revealed the growth of green algae in the drainage channel and a rust colour in the water (Photographs 22-23, Appendix A).

3.1.12.5 Recommendation

Approximately 3 more soil samples and 2 water samples coming from the drainage ditches should be collected in 2007 and analysed for TPH and metals to permit closure of this site. Additionally, 2 more soil samples should be taken from where sample 99-12828 was collected. These samples should be collected from under the ballast due to the fact that the original buildings have been demolished and the area leveled. If no inorganic element contamination is discovered during the summer 2007 campaign, no further action would be required.

Table XXXIV. (S-10201) 1CEU GP hut results.

	PARAMETERS	SOIL			1 CEU GP hut (S-10201)		
		UNITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	SOIL (Drainage sed.) 06CE0148 0-10 cm 07/08/06	SOIL (Drainage sed.) 06CE0149 0-10 cm 07/08/06	SOIL 06CE0150 0-10 cm 07/08/06
METALS	Arsenic (As)	mg/kg	12	0.27	20	10	11
	Barium (Ba)	mg/kg	2,000	5	55	22	19
	Cadmium (Cd)	mg/kg	22	0.22	<1	<1	<1
	Chromium (Cr)	mg/kg	87	3	49	46	30
	Cobalt (Co)	mg/kg	300	1.9	22	11	9
	Copper (Cu)	mg/kg	91	2.1	40	21	17
	Lead (Pb)	mg/kg	600	1.2	33	109	30
	Manganese (Mn)	mg/kg	---	1.1	610	512	503
	Molybdenum (Mo)	mg/kg	40	1.4	<2	<2	<2
	Nickel (Ni)	mg/kg	50	0.6	66	35	27
	Selenium (Se)	mg/kg	4	0.5	NA	NA	NA
	Silver (Ag)	mg/kg	40	0.4	<2	<2	<2
	Tin (Sn)	mg/kg	300	0.8	<5	<5	<5
	Zinc (Zn)	mg/kg	360	2.5	196	70	44
PETROLEUM HYDROCARBONS	Benzene	mg/kg	0.03	0.02	ND	ND	ND
	Toluene	mg/kg	0.37	0.02	ND	ND	ND
	Ethylbenzene	mg/kg	0.08	0.02	ND	ND	ND
	o-Xylene	mg/kg	---	0.02	ND	ND	ND
	p+m-Xylene	mg/kg	---	0.04	ND	ND	ND
	Total Xylene	mg/kg	11	0.04	ND	ND	ND
	F1 (C6-C10 Hydrocarbons)	mg/kg	310	10	ND	ND	ND
	F1 (C6-C10) -BTEX	mg/kg	310	10	ND	ND	ND
	F2 (C10-C16 Hydrocarbons)	mg/kg	760	10	ND	ND	ND
	F3 (C16-C34 Hydrocarbons)	mg/kg	1,700	10	810	280	ND
	F4(C34-C50 Hydrocarbons)	mg/kg	3,300	10	130	36	ND

ND Not detected
NA Not available
Higher than the criteria

Figure 18. (S-10201) 1CEU GP hut map.

3.1.13 S-10202 Construction Engineering Cold Storage General Purpose Hut – "Dog House"

3.1.13.1 Location and Site Description

The Dog House is located on the south side of the main station area, east of the power plant (Figure 19). One of the original building projects on the base, it is used for cold storage. "Its original layout has been altered, with the interior now one large warehouse and an additonal bay door at the east end of the north side." (ESG 2000).

The soil in the area consists of very coarse gravel on the north and west sides of the building and a mixture of gravel and native soil with a lot of silt on the south and east sides. There is a gentle southward slope going towards Alert Inlet. There is an elevated embankment surrounding the building itself. There is a tendency for garbage to be strewn about this area, which originates from kitchen area and is transported by both the wind and scavenging animals.

3.1.13.2 Potential Receptors and Valued Ecological Components

An active drainage channel runs along the east side of the building, which is the same channel that passes by the HAPS building and the CEU GP hut. This drainage channel ends in Alert Inlet, located roughly 0.5 km downslope from the site. Sparse vegetation consisting mostly of mosses have been observed on the south and east sides of the building. Arctic foxes and wolves have also been observed in the area. Human activities are predominantly inside the building.

3.1.13.3 Summary of Previous Investigations

Extensive studies were performed at this site in both 1999 and 2000. In 1999, 15 soil samples were taken in the area surrounding the Dog House, including 1 duplicate pair and 3 depth samples. Sampling was concentrated around the perimeter of the building and in the drainage channel and analyzed for metals, PCBs, TPH, PAHs, pesticides and BTEX (Table XXXV). TPH, copper, zinc, xylenes and PCBs were found to be present at

high levels in many samples. Of 11 samples, 7 had TPH levels above 2,500 mg/kg. The highest concentration was observed in sample 99-12839 at 37,000 mg/kg (with a composition of 100% fuel oil), collected from the drainage channel. This sample was obtained from a test pit at the south east corner of the building where several barrels had been buried. A hydrocarbon odour had been noticed in the area. Of the 15 samples, 5 contained at least 1 metal above the recommended criteria. Four (4) of these showed copper concentrations at or exceeding the Tier II criterion of 100 mg/kg. The highest copper concentration observed was in sample 99-12836, found on the north side of the building, which had a concentration of 340 mg/kg. Additionally, sample 99-12839 had a zinc concentration exceeding the Tier II criterion and lead exceeding the Tier I criterion. Two (2) soil samples, 99-12842 and 99-12847, contained high levels of xylene, measured at 14,000 mg/kg and 11,000 mg/kg, respectively. Five (5) out of 9 samples contained PCBs, but only 2 surpassed Tier I criterion and both were located in the drainage channel with concentrations of 4.8 mg/kg and 2 mg/kg. Naphthalene was detected in sample 99-12839 and exceeded the Tier I criterion with a concentration of 0.6 mg/kg. No benzene or pesticides were detected and toluene and ethylbenzene concentrations were low.

Forty-nine (49) delineation samples were collected in 2000, including 5 depth samples. These were tested for metals and TPH (Table XXXV). A total of 24 samples were tested for metals, yet only 1 surpassed any of the criteria: sample 00-10062 contained 530 mg/kg lead. Twenty-nine (29) samples were tested for TPH and 6 had concentrations above the 2,500 mg/kg criterion. The highest was sample 00-10054, with a concentration of 58,000 mg/kg, containing 18% fuel oil, 82% grease and lubricating oil. One (1) depth sample also contained hydrocarbons (4,800 mg/kg) indicating subsurface contamination. Three (3) separate contaminated areas were found to be located around the Dog House, extending south and southeast. Together, they occupy an area of roughly 240 m^2 and a soil volume of 115 m^3 with contamination extending to 0.5 m below surface. In light of the results obtained from the above research, BRI is in accordance with ESG, who concluded in their 1999 report that the types and concentrations

of contaminants are strongly suggestive of the existence of various different activities and sources on-site.

Table XXXV. (S-10202) Previous contaminated samples.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
99-12836	0	COPPER (CU)	100	340
99-12839	0	NAPHTHALENE	0.60	3.4
	0	TPH	2,500	37,000
	0	COPPER (CU)	100	250
	0	ZINC (ZN)	500	850
99-12840/41	0	COPPER (CU)	100	150
	0	TPH	2,500	33,000
99-12842	0	TPH	2,500	6,200
	0	XYLENES	1,000	14,000
99-12843	0	TPH	2,500	15,000
99-12844	0	ZINC (ZN)	500	540
99-12847	30	TPH	2,500	11,000
	30	XYLENES	1,000	11,000
99-12848	0	TPH	2,500	13,000
00-10054	0-10	TPH	2,500	58,000
00-10055	0-10	TPH	2,500	4,800
00-10056	30	TPH	2,500	12,000
00-10057	0-10	TPH	2,500	14,000
00-10058	0-10	TPH	2,500	5500
00-10062	0-10	LEAD (PB)	500	530
00-10067	0-10	TPH	2,500	12,000

3.1.13.4 Nature and Extent of Contamination

During the 2006 field visit, the team collected 3 soil samples, which were tested for metals, PAHs, PCBs and TPH (Table XXXVI). Of the 3 samples, only 1 (06CS0003) showed levels of hydrocarbons exceeding the CCME criterion: fraction 1 and 2 hydrocarbons reached 790 mg/kg and 6,900 mg/kg, respectively. This sample was taken from the north side of the Dog House, where previously, high levels of copper had been

recorded. In 2006 copper levels were much lower, only 26 mg/kg. However, copper concentrations were much higher in sample 06CS0004, taken from the southwest side of the building. Copper was as high as 880 mg/kg, almost 10 times the CCME recommended criterion. This sample, in addition to 06CS0005, also showed high arsenic levels that appeared to coincide with natural background levels. Finally, no PAHs, PCBs or other metals were detected in excess of the given criteria. The highest lead concentration was found southwest of the Dog House, at 93 mg/kg, significantly below the allowable concentration of 600 mg/kg. No odours or visual contamination were detected at the site.

3.1.13.5 Recommendations

Further delineation is recommended for the next field visit. This should include the collection of approximately 15 more soil samples for TPH and inorganic elements analysis. Verification of inorganic element concentrations should be performed for sample areas 06CS0003 (north of the Dog House), 06CS0004 (southwest of the Dog House) and the surface water from the drainage channel (one sample). Finally, more samples should be collected around sample 06CS0005 as no excavation has previously been performed. This would enable evaluation of the vertical migration of the contamination and delimit the contaminated area for an eventual excavation, if necessary.

Table XXXVI. (S-10202) Cold Storage Dog House GP Hut.

					Cold Storage Dog House GP Hut (S-10202)		
	PARAMETERS	SOIL			SOIL		
		UNITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	06CS0003 30 cm 06/24/06	06CS0004 0-10 cm 06/24/06	06CS0005 0-10 cm 06/23/06
METALS	Arsenic (As)	mg/kg	12	0.27	<6	13	21
	Barium (Ba)	mg/kg	2,000	5	25	26	24
	Cadmium (Cd)	mg/kg	22	0.22	<0.5	1.6	<0.5
	Chromium (Cr)	mg/kg	87	3	15	12	8
	Cobalt (Co)	mg/kg	300	1.9	9	10	11
	Copper (Cu)	mg/kg	91	2.1	26	880	24
	Lead (Pb)	mg/kg	600	1.2	31	93	16
	Manganese (Mn)	mg/kg	—	1.1	410	520	500
	Molybdenum (Mo)	mg/kg	40	1.4	<2	<2	<2
	Nickel (Ni)	mg/kg	50	0.6	28	34	22
	Selenium (Se)	mg/kg	3.9	0.5	NA	NA	NA
	Silver (Ag)	mg/kg	40	0.4	<2	<2	<2
	Tin (Sn)	mg/kg	300	0.8	<5	14	<5
	Zinc (Zn)	mg/kg	360	2.5	86	220	50
PAH	Naphthalene	mg/kg	22	0.008	1.7	<0.1	NA
	2-methylnaphthalene	mg/kg	—	0.005	16	<0.1	NA
	1-methylnaphthalene	mg/kg	—	0.005	16	<0.1	NA
	1,3-Dimethylnaphthalene	mg/kg	—	0.005	15	<0.1	NA
	Acenaphthylene	mg/kg	—	0.004	<0.1	<0.1	NA
	Acenaphthene	mg/kg	—	0.004	0.3	<0.1	NA
	2,3,5-trimethylnaphthalene	mg/kg	—	0.007	2.3	<0.1	NA
	Fluorene	mg/kg	—	0.007	0.5	<0.1	NA
	Phenanthrene	mg/kg	50	0.010	<0.1	<0.1	NA
	Anthracene	mg/kg	—	0.004	<0.1	<0.1	NA
	Fluoranthene	mg/kg	—	0.008	<0.1	<0.1	NA
	Pyrene	mg/kg	100	0.008	<0.1	<0.1	NA
	Benzo(c)Phenanthrene	mg/kg	—	0.008	<0.1	<0.1	NA
	Benzo(a)Anthracene	mg/kg	10	0.007	<0.1	<0.1	NA
	Chrysene	mg/kg	—	0.008	<0.1	<0.1	NA
	7,12-dimethylbenzo(a)anthracene	mg/kg	—	0.005	<0.1	<0.1	NA
	Benzo(b,j,k)fluoranthene	mg/kg	10	0.008	<0.1	<0.1	NA
	Benzo(a)pyrene	mg/kg	0.7	0.008	<0.1	<0.1	NA
	3-methylcholanthrene	mg/kg	—	0.022	<0.1	<0.1	NA
	Indeno(1,2,3-cd)pyrene	mg/kg	10	0.008	<0.1	<0.1	NA
	Dibenzo(a,h)anthracene	mg/kg	10	0.008	<0.1	<0.1	NA
	Benzo(g,h,i)perylene	mg/kg	—	0.008	<0.1	<0.1	NA
	Dibenzo (a,l) pyrene	mg/kg	—	0.008	<0.1	<0.1	NA
	Dibenzo (a,i) pyrene	mg/kg	—	0.007	<0.1	<0.1	NA
	Dibenzo (a,h) pyrene	mg/kg	—	0.008	<0.1	<0.1	NA
PCBs	bpc totaux	mg/kg	33	0.01	0.12	<0.01	NA
PETROLEUM HYDROCARBONS	Benzene	mg/kg	0.03	0.02	ND	NA	ND
	Toluene	mg/kg	0.37	0.02	ND	NA	ND
	Ethylbenzene	mg/kg	0.08	0.02	ND	NA	ND
	o-Xylene	mg/kg	—	0.02	2.9	NA	ND
	p+m-Xylene	mg/kg	—	0.04	1.6	NA	ND
	Total Xylene	mg/kg	11	0.04	4.6	NA	ND
	F1 (C6-C10 Hydrocarbons)	mg/kg	310	10	790	NA	ND
	F1 (C6-C10) -BTEX	mg/kg	310	10	780	NA	ND
	F2 (C10-C16 Hydrocarbons)	mg/kg	760	10	6,900	NA	ND
	F3 (C16-C34 Hydrocarbons)	mg/kg	1,700	10	210	NA	12
	F4(C34-C50 Hydrocarbons)	mg/kg	3,300	10	ND	NA	ND

ND Not detected
NA Not available
Higher than the criteria

Figure 19. (S-10202) Cold storage Dog House GP Hut map.

3.1.14 S-10203 Curling Club/Gym Complex

3.1.14.1 Location and Site Description

The Curling Club/Gym Complex is located at the southeast end of the main station area, southeast of the HAPS building (Figures 20-21). This facility also houses offices, washrooms, a weight room, a workout area with stationary bicycles and stair climbers, and a bowling alley. Although the site is still active, the curling club is not currently in operation. "Outside the complex on its west side there is an air-cooled condenser for the curling club ice..." (ESG 2000). The fuel tank located on the south side was removed before the commencement of the 2006 field work.

The soil on the west side of the building consists mainly of coarse gravel and the east side contains more native soil, rather than gravel, as the area has been less disturbed. New ballast has been installed under the building. This area also becomes saturated with melt water during the summer. The ground slopes sharply away to the southeast of the gym and there is a drainage channel found at the bottom of the slope, which flows west to east, starting at a culvert to the southwest of the gym. It ends in the bay, which is roughly 150 m away to the north.

As mentioned in the ESG report, the curling club is set for demolition and debate continues as to whether or not to demolish the gym due to its poor insulation and high heating costs.

3.1.14.2 Potential Receptors and Valued Ecological Components

The east side of the curling club and gym complex features undisturbed soils that facilitate the growth of vegetation, especially grasses. Signs of wildlife have been noted, in the form of feces from hares and wolves. Additionally, one small vole was seen during the field visit. The drainage channel that flows near the complex is also a potential receptor. No human activities normally occur outside the building.

3.1.14.3 Summary of Previous Investigations

In 1999, 13 soil samples, including 1 duplicate pair, were collected and analyzed for metals, PCBs, PAHs, TPH and glycol (Table XXXVII). Sampling was concentrated around the building entrances and drainage paths or catchments. The main contaminants found were TPH and copper. Six (6) soil samples (including one duplicate) were analyzed for TPH. While they all contained TPH, only 2 exceeded the criterion. Samples 99-12859 and 99-12860 contained 12,000 mg/kg and 5,600 mg/kg, respectively, and were collected near the area on the south side of the gym where a previously existing fuel tank was removed. The source was 100% fuel oil. Five (5) soil samples were tested for metals. Only 1 sample exceeded any of the criteria; sample 99-12864 contained 380 mg/kg of copper, which exceeded the Tier II criterion. No PCBs, PAHs or glycol concentrations surpassed the criteria. One (1) paint chip sample (99-12869) was also taken from the side of the curling club, and analyzed for metals and PCBs. Lead constituted 15% of the paint and there were also high concentrations of chromium (34,000 mg/kg) and zinc (8,400 mg/kg).

In 2000, contamination was found to be localized to 2 small areas; one on the south side of the gym and the other one near sample 99-12864. This was determined through the delineation of the entire curling club and gym area. All other samples taken from within the area did not contain any contamination.

Table XXXVII. (S-10203) Previous contaminated soil samples.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
99-12859	0	NAPHTHALENE	0.60	7.1
	0	TPH	2,500	12,000
99-12860	0	TPH	2,500	5,600
99-12864	0	COPPER (CU)	100	380

3.1.14.4 Nature and Extent of Contamination

A total of 4 samples were collected in the summer of 2006. These consisted of 2 surface water samples and 2 soil samples. These were tested for metals and TPH (Table XXXVIII). While the surface water samples did not show any elements exceeding the criterion, the soil sample showed TPH concentrations that surpassed the guidelines. Sample 06GY0001 showed toluene at 2.5 mg/kg, ethylbenzene at 1.2 mg/kg, total xylenes at 38 mg/kg, fraction 1 hydrocarbons at 6,300 mg/kg, BTEX at 6,200 mg/kg and fraction 2 hydrocarbons at 24,000 mg/kg. Fraction 3 hydrocarbons were also detected but did not exceed the criterion. This sample was retrieved from near the fuel tank on the south side of the gym. Soil sample 06GY0002, collected in the drainage pathway, contained a high concentration of petroleum hydrocarbons (fraction 2) which was 7 times greater than the applicable guideline and visual contamination (iridescence and rust color) was noted where the sample was collected (Photograph 24, Appendix A).

3.1.14.5 Recommendations

Further assessment should be performed at this site. This includes collecting roughly 10 more soil samples and 1 more surface water sample. The surface water sample should be collected at the junction of the 2 drainage pathways present at the site. One (1) soil sample should also be collected upstream of the drainage channel, to confirm if the contamination of the runoff is coming from the petroleum hydrocarbons found at sample site 06GY0001 or from another site upstream of the complex. Finally, 2 sub-surface and 2 surface sample should be collected from sample site 99-12864 to confirm the previously observed copper contamination. Only TPH levels require further investigation in the area surrounding the old fuel tank area while verification of metals and TPH contamination in the vicinity of the east side of the gym is recommended.

lub/Gym Complex results.

WATER			SOIL			FRESHWATER SEDIMENT				Curling Club / Gym Complex (S-10203)			
										FRESHWATER		SOIL	SED.
GUIDELINES AQUATIC LIFE		DETECTION LIMIT	UNITS	INDUSTRIAL GUIDELINES	DETECTION LIMIT	UNITS	GUIDELINES AQUATIC LIFE		DETECTION LIMIT	06GY0080 Surf. Water	06GY0081 Surf. Water	06GY0001 30 cm	06GY0002 0-10 cm
FRESH	MARINE			(Coarse)			(1) ISQG	(2) PEL		07/05/06	07/05/06	24/06/06	24/06/06
5	12.5	0.0001	mg/kg	12	0.27	mg/kg	5.9	17	0.27	0.005	<0.001	NA	NA
---	---	0.001	mg/kg	2,000	5	mg/kg	---	---	5	0.01	<0.01	NA	NA
0.017	0.12	0.0001	mg/kg	22	0.22	mg/kg	0.6	3.5	0.22	<0.001	<0.001	NA	NA
---	---	0.0007	mg/kg	87	3	mg/kg	37.3	90	3	0.003	0.002	NA	NA
---	---	0.0006	mg/kg	300	1.9	mg/kg	---	---	1.9	0.001	<0.001	NA	NA
2-4	2-4	0.0012	mg/kg	91	2.1	mg/kg	35.7	197	2.1	0.004	0.001	NA	NA
1-7	---	0.0011	mg/kg	600	1.2	mg/kg	35	91.3	1.2	0.002	<0.001	NA	NA
---	---	0.0003	mg/kg	---	1.1	mg/kg	---	---	1.1	0.051	0.014	NA	NA
73	---	0.0078	mg/kg	40	1.4	mg/kg	---	---	1.4	0.002	0.001	NA	NA
25-150	---	0.0005	mg/kg	50	0.6	mg/kg	---	---	0.6	0.004	0.001	NA	NA
1	---	0.0006	mg/kg	3.9	0.5	mg/kg	---	---	0.5	<0.001	<0.001	NA	NA
---	---	0.0008	mg/kg	40	0.4	mg/kg	---	---	0.4	<0.001	<0.001	NA	NA
---	---	0.011	mg/kg	300	0.8	mg/kg	---	---	0.8	<0.001	<0.001	NA	NA
30	---	0.006	mg/kg	360	2.5	mg/kg	123	315	2.5	0.11	0.01	NA	NA
370	110	0.03	mg/kg	0.03	0.02	mg/kg	---	---	0.02	NA	NA	ND	ND
2	215	0.03	mg/kg	0.37	0.02	mg/kg	---	---	0.02	NA	NA	2.5	ND
90	25	0.02	mg/kg	0.08	0.02	mg/kg	---	---	0.02	NA	NA	1.2	ND
---	---	0.02	mg/kg	---	0.02	mg/kg	---	---	0.02	NA	NA	32	0.67
---	---	0.05	mg/kg	---	0.04	mg/kg	---	---	0.04	NA	NA	37	0.11
---	---	0.05	mg/kg	11	0.04	mg/kg	---	---	0.04	NA	NA	38	0.78
---	---	100	mg/kg	310	10	mg/kg	---	---	10	NA	NA	6,300	120
---	---	100	mg/kg	310	10	mg/kg	---	---	10	NA	NA	6,200	120
---	---	100	mg/kg	760	10	mg/kg	---	---	10	NA	NA	24,000	5,500
---	---	100	mg/kg	1,700	10	mg/kg	---	---	10	NA	NA	430	650
---	---	100	mg/kg	3,300	10	mg/kg	---	---	10	NA	NA	ND	43

n Freshwater Sediment Quality Guideline (ISQG) of the Canadian Sediment Quality Guidelines for the Protection of Aquatic Life of the Canadian Council of Ministers of the Environment. (2002)
ible Effect Level (PEL) of the Canadian Sediment Guidelines for the Protection of Aquatic Life of the Canadian Council of Ministers of the Environment. (2002)

Figure 20. (S-10203) Curling Club/Gym Complex map 1.

