FOX – C DEW Line Site
Phase III Environmental Site Assessment and Waste Audit
FINAL REPORT

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Final Report

Prepared for:

Public Works & Government Services Canada
Environmental Services, Western Region
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January 2005

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January 3, 2005

Refer to File: 78850

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Public Works and Government Services Canada
Environmental Services
1000-9700 Jasper Avenue
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T5J 4E2

Attention: Mr. Chris Doupe
Senior Environmental Biologist

Telephone

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Dear Sir:

Re: FOX – C DEW Line Site, Phase III ESA and Waste Audit
Final Report

Please find enclosed eight copies of the Earth Tech Canada final report summarizing the Phase III ESA and Waste Audit that was completed at the FOX – C DEW Line Site.

It has been Earth Tech's pleasure to complete this project. If you have any questions, please do not hesitate to contact the undersigned at (780) 453-0710.

Very truly yours,

EARTH TECH (CANADA) INC.
Per:

Gordon Woollett

Gordon Woollett, P.Eng.
Project Manager Environment Group

Encl.

FOX-C DEW LINE SITE
PHASE III INVESTIGATION AND WASTE AUDIT

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1 EXECUTIVE SUMMARY

The FOX-C intermediate DEW line site is located on Baffin Island, approximately 240 km north of Qikiqtarjuaq, on the shores of Ekalugad Fiord (68° 42', 68° 33'). The station was constructed in 1957 as an intermediate DEW Line site and was occupied and operated until its closure in 1963. The site consists of a Beach Area, Water Lake Area, Mid-Station Area and an Upper Station Area. An access road connects all areas of the site. The Water Lake Area was used as a staging point to the upper station and to collect water from the lake. The Mid Station area includes the station road, which connects the Upper Station with the Water Lake Area, a helipad and various storage and dump areas. The Upper Station Area also has two large tanks for fuel storage and the majority of the operations infrastructure.

In order to assist in the development of a remedial plan for the FOX C site PWGSC is required to complete further assessments at the site. The assessments include the completion of a Phase III ESA and Waste Audit in order to delineate areas of environmental concern as well as to determine volumes of hazardous and non hazardous waste materials. The fieldwork for this program was completed between August 24 and September 2, 2004.

The Phase III investigation included the assessment of 15 areas of the site in-order to delineate previously identified contaminated areas and to confirm the presence of contaminants in areas that had not been previously identified.

Based on the findings of the Phase III Assessment, the following table presents a summary of the areas requiring remedial action at the FOX – C DEW Line site.

Table 1 Summary of Phase III Investigation Results

Location	Contaminant Exceeding Governing Criteria (Max Concentration ppm)	Media	Volume m^3	Comments
Beach Area POL Tanks	Hydrocarbons (F2 2890 ppm)	Soil	340	Close proximity to Fiord
Helipad Surface Stains	Hydrocarbons (F3 18000 ppm)	Soil	75	Maximum depth not achieved in hand augered testpits
Drainage Ditch Stain	Hydrocarbons (F3 13700 ppm, F4 8210 ppm)	Soil	6	
Mid Station Barrel Storage Area	Hydrocarbons, (F3 26,300 ppm and F4 15,600 ppm) PAHs (phenanthrene, 6.54 ppm)	Soil	75	Contaminant migration into rock material below gravel pad
Mid Station Barrel Dump #2	Hydrocarbons (F3 9,330 ppm, F4 21,000 ppm)	Soil	50	Complete delineation of hydrocarbons not achieved towards the south