Figure 21. (S-10203) Curling Club/Gym Complex map 2.

3.1.15 S-10204 50 Line GP Huts Drainage

3.1.15.1 Location and Site Description

Originally, the general purpose (GP) huts ran in numbered parallel lines. The 50 Line was the last line of huts, located on the east side of the main station, overlooking Dumbell Bay. The huts were demolished in 1995, after the accommodations were relocated to Chimo Hall. The only remaining evidence of the old 50 Line is a line of rectangular gravel pads, constructed out of the same shale material that is used throughout the site (Figures 22-23). The rest of the area features relatively undisturbed soils composed of native clays and silts with some shale.
During the last visit, some debris (nails, metal pieces) were present on the gravel pads, but no associated staining was found. The debris was probably a result of the wood brought onto the site, which has been used for bonfires built for celebrating statutory holidays. Several types of debris (such as pieces of plastic) were also present at the bottom of the second slope.

The field appears to have been leveled since the last time it was visited (2000). The sample points were buried under gravel and 3 slopes were present on-site during the BRI sampling campaign. The first is an abrupt slope located just beside the end of the gravel pads. The second is moderate and is situated between the first slope and the bottom of the site. (Photograph 25, Appendix A). Finally, a long slope starting at the end of the east side of the site is a gradual one that heads toward Dumbell Bay

Two (2) main drainage pathways where identified on the site, both heading toward the east side and finishing in pools of standing water at the bottom of the second slope. (Photograph 26, Appendix A). The remaining pads were constructed with the same shale material typically used throughout the site and the soil in the relatively undisturbed area east of the gravel pads consists of native clays and silts with some shale.

3.1.15.2 Potential Receptors and Valued Ecological Components

The principle receptor of this site is Dumbell Bay, which is roughly 400-500 m east of the area, down a long slope. Vegetation is abundant on the site, except where the gravel pads are constructed. During the BRI visit, staff observed signs of wildlife such as feces and old bird nests. Wildlife most likely use the existing pools as a water source. Military personnel use this site on occasion as a bonfire site.

3.1.15.3 Summary of Previous Investigations

ESG visited the site in 1999 and 2000. In 1999, sampling concentrated on the drainage pathways flowing between the gravel pads and in the drainage depressions at the base of some of the pads. Altogether, 10 soil samples were collected (including 1 duplicate) in the area. Several parameters were analyzed, such as PCBs, inorganic elements, pesticides and TPH (Table XXXIX). The main contaminants of concern were 3 different metals. Arsenic was found at concentrations exceeding the Tier II criterion (30 mg/kg) in the field duplicate. Copper and zinc were slightly elevated compared to background soil concentrations but they did not exceed the guideline limit. Samples (99-12941/42) collected in the gravel pad area where military personnel build bonfires contained an average of 41 mg/kg arsenic. PCBs and pesticides were not found in the soil analyzed. TPH (less than 2,500 mg/kg) was detected in 1 soil (sample 99-12934) analyzed by a field test kit.

In 2000, 49 soil samples (including 5 depth samples) were taken and analyzed for metals and PCBs (Table XXXIX). No PCBs were found in the 7 samples evaluated. Only 1 sample was taken where contamination was found in 1999 (99-12941/42) and contained concentrations above the guideline for 2 metals; copper and arsenic.

Table XXXIX. (S-10204) Previous contaminated soil samples.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
99-12940	0	ARSENIC (AS)	30	41
99-12941/42	0	ARSENIC (AS)	30	40
00-10254	0-10	COPPER (CU)	100	150
	0-10	ARSENIC (AS)	30	99

3.1.15.4 Nature and Extent of Contamination

During the 2006 investigation, 4 soil samples were collected at the bottom of the second slope, in the small flat area. Two (2) samples were obtained from drainage pathways (06GP0061/64) and contained hydrocarbons (fraction 2 to 4) below the CCME guidelines (Table XL). They also contained arsenic in concentrations just over the limit (12 mg/kg), which is not significantly higher than the natural background soil concentrations (7.9 mg/kg). Background samples will have to be taken in 2007 to compare the results. Nickel and zinc were also elevated for both samples but the results were inferior to the limits. The 2 other surface soil samples were obtained from the flat area at the bottom of the site, near samples 99-12942/41. Low concentrations (below guidelines) of hydrocaron fractions 2–4 were detected.

3.1.15.5 Recommendation

Additional assessment must be performed during the next sampling campaign, including 2 soil samples analyzed collected from the bottom for TPH and inorganic elements. One sample should be of the site, where standing water is located. The other one soil sample should be collected at a depth of approximately 60 cm, where the gravel pad is located and where the results were elevated (00-10254), in order to verify if the contamination is buried under the new gravel material installed here. This site may be closed after the next investigation if no further contamination is detected. The 2006 results should be compared to the background concentrations to confirm that no contamination is present at the site.

Table XL. (S-10204) 50 Line GP Huts Drainage results.

					50 Line GP Huts Drainage (S-10204)			
			SOIL		SOIL			SOIL (Drainage sed.)
	PARAMETERS	UNITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	06GP0061 0-10 cm 07/04/06	06GP0062 0-10 cm 07/04/06	06GP0063 0-10 cm 07/04/06	06GP0064 0-10 cm 07/04/06
METALS	Arsenic (As)	mg/kg	12	0.27	8	9	12	13
	Barium (Ba)	mg/kg	2,000	5	19	20	27	28
	Cadmium (Cd)	mg/kg	22	0.22	<1	<1	<1	<1
	Chromium (Cr)	mg/kg	87	3	27	57	29	31
	Cobalt (Co)	mg/kg	300	1.9	12	12	15	15
	Copper (Cu)	mg/kg	91	2.1	21	21	26	25
	Lead (Pb)	mg/kg	600	1.2	27	201	25	22
	Manganese (Mn)	mg/kg	—	1.1	432	406	594	533
	Molybdenum (Mo)	mg/kg	40	1.4	<2	2	<2	<2
	Nickel (Ni)	mg/kg	50	0.6	40	42	47	44
	Selenium (Se)	mg/kg	4	0.5	0.6	0.6	0.5	0.5
	Silver (Ag)	mg/kg	40	0.4	<2	<2	<2	<2
	Tin (Sn)	mg/kg	300	0.8	<5	<5	<5	<5
	Zinc (Zn)	mg/kg	360	2.5	69	69	96	118
PETROLEUM HYDROCARBONS	Benzene	mg/kg	0.03	0.02	ND	ND	ND	ND
	Toluene	mg/kg	0.37	0.02	ND	ND	ND	ND
	Ethylbenzene	mg/kg	0.08	0.02	ND	ND	ND	ND
	o-Xylene	mg/kg	—	0.02	ND	ND	ND	ND
	p+m-Xylene	mg/kg	—	0.04	ND	ND	ND	ND
	Total Xylene	mg/kg	11	0.04	ND	ND	ND	ND
	F1 (C6-C10 Hydrocarbons)	mg/kg	310	10	ND	ND	ND	ND
	F1 (C6-C10) -BTEX	mg/kg	310	10	ND	ND	ND	ND
	F2 (C10-C16 Hydrocarbons)	mg/kg	760	10	ND	32	11	27
	F3 (C16-C34 Hydrocarbons)	mg/kg	1,700	10	45	170	160	370
	F4(C34-C50 Hydrocarbons)	mg/kg	3,300	10	ND	85	66	51

ND Not detected
NA Not available
Higher than the criteria

Soil (Drainage sed.) refers to samples which were taken from a drainage ditch but were mislabeled as sediment instead of soil when they were sent for analysis

Figure 22. (S-10204) 50 line GP Huts Drainage map 1

Figure 23. (S-10204) 50 line GP Huts Drainage map 2.

3.1.16 S-10205 Dump #3

3.1.16.1 Location and Site Description

"Dump #3 is located at the end of Line Road southwest of the main station on the same slope as Dumps #1 and #2, overlooking the west end of Alert Inlet." (ESG 2000). The size of the dump is not evident, although it is estimated to be roughly 200 m long. It appears to contain mostly old vehicle parts and guy wires; rusting metal and a broken vehicle battery were found on-site.

The substrate here consists of very coarse shale stones with almost no finer fill material. The dump itself is on a southbound slope that heads toward Alert Inlet (Photograph 27, Appendix A). The site has not been active for several years.

3.1.16.2 Potential Receptors and Valued Ecological Components

The main potential receptor of this area is Alert Inlet, found at the bottom of the site with a main drainage pathway starting north of the site and going straight to the Inlet. Although vegetation is not often seen in this area, some plants were noted during the summer 2006 field visit. This included sparse grasses and some flowers. In terms of wildlife, birds and wolves were noted as well (Photograph 28, Appendix A). No human activities were present on site.

3.1.16.3 Summary of Previous Investigations

Three (3) surface soil samples were collected from the toe of the dump and from around exposed piles of debris in 1999. Two (2) samples were tested for metals and the only contaminants of concern were lead (1,700 mg/kg) and zinc (720 mg/kg) in sample 99-1111, taken from next to a broken vehicle battery (Table XLI).

Another 8 soil samples, including 1 depth sample, were collected in 2000. Seven (7) of these were tested for metals and only 1 sample exceeded the Tier I criterion; sample

00-10900 had a concentration of 440 mg/kg lead. The contaminated area in the dump was estimated to be approximately 25 m^2 with a volume of 5 m^3, based on a depth of contamination of 0.2 m.

Table XLI. (S-10205) Previous contaminated samples.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
99-11147	0	LEAD (PB)	500	1700
	0	ZINC (ZN)	500	720

3.1.16.4 Nature and Extent of Contamination

Two (2) soil samples and 2 soils from the drainage pathway were collected in July of 2006. The 4 samples were analyzed for metals and TPH and none were found to exceed the applicable criteria (Table XLII). Notably, the lead and zinc levels remained low. TPH (fraction 3) was present in the 2 soil samples collected in the drainage pathway, but concentrations remained low.

3.1.16.5 Recommendation

Further assessment should be performed on this site. This includes collecting approximately 2 more soil samples around sample site 99-11147 and 2 samples each of sediment and water from the drainage pathway. The collected samples should be tested for metals.

Table XLII. (S-10205) Alert Dump #3 results.

	PARAMETERS	SOIL			Dump #3 (S-10205)			
					SOIL		SOIL (Drainage sed.)	
		UNITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	06D30065 0-10 cm 07/05/06	06D30066 0-10 cm 07/05/06	06D30067 0-10 cm 07/05/06	06D30068 0-10 cm 07/05/06
METALS	Arsenic (As)	mg/kg	12	0.27	8.9	7.2	NA	NA
	Barium (Ba)	mg/kg	2,000	5	12	13	NA	NA
	Cadmium (Cd)	mg/kg	22	0.22	<1	<1	NA	NA
	Chromium (Cr)	mg/kg	87	3	26	29	NA	NA
	Cobalt (Co)	mg/kg	300	1.9	11	13	NA	NA
	Copper (Cu)	mg/kg	91	2.1	20	21	NA	NA
	Lead (Pb)	mg/kg	600	1.2	12	12	NA	NA
	Manganese (Mn)	mg/kg	---	1.1	483	518	NA	NA
	Molybdenum (Mo)	mg/kg	40	1.4	<2	<2	NA	NA
	Nickel (Ni)	mg/kg	50	0.6	44	46	NA	NA
	Selenium (Se)	mg/kg	3.9	0.5	0.6	<0.5	NA	NA
	Silver (Ag)	mg/kg	40	0.4	<2	<2	NA	NA
	Tin (Sn)	mg/kg	300	0.8	<5	<5	NA	NA
	Zinc (Zn)	mg/kg	360	2.5	70	69	NA	NA
PETROLEUM HYDROCARBONS	Benzene	mg/kg	0.03	0.02	NA	NA	ND	ND
	Toluene	mg/kg	0.37	0.02	NA	NA	ND	ND
	Ethylbenzene	mg/kg	0.08	0.02	NA	NA	ND	ND
	o-Xylene	mg/kg	---	0.02	NA	NA	ND	ND
	p+m-Xylene	mg/kg	---	0.04	NA	NA	ND	ND
	Total Xylene	mg/kg	11	0.04	NA	NA	ND	ND
	F1 (C6-C10 Hydrocarbons)	mg/kg	310	10	NA	NA	ND	ND
	F1 (C6-C10) -BTEX	mg/kg	310	10	NA	NA	ND	ND
	F2 (C10-C16 Hydrocarbons)	mg/kg	760	10	NA	NA	ND	ND
	F3 (C16-C34 Hydrocarbons)	mg/kg	1,700	10	NA	NA	11	15
	F4(C34-C50 Hydrocarbons)	mg/kg	3,300	10	NA	NA	ND	ND

ND Not detected
NA Not available
Higher than the criteria

Soil (Drainage sed.) refers to samples which were taken from a drainage ditch but were mislabeled as sediment instead of soil when they were sent for analysis.

Figure 24. (S-10205) Dump #3 map.

3.1.17 S-10206 TX Site

3.1.17.1 Location and Site Description

The transmitter (TX) site is located roughly 4 km south-southwest of the main station area, on the top of a ridge about 60 m above sea level (ESG 2000) (Figures 25-26). This DND facility comprises the main building (built after the demolition of the first one in 1982) with sleeping and eating areas and the old transformer building (Figures 25-26). The auxiliary power unit and the diesel fuel tank are new and were constructed at a slightly different location (Photograph 29, Appendix A).

During the ESG investigation, the remains of a demolished building and a dump were located southeast of the main building. When BRI staff visited, the remains and debris had already been moved to the Millionaire's Dump with the excavated soil of the small dump.

The land is generally flat, with the exception of some small depressions in which there is standing water during the summer months. Two pools are located south of the building remains and northwest of the dump (Photograph 30, Appendix A). Wet, clayey soils dominate the area.

This area remains active, yet not at the original site location. The Environment Canada Atmospheric Environment Service facilities were still active during our visit but they have not been included in the site evaluation.

3.1.17.2 Potential Receptors and Valued Ecological Components

Vegetation is evident in the area and wildlife has been noted as well. The standing water may also act as a water source for the local wildlife. There are no apparent drainage channels in the area. Human activities occur on this site, but remain mostly inside the building.

3.1.17.3 Summary of Previous Investigations

Eleven (11) soil samples were collected in 1999 around the main building, the electrical

generating shack and the fuel tanks. Samples were analyzed for TPH, PCBs, PAHs, pesticides and metals (Table XLIII). Seven (7) samples were tested for TPH and 2 of them exceeded the guidelines: sample 99-11154 was collected on the north side of the electrical generating shack and contained 7,500 mg/kg, which consisted of 69% fuel oil and 31% lubricating oil and grease. The second sample (99-11157) was taken from the middle of the building remains and was found to contain 4,700 mg/kg of 78% fuel oil and 22% lubricating oil and grease. This sample also contained 6.2 mg/kg cadmium, which was unusual as cadmium was not usually detected in background soil. Sample 99-11158, taken from the edge of the building remains contained 2,300 mg/kg of lead, which was almost 4 times the maximum allowable concentration according to the CCME guidelines. Similarly, all of the samples collected from the vicinity of the building remains had levels of copper, zinc and chromium that exceeded background soil concentrations. PCBs were found to surpass the Tier I criterion (2.6 mg/kg). PAH levels did not exceed the criterion and no pesticides were detected.

Delineation samples were collected in 2000 around the transmission building and the building remains. This consisted of 71 soil samples, including 7 depth samples and 7 duplicates. Nineteen (19) of these were tested for metals, PCBs and TPH and no further contamination was detected.

Table XLIII. (S-10206) Previous contaminated samples.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
99-11154	0	TPH	2500	7500
99-11157	0	TPH	2500	4100
	0	CADMINUM (CD)	5	6.2
99-11158	0	LEAD (PB)	500	2300

3.1.17.4 Nature and Extent of Contamination

Five (5) soil samples were collected in 2006, including 1 duplicate pair. These were

analyzed for metals and PCBs (Table XLIV). Of the 5 samples, none of the elements approached the CCME guidelines. No staining or odours were noted on site. However, a significant accumulations of snow made locating test areas and sample collection difficult.

3.1.17.5 Recommendations

Delineation should be performed during the next sampling campaign, which would include the collection of approximately 10 more depth soil samples. These samples should be collected from the area surrounding the remains of the demolished building, and directly from the dump. TPH and metals should be analyzed. BRI staff will need to examine the surrounding area if fuel tanks are present because a spill was said to have occured at the end of the summer of 2006.

Table XLIV. (S-10206) TX Site.

	PARAMETERS	SOIL			TX Site (S-10206) SOIL				
		UNITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	06TX0199 36 cm 15/07/2006	06TX0200 20 cm 15/07/2006	06TX0201 20 cm 15/07/2006	06TX0202 30 cm 15/07/2006	06TX0203 Dup. of 0201 20 cm 15/07/2006
METALS	Arsenic (As)	mg/kg	12	0.27	5.4	4.9	5.9	6.2	6.1
	Barium (Ba)	mg/kg	2,000	5	20	19	28	21	25
	Cadmium (Cd)	mg/kg	22	0.22	<1	<1	1	<1	<1
	Chromium (Cr)	mg/kg	87	3	22	23	27	24	24
	Cobalt (Co)	mg/kg	300	1.9	9	9	9	10	10
	Copper (Cu)	mg/kg	91	2.1	23	16	25	19	26
	Lead (Pb)	mg/kg	600	1.2	12	12	133	14	27
	Manganese (Mn)	mg/kg	---	1.1	427	386	394	417	431
	Molybdenum (Mo)	mg/kg	40	1.4	<2	<2	<2	<2	<2
	Nickel (Ni)	mg/kg	50	0.6	32	33	33	36	34
	Selenium (Se)	mg/kg	3.9	0.5	NA	NA	NA	NA	NA
	Silver (Ag)	mg/kg	40	0.4	<2	<2	<2	<2	<2
	Tin (Sn)	mg/kg	300	0.8	<5	<5	<5	<5	<5
	Zinc (Zn)	mg/kg	360	2.5	44	46	82	51	55
PCBs	Aroclor 1254	mg/kg	---	<0.01	NA	<0.1	<0.1	NA	NA
	BPC totaux	mg/kg	33	0.01	NA	ND	ND	NA	NA

ND Not detected
NA Not available
Higher than the criteria

Figure 25. (S-10206) TX Site map 1.

Figure 26. (S-10206) TX Site map 2.

3.1.18 S-10207 Airstrip Building HIL-124 "The Hilton"

3.1.18.1 Location and Site Description

Airstrip Building HIL-124, commonly known as The Hilton, is located west of the airstrip apron and northeast of the DREP (Defence Research Establishment Pacific) building (Figure 27). Currently, Traffic personnel use it for equipment storage. There are 2 fuel tanks on the north side of the building, 1 for diesel and the other for gasoline. The site remains active. The land here has a slight slope going toward the south and Dumbell Bay. The underlying soils are composed mostly of silt and clay with stones.

3.1.18.2 Potential Receptors and Valued Ecological Components

There was no apparent vegetation noted during the latest field visit and animals were not evident. A drainage channel runs southward and into Dumbell Bay on the east side of the site, from a large pool of standing water located northwest of the building (Photograph 31, Appendix A). Human activity was present on site, but the majority of the time, people remain inside the building.