Location	Contaminant Exceeding Governing Criteria (Max Concentration ppm)	Media	Volume m^3	Comments
Mid Station Barrel Dump #6	Hydrocarbons (F3 17800, F4 13800) Metals (Cu, 381 ppm, Pb 946 ppm, Zn 931 ppm)	Soil	60	Complete delineation of hydrocarbons not achieved towards the south. Metals concentrations exceed DCC Tier 2 criteria.
South of Module Train	PCB (5.6 ppm)	Soil	7	PCB concentrations exceed DCC Tier 2 criteria. Located near staircase.
West of Module Train	Hydrocarbons F2 8,050 ppm, F3 1,940 ppm)	Soil	14	Complete delineation of hydrocarbons not achieved
Sewer Outfall Area	PCBs (2.8 ppm), Hydrocarbons (F3 1,050 ppm)	Soil	30	Difficult area to delineate due to site conditions
Sewer Outfall Area	Metals (Cu 109, Pb 690)	Soil	5	Difficult area to delineate due to site conditions
Stain west of Garage	PCBs (3.8)	Soil	1	PCB levels less than DCC Tier 2 criteria
Stain below D8 Cat	Hydrocarbons F2 6540 ppm , F4 15600 ppm)	Soil	4	Leaking from Cat

A detailed Waste Audit was also completed to in order to determine the volumes of non-hazardous and hazardous materials. The following table briefly summarizes the quantities of the major categories for each waste type.

Table 2 Summary of Waste Volumes

Waste Type	Items	Estimated Volume m^3	Estimated Volume L
Non Hazardous			
	Wood, steel, domestic waste, vehicles, equipment parts building materials and contents, scattered debris	1824	
	Contents of Mid Station Dump	3300	
	8380 Empty Barrels	1257	
	Total	**6381**	
Hazardous			
	Miscellaneous materials, batteries, asbestos materials, oil filters, blasting caps	25	
	36 Full to partially full barrels		7400 L
	120 split open lube oil barrels at Mid station Barrel Dump #3		9000 L
	200 leaking 45 L barrels at Garage dump		2500 L
	PCB painted building materials (2000 m^2)	115	
	Miscellaneous fuel in day tanks and skid mounted tank		9000 L
	Total	**170 m^3**	**27,900 L**

Based on the scope of work of the Phase III Environmental Assessment and Waste Audit that was completed at the FOX – C DEW Line site the following conclusions are made.

Phase III ESA

- The Phase III investigation included the assessment of 15 areas of the site in order to delineate previously identified contaminated areas and to confirm the presence of contaminants in areas that had not been previously identified.

- The total volume of hydrocarbon, metal and PCB contaminated material found to be contaminated was estimated at 1444 m^3. Due to site conditions, full delineation was not achieved in some locations.

- Hydrocarbon impacted soils and groundwater were identified between the Beach Area POL tanks and Ekalugad Fiord. Due to the proximity of the material to the fiord, removal of this contaminated material is recommended.

- Study areas located at the Mid-Station and Upper Station areas typically had very small amounts of soil media. Fine to coarse grained, weathered material was encountered on the ground surface in some areas, however the site is dominated with large boulder sized (>300 mm) rocks. In some areas, contaminants are located on and below the large diameter rock. Remediation of contaminants located in these areas may be impractical.

- Runoff surface water was occasionally encountered, in some locations, this water was visible, however it was commonly located within a gully filled with coarse/fine grained material or with bolder sized material.

- Total metal concentrations in collected perched groundwater samples typically indicated exceedances for a number of metal concentrations. Comparison of dissolved metal concentrations to CCME criteria indicated no exceedances above CCME criteria except for cadmium in some locations.

Waste Audit

- Approximately 6400 m^3 of non-hazardous materials are located on the site. The vast majority of this material is located in accessible areas and this material should be removed from the site. Minor amounts of debris were located at the bottom of a cliff area below the Modular Train outfall and Mid-Station Dump. This material would be removable provided an access to the lower area on the north side of the mountain was available.

- A number of non-hazardous waste items including a partially buried crane and barrels were located either in Water Lake or in the streams flowing into and out of

Water Lake. The removal of these items will need to be completed in a manner that will satisfy DFO requirements.

- A total of 8380 empty barrels were identified at the site, it is recommended that subsurface soil conditions below the barrels be determined following their removal.

- A total of 36 full to partially full barrels were identified on the site. In addition, 120 lube oil barrels were split open and left at a dumpsite. Minor amounts of fuel were also identified in some of the day tanks located on the site. The remedial program will need to include a program to recover all liquids from these barrels and tanks.

- Approximately 2000 m^2 of material was observed to be painted with PCB containing paint. The majority of the paint products on a metal substrate was in poor condition (peeling) and may require some form of abatement prior to removal of the painted components. Wood materials painted with PCB containing paint was typically weathered and non peeling. It is recommended that the painted materials be removed by a contractor following a waste reduction process.

2 INTRODUCTION

Canada's north contains many federal contaminated sites. The Department of Indian and Northern Development (DIAND) is responsible for the care and management of many of these sites and has made it a priority to assess, prioritize and mitigate/remediate the environmental impacts. FOX-C is an Intermediate Distant Early Warning (DEW) line site that is currently listed as a high priority site as part of the Federal Contaminated Sites Accelerated Action Plan (FCSAAP). A consort of Federal departments including the Treasury Board Secretariat and Environment Canada developed the FCSAAP and the associated Accelerated Action Fund. The Accelerated Action Fund will fund the FOX-C remediation. Earth Tech Canada, on behalf of DIAND and at the request of Public Works and Government Services Canada (PWGSC) – Environmental Services Western Region, has been requested to complete a Phase III Site Assessment and Waste Audit at the FOX-C intermediate DEW line site. The following is the Earth Tech Phase III Site Assessment and Waste Audit Report based on field work completed between August 24 and September 2, 2004.

2.1 Background Information

The FOX-C intermediate DEW line site is located on Baffin Island, approximately 240 km north of Qikiqtarjuaq, on the shores of Ekalugad Fiord (68° 42', 68° 33'), shown in Figure 1.0 (Appendix A). The station was constructed in 1957 as an intermediate DEW line site to monitor the northern approach. The site was occupied and operated until its closure in 1963. The site consists of a Beach Area, Water Lake Area, Mid-Station Area and an Upper Station Area. An access road connects all areas of the site. The Beach Area contains two large tanks that were used to store fuel for site operations. The Water Lake Area was used as a staging point to the upper station and to collect water from the lake. The Mid Station area includes the station road, which connects the Upper Station with the Water Lake Area, a helipad and various storage and dump areas. The Upper Station Area also has two large tanks for fuel storage and the majority of the operations infrastructure. Figure 2 shows the layout of this site.

Various locations in all the areas of concern at the site were used for barrel storage, dumpsites and derelict equipment. In 1985 a partial assessment and clean up of the site was conducted by Environment Canada and DIAND. Various assessment and design work has since been completed and is summarized in the following section.

2.2 Previous Environmental Investigations

2.2.1 General

The following is a brief summary of the background reports that were available for review. Excerpts of these reports are reproduced in Appendix G. The scope of work for the 2004 investigation completed at the FOX–C DEW Line site was based on the findings and conclusions of these background reports.

2.2.2 Royal Roads Military College

The Royal Roads Military College (RRMC) conducted an Environmental Assessment of six abandoned DEW line sites in 1993. The RRMC Environmental Sciences Group conducted the Group F assessments, which included the FOX-C assessment. FOX-C and CAM-F were noted as being most affected by chemical contamination out of the six sites addressed. The RRMC assessment of FOX-C included visual observations, inspections of landfills, barrel dumps and station facilities. Soil and water samples were taken along with water and plant specimens for laboratory analysis. Barrels of hydrocarbon products and site staining (around buildings of the upper station) were noted. It was estimated that approximately ten thousand barrels were abandoned at the site. Seventy seven PCB/metals in soil samples were taken with fifteen samples exceeding the applied DCC PCB criteria and four exceeding the metal criteria. PCB paint and swab samples taken from the Upper Station buildings exceeded the PCB criteria. It was concluded that there was a high possibility of contaminants at FOX-C migrating off site.