3.1.18.3 Summary of Previous Investigations

Ten (10) surface soil samples, including 1 duplicate pair were collected in 1999. These samples were tested for metals, TPH, PAHs, BTEX and glycol (Table XLV). Of these, 8 were tested for TPH. It was undetected in 6 samples and exceeded the 2,500 mg/kg criterion in 2 others. Sample 99-12528 contained 53,000 mg/kg (the average of a duplicate pair), which was collected from a stained area next to the south corner of the building. Benzo(*a*)pyrene, a PAH, was also detected at 1.0 mg/kg, which just surpasses the CCME guideline of 0.7 mg/kg. The second sample (99-12535) was taken from a bucket of oily absorbent material, and this was found to contain 36,000 mg/kg TPH. TPH contaminants around the Hilton were found to consist of lubricating oil and grease. One (1) sample was tested for metals; nickel, zinc and arsenic were detected although

comparable to background levels. No glycol or BTEX was observed above the detection limits.

Table XLV. (S-10207) Previous contaminated samples.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
99-12528	0	BENZO(A) PYRENE	0.7	1.0
	0	TPH	2,500	35,000
99-12535	0	TPH	2,500	36,000

3.1.18.4 Nature and Extent of Contamination

The Hilton was revisited in 2006 by BRI staff, and 3 surface soil samples were collected. These were analyzed for metals, PAHs and TPH (Table XLVI). While a range of metals were found in small quantities in the 3 samples, the only element to exceed criteria was cadmium (53 mg/kg) in sample 06HI0154. The only hydrocarbon detected was fraction 3, although only present at low concentrations in the 3 positive samples.

3.1.18.5 Recommendations

Further assessment is recommended for this site. This should include the collection and analysis of approximately 9 more soil samples and 1 water sample collected from the drainage pathway. The samples should be evaluated for inorganic elements and petroleum hydrocarbons. Closure is possible if no further contamination is found during the next field visit.

Table XLVI. (S-10207) Airstrip Building HIL-124 results.

					Airstrip Bldg HIL-124 (S-10207)		
		SOIL			SOIL		
	PARAMETERS	UNITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	06HI0153 0-10 cm 07/09/06	06HI0154 0-10 cm 07/09/06	06HI0155 0-10 cm 07/09/06
METALS	Arsenic (As)	mg/kg	12	0.27	11.6	9	8.4
	Barium (Ba)	mg/kg	2,000	5	15	17	16
	Cadmium (Cd)	mg/kg	22	0.22	<1	53	<1
	Chromium (Cr)	mg/kg	87	3	25	27	26
	Cobalt (Co)	mg/kg	300	1.9	10	11	10
	Copper (Cu)	mg/kg	91	2.1	16	24	18
	Lead (Pb)	mg/kg	600	1.2	11	14	12
	Manganese (Mn)	mg/kg	---	1.1	542	493	443
	Molybdenum (Mo)	mg/kg	40	1.4	<2	<2	<2
	Nickel (Ni)	mg/kg	50	0.6	30	39	35
	Selenium (Se)	mg/kg	3.9	0.5	NA	NA	NA
	Silver (Ag)	mg/kg	40	0.4	<2	<2	<2
	Tin (Sn)	mg/kg	300	0.8	<5	<5	<5
	Zinc (Zn)	mg/kg	360	2.5	48	61	57
PAH	Naphthalene	mg/kg	22	0.008	<0.1	<0.1	<0.1
	2-methylnaphthalene	mg/kg	---	0.005	<0.1	<0.1	<0.1
	1-methylnaphthalene	mg/kg	---	0.005	<0.1	<0.1	<0.1
	1,3-Dimethylnaphthalene	mg/kg	---	0.005	<0.1	<0.1	<0.1
	Acenaphthylene	mg/kg	---	0.004	<0.1	<0.1	<0.1
	Acenaphthene	mg/kg	---	0.004	<0.1	<0.1	<0.1
	2,3,5-trimethylnaphthalene	mg/kg	---	0.007	<0.1	<0.1	<0.1
	Fluorene	mg/kg	---	0.007	<0.1	<0.1	<0.1
	Phenanthrene	mg/kg	50	0.010	<0.1	<0.1	<0.1
	Anthracene	mg/kg	---	0.004	<0.1	<0.1	<0.1
	Fluoranthene	mg/kg	---	0.008	<0.1	<0.1	<0.1
	Pyrene	mg/kg	100	0.008	<0.1	<0.1	<0.1
	Benzo(c)Phenanthrene	mg/kg	---	0.008	<0.1	<0.1	<0.1
	Benzo(a)Anthracene	mg/kg	10	0.007	<0.1	<0.1	<0.1
	Chrysene	mg/kg	---	0.008	<0.1	<0.1	<0.1
	7,12-dimethylbenzo(a)anthracene	mg/kg	---	0.005	<0.1	<0.1	<0.1
	Benzo(b,j,k)fluoranthene	mg/kg	10	0.008	<0.1	<0.1	<0.1
	Benzo(a)pyrene	mg/kg	0.7	0.008	<0.1	<0.1	<0.1
	3-methylcholanthrene	mg/kg	---	0.022	<0.1	<0.1	<0.1
	Indeno(1,2,3-cd)pyrene	mg/kg	10	0.008	<0.1	<0.1	<0.1
	Dibenzo(a,h)anthracene	mg/kg	10	0.008	<0.1	<0.1	<0.1
	Benzo(g,h,i)perylene	mg/kg	---	0.008	<0.1	<0.1	<0.1
	Dibenzo (a,l) pyrene	mg/kg	---	0.008	<0.1	<0.1	<0.1
	Dibenzo (a,i) pyrene	mg/kg	---	0.007	<0.1	<0.1	<0.1
	Dibenzo (a,h) pyrene	mg/kg	---	0.008	<0.1	<0.1	<0.1
HYDROCARBONS	Benzene	mg/kg	0.03	0.02	ND	ND	ND
	Toluene	mg/kg	0.37	0.02	ND	ND	ND
	Ethylbenzene	mg/kg	0.08	0.02	ND	ND	ND
	o-Xylene	mg/kg	---	0.02	ND	ND	ND
	p+m-Xylene	mg/kg	---	0.04	ND	ND	ND
	Total Xylene	mg/kg	11	0.04	ND	ND	ND
	F1 (C6-C10 Hydrocarbons)	mg/kg	310	10	ND	ND	ND

Figure 27. (S-10207) Airstrip Building HIL-124 map.

3.1.19 S-10208 Airstrip Building FH-128

3.1.19.1 Location and Site Description

The airstrip garage (Airstrip Building FH-128) is located on the southwestern end of the of the airstrip apron, approximately 80 m southwest of the refueling shed (Figure 28). The garage is used for storing a deicing machine and there is a fuel tank located just outside the south end of the building. The report from 1999 states that this fuel tank is no longer in use. A bay door is situated at the north end and there is a regular doorway at the southeast end. The building sits on a raised gravel pad and active drainage channels flow under it towards the south during freshet. The raised gravel platform extends 8 m from the edge of the garage toward the southwest and Dumbell Bay. The platform subsequently drops 3 m and from here the bay is roughly 300 m away. The airstrip garage is slated for demolition in the next few years (ESG 2000).

3.1.19.2 Potential Receptors and Valued Ecological Components

Small tufts of vegetation and flowers were observed during the site visit in June of 2006. The team also saw an Arctic hare on site, signifying the presence of wildlife. Also of concern is the drainage channels that flow into Dumbell Bay, mostly during freshet. Any contaminants present in the soil may easily be transported into the bay. (Photograph 32, Appendix A) Human activities were present inside and around the building.

3.1.19.3 Summary of Previous Investigations

Ten (10) soil samples were taken in 1999, which included 1 duplicate pair and 1 depth sample. Of these, 8 were tested for TPH and 4 of them were above 2,500 mg/kg (Table XLVII). Sample 99-12514 had TPH concentrations of 15,000 mg/kg, being sampled at a depth of 10 – 20 cm in the drainage catchment northeast of the garage. The other 3 samples, at 3,000 mg/kg and 7,800 mg/kg including the duplicate pair, were collected from below the fuel tanks found at the south end of the garage. Of the 10 samples, none contained metals, PCBs, BTEX or glycol.

In 2000, ESG collected 20 soil samples (including 2 depth samples) in and around the drainage channels, in order to determine if any contaminants were migrating toward the Dumbell Bay by way of the channels. Eleven (11) samples were analyzed for metals and TPH and none of them contained these elements above the applicable criteria.

Table XLVII. (S-10208) Previous contaminated samples.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
99-12509	0	TPH	2,500	3,000
99-12510/11	0	TPH	2,500	7,000
99-12514	0	TPH	2,500	15,000

3.1.19.4 Nature and Extent of Contamination

In June, 2006, 7 soil samples, including 1 duplicate pair were taken from the site to delineate the contaminated area and to test for TPH. Samples 06AS0009 – 06AS0013 were taken from between 40 and 100 cm away from the fuel tank located at the south end of the garage. Samples 06AS0009/10/11 were taken from 50 cm away from the previously mentioned fuel tank. BRI staff detected a fuel odour on site around the tank. Of the five (5) samples, three (3) showed C10 – C16 hydrocarbon concentrations above the CCME criteria (TableXLVIII): samples 06AS0010, 06AS0011 (30 cm depth) and 06AS0012 had concentrations of 1,700, 6,800 and 11,000 mg/kg fuel oil, respectively. No other samples were found to have hydrocarbon concentrations above the guidelines, although the 2 other samples (06AS0009/13) collected near the fuel tank also contained high concentrations of fraction 2 hydrocarbons (Photograph 34, Appendix A). The 2 samples were taken from where the drainage catchment was located during the summer of 2006, and contained traces of fuel oil that did not approach the criteria. No BTEX was detected.

3.1.19.5 Recommendations

Further delineation, including roughly 14 soil samples and 1 surface water sample should be performed to establish the extent of TPH and PAH contamination for eventual

excavation work. Soil samples should be collected in the area previously found to be contaminated (Figure 28) and surface water samples from the downstream drainage channel leading to the bay, in order to evaluate potential migration.

Table XLVIII. (S-10208) Airstrip Building FH-128 results.

	PARAMETERS	UNITS	SOIL INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	Airstrip Building FH-128 SOIL 06AS0009 5 cm 24/06/06	06AS0010 Dup. of 0009 5 cm 24/060/06	06AS0011 30 cm 24/060/06	06AS0012 5 cm 24/060/06	06AS0013 25 cm 24/060/06	06AS0014 10-20 cm 24/060/06	06AS0015 15 cm 24/060/06
PETROLEUM HYDROCARBONS	Benzene	mg/kg	0.030	0.02	ND	ND	ND	ND	ND	ND	ND
	Toluene	mg/kg	0.37	0.02	ND	ND	ND	ND	ND	ND	ND
	Ethylbenzene	mg/kg	0.082	0.02	ND	ND	ND	ND	ND	ND	ND
	o-Xylene	mg/kg	---	0.02	ND	ND	ND	ND	ND	ND	ND
	p+m-Xylene	mg/kg	---	0.04	ND	ND	ND	ND	ND	ND	ND
	Total Xylene	mg/kg	11	0.04	ND	ND	ND	ND	ND	ND	ND
	F1 (C6-C10 Hydrocarbons)	mg/kg	310	10	ND	ND	ND	ND	24	ND	ND
	F1 (C6-C10) -BTEX	mg/kg	310	10	ND	ND	ND	ND	24	ND	ND
	F2 (C10-C16 Hydrocarbons)	mg/kg	760	10	700	1,700	6,800	11,000	620	ND	ND
	F3 (C16-C34 Hydrocarbons)	mg/kg	1,700	10	36	36	120	320	48	63	27
	F4(C34-C50 Hydrocarbons)	mg/kg	3,300	10	ND	ND	ND	ND	ND	ND	ND

ND Not detected
NA Not available
Higher than the criteria

Figure 28. (S-10208) Airstrip Building FH-128 map.

3.1.20 S-10209 Airstrip DREP Building & Barrel Cache

3.1.20.1 Location and Site Description

The Airstrip DREP (Defense Research Establishment Pacific) Building & Barrel Cache is located 140 m southwest of the Hurricane building and south of where Lancaster Drive reaches the runway (Figure 29). "It covers an area approximately 75 m x 40 m and is surrounded on three sides by a berm constructed of coarse gravel and reinforced with plastic geogridding" (ESG 2000) (Photograph 33, Appendix A). However, the membrane was apparently punctured by a backhoe at approximately 17 cm. Several pallets holding hydrocarbon products and batteries are located here. Standing water was observed in the berm in June of 2006. There are no buildings in the area and the site remains active.

3.1.20.2 Potential Receptors and Valued Ecological Components

The main receptor is Dumbell bay, which is not far away, to the south of the area, down a small slope. No plant or animal life was apparent in the area. However, some standing water was found on site. As shown in Photograph 34, Appendix A, a large drainage channel is located east of the area toward the bay but it was not connected with the bermed site during the summer 2006 visit. There were no human activities in this area, with the exception of when the staff moves barrels.

3.1.20.3 Summary of Previous Investigations

In 1999, 11 soil samples were collected, including 2 test pits. These were analyzed for TPH, which was detected in 2 samples (Table XLIX). Sample 99-12562 contained 17,000 mg/kg and sample 99-12564 contained 22,000 mg/kg; they were 6.8 and 8.8 times, respectively, higher than the TPH guidelines. ESG has proposed excavation of this small area.

ilding & Barrel Cache results.

							Airstrip DREP Building and Barrel Cache (S-10209)					
SOIL			WATER				FRESHWATER	SOIL				
ITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	UNITS	GUIDELINES AQUATIC LIFE FRESH	GUIDELINES AQUATIC LIFE MARINE	DETECTION LIMIT	06DP0171 Surf. Water 11/07/06	06DB0016 50 cm 24/06/06	06DB0017 15 cm 24/06/06	06DB0018 0-10 cm 24/06/06	06DB0019 0-10 cm 24/06/06	06DB0020 30-40 cm 24/06/06
g/kg	0.03	0.02	ug/L	370	110	0.03	NA	ND	ND	ND	ND	ND
g/kg	0.37	0.02	ug/L	2	215	0.03	NA	ND	ND	ND	ND	ND
g/kg	0.08	0.02	ug/L	90	25	0.02	NA	ND	ND	ND	ND	ND
g/kg	---	0.02	ug/L	---	---	0.02	NA	ND	ND	ND	ND	ND
g/kg	---	0.04	ug/L	---	---	0.05	NA	ND	ND	ND	ND	ND
g/kg	11	0.04	ug/L	---	---	0.05	NA	ND	ND	ND	ND	ND
g/kg	310	10	ug/L	---	---	100	NA	ND	ND	ND	ND	ND
g/kg	310	10	ug/L	---	---	100	NA	ND	ND	ND	ND	ND
g/kg	760	10	ug/L	---	---	100	ND	ND	410	520	ND	ND
g/kg	1,700	10	ug/L	---	---	100	ND	ND	ND	24,000	20,000	35
g/kg	3,300	10	ug/L	---	---	100	ND	ND	ND	280	2,000	ND

Figure 29. (S-10209) Airstrip DREP Building & Barrel Cache map.

3.1.21 S-10210 Airstrip Diesel Pipeline

3.1.21.1 Location and Site Description

The Airstrip Diesel Pipeline runs from the airstrip fuel tank farm (S-10193) to the station tank farm (S-10214) (Figure 30). It starts in the station day tank area, heading straight north to the 8 diesel fuel storage tanks and continuing on to the refueling building located adjacent to the runway (Photograph 35, Appendix A).

During our investigation, the pipeline had been out of service for a couple of months because it was broken. Military personnel advised the team that the pipeline had burst in 2004 when a main valve had been closed near the tank when the pump was going. Repairmen were there during the summer of 2006 to construct a new pipeline. The new pipeline is at approximately the same place, but the valve does not necessary fit with the old location. In addition, a fuel spill discovered in 1999 has been evaluated separately in section 3.1.30. The topography of the site features a gradual slope to the south and the soil is wet and consists of clay and small stones.

3.1.21.2 Potential Receptors and Valued Ecological Components

As this site is a natural drainage area, migration of contaminants to the Dumbell Bay is a concern. Sparse vegetation has been noted in the area and Arctic hares and traces of animal life are evident in the form of footprints and feces. No human activity regularly occurs along the length of the pipeline but is concentrated in the area where transfer and refueling is performed.

3.1.21.3 Summary of Previous Investigations

In 1999, 4 soil samples, 3 of which were taken from depths greater than 10 cm, were collected from below a valve in the pipeline. Depending on the sample location, a light to heavy hydrocarbon odour was noted. The samples were found to contain TPH, naphthalene and xylenes (Table LI). All 4 samples (99-12547/48 and 99-11732/33) collected at the same place but at different depths, exceeded the 2,500 mg/kg criterion for

of the samples, but remained below the guidelines.

No visual contamination was noted but moderate to strong odours were present in each sampling area. No samples were collected on the other side of Lancaster Drive because no odour or visual contamination was present.

3.1.21.5 Recommendations

Delineation should be completed during the next site visit in the area where contamination was found in 2006 (Figure 30). This includes collecting approximately 20 more surface and depth soil samples, to be tested for TPH and BTEX.

The pipeline is said to have ruptured in the fall of 2006, just after the last rebuild was completed. This new area will have to be examined and characterized during the next field investigation.

Table LII. (S-10210) Airstrip Diesel Pipeline results.

					Airstrip Diesel Pipeline (S-10210)				
		SOIL			SOIL				
	PARAMETERS	UNITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	06DP0160 20 cm 14/07/06	06DP0163 10 cm 14/07/06	06DP0196 Dup. Of 0163 10 cm 14/07/06	06DP0197 20 cm 14/07/06	06DP0199 20 cm 14/07/06
METALS	Arsenic (As)	mg/kg	12	0.27	NA	NA	NA	NA	12.2
	Barium (Ba)	mg/kg	2,000	5	NA	NA	NA	NA	12
	Cadmium (Cd)	mg/kg	22	0.22	NA	NA	NA	NA	<1
	Chromium (Cr)	mg/kg	87	3	NA	NA	NA	NA	25
	Cobalt (Co)	mg/kg	300	1.9	NA	NA	NA	NA	11
	Copper (Cu)	mg/kg	91	2.1	NA	NA	NA	NA	20
	Lead (Pb)	mg/kg	600	1.2	NA	NA	NA	NA	12
	Manganese (Mn)	mg/kg	---	1.1	NA	NA	NA	NA	459
	Molybdenum (Mo)	mg/kg	40	1.4	NA	NA	NA	NA	<2
	Nickel (Ni)	mg/kg	50	0.6	NA	NA	NA	NA	38
	Selenium (Se)	mg/kg	3.9	0.5	NA	NA	NA	NA	NA
	Silver (Ag)	mg/kg	40	0.4	NA	NA	NA	NA	<2
	Tin (Sn)	mg/kg	300	0.8	NA	NA	NA	NA	<5
	Zinc (Zn)	mg/kg	360	2.5	NA	NA	NA	NA	54
TPH	F1 (C6-C10 Hydrocarbons)	mg/kg	310	10	360	1,200	1,600	370	710
	F1 (C6-C10) -BTEX	mg/kg	310	10	330	1,200	1,600	370	700
	F2 (C10-C16 Hydrocarbons)	mg/kg	760	10	5,700	9,500	8,800	9,500	7,300
	F3 (C16-C34 Hydrocarbons)	mg/kg	1,700	10	33	340	260	500	330
	F4(C34-C50 Hydrocarbons)	mg/kg	3,300	10	ND	10	ND	ND	ND

ND Not detected
NA Not available
Higher than the criteria

Figure 30. (S-10210) Airstrip Diesel Pipeline map.

3.1.22 S-10211 Airstrip Hurricane Building

3.1.22.1 Location and Site Description

The Airstrip Hurricane Building is located to the east of both Airstrip Building HIL-124 (S-10207) and the Airstrip DREP Building, along the south side of Airstrip Building FH-128 (S-10208) (Figure 31). Personnel assigned to support Operation Hurricane (DND activities at CFS-Eureka and its associated radio towers) use this building primarily as a garage for storage and also for vehicle maintenance, including aircraft. Only 1 fuel tank could be found on the southwest side of the building, although the most recent study performed in 1999, suggests there used to be a second fuel tank. One (1) other white tank, contents unknown, is located northeast of the building. There is also a control box located 15 m west of the building. At the time of our investigation, 1 refrigerated container was located on the southeast side of the building and one HAZ MAT emergency caravan was positioned at the west side of the building. Also, several piles of debris were seen on site; 1 was stored on a wooden pallet on the west side of the building, just beside the fuel tank, and some antennae and debris were left along the east side of the building (Photograph 37, Appendix A).

The land slopes toward the Dumbell Bay which is roughly 1 km to the east. A steep slope turns gradually into a gentle slope as it approaches the shore. Soils in the area are primarily gravel with some native clay and silt to the east.