2.2.3 Engineering Design (95%) Clean up of FOX C 2001

In 2001, Sinanni Company and Qikiqtaaluk Corporation developed a remedial plan for the FOX-C Site. The engineering design included a remediation plan and a general scope for the required clean up activities based on the available information at that time. The design included an Environmental Screening Report to mitigate measures from the clean up activities, development of project specifications and a cost estimate to complete the work. It was estimated the clean up work would require fifteen million dollars over four years of activities. It was recommended that a comprehensive site assessment be conducted to delineate the contaminated areas.

2.2.4 CANTOX Inc. and Gartner Lee Ltd. 1998 Site Risk Assessment

In 1998 Cantox and Gartner Lee Ltd. conducted a screening level human health and ecological risk assessment for submission to the Qikiqtaaluk Corporation. The Site risk assessment included a comparison of screening level information and a communication plan for the surrounding communities. The final recommendation of the report stated that more information was required and could be provided by a tissue sampling program and a detailed assessment of the risk associated with the contaminated surface soils and the consumption of wild game (Metal, PCB bioaccumulation).

2.2.5 SENES Consultants Risk Assessment November 2003

In 2003 SENES Consultants conducted and submitted a Human Health Screening Level Risk Assessment for submission to INAC. The assessment included receptor characterization, exposure assessment, hazard identification/assessment and a risk characterization using the information provided in the 1994 RRMC Environmental Assessment. The results of this evaluation indicated potentially unacceptable ecological risks associated with the PCBs and lead levels in soils at the site. Based on these findings, the FOX-C site was prioritized high on the list of sites requiring further investigation and remedial activity.

2.2.6 Contaminated Sites Monitoring Program, Gartner Lee Limited 2004

In 2003 Gartner Lee Ltd. completed a surface and groundwater water sampling program at FOX-C. This annual program was the continuation of a monitoring program that commenced in 2002. The results from this program include the following.

Exceedances above CCME freshwater aquatic life criterion for metals were detected in samples collected near (within 15 m) the shore of Ekalugad Fiord. Samples FC-SW-7 and FC-SW-2, taken from the area between the Beach Area fuel tanks and Ekalugad Fiord. The metals which exceeded CCME criteria included copper, iron and mercury and zinc. Detectable amounts of hydrocarbons were measured at both locations.

Further west down the beach samples FC-GW-1 and FC-SW-2 were taken in the area between beach area barrel dump #2 and Ekalugad Fiord. FC-SW-2 exceeded CCME Criteria for iron and mercury and FC-GW-1 exceeded criteria for iron. Detectable amounts of hydrocarbons were measured at both locations.

Petroleum hydrocarbons were detected from trace to high concentrations in an area down gradient of the Upper Site and Drum Storage Area. A lead concentration was also measured to exceed the CCME Freshwater Aquatic Life Criteria at this location.

In an area down gradient of a drum storage area on Freshwater Lake Road, concentrations of copper, iron and lead in a surface water sample were elevated above CCME criteria.

Exceedances above CCME criteria were also detected in samples collected from Water Lake. This analysis indicated copper, iron and lead exceeded CCME criteria for drinking water. Detectable amounts of hydrocarbons were also measured in the samples recovered from Water Lake.

This report also noted that Sample FC-SW-10 was a background water sample collected in a shallow drainage channel located on the west side of Water Lake. The PCB analysis of this sample indicated that it contained 0.12 µg/L of PCBs. This was the highest total PCB concentration recorded in this sampling program. This report also indicated that it was unknown if the elevated PCB levels were indicators of actual conditions or attributed to interference from sampling or analysis.