3.1.22.2 Potential Receptors and Valued Ecological Components

With the Dumbell Bay close by there is an adequate water supply for vegetation, which is apparent on the east side of the Hurricane building, in the form of grasses and mosses. This would suggest the presence of animal life in the area, but none was observed during the field visit. Although there is no drainage channel evident on the site, there are active channels in the general vicinity. Human activity appeared to be short and irregular.

3.1.22.3 Summary of Previous Investigations

In 1999, 10 soil samples, including 1 duplicate pair and 1 depth sample were collected and analyzed for metals, PCBs and TPH (Table LIII). Only TPH exceeded the guidelines in some samples. Soil sample 99-12557 was taken from between the 2 existing fuel tanks and its TPH concentration was found to be 6,500 mg/kg, as 100% fuel oil. No other elements surpassed the guidelines, although the level of zinc near the electrical control box was high considering natural background levels.

Table LIII. (S-10211) Previous contaminated soil samples.

Samples	Depth (cm)	Contaminant	Criterion mg/kg)	Concentration (mg/kg)
99-12557	0	TPH	2,500	6,500

3.1.22.4 Nature and Extent of Contamination

Six (6) soil samples were collected in 2006, including 2 duplicate pairs. These were tested for metals (5/6) and hydrocarbons (4/6) (TableLIV). Hydrocarbons in excess of the industrial guidelines were found in a duplicate pair of samples taken 20 cm north of the fuel tank; sample 06HB0166 had concentrations of 310 mg/kg for both fraction 1 and BTEX, while sample 06HB0170 had concentrations of 420 mg/kg for both fraction 1 and BTEX. Fraction 2 concentrations for the two above mentioned samples were at 5,300 mg/kg and 4,200 mg/kg, respectively. Sample 06HB0166, where the team noted a strong odour, also showed high zinc levels; 590 mg/kg, whereas the guideline is at 360 mg/kg. The depth sample, 06HB0164 also showed high hydrocarbon concentrations for fraction 1, BTEX and fraction 2. These concentrations were found to reach 1,800 mg/kg, 1,800 mg/kg and 7,900 mg/kg, respectively. This sample was collected at 50 cm from the fuel tank. A light to medium hydrocarbon odour was noted in this area. Stains on the soil were also noticed north and east of the building, yet neither of these samples showed any elements exceeding the guidelines.

3.1.22.5 Recommendations

Delineation should be performed around the fuel tank. This should include approximately another 10 soil samples to be analyzed for TPH and metals. PAHs should be evaluated in the samples collected around the fuel tank to characterize the contamination for at least 1 surface soil sample and 1 depth soil sample. Samples taken from deeper than 50 cm should also be collected to evaluate the extent of vertical migration.

Table LIV. (S-10211) Airstrip Hurricane Building results.

					Airstrip Hurricane Building (S-10211)					
		SOIL			SOIL					
	PARAMETERS	UNITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	06HB0164 50 cm 07/09/06	06HB0165 0-10 cm 07/09/06	06HB0166 20 cm 07/09/06	06HB0168 0-10 cm 07/09/06	06HB0169 Dup. of 0168 0-10 cm 07/09/06	06HB0170 Dup. of 0166 20 cm 07/09/06
METALS	Arsenic (As)	mg/kg	12	0.27	10.6	14.2	10.5	11.1	11.2	NA
	Barium (Ba)	mg/kg	2,000	5	20	13	20	16	22	NA
	Cadmium (Cd)	mg/kg	22	0.22	<1	<1	<1	<1	<1	NA
	Chromium (Cr)	mg/kg	87	3	29	21	27	37	68	NA
	Cobalt (Co)	mg/kg	300	1.9	14	9	10	9	9	NA
	Copper (Cu)	mg/kg	91	2.1	22	11	43	11	13	NA
	Lead (Pb)	mg/kg	600	1.2	16	12	47	13	18	NA
	Manganese (Mn)	mg/kg	---	1.1	564	497	472	486	521	NA
	Molybdenum (Mo)	mg/kg	40	1.4	<2	<2	<2	<2	<2	NA
	Nickel (Ni)	mg/kg	50	0.6	42	22	32	23	24	NA
	Selenium (Se)	mg/kg	3.9	0.5	NA	NA	NA	NA	NA	NA
	Silver (Ag)	mg/kg	40	0.4	<2	<2	<2	<2	<2	NA
	Tin (Sn)	mg/kg	300	0.8	<5	<5	<5	<5	<5	NA
	Zinc (Zn)	mg/kg	360	2.5	64	37	590	64	108	NA
PETROLEUM HYDROCARBONS	Benzene	mg/kg	0.03	0.02	ND	NA	ND	ND	NA	ND
	Toluene	mg/kg	0.37	0.02	ND	NA	ND	ND	NA	ND
	Ethylbenzene	mg/kg	0.08	0.02	ND	NA	ND	ND	NA	ND
	o-Xylene	mg/kg	---	0.02	7.2	NA	0.7	ND	NA	0.69
	p+m-Xylene	mg/kg	---	0.04	2.8	NA	0.4	ND	NA	0.41
	Total Xylene	mg/kg	11	0.04	9.9	NA	1.2	ND	NA	1.1
	F1 (C6-C10 Hydrocarbons)	mg/kg	310	10	1,800	NA	310	ND	NA	420
	F1 (C6-C10) -BTEX	mg/kg	310	10	1,800	NA	310	ND	NA	420
	F2 (C10-C16 Hydrocarbons)	mg/kg	760	10	7,900	NA	5,300	ND	NA	4,200
	F3 (C16-C34 Hydrocarbons)	mg/kg	1,700	10	51	NA	84	ND	NA	72
	F4(C34-C50 Hydrocarbons)	mg/kg	3,300	10	ND	NA	ND	ND	NA	ND

ND Not detected
NA Not available
Higher than the criteria

Figure 31. (S-10211) Airstrip Hurricane Building map.

3.1.23 S-10212 Airstrip Met Shack

3.1.23.1 Location and Site Description

The Airstrip Met (Meteorological) Shack is located just north of the airstrip, on the eastern portion of the base (Figure 32). Here, weather information is collected and distributed to pilots flying into and out of the station. The weather gathering instruments are found immediately to the west of the building and there are 2 fuel tanks. There are also 3 other buildings in the area; an electrical cold storage shack (Building 103) maintained by the construction engineers and 2 electrical generator sheds (Buildings 101 and 102) (Photograph 38, Appendix A). The electrical shop was slated for demolition in 2005 but remains standing. It seems to be deserted and no longer in use. Previously, 2 fuel tanks had been noted on the northeast side of the Met Shack, yet in 2006 one appears to have been moved to the south side of building 101 and a new one installed on the northeast side of the building replacing the old one. Rocky native soils are predominant in the area and the topography is generally flat with several standing water pools established in the area. The main swampy area was located under the Met Shack and first headed north and then southeast after approximately 12-15 meters (Photograph 39, Appendix A). The southeast part was frozen during the 2006 field visit.

3.1.23.2 Potential Receptors and Valued Ecological Components

Several pools of standing water were observed on the side. In addition to this water source is the swampy area north of the study area. This encourages the presence of animal life and several different species were observed in the area, including foxes and Arctic hares and frass indicating the presence of insects. A polar bear was spotted in August 2006, right in front of the building. Vegetation is also apparent in the area and well established. There is a drainage channel that joins the swamp to the north, but does not pass through the site. Human activities on this site remain mostly inside the building.

3.1.23.3 Summary of Previous Investigations

Twelve (12) soil samples, including 1 duplicate pair, were collected in 1999, in addition to 1 water sample and 1 plant sample. These samples came from the vicinity of the Met Shack and around the peripheral buildings to the north. The samples were analyzed for metals, PCBs, TPH, pesticides and BTEX (Table LV). A stain was noted between the 2 fuel tanks and the subsequent sample (99-12709) showed xylene exceeding CCME criterion at 1000 µg/kg. Toluene was present as well but did not surpass the advised criterion. Additionally, the 3 samples tested for metals showed findings comparable to background soil concentrations. TPH just exceeded the detection limit (40 mg/kg) in 1 soil sample (46 mg/kg). PCBs and pesticides were not detected in the samples. The plant sample was not analyzed.

A water sample (99-11195W) collected in a large pool of standing water (frozen during our investigation), east of the Met Shack was found to contain 0.005 mg/L copper, which exceed the CCME Protection of Freshwater Aquatic Life criterion of 0.002-0.004 mg/L. Zinc was also present but below the guideline. Water pH was measured at 7.4

An additional 15 soil samples, including 2 depth samples, were collected in 2000 and analyzed for metals, PCBs and TPH. No contamination above the applicable criteria was found.

Table LV. (S-10212) Previous contaminated samples.

Samples	Depth (cm)	Contaminant	Criterion	Concentration
99-11195 water	Surface water	COPPER (CU)	2-4 ug/L	5 ug/L
99-12709	0	XYLENES	1,000 mg/kg	5,100 mg/kg

3.1.23.4 Nature and Extent of Contamination

During the site visit in the summer of 2006, 5 soil samples (including 1 duplicate pair) and 2 freshwater samples were collected. The duplicate samples (06ME0076 and 06ME0115) showed BTEX concentrations exceeding the criterion, including

ethylbenzene levels reaching 1.3 and 3.2 mg/kg, respectively. (Table LVI). Sample 06ME0115 also had a toluene concentration of 0.7 mg/kg (the guideline is 0.37 mg/kg) and xylene at 19.5 mg/kg (guidelines is 11 mg/kg). Hydrocarbon contamination was also apparent, the first sample exceeding the applicable guidelines in fraction 2 (1,200 mg/kg) and the second sample exceeding guidelines in hydrocarbon fractions 1 and 2. Benzene, toluene and ethylbenzene were also detected in several samples with a criteria lower than the detection limit.

The 2 freshwater samples (06ME0080 and 06ME0081), which were duplicates, showed extensive metals contamination and results were very similar: arsenic concentrations reached 6 and 5 µg/L, respectively, just surpassing the freshwater guidelines. The cadmium concentration in 06ME0081 was 1 ug/L, whereas the guidelines recommend no higher than 0.017 µg/L. The freshwater guidelines for copper are recommended not to exceed 2-4 µg/L, yet samples 06ME0080 and 06ME0081 possessed concentrations of 14 and 13 µg/L, respectively. In both 06ME0080 and 06ME0081, lead and zinc were present at 1 µg/L and 30 µg/L, respectively, which are the guideline thresholds for both elements. Glycol levels were analyzed in the water samples and none was detected. Visual contamination was observed in the standing water where the 2 samples were collected (Photograph 40 , Appendix A).

3.1.23.5 Recommendations

During the next sampling campaign, delineation should be performed around the location of the fuel tank on the northeast side of the main building and also around the standing water situated under and around the Met Shack. Approximately 10 soil samples and 3 water samples should be collected and analyzed for metals, TPH and BTEX. Water samples should be collected in the swampy area and downstream of the drainage channel, if one is present during the investigation. Analysis of PAHs should be performed on all samples collected around the fuel tank.

ack results.

	WATER			SOIL			Airstrip MET Shack (S-10212)						
							SOIL					FRESHWATER	
UNITS	GUIDELINES AQUATIC LIFE		DETECTION LIMIT	UNITS	INDUSTRIAL GUIDELINES	DETECTION LIMIT	06ME0076 Dup. of 0115	06ME0113	06ME0114	06ME0115	06ME0116	06ME0080	06ME0081 Dup. of 0080
	FRESH	MARINE			(Coarse)		0-10 cm 07/05/06	0-10 cm 07/05/06	0-10 cm 07/05/06	0-10 cm 07/05/06	0-10 cm 07/05/06	Surf. Water 07/01/06	Surf. Water 07/01/06
ug/L	5	12.5	0.0001	mg/kg	12	0.27	NA	NA	NA	NA	NA	6	5
ug/L	---	---	0.001	mg/kg	2,000	5	NA	NA	NA	NA	NA	<10	<10
ug/L	0.017	0.12	0.0001	mg/kg	22	0.22	NA	NA	NA	NA	NA	<1	1
ug/L	---	---	0.0007	mg/kg	87	3	NA	NA	NA	NA	NA	2	2
ug/L	---	---	0.0006	mg/kg	300	1.9	NA	NA	NA	NA	NA	1	1
ug/L	2-4	2-4	0.0012	mg/kg	91	2.1	NA	NA	NA	NA	NA	14	13
ug/L	1-7	---	0.0011	mg/kg	600	1.2	NA	NA	NA	NA	NA	1	1
ug/L	---	---	0.0003	mg/kg	---	1.1	NA	NA	NA	NA	NA	11	11
ug/L	73	---	0.0078	mg/kg	40	1.4	NA	NA	NA	NA	NA	<1	<1
ug/L	25-150	---	0.0005	mg/kg	50	0.6	NA	NA	NA	NA	NA	2	1
ug/L	1	---	0.0006	mg/kg	3.9	0.5	NA	NA	NA	NA	NA	<1	<1
ug/L	---	---	0.0008	mg/kg	40	0.4	NA	NA	NA	NA	NA	<1	<1
ug/L	---	---	0.011	mg/kg	300	0.8	NA	NA	NA	NA	NA	<1	<1
ug/L	30	---	0.006	mg/kg	360	2.5	NA	NA	NA	NA	NA	30	30
ug/L	192000	---	<0.001	mg/kg	960	<8	NA	NA	NA	NA	NA	<1,000	<1,000
ug/L	---	---	<0.001	mg/kg	---	<4	NA	NA	NA	NA	NA	<1,000	<1,000
ug/L	---	---	<0.002	mg/kg	---	<16	NA	NA	NA	NA	NA	<2,000	<2,000
ug/L	---	---	<0.010	mg/kg	---	<60	NA	NA	NA	NA	NA	<10,000	<10,000
ug/L	500000	---	<0.001	mg/kg	---	<8	NA	NA	NA	NA	NA	<1,000	<1,000
ug/L	370	110	0.03	mg/kg	0.030	0.02	<0.1	<0.1	<0.1	<0.1	<0.1	NA	NA
ug/L	2	215	0.03	mg/kg	0.37	0.02	0.3	<0.1	<0.1	0.7	<0.1	NA	NA
ug/L	90	25	0.02	mg/kg	0.082	0.02	1.3	<0.1	<0.1	3.2	<0.1	NA	NA
ug/L	---	---	0.02	mg/kg	11	0.04	8.1	<0.1	<0.1	19.5	<0.1	NA	NA
ug/L	---	---	100	mg/kg	310	10	43	ND	ND	450	ND	NA	NA
ug/L	---	---	100	mg/kg	310	10	42	ND	ND	440	ND	NA	NA
ug/L	---	---	100	mg/kg	760	10	1,200	ND	ND	2,600	ND	NA	NA
ug/L	---	---	100	mg/kg	1,700	10	37	18	170	52	ND	NA	NA
ug/L	---	---	100	mg/kg	3,300	10	ND	ND	29	ND	ND	NA	NA

Higher than the criteria

The criteria is lower than the detection limit.

Figure 32. (S-10212) Airstrip Met Shack map.

3.1.24 S-10213 Main Station POL Pallet Line

3.1.24.1 Location and Site Description

The Main Station POL Pallet Line is located to the north of the main station area and also just north of the day tank area and on the south side of Lancaster Drive (Figure 33). The site is characterized by uniformly flat land with a very gentle slope to the east toward Alert Inlet in the distance. The area is enclosed by a metal fence. This is an active site that is still used for storing barrels on 6 raised metal pallets (Photograph 41, Appendix A). The barrels were found to contain such substances as POL, chemical products and waste oil. Lubricating oil, deicing fluid, and acids were also found in this area. The 2 old fuel tanks stored on the east side of the site were removed during our visit. The soil composition is mainly rocky sandy soils.

3.1.24.2 Potential Receptors and Valued Ecological Components

No vegetation or animal life was apparent in the area and there were no drainage channels evident during the field study in July, 2006. No human activities exist on this site except during the transfer of barrels.

3.1.24.3 Summary of Previous Investigations

The previous study conducted in 1999 included the collection of nine (9) soil samples, including one duplicate pair, that were tested for TPH, metals and pesticides (Table LVII). Samples were taken from around the pallets and beside the fuel tanks, in visibly stained areas. One (1) sample had TPH levels 4.8 times above the 2,500 mg/kg limit and consisted of lubricating oil and grease. No other samples had contaminant concentrations exceeding the guidelines. The concentrations of inorganic elements were comparable to the background levels and no pesticides were detected.

Table LVII. (S-10213) Previous contaminated samples.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
99-12726	0	TPH	2,500	12,000

3.1.24.4 Nature and Extent of Contamination

Three (3) test pits were made around the station pallet line in July, 2006, and one composite sample was taken from each trench. The trenches measured approximately 1.0 m wide, 3.0 to 4.5 m long and the depth varied between 80 cm and 1.40 m. Each sample was tested for TPH and metals (TableLVIII). The only element to surpass guidelines was arsenic, which was comparable to existing background conditions. Nickel was elevated in all the samples, but remained below guildelines. One sample (06SP0138) taken in the same location in which the high TPH levels had been discovered in 1999, was now below the current CCME threshold criteria (Photograph 42, Appendix A). Of note was sample 06SP0140, taken from near the fuel tank where high hydrocarbon concentrations were previously found. Elevated levels of fractions 3 and 4 were observed, but below CCME criteria. No visual contamination was seen during the investigation.

3.1.24.5 Recommendations

An assessment should be performed for this site. This includes taking approximately 4 soil samples for further testing for TPH and metals, in addition to digging 2 more test pits near the east and west sides of the trenches to look for any vertical migration of contaminants. The estimation of the volume of impacted soil should also be performed in the vicinity of sample 06SP0138. The 2006 results for inorganic elements should be compared to the background levels obtained during the next sampling campaign. Site closure could be possible if no more contamination is found during the next campaign.

The team is also in accordance with the 1999 study, which suggested periodically removing drip pans that make up part of the raised pallets, to ensure that water is sieved through hydrocarbon-absorbent material before it is released onto the ground, as a precaution against future contamination.

Table LVIII. (S-10213) Main Station POL Pallet Line results.

					Main Station POL Pallet Line (S-10213)		
		SOIL			SOIL		
	PARAMETERS	UNITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	06SP0138 0-10 cm 07/07/06	06SP0139 0-10 cm 07/07/06	06SP0140 0-10 cm 07/07/06
METALS	Arsenic (As)	mg/kg	12	0.27	11.8	14.2	13.6
	Barium (Ba)	mg/kg	2,000	5	14	17	26
	Cadmium (Cd)	mg/kg	22	0.22	<1	<1	<1
	Chromium (Cr)	mg/kg	87	3	27	27	29
	Cobalt (Co)	mg/kg	300	1.9	11	12	13
	Copper (Cu)	mg/kg	91	2.1	18	19	22
	Lead (Pb)	mg/kg	600	1.2	12	18	18
	Manganese (Mn)	mg/kg	—	1.1	513	526	491
	Molybdenum (Mo)	mg/kg	40	1.4	<2	<2	<2
	Nickel (Ni)	mg/kg	50	0.6	38	38	44
	Selenium (Se)	mg/kg	3.9	0.5	NA	NA	NA
	Silver (Ag)	mg/kg	40	0.4	<2	<2	<2
	Tin (Sn)	mg/kg	300	0.8	<5	<5	<5
	Zinc (Zn)	mg/kg	360	2.5	56	55	67
PETROLEUM HYDROCARBONS	Benzene	mg/kg	0.03	0.02	ND	ND	ND
	Toluene	mg/kg	0.37	0.02	ND	ND	ND
	Ethylbenzene	mg/kg	0.08	0.02	ND	ND	ND
	o-Xylene	mg/kg	—	0.02	ND	ND	ND
	p+m-Xylene	mg/kg	—	0.04	ND	ND	ND
	Total Xylene	mg/kg	11	0.04	ND	ND	ND
	F1 (C6-C10 Hydrocarbons)	mg/kg	310	10	ND	ND	ND
	F1 (C6-C10) -BTEX	mg/kg	310	10	ND	ND	ND
	F2 (C10-C16 Hydrocarbons)	mg/kg	760	10	ND	ND	ND
	F3 (C16-C34 Hydrocarbons)	mg/kg	1,700	10	32	22	680
	F4(C34-C50 Hydrocarbons)	mg/kg	3,300	10	ND	ND	390

ND Not detected
NA Not available
Higher than the criteria

Figure 33. (S-10213) Main Station POL Pallet Line map.

3.1.25 S-10214 Main Station Day Tank Area

3.1.25.1 Location and Site Description

The Main Station Day Tank area is located at the north end of the main station area, west of the Operations Building (Figure 34-36). The area is bordered by a baseball diamond on the north side and roads to the west and south. "It consists of one diesel and one gasoline day tank for vehicle refuelling, a pumphouse, a fuel-dispensing hose shed. A couple of storage trailers border the area, and power lines and utilidors extend through it." (ESG 1999) (Photograph 43, Appendix A). A fuel additive building was also present on site during our investigation. This is still used for pumping fuel through pipes into the day tank from the station fuel tank farm. During our 2006 field work, a bioremediation installation was present, located on a flat area to the north of the day tank site. The site is generally flat, with a gentle slope near the pumphouse. Gravel berms surround the site in order to contain fuel spills from the tanks. The soil near the day tank consists mainly of native silts and clays with shale and slate gravel in a thin layer in a few locations. A huge pool of standing water is located to the west of the diesel day tank and a drainage channel is located on the east side of the berm going towards the OPS building.

3.1.25.2 Potential Receptors and Valued Ecological Components

There was no vegetation or animal life evident in the study area. However, the pool of standing water could attract animals (Photograph 44, Appendix A). A drainage channel flows south towards the OPS building drainage channel. Human activities are frequent on this site during the refilling of vehicles.

3.1.25.3 Summary of Previous Investigations

Delineation of the Station Day Tank area was performed in 1998 and 1999, with the collection of 125 soil samples on a grid surrounding the day tank and extending further north, where it was discovered that the contamination had migrated (TableLIX).

An area of 11,280 m^2 around the day tanks was estimated to have an affected volume of approximately 25,000 m^3, based on an average depth to permafrost of 100 cm. The area north of the day tanks in which additional contamination was thought to occur in fact possessed little contamination. Only 1 sample (99-11021) out of 45 contained TPH exceeding the criterion, reaching 35,000 mg/kg. In fact, TPH was not detected in most of the samples. In total, the volume of soil containing TPH levels above the applicable criterion is estimated to be 18,750 m^3.

In 1999, the ESG recommended a form of *in situ* bioremediation or bioventing as the most efficient treament method to reduce the levels of contamination in this area.

Table LIX. (S-10214) Previous contaminated samples.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
98-12174	410	TPH	2,500	11,000
98-12175	30	TPH	2,500	16,000
98-12185	30	TPH	2,500	5,900
98-12187	10	TPH	2,500	3,300
98-12188	10	TPH	2,500	5,000
98-12189	30	TPH	2,500	5,400
98-12193	10	TPH	2,500	32,000
98-12209	10	TPH	2,500	4,700
98-12210/11	10	TPH	2,500	4,700
98-12219	10	TPH	2,500	12,000
98-12224	30	TPH	2,500	20,000
98-12225	10	TPH	2,500	15,000
98-12229	30	TPH	2,500	>2,500
98-12234	10	TPH	2,500	4,000
98-12235	10	TPH	2,500	7,900
98-12384	30	TPH	2,500	4,100
98-12386	10	TPH	2,500	4,800
98-12387	10	TPH	2,500	4,900
98-12388	30	TPH	2,500	6,900
98-12396	10	TPH	2,500	5,200
98-12397	10	TPH	2,500	3,900
98-12398	30	TPH	2,500	5,500
98-12399	10	TPH	2,500	4,000
98-12400/401	10	TPH	2,500	2,900
98-12413	50	TPH	2,500	23,000
98-12414	100	TPH	2,500	20,000
99-11021	60	TPH	2,500	35,000
99-12733	0	TPH	2,500	16,000
99-12734	20	TPH	2,500	9,900
99-12980	0	TPH	2,500	5,300

3.1.25.4 Nature and Extent of Contamination

Five (5) soil samples were collected in 2006 and analyzed for metals and hydrocarbons (Table LXI). A light to medium hydrocabon odour was noted at each sampling point and iridescence was noticed in the pool of standing water. While no metals were found to surpass the applicable guidelines, hydrocarbon concentrations were high in all 5 samples, especially in the case of fraction 2 (diesel); these concentrations ranged from 3,600 mg/kg (06DT0106) to 30,000 mg/kg (06DT0103). Three samples exceeded fraction 1 guidelines. Toluene, ethylbenzene and total xylene exceeded guidelines in 2 samples each. Samples 06DT0103 (located on the northeast side of the day tank) and 06DT0104 (to the east of the pumphouse) exceeded guidelines in all of the detected hydrocarbons. Sample 06DT0103, collected from under a valve, was sampled as it was stained and spill absorbents were present. (Photograph 45, Appendix A) A moderate odour was also detected in this small area.
A spill of approximately 700 L apparently occurred some months before the investigation, in the drainage basin of the tank.

During our investigation, the staff had observed a bioremediation installation as proposed by ESG. The bioremediation trial area is located just west of the bermed area of the Main Station Day Tank Area and consists of 4 pipes jutting up from the ground – suggesting an underground system of pipes - which allows for bioremediation experiments (Photograph 46, Appendix A)

In light of this, 3 additionnal surface soil samples were collected in 2006 and tested for metals and TPH (Table LX). The only metal to exceed the applicable criteria was arsenic, although the concentration was comparable to average background levels. Fraction 2 and 3 hydrocarbons were detected in small amounts, but did not approach the guideline levels.

3.1.25.5 Recommendations

Additional sampling must be performed for this site in order to evaluate the contaminated area. This includes collecting approximately 5 soil samples, primarily near the pumphouse, to evaluate TPH and BTEX concentrations and define the contaminated area. PAHs should be evaluated where samples 06DT0103/104 were collected, including 1 surface and 1 depth soil sample. The site will eventually be displaced, which will provide more opportunity for delineation, excavation and remediation.

For the bioremediation area, no more work is necessary. The 2006 results should be compared to the background soil results to confirm that it was not contaminated.

Table LX. (S-10214) Bioremediation located at the Main Station Day Tank Area.

					Bioremediation at the Station Day Tank (S-10214)		
		SOIL			SOIL		
	PARAMETERS	UNITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	06BI0187 10 cm 13/07/2006	06BI0188 20 cm 13/07/2006	06BI0189 10 cm 13/07/2006
METALS	Arsenic (As)	mg/kg	12	0.27	19.2	12.1	10.9
	Barium (Ba)	mg/kg	2,000	5	14	14	13
	Cadmium (Cd)	mg/kg	22	0.22	<1	<1	<1
	Chromium (Cr)	mg/kg	87	3	26	27	26
	Cobalt (Co)	mg/kg	300	1.9	16	12	11
	Copper (Cu)	mg/kg	91	2.1	26	22	19
	Lead (Pb)	mg/kg	600	1.2	17	14	14
	Manganese (Mn)	mg/kg	---	1.1	494	444	439
	Molybdenum (Mo)	mg/kg	40	1.4	<2	<2	<2
	Nickel (Ni)	mg/kg	50	0.6	46	39	38
	Selenium (Se)	mg/kg	3.9	0.5	NA	NA	NA
	Silver (Ag)	mg/kg	40	0.4	<2	<2	<2
	Tin (Sn)	mg/kg	300	0.8	<5	<5	<5
	Zinc (Zn)	mg/kg	360	2.5	61	64	57
PETROLEUM HYDROCARBONS	Benzene	mg/kg	0.03	0.02	NA	NA	NA
	Toluene	mg/kg	0.37	0.02	NA	NA	NA
	Ethylbenzene	mg/kg	0.08	0.02	NA	NA	NA
	o-Xylene	mg/kg	---	0.02	NA	NA	NA
	p+m-Xylene	mg/kg	---	0.04	NA	NA	NA
	Total Xylene	mg/kg	11	0.04	NA	NA	NA
	F1 (C6-C10 Hydrocarbons)	mg/kg	310	10	ND	ND	ND
	F1 (C6-C10) -BTEX	mg/kg	310	10	ND	ND	ND
	F2 (C10-C16 Hydrocarbons)	mg/kg	760	10	11	440	ND
	F3 (C16-C34 Hydrocarbons)	mg/kg	1,700	10	12	130	37
	F4(C34-C50 Hydrocarbons)	mg/kg	3,300	10	ND	ND	ND

ND Not detected
NA Not available
Higher than the criteria

Table LXI. (S-10214) Main Station Day Tank Area results.

					Main Station Day Tank Area (S-10214)				
		SOIL			SOIL				
	PARAMETERS	UNITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	06DT0103 0-10 cm 07/05/06	06DT0104 0-10 cm 07/05/06	06DT0105 0-10 cm 07/05/06	06DT0106 0-10 cm 07/05/06	06DT0107 0-10 cm 07/05/06
METALS	Arsenic (As)	mg/kg	12	0.27	8.6	9.7	11	9	11.9
	Barium (Ba)	mg/kg	2,000	5	18	19	21	21	19
	Cadmium (Cd)	mg/kg	22	0.22	<1	<1	<1	<1	<1
	Chromium (Cr)	mg/kg	87	3	27	26	21	23	23
	Cobalt (Co)	mg/kg	300	1.9	12	11	9	11	10
	Copper (Cu)	mg/kg	91	2.1	15	18	22	18	16
	Lead (Pb)	mg/kg	600	1.2	14	13	10	14	20
	Manganese (Mn)	mg/kg	---	1.1	488	517	469	488	463
	Molybdenum (Mo)	mg/kg	40	1.4	<2	<2	<2	<2	<2
	Nickel (Ni)	mg/kg	50	0.6	34	39	26	34	27
	Selenium (Se)	mg/kg	3.9	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Silver (Ag)	mg/kg	40	0.4	<2	<2	<2	<2	<2
	Tin (Sn)	mg/kg	300	0.8	<5	<5	<5	<5	<5
	Zinc (Zn)	mg/kg	360	2.5	65	61	41	52	74
PETROLEUM HYDROCARBONS	Benzene	mg/kg	0.03	0.02	ND	ND	ND	ND	ND
	Toluene	mg/kg	0.37	0.02	18	1	0.07	ND	ND
	Ethylbenzene	mg/kg	0.08	0.02	45	1.3	ND	ND	ND
	o-Xylene	mg/kg	---	0.02	130	12	ND	ND	ND
	p+m-Xylene	mg/kg	---	0.04	190	12	ND	ND	ND
	Total Xylene	mg/kg	11	0.04	320	24	ND	ND	ND
	F1 (C6-C10 Hydrocarbons)	mg/kg	310	10	9,500	1,900	470	300	180
	F1 (C6-C10) -BTEX	mg/kg	310	10	9,100	1,800	470	300	180
	F2 (C10-C16 Hydrocarbons)	mg/kg	760	10	30,000	12,000	6,800	3,600	6,200
	F3 (C16-C34 Hydrocarbons)	mg/kg	1,700	10	760	360	190	400	1,100
	F4(C34-C50 Hydrocarbons)	mg/kg	3,300	10	ND	ND	ND	23	130

ND Not detected
NA Not available
Higher than the criteria

Figure 34. (S-10214) Main Station Day Tank Area map 1.

Figure 35. (S-10214) Main Station Day Tank Area map 2.

Figure 36. (S-10214) Main Station Day Tank Area map 3.

3.1.26 S-10215 Main Station HAPS

3.1.26.1 Location and Site Description

"The [Main Station] HAPS building was constructed between 1982 and 1984, replacing the original GP hut style buildings that contained offices and personnel services." (ESG 2000). The present building contains the kitchen and dining room, administrative offices, theatre, barber shop, an all-ranks mess, library, TV and radio stations and games and activity rooms. The building itself is located on the southwestern end of the site, just north of the gym and curling club (Figure 37). There are also 2 tanks inside the building and the site remains active. The topography of the site features a gentle slope underneath the building toward the southeast and Dumbell Bay. The surface soil is mainly rocks with clayey soil beneath.

3.1.26.2 Potential Receptors and Valued Ecological Components

No plant life was apparent in the area. However, during the summer 2006 visit, the presence of wolves and an Arctic hare were noted. There were no apparent drainage channels on the site. Human activities occur frequently in the area, although most are restricted to inside the building.

3.1.26.3 Summary of Previous Investigations

Nine (9) soil samples were collected in 1999 and were tested only for TPH (Table LXII). Only 1 sample returned results of high TPH concentrations. This sample was collected from underneath the vents of the boiler room on the northwest side of the building, where hydrocarbon spills are frequently reported. The sample had a TPH concentration of 10,000 mg/kg.

In 2000, 14 soil samples and 2 depth samples were collected from underneath the vents and tested for TPH and metals (Table LXII). Two (2) samples (00-10215 and 00-10216) taken from the same location as those retrieved in 1999 revealed copper levels of 110 and

120 mg/kg, respectively, which are just above the 100 mg/kg criterion. Sample 00-10215 had a TPH concentration of 16,000 mg/kg at a depth of 30 cm. The samples taken in 2000 suggest that the contamination beneath the boiler room vents covers an area of approximately 58 m^2 and a soil volume of 29 m^3.

Table LXII. (S-10215) Previous contaminated soil samples.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
99-12972	0	TPH	2500	10,000
00-10215	30	COPPER (Cu)	100	110
	30	TPH	2500	16,000
00-10216	0-10	COPPER (Cu)	100	120

3.1.26.4 Nature and Extent of Contamination

Two (2) more soil samples were taken from beneath the boiler room vents in June of 2006. Before retrieving samples the team noted light hydrocarbon odours and iridescence in both of the sampling locations. Only fraction 2 hydrocarbons exceeded CCME criterion in 1 sample, 06HA0181 (taken at a depth of 50 cm), where the concentration reached 1,200 mg/kg (guideline limit of 760 mg/kg) (Table LXIII). Retrieval of this sample also revealed groundwater just below the surface, causing the sampling depression to quickly fill with water. Hydrocarbon staining was also evident under the soil surface.

3.1.26.5 Recommendations

An assessment is recommended for the next site visit. Approximately 6 surface and depth soil samples should be collected to test for TPH, BTEX, PAH and metals, and 1 groundwater sample should be collected for TPH and BTEX analysis to verify whether migration of the contamination has occurred.

Table LXIII. (S-10215) Main Station HAPS results.

					Main Station HAPS (S-10215)	
	PARAMETERS	SOIL			SOIL	
		UNITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	06HA0180 57 cm 12/07/06	06HA0181 50 cm 12/07/06
PETROLEUM HYDROCARBONS	Benzene	mg/kg	0.03	0.02	NA	NA
	Toluene	mg/kg	0.37	0.02	NA	NA
	Ethylbenzene	mg/kg	0.08	0.02	NA	NA
	o-Xylene	mg/kg	—	0.02	NA	NA
	p+m-Xylene	mg/kg	—	0.04	NA	NA
	Total Xylene	mg/kg	11	0.04	NA	NA
	F1 (C6-C10 Hydrocarbons)	mg/kg	310	10	ND	220
	F1 (C6-C10) -BTEX	mg/kg	310	10	ND	210
	F2 (C10-C16 Hydrocarbons)	mg/kg	760	10	50	1,200
	F3 (C16-C34 Hydrocarbons)	mg/kg	1,700	10	110	26
	F4(C34-C50 Hydrocarbons)	mg/kg	3,300	10	28	ND

ND Not detected
NA Not available
Higher than the criteria

Figure 37. (S-10215) Main Station HAPS map.

3.1.27 S-10216 Baker's Dozen

3.1.27.1 Location and Site Description

The Baker's Dozen site is located at the southweste end of the station area below the auxiliary power plant (B-143) (Figure 38). It occupies an area of 6,800 m², in a 'V' shape between Herc Drive and DOE Road. Thirteen (13) POL tanks were previously located in this area. The site features a slope on the southwest side and any fuel spills that occurred during its operation and/or demolition would have migrated down the slope and possibly into the collection basin (S-352). "A large drainage channel that enter the Baker's Dozen at is northeast corner is another potential source of hydrocarbon contamination, as power plants and station day tank area are located upslope. The Oxidator Building and Dog House, 2 areas shown to have been significantly contaminated with hydrocarbons, are located to the northeast of the Baker's Dozen and connected to it via culverts." (ESG 2000). The contamination on these sites is most likely connected to the fuel spills that occurred at the Baker's Dozen in 1999. A small area was previously excavated but contamination was still found in 2006 (Photograph 47, Appendix A).

The soil in the area contains clay and small rocks. The southern part of the site becomes saturated with melt water in the summer months.

3.1.27.2 Potential Receptors and Valued Ecological Components

While no vegetation or wildlife has been noted on this site, numerous drainage basins in the area are a cause for concern, considering the contamination on this and surrounding sites. From the basins, several drainage pathways have been identified, heading toward Alert Inlet. No human activities are present on this site.

3.1.27.3 Summary of Previous Investigations

In 1998, 61 delineation samples were taken in or near the collection basin (S-143) below the Baker's Dozen. The samples were tested for TPH and the mean concentration of the

soil samples was found to be 1,100 mg/kg and the samples with higher concentrations were taken from the southernmost portion of the area.

Delineation of the Baker's Dozen itself was performed in 1999, in which 88 soil samples, including 9 duplicate samples and 35 depth samples were collected. These were collected on a 12 m x 12 m grid in the Baker's Dozen. Of the 88, 31 samples including 2 duplicates and 16 depth samples had TPH concentrations that exceeded the criterion (Table LXIV). Sample 99-11091, collected in the active drainage path on the eastern side of the site, had the highest TPH concentration. Even samples taken from 80 cm below surface were found to be contaminated, the source being 100% fuel oil (fraction 3). Three sub-surface samples contained naphthalene concentrations that exceeded the CCME criterion, ranging from 1.5 mg/kg to 62 mg/kg. Additionally, xylenes exceeded their criterion in 3 out of 5 samples, ranging from 7.1 mg/kg to 30 mg/kg, and 2 samples had high ethylbenzene levels, also exceeding CCME criterion with levels at 2.0 mg/kg and 3.0 mg/kg. The delineation work found that hydrocarbon contamination exists on the eastern half of the Baker's Dozen and extends to the permafrost in some locations. The area contaminated with TPH concentrations above the 2,500 mg/kg criterion is roughly 6,100 m^2, with a total volume of 6,100 m^3. The sources of contamination appear to be the fuel tanks that previously occupied the area and external sources upstream of the Baker's Dozen, as suggested by the contamination in the drainage channel. Some samples were also analyzed for metals, although none were found to surpass normal background soil levels.

ESG fully delineated the Baker's Dozen in 2000, with the collection of 176 soil samples, including 26 depth samples. Sampling was concentrated around Herc Road and DOE lane to determine whether the contamination had migrated beyond these site boundaries. Twelve (12) samples, taken mostly from the northeast section of the site contained TPH concentrationst hat exceeded the CCME criterion (Table LXV), but no contamination was found outside the v-shaped area defined by the roads. Additionally, no contamination from metals was detected. Two (2) contaminated areas were defined, covering a total area of roughly 1,620 m^2 with a soil volume of 810 m^3 based on a depth of contamination of 0.5 m.

Table LXIV. (S-10216) Previous contaminated samples collected in 1999.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
99-1150	10	TPH	2,500	6,100
99-11055	10	TPH	2,500	13,000
99-11023	30	TPH	2,500	11,000
99-11024	60	TPH	2,500	3,300
99-11058	10	TPH	2,500	10,000
99-11062	10	TPH	2,500	3,300
99-11063	10	TPH	2,500	>2,500
99-11064	10	TPH	2,500	>2,500
99-11065	10	TPH	2,500	>2,500
99-11066	10	TPH	2,500	6,500
99-11069	10	TPH	2,500	5,500
99-11074	10	TPH	2,500	6,900
99-11077	10	TPH	2,500	4,400
99-11087	10	TPH	2,500	>2,500
99-11088	10	TPH	2,500	>2,500
99-11089	10	NAPHTHALENE	0.60	6.2
	10	TPH	2,500	16,000
99-11090/91	10	TPH	2,500	39,000
99-11755	50	TPH	2,500	>2,500
99-11756	70	TPH	2,500	>2,500
99-11758	50	TOLUENE	800	2,700
	50	ETHYLBENZENE	1,200	3,000
	50	P+M+XYLENES	1,000	18,000
	50	O-XYLENES	1,000	12,000
	50	TPH	2,500	4,300
99-11759	50	TPH	2,500	>2,500
99-11761	100	P+M+XYLENES	1,000	4,800
	100	O-XYLENES	1,000	2,300
	100	NAPHTHALENE	0.60	3.8
99-11762	50	TPH	2,500	>2,500
99-11763	85	ETHYLBENZENE	1,200	2,000
	85	XYLENES	1,000	23,000
	85	TPH	2,500	>2,500
99-11764	50	TPH	2,500	28,000
99-11765	65	XYLENES	1,000	1,500

The 2 soil samples from drainage area also showed various contaminants, both metals and TPH. In terms of metals, sample 06KZ0077, taken from near the collection basin, exceeded the applicable criterion for selenium (7.8 mg/kg) and zinc (42,800 mg/kg). Sample 06KZ0070 (where iridescence was noted on the surface of the water) only exceeded the criterion for zinc, with a concentration of 2,750 mg/kg. Several types of hydrocarbons exceeded the criterion; for example, the highest concentration was found in sample 06KZ0070, where fraction 2 was 23,000 mg/kg. Other hydrocarbons to exceed the applicable criterion in both samples were ethylbenzene, fraction 1 and 2 and BTEX. Sample 06KZ0070 also surpassed the criterion for fraction 3.
The team attempted to collect groundwater samples in the vicinity of samples 99-11061 and 99-11053 but no water was encountered.

3.1.27.5 Recommendations

Delineation is recommended for this site (Figure 38). This would include the collection of approximately 18 more soil samples to delimit the contaminated area, required for an eventual treatment program or excavation. The remediaiton of this site will have to be performed after remediation at the Oxidator Building (S-349) is complete, as the Oxidator Building site remians the main contamination source for this area. The samples should be tested for metals, PAHs, BTEX and TPH. Special consideration should be given to the drainage ditch in terms of surface water samples.