2.3 Scope of Work and Objectives

In order to develop a remedial plan for the FOX C site PWGSC is required to complete further assessments at the site. The assessments include the following components:

- Geotechnical Assessment/Site Survey – assessment of volumes of types of locally available borrow materials, and topographic survey.
- Geophysical Assessment – geophysical assessment of dump sites and other disturbances.
- Phase III ESA and Waste Audit - completion of environmental investigation in order to delineate areas of environmental concern as well as to determine volumes of hazardous and non hazardous waste materials.
- Risk Assessment – completion of ecological human health risk assessment based on the contaminated levels determined in the Phase III ESA program.
- Remedial Design – based on the results of all the above programs a remedial design will be completed.

The objectives of the Phase III ESA and Waste Audit of the project include the following:

- Quantify the volume of contaminated soil through both horizontal and vertical delineation at the site (Contaminants of concern included PCBs, petroleum hydrocarbons and metals).
- Quantify the volume of hazardous materials at the site (i.e. asbestos, paint with PCBs).
- Quantify the volume of non-hazardous materials at the site.
- Quantify and identify the volume of liquid waste located in barrels and tanks.

The main scope of work for the FOX-C project was to conduct a Phase III assessment of the site using previous report information and data as outlined in the Terms of Reference prepared by PWGSC-Environmental Services, Western Region (Appendix B). The scope of work includes the development and implementation of a Site Specific Health and Safety Plan (HASP) on site (Earth Tech FOX-C HASP is attached in Appendix C). The scope of work also included the delineation of known contaminated areas and suspected contaminated areas, biological tissue sampling (collection of local sport fish), and completion of an inventory of hazardous and non hazardous materials inventory of all onsite material. Earth Tech was one of four engineering consultants who collected data during the field program at this site. The other consultants consisted of UMA Engineering (site survey), EBA Engineering (geotechnical engineering and geophysics) and Jacques Whitford (Risk Assessment).

3 EARTH TECH WORK COMPLETED

3.1 Methodologies

The following is a summary of the investigation protocols and methodologies, which were used during the completion of this investigation program.

Soil Sampling

In total, Earth Tech collected approximately 234 soil samples (at 97 different locations) to a depth of up to 1.5 meters where permitted. All soil samples were collected from hand augered testholes or from testpits excavated with a shovel/pickaxe. Hydraulic excavators and/or drill rigs were not used in this sampling program since the excavator was inoperable or located in other areas of the site while the contaminant investigation was ongoing. The road conditions also limited the area where the excavator was able to operate.

During the testpit excavation operation, all soil samples obtained were carefully trimmed to remove surface contamination, minimizing the potential for cross-depth contamination during the sampling process. Samples were handled with fresh nitrile or latex gloves for each location. Soil sampling equipment were cleaned with a wire brush as outlined in the ASTM Designation D 5088-90, "Standard Practice for Decontamination of Field Equipment Used at Non Radioactive Waste Sites".

Testpit observations were be recorded and soil samples taken from the fill stratigraphy at 0.3 m intervals as well as at the bottom of the active layer. All surface stained areas greater than 2 m^2 were to be delineated. All sample locations were marked with UV resistant stakes with labels in order to assist in any follow up remedial activity at the site.

Due to the age of the petroleum products and lack of volatile fraction field screening was not aided with a GasTech style hydrocarbon surveyor. To help confirm if delineation was achieved, the field program also included a field screening component. Selected soil samples were field screened using a PCB 'Chlor N soils' kit and fir hydrocarbons with a 'Petro Flag' kit. Selected soil samples were sent for analysis for various contaminants including PCBs, Hydrocarbons (BTEX and F1-F4 fractions), PAHS and metals.

Sediment Sampling

The field sampling program also included the collection of four sediment samples. These samples were collected from the both of Water Lake and from sediments in the River between Water Lake and the Beach (Ekalugad Fiord). All sediment samples were collected with an Eckmann Sediment dredge. Access to areas of the Lake was provided with the outfitter supplied boat.

Surface Water Sampling

Surface water samples were also taken at various locations around the site. A total of 7 water samples were collected and submitted to the lab for analysis. Water samples were be collected with dedicated water sampling equipment installed in each previous installed

monitoring wells. The water samples were collected and stored in laboratory supplied bottles and coolers until delivery to the laboratory.

Sample Submission and Analysis

Soil, sediment and groundwater samples were collected in laboratory-supplied jars, bottles and bags (depending upon the parameters to be analyzed), and stored in coolers until their delivery to a CAEAL certified laboratory. Fresh nitrile or latex gloves were utilized for each sampling location. Samples were placed in coolers prior to offsite shipping.

Biological Sampling

As per the TOR requirements, living tissue samples were also taken. Five fish of varying sizes were netted at the lake river outfall area. The samples were frozen, kept on ice and submitted to Norwest labs for PCB and metal analysis.

Once the fish were captured and on-shore, each specimen were identified, weighed, and measured (tip to tail). The time, date and location of capture were also recorded. The fish were tagged and placed in coolers packed with ice for shipment to the analytical laboratory for analysis.

Sampling of Building Materials

All buildings were inspected by the Earth Tech field team to inventory all suspected hazardous building materials and contents. The goal of the building material inventory program was to fill any data gaps from the previous sampling programs. The following paragraphs present the methods used in the collection of suspected asbestos containing materials and PCB containing paint samples.

Asbestos

Samples were sampled "adequately wet" to prevent the release of fibers and respirators were dawned when sampling friable ACM. Samples were placed in sealed plastic bags, labelled accordingly, and the sample area sealed to prevent the release of additional fibers.

Lead/PCBs in Paint

Generally speaking paint samples were collected with a utility knife or putty knife. Paint on concrete were scraped off utilizing an industrial grade abrasive scraper or with a cold chisel and hammer. Concrete samples were collected using a pickaxe. Substrate materials were also recorded.

Quantification of Non-hazardous and Hazardous Materials (Waste Audit)

A waste audit was performed to inventory all hazardous and non hazardous materials on the site. This process involved measuring the dimensions of surfaces, piles, counting the quantity of like materials, and visual estimations of volumes. Materials that were quantified included, volumes of debris piles, barrels, concrete, steel structures, metal cladding, equipment parts, wood, glass and other debris noted on site. The survey included a complete room-by-room assessment of all structures, including wall, floor, and ceiling coverings, construction materials, and any items stored inside the structures. Due to the amount of snow cover, identification of some materials was difficult.

Barrel Sampling

A review of available background information on this site has indicated that there are a large number of barrels at this site (approx. 10,000). It is understood that some of these barrels have been previously assessed to determine if they contain product or if they are empty. Earth Tech is proposing to expand on the previous barrel information in order to develop an accurate inventory of barrels containing liquids.

As required by the PWGSC RFP, Earth Tech was able to sample a small number of barrels in order to determine barrel contents. In the event that a full to partially full barrel was encountered, an attempt was made to open the barrel. Due to the poor condition or rusted condition of the barrels not all of the barrels could be opened. If the barrel could be opened, product samples were collected and analyzed for TEH (Total Extractable Hydrocarbons)-CHROM-ED analysis with:

- Product Histogram
- Product Chromatograph
- Percent water
- Lab spike match to known histogram/chromatograph for known fuels

Proper TDG and IATA documentation was required to send samples to the laboratory. The inventory of empty and full barrels is included in the Waste Audit (Section 5.0).

3.2 Site Identification

In preparation for the field sampling, information from past investigations was reviewed to identify areas where contaminants had been previously identified and where further lateral and vertical delineation was required. Proposed testpit locations were plotted on old site plans as visualize the location of samples, number of samples and the contaminant(s) of concern.

Once onsite, the Earth Tech first task was to map out the location of past sample points by conducting a reconnaissance walk over the site. Although this was found to be challenging in some cases due to marker pins and stakes either missing or found dislodged from their original locations, most locations had a satisfactory amount of markers to properly map out the area of concern. The proposed testpit locations were then reviewed to determine whether site influences such as topography and geology would govern moving the testpits to a more suitable location. Once the testpit location was finalized, an Earth Tech survey pin equipped with a numbered tag was placed in the ground at the sample location. Previously documented protocols were followed once the testhole location was identified.