Table LXVI. (S-10216) Baker's Dozen results.

	PARAMETERS	WATER				SOIL			Baker's Dozen (S-10216)			
									Soil (Drainage sed.)		Freshwater	
		UNITS	GUIDELINES AQUATIC LIFE		DETECTION LIMIT	UNITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	06KZ0070 0-10 cm 07/05/06	06KZ0077 0-10 cm 07/05/06	06KZ0071 Surf. Water 07/05/06	06KZ0072 Surf. Water 07/05/06
			FRESH	MARINE								
METALS	Arsenic (As)	ug/L	5	12.5	0.0001	mg/kg	12	0.27	11.8	7.6	2	2
	Barium (Ba)	ug/L	---	---	0.001	mg/kg	2,000	5	18	9	10	10
	Cadmium (Cd)	ug/L	0.017	0.12	0.0001	mg/kg	22	0.22	1	19	<1	<1
	Chromium (Cr)	ug/L	---	---	0.0007	mg/kg	87	3	30	17	3	3
	Cobalt (Co)	ug/L	---	---	0.0006	mg/kg	300	1.9	14	7	2	2
	Copper (Cu)	ug/L	2-4	2-4	0.0012	mg/kg	91	2.1	25	20	4	5
	Lead (Pb)	ug/L	1-7	---	0.0011	mg/kg	600	1.2	25	227	2	2
	Manganese (Mn)	ug/L	---	---	0.0003	mg/kg	---	1.1	551	324	63	68
	Molybdenum (Mo)	ug/L	73	---	0.0078	mg/kg	40	1.4	<2	4	2	2
	Nickel (Ni)	ug/L	25-150	---	0.0005	mg/kg	50	0.6	48	28	4	2
	Selenium (Se)	ug/L	1	---	0.0006	mg/kg	4	0.5	0.9	7.8	<1	4
	Silver (Ag)	ug/L	---	---	0.0008	mg/kg	40	0.4	<2	<2	<1	<1
	Tin (Sn)	ug/L	---	---	0.011	mg/kg	300	0.8	<5	13	<1	<1
	Zinc (Zn)	ug/L	30	---	0.006	mg/kg	360	2.5	2,570	42,800	490	65
PETROLEUM HYDROCARBONS	Benzene	ug/L	370	110	0.03	mg/kg	0.030	0.02	ND	ND	NA	NA
	Toluene	ug/L	2	215	0.03	mg/kg	0.37	0.02	0.11	0.1	NA	NA
	Ethylbenzene	ug/L	90	25	0.02	mg/kg	0.082	0.02	0.16	0.36	NA	NA
	o-Xylene	ug/L	---	---	0.02	mg/kg	---	0.02	1.6	1.6	NA	NA
	p+m-Xylene	ug/L	---	---	0.05	mg/kg	---	0.04	1.5	2.6	NA	NA
	Total Xylene	ug/L	---	---	0.05	mg/kg	11	0.04	3	4.2	NA	NA
	F1 (C6-C10 Hydrocarbons)	ug/L	---	---	100	mg/kg	310	10	640	660	NA	NA
	F1 (C6-C10) -BTEX	ug/L	---	---	100	mg/kg	310	10	640	650	NA	NA
	F2 (C10-C16 Hydrocarbons)	ug/L	---	---	100	mg/kg	760	10	23,000	5,400	NA	NA
	F3 (C16-C34 Hydrocarbons)	ug/L	---	---	100	mg/kg	1,700	10	3,200	760	NA	NA
	F4(C34-C50 Hydrocarbons)	ug/L	---	---	100	mg/kg	3,300	10	440	130	NA	NA

ND Not detected
NA Not available
Higher than the criteria
The criteria is lower than the detection limit.

Soil (Drainage sed.) refers to samples which were taken from a drainage ditch but were mislabeled as sediment instead of soil when they were sent for analysis.

Figure 38. (S-10216) Baker's Dozen map.

3.1.28 S-10217 Building 113, Heated Vehicle Storage

3.1.28.1 Location and Site Description

The Building 113, Heated Vehicle Storage is located at the northwest end of the main station area, north of the vehicle maintenance garage (Figure 39). The building is metal clad with a gravel floor. Station vehicles are kept here during the winter and periods of inclement weather. One (1) fuel tank covered by a metal hut and a small pipeline are still present in the north corner of the building. However, a fuel tank that was located south of the hut was removed. The site remains active.

The site topography is flat with clayey, silty soils containing gravel and stones predominanting the area. Digging causes a swift upwelling of water.

The Cold Storage (Building 110) located north of the Building 113 was demolished and a standing pool of water was observed at this location at the time of our visit.

3.1.28.2 Potential Receptors and Valued Ecological Components

No potential receptors were observed on this site. In fact, this building was built solely for vehicle storage, therefore human activity is short and sporadic. No evidence of animal life was observed on the site. No drainage channels are located around the building.

3.1.28.3 Summary of Previous Investigations

Ten (10) soil samples, including 1 duplicate pair, were collected in 1999 and analyzed for metals, PCBs, PAHs and glycol (Table LXVII). Two (2) samples out of 5 contained TPH levels exceeding the guidelines, 2 approached the guidelines and the fifth sample didn't contain any TPH. The highest concentration of TPH reached 35,000 mg/kg (sample 99-12744) and was collected from a small stain at the west end of the garage where a 1 m x 1 m stain had been found. This was found to contain lubricating oil and grease. BTEX, PCBs, PAHs and glycol were not detected in any samples.

3.1.28.4 Nature and Extent of Contamination

In 2006, 3 soil samples were taken, including 1 depth sample. The team noted hydrocarbon odours and staining both inside and outside the garage. The depth sample (06VH0135) was collected at a depth of 50 cm in a trench dug from the north side of the building, where staining had been noted on previous studies. This sample was found to contain many hydrocarbon compounds exceeding the industrial guidelines, including toluene, ethylbenzene, total xylenes, BTEX and fraction 1 and 2 hydrocarbons (TableLXVIII). It appears that the petroleum hydrocarbon contamination has migrated vertically. No PAHs or metals surpassed the guidelines.

Sample 06VH0136 was collected from inside the garage, where sample 99-12744 had been taken in 1999. A stain was noted in this area as well. This sample was found to have a very high hydrocarbon content, with 52,000 mg/kg of fraction 3 hydrocarbons. Additionally, fraction 2 concentrations were 1,700 mg/kg and fraction 4 was 3,900 mg/kg. No TPH or metals were found exceeding the guidelines.

The last sample was collected from the south side of the building and analyzed for metals and hydrocarbons. No metals exceeded the guidelines and no hydrocarbons were detected.

Stains were evident on the floor of the garage and there were some additional stains around the garage's exterior. Iridescence was observed in the water in the trench dug on the northeast side of the building.

Table LXVII. (S-10217) Previous contaminated samples.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
99-12744	0	TPH	2,500	35,000
99-12746	0	TPH	2,500	4,900

3.1.28.5 Recommendation

The extent of the hydrocarbon contamination is as yet unknown, so delineation of the area should be performed during the next site visit. This would involve collecting approximately 20 soil samples both inside and outside of the building. Deeper samples

should be collected at the north end of the building where the former tank was located and near the fuel intake pipe. PAHs, BTEX and TPH should be evaluated.

Table LXVIII. (S-10217) Building 113, Heated Vehicle Storage site results.

					Bldg 113, Heated Vehicule Storage (S-10217)		
	PARAMETERS	SOIL			SOIL		
		UNITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	06HV0135 50 cm 07/07/06	06HV0136 0-10 cm 07/07/06	06HV0137 0-10 cm 07/07/06
METALS	Arsenic (As)	mg/kg	12	0.27	10.4	10.9	9
	Barium (Ba)	mg/kg	2,000	5	14	21	13
	Cadmium (Cd)	mg/kg	22	0.22	<1	<1	<1
	Chromium (Cr)	mg/kg	87	3	26	24	26
	Cobalt (Co)	mg/kg	300	1.9	12	10	12
	Copper (Cu)	mg/kg	91	2.1	22	16	20
	Lead (Pb)	mg/kg	600	1.2	15	16	14
	Manganese (Mn)	mg/kg	---	1.1	471	450	481
	Molybdenum (Mo)	mg/kg	40	1.4	<2	<2	<2
	Nickel (Ni)	mg/kg	50	0.6	40	31	40
	Selenium (Se)	mg/kg	3.9	0.5	NA	NA	NA
	Silver (Ag)	mg/kg	40	0.4	<2	<2	<2
	Tin (Sn)	mg/kg	300	0.8	<5	<5	<5
	Zinc (Zn)	mg/kg	360	2.5	59	237	62
PETROLEUM HYDROCARBONS	Benzene	mg/kg	0.03	0.02	ND	ND	ND
	Toluene	mg/kg	0.37	0.02	2	ND	ND
	Ethylbenzene	mg/kg	0.08	0.02	2.4	ND	ND
	o-Xylene	mg/kg	---	0.02	12	0.03	ND
	p+m-Xylene	mg/kg	---	0.04	16	ND	ND
	Total Xylene	mg/kg	11	0.04	28	ND	ND
	F1 (C6-C10 Hydrocarbons)	mg/kg	310	10	2,100	13	ND
	F1 (C6-C10) -BTEX	mg/kg	310	10	2,000	13	ND
	F2 (C10-C16 Hydrocarbons)	mg/kg	760	10	8,400	1,700	ND
	F3 (C16-C34 Hydrocarbons)	mg/kg	1,700	10	90	52,000	23
	F4(C34-C50 Hydrocarbons)	mg/kg	3,300	10	ND	3,900	ND
PAH	Naphthalene	mg/kg	22	0.008	11.2	NA	NA
	2-methylnaphthalene	mg/kg	---	0.005	16.9	NA	NA
	1-methylnaphthalene	mg/kg	---	0.005	15.2	NA	NA
	1,3-Dimethylnaphthalene	mg/kg	---	0.005	10.6	NA	NA
	Acenaphthylene	mg/kg	---	0.004	0.1	NA	NA
	Acenaphthene	mg/kg	---	0.004	0.1	NA	NA
	2,3,5-trimethylnaphthalene	mg/kg	---	0.007	0.8	NA	NA
	Fluorene	mg/kg	---	0.007	0.2	NA	NA
	Phenanthrene	mg/kg	50	0.010	<0.1	NA	NA
	Anthracene	mg/kg	---	0.004	<0.1	NA	NA
	Fluoranthene	mg/kg	---	0.008	<0.1	NA	NA
	Pyrene	mg/kg	100	0.008	<0.1	NA	NA
	Benzo(c)Phenanthrene	mg/kg	---	0.008	<0.1	NA	NA
	Benzo(a)Anthracene	mg/kg	10	0.007	<0.1	NA	NA
	Chrysene	mg/kg	---	0.008	<0.1	NA	NA
	7,12-dimethylbenzo(a)anthracene	mg/kg	---	0.005	<0.1	NA	NA
	Benzo(b,j,k)fluoranthene	mg/kg	10	0.008	<0.1	NA	NA
	Benzo(a)pyrene	mg/kg	0.7	0.008	<0.1	NA	NA
	3-methylcholanthrene	mg/kg	---	0.022	<0.1	NA	NA
	Indeno(1,2,3-cd)pyrene	mg/kg	10	0.008	<0.1	NA	NA
	Dibenzo(a,h)anthracene	mg/kg	10	0.008	<0.1	NA	NA
	Benzo(g,h,i)perylene	mg/kg	---	0.008	<0.1	NA	NA
	Dibenzo (a,l) pyrene	mg/kg	---	0.008	<0.1	NA	NA
	Dibenzo (a,i) pyrene	mg/kg	---	0.007	<0.1	NA	NA
	Dibenzo (a,h) pyrene	mg/kg	---	0.008	<0.1	NA	NA

ND Not detected
NA Not available
Higher than the criteria

Figure 39. (S-10217) Bdlg 113, Heated Vehicle Storage map.

3.1.29 S-10218 Burner Project Site (Old Hazmat Storage Site)

3.1.29.1 Location and Site Description

The Burner Project Site is situated in the western area of the main station, on the left side of Pusher road (Figure 40). "In 1998, [...] started a project at Alert to develop a burner for waste hydroocarbon disposal. The project, [...] continued in the summers of 1999 and 2000, and has been used to reduce the inventory of waste hydrocarbons at Alert. Thousands of litres of fuel and waste oil have already been disposed of through this cost-effective technology." (ESG 2000). The burner, mixer and diesel tank were removed between the end of the 2000 and the summer of 2006. Only one container remains on site. The site is inactive and no excavation has been done other than to use the earth to construct berms.

The topography of the site features a flat area with a soft southwest slope. A pool of water was observed at the old site of the barrel storage area (Photograph 48, Appendix A).

3.1.29.2 Potential Receptors and Valued Ecological Components

This area drains into the freshwater Upper Dumbell Lake, which is situated downstream approximately 2.0 - 2.5 km. Nevertheless, no drainage canals are located around the flat land. No evidence of animal life was observed on site. Human activities no longer occur on site since the burner was demolished.

3.1.29.3 Summary of Previous Investigations

In 2000, ESG collected several soil samples around the area and 33 soil samples were analyzed. TPH, nickel and arsenic were found in samples collected near the burner. Two (2) of them, which contained over 8,400 mg/kg of TPH, were taken from around the area in which the burner used to operate. (Table LXIX) Nickel and arsenic, above the Tier II criterion, were found in 1 and 3 samples, respectively, near the burner.

3.1.29.4 Nature and Extent of Contamination

During the summer of 2006, 4 trenches were dug (between 4-6 m length, 1.0 m width and 0.60-1.0 m in depth); 3 around the burner site and one at the southeast end of the old Barrel site. One composite soil sample was collected in each trench at a depth of between 40 - 60 cm to evaluate the extent of the vertical contamination and to verify any visual contamination. One (1) soil sample was also taken directly from where the burner was located.

For sample 06BU0125 at the southeast end of the old Barrel site, petroleum hydrocarbon concentrations were above the CCME criteria (Table LXX), due to the contribution of fractions 1 (C6 to C10), 2 (C10 to C16) and BTEX (except benzene). The groundwater upwelling into the trench was visually contaminated (Photograph 49, appendix A). It appeared that the petroleum hydrocarbon contamination had migrated vertically. Traces of nickel were also found.

For the 2 samples analyzed around the burner site, only a small quantity of nickel was detected. Arsenic was also present, but is most likely associated with the high background concentrations of this element in the soil.

In the sample (06BU0000) taken directly where the burner was located, a high concentration of petroleum hydrocarbon fraction 3 (C16-C34) was found and fractions 2 and 4 were also above the CCME criteria. Several metals, such as chromium, copper, nickel and zinc were present at high concentrations. Petroleum hydrocarbons were found in only 2 of 4 samples and it was clear that this contamination originated from 2 different sources because the fractions were different.

Tab. LXIX (S-10218) Burner Project Site results.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
00-10836	0-10	TPH	2,500	9,400
00-10837	30	TPH	2,500	8,400
00-10840	0-10	NICKEL (NI)	100	340
00-10841	30	ARSENIC (AS)	30	34
00-10842	0-10	ARSENIC (AS)	30	30
00-10845	30	ARSENIC (AS)	30	30

3.1.29.5 Recommendation

Delineation (approximately 8 soil samples) must be performed around the area where the burner was located and also in the extended area where the samples were found to be contaminated in 2006 (Figure 40). Deeper samples should also be collected to evaluate the vertical migration of the contamination. Metals analysis should be performed for every sample and TPH should be analyzed in samples that were obtained from close to the burner.

An additional 8 samples should be collected where sample 06BU0125 was taken to evaluate the volume of impacted soil and analyzed for TPH, BTEX and metals. PAH should be also evaluated in 2 depth and 2 surface samples in the 2 areas found to be contaminated with TPH in 2006, to characterize the contaminant(s).

Table LXX. (S-10218) Burner Project Site results.

	PARAMETERS	SOIL			Burner Project Site (S-10218) SOIL			
		UNITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	06BU0000 0-10 cm 07/07/06	06BU0122 40 cm 07/07/06	06BU0125 50 cm 07/07/06	06BU0126 60 cm 07/07/06
METALS	Arsenic (As)	mg/kg	12	0.27	11.7	14	5.8	19.9
	Barium (Ba)	mg/kg	2,000	5	592	19	7	21
	Cadmium (Cd)	mg/kg	22	0.22	<1	<1	<1	<1
	Chromium (Cr)	mg/kg	87	3	302	29	54	28
	Cobalt (Co)	mg/kg	300	1.9	16	17	18	17
	Copper (Cu)	mg/kg	91	2.1	118	27	50	27
	Lead (Pb)	mg/kg	600	1.2	21	16	<10	15
	Manganese (Mn)	mg/kg	—	1.1	756	581	280	622
	Molybdenum (Mo)	mg/kg	40	1.4	13	<2	<2	<2
	Nickel (Ni)	mg/kg	50	0.6	1,670	51	76	51
	Selenium (Se)	mg/kg	3.9	0.5	NA	NA	NA	NA
	Silver (Ag)	mg/kg	40	0.4	<2	<2	<2	<2
	Tin (Sn)	mg/kg	300	0.8	<5	<5	<5	<5
	Zinc (Zn)	mg/kg	360	2.5	1,660	64	113	64
PETROLEUM HYDROCARBONS	Benzene	mg/kg	0.03	0.02	ND	ND	ND	ND
	Toluene	mg/kg	0.37	0.02	ND	ND	6	ND
	Ethylbenzene	mg/kg	0.08	0.02	ND	ND	6.5	ND
	o-Xylene	mg/kg	—	0.02	ND	ND	16	ND
	p+m-Xylene	mg/kg	—	0.04	ND	ND	31	ND
	Total Xylene	mg/kg	11	0.04	ND	ND	48	ND
	F1 (C6-C10 Hydrocarbons)	mg/kg	310	10	25	ND	1,200	ND
	F1 (C6-C10) -BTEX	mg/kg	310	10	25	ND	1,200	ND
	F2 (C10-C16 Hydrocarbons)	mg/kg	760	10	4,300	ND	5,100	24
	F3 (C16-C34 Hydrocarbons)	mg/kg	1,700	10	25,000	ND	180	ND
	F4(C34-C50 Hydrocarbons)	mg/kg	3,300	10	4,800	ND	30	ND

ND Not detected
NA Not available
Higher than the criteria

Figure 40. (S-10218) Burner Project Site map

3.1.30 S-10219 New Fuel Line Spill 1999

3.1.30.1 Location and Site Description

In July of 1999 the ESG field team discovered a fuel spill that originated from a valve in a diesel fuel pipeline connecting the airstrip fuel tank to the station tank farm. The valve is located roughly halfway along the pipeline, north of the large pile of gravel in the road connecting the station and the airstrip (Figure 41).

Previously, station personnel had noted the smell of hydrocarbons but were unable to locate its source. The period between July 1st and July 5th, 1999 was uncommonly warm allowing the snow to melt in the vicinity of the fuel spill allowing for its discovery. Fuel contamination exists in a ditch west of the DREP and Hurricane buildings, the drainage path running parallel to the Airstrip road and near the valve itself. In 2006, the staff noted that the drainage channel appeared to contain water on June 24th, 2006, but was dry on July 5th, 2006. This site is also a natural drainage area.

Topographically speaking , there is 10° slope toward the east and the soil consists of earth and small stones.

Upon discovering the fuel spill, 2 dykes were constructed in an effort to divert meltwaters and minimize contamination in the bay. One (1) dyke is to the north of the spill site, the other to the west. Prior to the construction of the dykes the soil was saturated water and many surface streams ran through the site making it impossible to walk in the area. However, most of the streams and the area in general dried up as a result of the construction of the dyke.

3.1.30.2 Potential Receptors and Valued Ecological Components

While no vegetation was noted in the area, polar bears are seen on occasion. Additionally, the site was previously a drainage area in which streams would naturally occur without the presence of the dykes. Although the dykes provide partial diversion of drainage channels, contamination from this site may still enter into Dumbell Bay. No human activities occur on the site.

3.1.30.3 Summary of Previous Investigations

When the fuel spill was discovered in 1999, ESG collected 88 soil samples. Of these, 25 samples were found to have TPH concentrations above 2,500 mg/kg, with sample 99-11021 containing 35,000 mg/kg of 100% fuel oil (Table LXXI). Other samples ranged from 2,500 – 6,800 mg/kg. The contaminated area was found to occupy two distinct zones, one on either side of the pipeline valve. Together, they occupy an area of approximately 970 m^2 and a volume of 1,450 m^3 of contaminated soil based on a depth of contamination of 1.5 m.

In 2000, 102 soil samples were collected. This included 43 depth samples (permafrost present at 30 cm) and 1 monitoring well, although there was not enough water for sampling. In 2000, only 9 out of 65 samples had TPH concentrations surpassing CCME guidelines, the highest concentration being 4,100 mg/kg (Table LXXI). Nine (9) of these were depth samples and 5 of these also had high TPH concentrations, suggesting vertical migration. Notably, depth samples taken along the airport road did not indicate any migration toward the airport and Dumbell Bay. Thirty-nine (39) samples were tested for metals but none were found to exceed the applicable criteria.

Table LXXI. (S-10219) Contaminated soil samples.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
99-11021	60	TPH	2,500	35,000
99-12568	0	TPH	2,500	4,600
	0	TOLUENE	800	1,500
	0	ETHYLBENZENE	1,200	1,900
	0	XYLENES	1,000	6,600
99-12569	0	TPH	2,500	2,600
99-12584	0	TPH	2,500	5,700
99-12585	0	TPH	2,500	3,300
99-12594	0	TPH	2,500	2,600
99-12595	0	TPH	2,500	6,800
99-12597	0	TPH	2,500	6,400
99-12608	0	TPH	2,500	2,700
99-12609	30	TPH	2,500	6,800
99-12614	0	TPH	2,500	3,500
99-12819	0	TPH	2,500	>2,500
99-12821	0	TPH	2,500	>2,500
99-12822	0	TPH	2,500	>2,500
99-12823	0	TPH	2,500	>2,500
99-12910/11	35	TPH	2,500	>2,500
99-12912	0	TPH	2,500	>2,500
99-12922	0	TPH	2,500	>2,500
99-12923	0	TPH	2,500	>2,500
99-12924	20	TPH	2,500	>2,500
99-12925	35	TPH	2,500	>2,500
99-12927	30	TPH	2,500	>2,500
99-12928	20	TPH	2,500	>2,500
99-12929	45	TPH	2,500	>2,500
00-10395	45	TPH	2,500	2,800
00-10397	0-10	TPH	2,500	3,400
00-10399	50	TPH	2,500	2,600
00-10949/50	60-70	TPH	2,500	4,100
00-10959	0-10	TPH	2,500	2,500
00-10960	80-90	TPH	2,500	3,400
00-10963	0-10	TPH	2,500	3,800
00-10986	0-10	TPH	2,500	3,100

3.1.30.4 Nature and Extent of Contamination

The BRI sampling team noticed a strong hydrocarbon odour but no iridescence upon visiting the site in June, 2006. A total of 3 soil samples were collected for evaluation of TPH concentrations. (Table LXXII) An attempt at collecting a groundwater sample was made, but there was not enough water to take an accurate sample. Soil samples 06NF0022/23 were duplicates retrieved 8 m away from the pipeline, near the edge of the excavated area at a depth of 30 cm (Photograph 50, Appendix A). Several contaminants were found to be present above the CCME guidelines: sample 06NF0022 contained toluene at 20 mg/kg, ethylbenzene at 41 mg/kg, total xylenes at 170 mg/kg, fraction 1 hydrocarbons at 7,200 mg/kg, BTEX at 7,000 mg/kg and fraction 2 hydrocarbons at 29,000 mg/kg. Sample 06NF0023, the duplicate, contained the same contaminants at lower levels yet remained above the guideline concentrations. The last sample collected during this investigation, 06NF0021, showed very low concentrations of fuel oil.

3.1.30.5 Recommendations

With the previous investigation performed by ESG between 1999 and 2000, the contaminated area has been delineated to an area mesuring approximately 1,625 m^2 (65 m by 25 m), with a volume of roughly 1,300 m^3 (depth of contamination of 80 cm).

The contaminated soil in the delineated area was to have been excavated and bioremediated using a biopile system. Samples taken in 2006 (06NF0022 and 06NF0023) demonstrated significant levels of fraction F1 and F2 contamination, suggesting that not all of the contaminated soil was excavated. Due to this finding, delineation is recommended during the next sampling campaign in order to evaluate the volume of contaminated soil remaining on site. This would include the collection of 20 soil samples and 3 surface water samples for TPH and BTEX analysis. In addition, maintainance of the 2 previously constructed dykes must be continued.

Table LXXII. (S-10219) New Fuel Line Spill 1999 results.

					New Fuel Line Spill 1999 (S-10219)		
					SOIL		
	PARAMETERS	SOIL			06NF0021	06NF0022	06NF0023
		UNITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	5 cm 24/06/06	30 cm 24/06/06	Dup. of 0022 30 cm 24/06/06
PETROLEUM HYDROCARBONS	Benzene	mg/kg	0.03	0.02	ND	ND	ND
	Toluene	mg/kg	0.37	0.02	ND	20	9.8
	Ethylbenzene	mg/kg	0.08	0.02	ND	41	20
	o-Xylene	mg/kg	—	0.02	ND	67	33
	p+m-Xylene	mg/kg	—	0.04	ND	100	50
	Total Xylene	mg/kg	11	0.04	ND	170	83
	F1 (C6-C10 Hydrocarbons)	mg/kg	310	10	ND	7,200	3,800
	F1 (C6-C10) -BTEX	mg/kg	310	10	ND	7,000	3,700
	F2 (C10-C16 Hydrocarbons)	mg/kg	760	10	ND	29,000	28,000
	F3 (C16-C34 Hydrocarbons)	mg/kg	1,700	10	35	140	250
	F4(C34-C50 Hydrocarbons)	mg/kg	3,300	10	ND	ND	ND

ND Not detected
NA Not available
Higher than the criteria

Figure 41. (S-10219) New Fuel Line Spill 1999 map.

3.1.31 S-10522 AES Weather Station Remains-GA

3.1.31.1 Location and Site Description

The AES Weather Station Remains-GA are located on the southern portion of the site, southeast of the ESG C-Span building (Figure 42-43). The weather station buildings were demolished in 1995 and all that remains are two concrete foundations (one just east of the C-Span and the other 200 m further south). Notably, the debris of an old and inactive burn pile was found approximately 100-150 meters south of the ESG C-Span building (Photograph 51, appendix A).

During our visit, 2 new containers for HAZ MAT storage were installed northeast of the ESG C-Span building. Two (2) antennae were present northeast of the site near the slope. In addition, several articles were stored in a small area on the east side of the site, such as wooden boxes (2m x 2m), gas cylinders, construction materials, etc. Finally, 2 areas used for wire storage were also present on-site (Photograph 52, Appendix A).

The soil in the area consists of native clay and silt. The site is generally flat, except for a moderate downward slope toward the inlet to the south and east of the site.

3.1.31.2 Potential Receptors and Valued Ecological Components

The principle receptor for this site is Alert Inlet, located nearby at the bottom of the slope. However, no drainage channels were observed during the site visit. Considering the presence of grasses and standing water, there remains the possibility of animal life in the area. Human activities are present in the area.

3.1.31.3 Summary of Previous Investigations

In 1999, 18 soil samples were taken from around the 2 foundations, the AES supply building remains and the burn pile. Four (4) samples exceeded the 2,500 mg/kg concentration for TPH (Table LXXIII). Three samples from around the concrete foundations contained 100% fuel oil and 1 sample southeast of the AES Supply building

remains contained TPH in the form of grease and lubricating oil. The burn pile featured 3 samples containing metals, with 1 being a duplicate: copper and cadmium exceeded Tier II criteria, zinc was close to Tier II in 2 samples, and exceeded Tier II in the third sample. There were no detectable traces of PCBs, except for 1 of the 8 samples (99-11096) which had a concentration of 0.2 mg/kg, below the Tier I limit of 1.0 mg/kg.

In 2000, 49 soil samples were collected and only 1 sample (00-10607) showed cadmium concentrations exceeding Tier II criteria (Table LXXIII). The contaminated area is estimated at 40 m^2 with an approximate volume of 8 m^3 with a depth of contamination to 0.2 m. No TPH contamination was found over the limit in the 22 samples analyzed.

3.1.31.4 Nature and Extet of Contamination

Four (4) soil samples were taken in July of 2006; 2 by the concrete foundation, 1 (06WS0145) to the east of the AES Supply Building Remains-GA and 1 at the burn pile (Photograph 53, Appendix A). Sample 06WS0141 (the burn pile) only contained arsenic above the guidelines, which corresponds with the naturally high background arsenic concentrations (Table LXXIV). The area east of the AES building supply showed a level of 52 mg/kg of nickel, just slightly higher than the Industrial guidelines. Nickel also showed high concentrations in all 3 soil samples that were taken around the AES Supply Building Remains-GA but did not exceed the criterion.

Of the concrete foundation samples, 1 (06WS0146) contained high levels of toluene and ethylbenzene and 2 samples showed high levels of C10–C16 hydrocarbons; 1,300 mg/kg (06WS0144) and 6,100 mg/kg (06WS0146), which are 1.7 and 8 times the guideline limits, respectively. Sample 06WS0144 had a high concentration of lead close to the CCME limit.

Table LXXIII. (S-10522) Previous contaminated samples.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
99-11099	0	TPH	2,500	3,200
99-11100/01	0	TPH	2,500	33,000
99-11106	0	TPH	2,500	210,000
99-11130/31	0	CADMIUM (CD)	5	6.5
99-11130/31	0	COPPER (CU)	100	3,500
99-11132	0	ZINC (ZN)	500	810
00-10607	0-10	CADMIUM (CD)	5	5.9

3.1.31.5 Recommendations

Delineation must be performed during the next field visit for the Weather Station Remains-GA. This includes collecting approximately 12 soil samples and 1 surface water sample from the drainage channel leading to Alert Inlet. These samples should be analysed for metals, TPH and BTEX. PAHs should be evaluated in the area where samples 06WS0144 and 06WS0146 were collected, in order to determine if PAH contamination is present in the area. No more samples around the pile of burnt debris need to be collected because the area is defined and the contaminated area is contained.

Table LXXIV. (S-10522) Weather Station Remains-GA results.

					AES Weather Station Remains-GA (S-10522)			
		SOIL			SOIL			
	PARAMETERS	UNITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	06WS0144 0-10 cm 07/07/06	06WS0145 0-10 cm 07/07/06	06WS0141 0-10 cm 07/07/06	06WS0146 0-10 cm 07/07/06
METALS	Arsenic (As)	mg/kg	12	0.27	8.4	9.4	14.3	7.2
	Barium (Ba)	mg/kg	2,000	5	18	14	11	31
	Cadmium (Cd)	mg/kg	22	0.22	<1	<1	<1	<1
	Chromium (Cr)	mg/kg	87	3	30	31	28	27
	Cobalt (Co)	mg/kg	300	1.9	11	13	11	11
	Copper (Cu)	mg/kg	91	2.1	23	23	20	52
	Lead (Pb)	mg/kg	600	1.2	507	15	13	46
	Manganese (Mn)	mg/kg	---	1.1	530	557	487	519
	Molybdenum (Mo)	mg/kg	40	1.4	<2	<2	<2	<2
	Nickel (Ni)	mg/kg	50	0.6	41	52	41	38
	Selenium (Se)	mg/kg	3.9	0.5	NA	NA	NA	NA
	Silver (Ag)	mg/kg	40	0.4	<2	<2	<2	<2
	Tin (Sn)	mg/kg	300	0.8	6	<5	<5	<5
	Zinc (Zn)	mg/kg	360	2.5	69	65	118	68
PETROLEUM HYDROCARBONS	Benzene	mg/kg	0.03	0.02	ND	ND	ND	ND
	Toluene	mg/kg	0.37	0.02	0.08	ND	ND	0.38
	Ethylbenzene	mg/kg	0.08	0.02	ND	ND	ND	0.28
	o-Xylene	mg/kg	---	0.02	0.18	ND	ND	1.6
	p+m-Xylene	mg/kg	---	0.04	0.24	ND	ND	2.7
	Total Xylene	mg/kg	11	0.04	0.42	ND	ND	4.3
	F1 (C6-C10 Hydrocarbons)	mg/kg	310	10	32	ND	ND	290
	F1 (C6-C10) -BTEX	mg/kg	310	10	31	ND	ND	290
	F2 (C10-C16 Hydrocarbons)	mg/kg	760	10	1,300	ND	ND	6,100
	F3 (C16-C34 Hydrocarbons)	mg/kg	1,700	10	580	ND	19	1,300
	F4(C34-C50 Hydrocarbons)	mg/kg	3,300	10	130	ND	ND	290

ND Not detected
NA Not available
Higher than the criteria

Figure 42. (S-10522) Weather Station Remains-GA map 1.

Figure 43. (S-10522) Weather Station Remains-GA map 2.

3.1.32 S-10523 Operations Building

3.1.32.1 Location and Site Description

The Operations Building is found at the northern end of the main building, and is attached to the accommodations buildings and the HAPS building via a long corridor that runs south from the Operations Building (Figure 44). It houses the Environment Canada AES offices, a storm gym and other offices and storage areas. This complex is one of the newer structures at the station and is located at the site of the old 40 Line buildings (Photograph 54, appendix A). As a result, historical land use may have caused previous contamination that is not representative of current land use. Beneath the north side of the building is permanent ice cover and just north of the building are 2 small shacks; an electrical splice hut to the east and a compressed gas and maintenance storage shed with a fuel line entering on the east side of the hut (Photograph 55, Appendix A).

The study area's topography consists mainly of coarse gravel, but the undisturbed northern section of the area contains some native soil. There is a gentle slope that heads toward the north. The site remains active.

3.1.32.2 Potential Receptors and Valued Ecological Components

Animal species' such as hares and wolves have been sighted in the area. The northern part of the site also features small plants where there is enough soil. One (1) small drainage pathway was present on-site, heading toward Dumbell bay, but was set apart from the area. Human activities occur all around the building, especially around the maintenance storage building.

3.1.32.3 Summary of Previous Investigations

Seven (7) surface soil samples, including 1 duplicate pair, were collected in 1999, around the Operations Building. They were analyzed for metals, PCBs and TPH (TableLXXV). Three (3) of the samples were analyzed for TPH and all 3 were found to contain TPH in

varying amounts. Sample 99-12976 (collected from under the northeast corner of the building), contained 20,000 mg/kg TPH as 100% fuel oil and arsenic just exceeding the Tier II criterion (34 mg/kg). Three (3) samples were tested for metals and 1 contained analytes exceeding the criteria, although all 3 contained elevated levels of zinc. PCBs were analyzed in 1 sample (99-12976), but none were detected.

In 2000, ESG collected 36 soil delineation samples, including 3 depth samples. Twenty (20) of these were tested for metals and TPH (Table LXXV). One (1) sample (00-10246), taken from near the maintenance building, was found to contain 4,300 mg/kg TPH and a strong hydrocarbon odour was noted. None of the samples contained any metals exceeding the applicable criteria but sample 00-10246 contained a high concentration of zinc and arsenic (36% under the guideline for both parameters). It was found that the contamination on site is limited to a small area beside the maintenance building and has not migrated horizontally. The contaminated area is roughly 25 m^2 with a volume of 13 m^3, based on a depth of 0.5 m.

Table LXXV. (S-10523) Previous contaminated soil samples.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
99-12976	0	TPH	2500	20,000
	0	CADMIUM (CD)	5	11
	0	ARSENIC (AS)	30	34
00-10246	0-10	TPH	2500	4300

3.1.32.4 Nature and Extent of Contamination

Two (2) soil samples were collected during the summer, 2006 field visit. The soil samples were tested for TPH and both exceeded the CCME guidelines for fraction 2 hydrocarbons (Table LXXVI). Samples 06OP0034 and 06OP0035 contained 1,800 mg/kg and 3,200 mg/kg, respectively. The analysis for metals showed arsenic levels above the limit for sample 06OP0034, but comparable to the high background concentrations. Both samples showed relatively moderate zinc levels, with a

concentration of 280 mg/kg for 06OP0034, retrieved from near the maintenance building. Finally, both samples were analyzed for PCBs and only 1 was found to contain PCBs at a very low level.

3.1.32.5 Recommendations

Further assessment is recommended for this site. Six (6) or more soil samples should be collected at the 2 same locations where the diesel contamination was found during the 2006 field study, but deeper down, in order to verify if contamination has migrated vertically. PAHs should also be evaluated in at least 1 surface and 1 depth sample in the same 2 areas. As the ESG suggested in their 1999 report, if the building is eventually demolished or moved, some samples would have to be collected in the area prior to demolition. Excavation should be performed after the sampling and subsequent demolition.

Table LXXVI. (S-10523) Operations Building results.

					Operations Building (S-10523)	
	PARAMETERS	SOIL			SOIL	
		UNITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	06OP0034 0-10 cm 06/26/06	06OP0035 0-10 cm 06/26/06
METALS	Arsenic (As)	mg/kg	12	0.27	17	6
	Barium (Ba)	mg/kg	2,000	5	31	21
	Cadmium (Cd)	mg/kg	22	0.22	<0.5	<0.5
	Chromium (Cr)	mg/kg	87	3	24	24
	Cobalt (Co)	mg/kg	300	1.9	11	8
	Copper (Cu)	mg/kg	91	2.1	20	18
	Lead (Pb)	mg/kg	600	1.2	10	13
	Manganese (Mn)	mg/kg	—	1.1	480	440
	Molybdenum (Mo)	mg/kg	40	1.4	<2	<2
	Nickel (Ni)	mg/kg	50	0.6	28	38
	Selenium (Se)	mg/kg	3.9	0.5	NA	NA
	Silver (Ag)	mg/kg	40	0.4	3	2
	Tin (Sn)	mg/kg	300	0.8	<5	<5
	Zinc (Zn)	mg/kg	360	2.5	280	86
PETROLEUM HYDROCARBONS	Benzene	mg/kg	0.03	0.02	ND	ND
	Toluene	mg/kg	0.37	0.02	ND	ND
	Ethylbenzene	mg/kg	0.08	0.02	ND	ND
	o-Xylene	mg/kg	—	0.02	ND	ND
	p+m-Xylene	mg/kg	—	0.04	ND	ND
	Total Xylene	mg/kg	11	0.04	ND	ND
	F1 (C6-C10 Hydrocarbons)	mg/kg	310	10	28	85
	F1 (C6-C10) -BTEX	mg/kg	310	10	28	85
	F2 (C10-C16 Hydrocarbons)	mg/kg	760	10	1,800	3,200
	F3 (C16-C34 Hydrocarbons)	mg/kg	1,700	10	40	110
	F4(C34-C50 Hydrocarbons)	mg/kg	3,300	10	ND	ND
PCBs	bpc totaux	mg/kg	33	0.01	<0.01	0.05

ND Not detected
NA Not available
Higher than the criteria

Figure 44. (S-10523) Operations Building map.

3.1.33 S-10524 Sewage Outfall

3.1.33.1 Location and Site Description

The Sewage Outfall is located at the southern end of the station, with the Gym and Curling Club complex at its northwestern end (Figure 45). It flows from north to south, ending in Alert Inlet. The sewage and grey water is transported downhill in pipes via gravity, and dumps onto the ground further down. The bottom of the slope is littered with barrels and domestic garbage.

Silty, undisturbed soil dominates the hillside and the site remains active.

3.1.33.2 Potential Receptors and Valued Ecological Components

Possible contamination in Alert Inlet remains a concern. Additionally, high phosphorus and nitrogen content in the sewage, in addition to the southern exposure, has facilitated the proliferation of vegetation along the outfall. Insects, birds and algae are abundant here. Evidence of wolves, foxes and lemmings has also been noted in this area. There are no human activities on this site.

3.1.33.3 Summary of Previous Investigations

Fourteen (14) soil samples, including 1 duplicate pair, were collected in 1999. These samples were taken at intervals along the outfall and analyzed for metals, PCBs, TPH, pesticides, VOCs, glycol and phenol (Table LXXVII). Eleven (11) of these were tested for metals and 3 were found to contain copper concentrations exceeding the Tier II criterion (100 mg/kg). These ranged from 110 mg/kg (99-12992) to 170 mg/kg (99-12998 – collected at the bottom of the outfall). Two (2) plant samples taken from the same area also had high copper concentrations. TPH, VOCs and phenols were found in low concentrations in various samples and PCBs, pesticides and glycol were not detected. Phenol exceeded the criterion in sample 99-12998, at 7.3 mg/kg. One (1) water sample was collected and analyzed for TPH and metals. TPH went undetected and copper, zinc, chlorine, sulphate and phosphorus were detected in low concentrations. Nitrate and

nitrites were not detected. The pH of the water was neutral. It has been theorized that the source of copper in the samples is derived from the plumbing in the buildings, in addition to some metallic debris near the sampling location where the highest concentrations were found. The lead and phenol found in the water are most likely due to improper disposal of chemicals down sinks. For example, military personnel have reported washing leaded battery contents down the sinks in the vehicle maintenance building.

In 2000, 56 soil samples, including 8 depth samples were collected. Twenty (20) of these were analyzed for metals and phenols (Table LXXVII). Only 2 exceeded Tier II criteria for metals; sample 00-10714 contained 230 mg/kg copper and 1,000 mg/kg zinc, sample 00-10715 (collected at 30 cm below surface) contained 110 mg/kg copper. Two (2) water samples were collected; 1 at the source of the effluent (00-10728) and the other at the point of entrance to Alert Inlet (00-10729). Both were analyzed for metals and phenols (Table LXXVIII). Sample 00-10728 contained 0.082 µg/L copper and 7.8 µg/L phenols, both of which exceed the CCME criterion for Freshwater Aquatic Life. The other sample contained 66 µg/L copper and 23 µg/L phenols. Metals, PCBs and TPH were undetectable in 2 sediment samples. Two (2) separate contaminated areas were defined halfway up the slope. They cover an area of roughly 180 m^2 and a volume of 36 m^3, based on a depth of contamination of 0.2 m.

Table LXXVII. (S-10524) Previous contaminated SOIL samples.

Samples	Depth (cm)	Contaminant	Criterion (mg/kg)	Concentration (mg/kg)
99-12990/91	0	COPPER (CU)	100	112
99-12992	0	COPPER (CU)	100	110
99-12998	0	PHENOL	3.8	7.3
	0	COPPER (CU)	100	170
00-10714	0-10	COPPER (CU)	100	230
	0-10	ZINC (ZN)	500	1,000
00-10715	30	COPPER (CU)	100	110

Table LXXVIII. (S-10524) Previous contaminated WATER samples.

Samples	Depth (cm)	Contaminant	Criterion (ug/L)	Concentration (ug/L)
00-10728	0	COPPER (CU)	2-4	82
	0	PHENOL	4	7.8
00-10729	0	COPPER (CU)	2-4	66
	0	PHENOL	4	23

3.1.33.4 Nature and Extent of Contamination

A total of 7 samples were collected during the summer, 2006 field study. This included 4 soil samples, 1 sediment sample and 2 freshwater samples. (Table LXXVIX) The contaminant of greatest concern was copper, which exceeded the guidelines in all but 1 of the samples (copper remained low in soil sample 06SO0032). The soil samples were also analyzed for phosphorus and phenol, with concentrations remaining very low. The mean copper concentration for the 4 soil samples was 500.75 mg/kg, ranging from 19 mg/kg to 1,100 mg/kg. The sediment sample, tested only for metals, exceeded the criterion for arsenic, with a concentration of 9 mg/kg. The copper concentration in this sample reached 91 mg/kg. No other analytes surpassed any guidelines. In addition to exceeding the copper criterion, the surface water samples (06SO0078/9) contained high levels of lead; 1 µg/L and 14 µg/L, respectively, where the guideline is 1-7 µg/L. Sample 06SO0079 is at the threshold limit for zinc, with a concentration of 30 µg/L. Cadmium was detected in the water samples as well, but at a concentration less specific than the criterion. The pH of the water was measured at 7.1 and 7.2. The water samples also possessed detectable levels of phosphorus and phenols, but at concentrationsbelow the guidline criteria.

3.1.33.5 Recommendations

A delineation should be done at the bottom of the pipe, in the area just beside the bay. Approximately 10 soil and sediment samples should be collected to analyze for metals and phenols. Sub-surface samples should also be collected in this area. Two (2) water

samples should be collected at the bottom of the pipe and analyzed for metals, phenols, phosphorus, nitrite and nitrate.

Further assessment is also recommended along the drainage discharge channel coming from the pipe including an additional 8 soil samples collected and analyzed for metals and phenol; 2 samples should be collected where sample 06SO0033 was collected, and 2 samples between the old tags for samples 00-10714 and 00-10715.

BRI also recommends the installation of a permanent sewage treatment facility at Alert to properly treat sewage before it is released into the environment. This would result in the protection of this fragile environment from the introduction of potentially detrimental bacterial contaminants such as coliforms and fecal coliforms.

	SOIL			FRESHWATER SEDIMENT				MARINE SEDIMENT				Freshwater	Marine water
	UNITS	INDUSTRIAL GUIDELINES (Coarse)	DETECTION LIMIT	UNITS	GUIDELINES AQUATIC LIFE (1) ISQG	(2) PEL	DETECTION LIMIT	UNITS	GUIDELINES AQUATIC LIFE (3) ISQG	(4) PEL	DETECTION LIMIT	06SO0078 Surf. Water 07/05/06	06SO0079 Surf. Water 07/05/06
	mg/kg	12	0.27	mg/kg	5.9	17	0.27	mg/kg	7.24	41.6	0.27	<1	<1
	mg/kg	2,000	5	mg/kg	---	---	5	mg/kg	---	---	5	<10	10
	mg/kg	22	0.22	mg/kg	0.6	3.5	0.22	mg/kg	0.7	4.2	0.22	<1	<1
7	mg/kg	87	3	mg/kg	37.3	90	3	mg/kg	52.3	160	3	2	2
5	mg/kg	300	1.9	mg/kg	---	---	1.9	mg/kg	---	---	1.9	<1	<1
2	mg/kg	91	2.1	mg/kg	35.7	197	2.1	mg/kg	18.7	108	2.1	52	64
1	mg/kg	600	1.2	mg/kg	35	91.3	1.2	mg/kg	30.2	112	1.2	1	14
3	mg/kg	---	1.1	mg/kg	---	---	1.1	mg/kg	---	---	1.1	<5	34
3	mg/kg	40	1.4	mg/kg	---	---	1.4	mg/kg	---	---	1.4	<1	<1
5	mg/kg	50	0.6	mg/kg	---	---	0.6	mg/kg	---	---	0.6	1	2
6	mg/kg	3.9	0.5	mg/kg	---	---	0.5	mg/kg	---	---	0.5	<1	<1
3	mg/kg	40	0.4	mg/kg	---	---	0.4	mg/kg	---	---	0.4	<1	<1
	mg/kg	300	0.8	mg/kg	---	---	0.8	mg/kg	---	---	0.8	<1	8
	mg/kg	360	2.5	mg/kg	123	315	2.5	mg/kg	124	271	2.5	20	30
	mg/kg	6-8	---	mg/kg	---	---	---	mg/kg	---	---	---	7.2	7.1
	mg/kg	---	2	mg/kg	---	---	2	mg/kg	---	---	2	<0.02	<0.02
	mg/kg	---	155	mg/kg	---	---	155	mg/kg	---	---	155	NA	NA
	mg/kg	---	---	mg/kg	---	---	---	mg/kg	---	---	---	0.52	0.71
	mg/kg	5	0.03	mg/kg	---	---	0.03	mg/kg	---	---	0.03	<0.4	<0.4
	mg/kg	5	0.02	mg/kg	---	---	0.02	mg/kg	---	---	0.02	<0.4	<0.4
	mg/kg	5	0.02	mg/kg	---	---	0.02	mg/kg	---	---	0.02	<0.4	<0.4
	mg/kg	5	0.02	mg/kg	---	---	0.02	mg/kg	---	---	0.02	<0.4	<0.4
	mg/kg	5	0.02	mg/kg	---	---	0.02	mg/kg	---	---	0.02	<0.4	<0.4
	mg/kg	5	0.01	mg/kg	---	---	0.01	mg/kg	---	---	0.01	<0.4	<0.4
	mg/kg	5	0.02	mg/kg	---	---	0.02	mg/kg	---	---	0.02	<0.4	<0.4
	mg/kg	5	0.02	mg/kg	---	---	0.02	mg/kg	---	---	0.02	<0.4	<0.4
	mg/kg	5	0.02	mg/kg	---	---	0.02	mg/kg	---	---	0.02	<0.4	<0.4
	mg/kg	5	0.04	mg/kg	---	---	0.04	mg/kg	---	---	0.04	<0.4	<0.4
	mg/kg	5	0.02	mg/kg	---	---	0.02	mg/kg	---	---	0.02	<0.4	<0.4
	mg/kg	5	0.03	mg/kg	---	---	0.03	mg/kg	---	---	0.03	<0.4	<0.4
	mg/kg	5	0.01	mg/kg	---	---	0.01	mg/kg	---	---	0.01	<0.4	<0.4
	mg/kg	5	0.04	mg/kg	---	---	0.04	mg/kg	---	---	0.04	<0.4	<0.4
	mg/kg	5	0.01	mg/kg	---	---	0.01	mg/kg	---	---	0.01	<0.4	<0.4
	mg/kg	5	0.02	mg/kg	---	---	0.02	mg/kg	---	---	0.02	<0.4	<0.4
	mg/kg	5	0.02	mg/kg	---	---	0.02	mg/kg	---	---	0.02	<0.4	<0.4
	mg/kg	7.6	0.02	mg/kg	---	---	0.02	mg/kg	---	---	0.02	<0.4	<0.4
	mg/kg	3.8	0.06	mg/kg	---	---	0.06	mg/kg	---	---	0.06	0.6	2.3
	mg/kg	10	0.03	mg/kg	---	---	0.03	mg/kg	---	---	0.03	<0.4	0.8
	mg/kg	10	0.04	mg/kg	---	---	0.04	mg/kg	---	---	0.04	<0.4	0.5
	mg/kg	10	0.03	mg/kg	---	---	0.03	mg/kg	---	---	0.03	3.3	19.2
	mg/kg	10	0.05	mg/kg	---	---	0.05	mg/kg	---	---	0.05	<0.4	<0.4
	mg/kg	10	0.03	mg/kg	---	---	0.03	mg/kg	---	---	0.03	<0.4	<0.4
	mg/kg	10	0.04	mg/kg	---	---	0.04	mg/kg	---	---	0.04	<14	<14
	mg/kg	10	0.04	mg/kg	---	---	0.04	mg/kg	---	---	0.04	<0.4	<0.4
	mg/kg	10	0.04	mg/kg	---	---	0.04	mg/kg	---	---	0.04	<14	<14
	mg/kg	---	---	mg/kg	---	---	---	mg/kg	---	---	---	4	22.9

the result.

of the Canadian Sediment Quality Guidelines for the Protection of Aquatic Life of the Canadian Council of Ministers of the Environment. (2002)

Figure 45. (S-10524) Sewage Outfall map.

3.1.34 S-10529 Lower Dumbell Lake

3.1.34.1 Location and Site Description

Lower Dumbell Lake is located approximately 2 km southeast of CFS-Alert and just west of Upper Dumbell Lake (Figure 47). The study area is on the northwest side of the lake, in a small bay (Photograph 56, Appendix A). Access to the site is difficult as there is no established route after the pumphouse station at Upper Dumbell Lake. The site itself features slopes that surround the area and descend toward the lake. A peak on the northwest side rises approximately 125 m and another on the southwest side rises approximately 165 m.

Military personnel advised the BRI team that a couple of years ago, this area was used for fishing activities. At this time, a hut was built near the shore but was ultimately demolished when the fishing spot was moved. Debris from the foundation was still present during the investigation. In addition, the floor of the hut appeared to have been thrown directly into the lake, as shown in Photograph 57, Appendix A. More waste such as old barrels, wood pallets and old construction debris was found along the shoreline (Photograph 58, Appendix A). This gives rise to the concern that other building debris has been disposed of in the lake. Additionally, 2 barrels were pulled out of the lake 2 years ago, although it is not known whether they were full or empty and what they might have contained. One theory is that it contained fuel for the shed's generator.

3.1.34.2 Potential Receptors and Valued Ecological Components

Lower Dumbell Lake's proximity and physical attachment to Upper Dumbell Lake is of significance as Upper Dumbell Lake is the freshwater source for CFS-Alert and contamination in Lower Dumbell Lake could eventually affect the water quality in Upper Dumbell Lake. Moreover, should Upper Dumbell Lake ever become contaminated, Lower Dumbell Lake could become a back-up water source. Several types of wildlife are probably present in Lower Dumbell lake, such as fish, aquatic vegetation, microorganisms, etc. In addition, fishing is a common activity in the lake and assuming

that the lake is contaminated, consuming the fish may be dangerous as they may be poisoned from the polluted lake water. Vegetation was evident on the shores and caribou were noted in the area as well.

3.1.34.3 Summary of Previous Investigations

No previous sampling has been conducted on this site. The closest indication of any contamination can be taken from the 1999 sampling results for Upper Dumbell Lake, from the area of the freshwater pumphouse on the east side of the lake. Eight (8) soil samples, including 1 duplicate pair, were collected and analyzed for metals and PCBs. The results indicated a lack of contamination in the area. Additionally, 2 samples of drinking water at the station were tested and they both met the CCME Drinking Water Quality Guidelines (CCME, 1996).

3.1.34.4 Nature and Extent of Contamination

Two (2) samples were collected in 2006 at the Lower Dumbell Lake site; 1 freshwater and 1 sediment. Both samples were analyzed for metals and TPH (Table LXXX). The freshwater sample (06LL0175) showed no contaminants exceeding the guidelines for aquatic life with all contaminant concentrations remaining very low. Petroleum hydrocarbon fraction 3 (fuel oil) was detected in the lake water at 27 mg/L, however no guidelines exist for this parameter. The sediment sample (06LL0176) showed high arsenic concentrations, at 8.6 mg/kg. Although this can be attributed to the high background soil concentrations, uptake from marine life remains a concern. It is not known whether cadmium concentrations exceed the guidelines for aquatic life, as the criterion is more specific than the result obtained. pH of the lake was in the preferred range of 7.4. No visual contamination was observed on site, with the exception of the noted debris.

3.1.34.5 Recommendations

Assessment should be performed on this site during the next field visit. This should include the collection and analysis of approximately 2 soil samples from the same location as the 2006 investigation. The samples should be collected from directly between the 2 markers that were placed on site during the 2006 field visit (Photograph 59, Appendix A). One (1) surface water sample should be collected to confirm whether there is any petroleum contamination in the lake. The 2006 results should be compared to the background concentrations to confirm that no contamination is present at the site. The closure of the site could eventually be possible if no contamination is found during the next sampling campagn.

Additionally, an underwater survey should be completed in order to establish how much debris has been thrown into the lake. (Section 3.2.4.1)

Table LXXX. (S-10529) Lower Dumbell Lake results.

	PARAMETERS	WATER				FRESHWATER SEDIMENT				Lower Dumbell Lake (S-10529)	
		UNITS	GUIDELINES AQUATIC LIFE		DETECTION LIMIT	UNITS	GUIDELINES AQUATIC LIFE		DETECTION LIMIT	Sed. 06LL0176 Surf. Sed. 07/11/06	Freshwater 06LL0175 Surf. Water 07/11/06
			FRESH	MARINE			(1) ISQG	(2) PEL			
METALS	Arsenic (As)	ug/L	5	12.5	0.0001	mg/kg	5.9	17	0.27	8.6	0.002
	Barium (Ba)	ug/L	---	---	0.001	mg/kg	---	---	5	15	0.02
	Cadmium (Cd)	ug/L	0.017	0.12	0.0001	mg/kg	0.6	3.5	0.22	<1	0.001
	Chromium (Cr)	ug/L	---	---	0.0007	mg/kg	37.3	90	3	21	0.011
	Cobalt (Co)	ug/L	---	---	0.0006	mg/kg	---	---	1.9	11	0.004
	Copper (Cu)	ug/L	2-4	2-4	0.0012	mg/kg	35.7	197	2.1	18	0.006
	Lead (Pb)	ug/L	1-7	---	0.0011	mg/kg	35	91.3	1.2	12	0.003
	Manganese (Mn)	ug/L	---	---	0.0003	mg/kg	---	---	1.1	470	0.115
	Molybdenum (Mo)	ug/L	73	---	0.0078	mg/kg	---	---	1.4	<2	<0.001
	Nickel (Ni)	ug/L	25-150	---	0.0005	mg/kg	---	---	0.6	31	0.013
	Selenium (Se)	ug/L	1	---	0.0006	mg/kg	---	---	0.5	NA	NA
	Silver (Ag)	ug/L	---	---	0.0008	mg/kg	---	---	0.4	<2	<0.001
	Tin (Sn)	ug/L	---	---	0.011	mg/kg	---	---	0.8	<5	<0.001
	Zinc (Zn)	ug/L	30	---	0.006	mg/kg	123	315	2.5	51	0.02
pH	pH	ug/L	6.5-9.0	7.0-8.7	---	mg/kg	---	---	---	NA	7.4
PETROLEUM HYDROCARBONS	Benzene	ug/L	370	110	0.03	mg/kg	---	---	0.02	NA	ND
	Toluene	ug/L	2	215	0.03	mg/kg	---	---	0.02	NA	ND
	Ethylbenzene	ug/L	90	25	0.02	mg/kg	---	---	0.02	NA	ND
	o-Xylene	ug/L	---	---	0.02	mg/kg	---	---	0.02	NA	ND
	p+m-Xylene	ug/L	---	---	0.05	mg/kg	---	---	0.04	NA	ND
	Total Xylene	ug/L	---	---	0.05	mg/kg	---	---	0.04	NA	ND
	F1 (C6-C10 Hydrocarbons)	ug/L	---	---	100	mg/kg	---	---	10	NA	ND
	F1 (C6-C10) -BTEX	ug/L	---	---	100	mg/kg	---	---	10	NA	ND
	F2 (C10-C16 Hydrocarbons)	ug/L	---	---	100	mg/kg	---	---	10	ND	ND
	F3 (C16-C34 Hydrocarbons)	ug/L	---	---	100	mg/kg	---	---	10	ND	27
	F4(C34-C50 Hydrocarbons)	ug/L	---	---	100	mg/kg	---	---	10	ND	ND

ND Not detected
NA Not available

Higher than the criteria
The criteria is lower than the detection limit.

FRESHWATER SEDIMENT (1) Following the Interim Freshwater Sediment Quality Guideline (ISQG) of the Canadian Sediment Quality Guidelines for the Protection of Aquatic Life of the Canadian Council of Ministers of the Environment. (2002)

FRESHWATER SEDIMENT (2) Following the Probable Effect Level (PEL) of the Canadian Sediment Guidelines for the Protection of Aquatic Life of the Canadian Council of Ministers of the Environment. (2002)

Figure 46. (S-10529) Lower Dumbell Lake map.

3.2 CFS-Alert Conclusion

3.2.1 Priority with FCSAP

The high priority sites at CFS-Alert were classified using the FCSAP Contaminated Site Classification provided by CFB-Trenton (Appendix B). The list of high priority areas is as follows:

Class 1 Sites / Action required

- Oxidator Building
- Airstrip Diesel Pipeline
- Main Station Day Tank Area
- Baker's Dozen
- New Fuel Line Spill 1999
- Sewage Outfall

3.2.2 Special Consideration for Sites in Proximity to Fish Bearing Bodies of Water

Some sites may require special attention due to their proximity to fish-bearing bodies of water. These sites include:

- Main Station Landfill
- Sewage Outfall
- New Fuel Line Spill 1999

BRI also recommends the installation of a permanent sewage treatment facility at CFS-Alert to properly treat sewage before it is released into the environment. This would result in the protection of this fragile environment from the introduction of potentially detrimental bacterial contaminants such as coliforms and fecal coliforms.

3.2.3 The Sites with the Highest Contamination

Provided is a list of sites with the highest contamination levels and/or sites which had 100% of their respective samples test above guideline criteria. These sites should receive special attention because of the more concentrated nature of the contamination:

- Main Station Day Tank Area
- Oxidator Building
- New Fuel Line Spill 1999
- MSE-17 Vehicle Maintenance Building
- Burner Project Site

3.2.4 Sites Not Assessed in 2006

Six sites were not assessed in 2006 and should be assessed during the next field campaign. The following outlines our recommendations for the 6 sites:

3.2.4.1 S-146 Contaminated sites underwater survey

The 3 main water areas of CFS-Alert should be evaluated; Lower Dumbell Lake, Alert Inlet and Dumbell Bay. This will include the collection of approximately 30 shoreline sediment samples in the bay and in the inlet adjacent to where the base is located. In both lakes, 4 sediment samples should be taken from each side of the lake and 1 in the middle, if possible. Sampling should be concentrated around the inlets and outlets of each water body. Additionally, one water sample from each water body should be collected for chemical analysis. All samples should be analyzed for TPH, metals, nitrites, nitrates and phosphorus.

3.2.4.2 S-10220 Barrel Cache

An assessment should be performed in this area to evaluate the extent of petroleum hydrocarbon contamination in the previously contaminated area and where visual evidence of contamination is encountered.

3.2.4.3 S-350 Supply spill of October 1995.

An assessment at the main supply warehouse, concentrating around the location of the fuel valve, should be performed by collecting 5 soil samples and 1 water sample for TPH analysis. The water sample should be collected in the drainage pathway located near the main road.

3.2.4.4 S-353 Fuel line spill (March 1996)

An assessment for TPH in this area should be performed, by collecting 5 soil samples and concentrating around the location of the fuel valve.

3.2.4.5 S-354 Old Upper POL Farm.

A delineation for TPH in this area should be performed by collecting 10 soil samples.

3.2.4.6 New site – New fuel spill of August 2006

An assessment for TPH in this area should be performed by collecting 10 soil samples.

3.2.5 Projected Work for the Next Sampling Campaign

During the next sampling campaign, 22 delineations and 18 assessments should be performed to determine the extent of contamination in the examined sites (sections 3.1.1-3.1.34). This will include approximately 1000 soil analyses and 100 water analyses. Please refer to appendix C for a compilation of the analyses planned for the next investigation.

3.2.6 Conclusion

In conclusion, further delineation is still necessary for the majority of the CFS-Alert sites. Eventually, the remediation of several contaminated areas will have to be performed. This may include the excavation of soil for ex situ biopile treatment or employing an in situ treatment system. The team at BRI can provide more details for possible remediation during a subsequent evaluation. This would include biofeasibility assays on samples collected during the next sampling campaign to evaluate biotreatment possibilities.