In areas of potential contamination identified by geophysical investigations being conducted simultaneously, locations for Earth Tech testpits were determined based on the extent of potential contamination mapped out by the geophysicist's pin flags. In such cases, one or more testpits were advanced inside the mapped area and delinatory testpits were advanced outside the pin flag boundary to identify the presence of contaminated soils.

Soil sampling conducted on site involved delineation of heavy metals, hydrocarbons and PCB contamination. Although heavy metals cannot easily be identified in soils by visual observations, they are often associated with hydrocarbon staining. Surface staining was used to aid in identifying the outer limits of impacted soils.

3.3 Health and Safety

A detailed Health and Safety Plan was prepared for this field program. A copy of this plan was submitted to PWGSC and/or to the Camp Outfitter (General Contractor) upon arrival at the site. A copy of this plan has been reproduced in Appendix C of this report.

4 RESULTS OF SITE INVESTIGATIONS

4.1 Summary of Investigated Areas

The following table presents a brief summary of the areas that were investigated during the completion of the Phase III ESA at the FOX – C DEW Line site.

Table 4.1 Summary of Investigated Areas

Location	Site	Contaminant	Comments
Beach Area	Beach Area POL Tanks	Hydrocarbons	Close proximity to Fiord
	Beach Area Barrel Dumps	Metals, hydrocarbons	
Water Lake Area	Surface Stains	Hydrocarbons	
Mid-Station	Mid Station Dump Site	Hydrocarbons, metals, PCBs PAHs	Dumpsite on north facing slope
	Mid Station Barrel Dumps	Hydrocarbons	Large stain, barrels burned in place
Upper Station	Around Module Train	PCB, metals, hydrocarbons	
	Sewer Outfall Area	PCBs, metals, hydrocarbons	
	Around Garage	Metals, PCBs, hydrocarbons	Various surface stains
	Garage Dump Area	PCBs, metals, hydrocarbons	Extensive amount of surface staining, barrels onsite continue to be source for additional contamination
	POL Storage Facility	Hydrocarbons	
	Warehouse ASTs	Hydrocarbons	
	Inuit House Stain and Dump	Metals, hydrocarbons	
	Surface Stain – Antenna Base Area	PCBs, hydrocarbons	
	Surface Stains – NW of Module Train	PCBs, hydrocarbons	

4.2 Background Conditions

The following table presents a summary of the background metal concentrations determined in both the 2004 investigation as well as the from the 1994 investigation completed by RRMC. The background values determined in the 1994 investigation were based on the analysis of one sample collected at the east side of Water Lake (local background) as well as from the analysis of five samples (plus four field duplicates) that were collected in remote areas located between 7 to 51 km from FOX-C.

Parameter	Criteria	West Side of Water Lake	RRMC Local Background	RRMC Background Mean	RRMC	RRMC
	ppm	2004	1994	1994	Max.	Min
Antimony	20	2.4	-	-	-	-
Arsenic	30*	2	0.7	1.4	2.6	0.6
Barium	500	126	-	-	-	-
Beryllium	4	0.39	-	-	-	-
Boron	2	0.3	-	-	-	-
Cadmium	5*	0.1	<1.0	0.5	<1.0	<1.0
Chromium	250*	72.5	24	30	53	28
Cobalt	50*	10.7	<5.0	5.1	10.9	7.8
Copper	100	25.8	13.6	15.8	33	7
Lead	200/500	10.5	<10	5	<10	<10
Mercury	6.6	<0.01	-	-	-	-
Molybdenum	10	1	-	-	-	-
Nickel	100*	29.9	11.3	11.9	27	8
Selenium	1	0.3	-	-	-	-
Silver	20	0.07	-	-		-
Thallium	1	<0.3	-	-	-	-
Tin	50	2.6	-	-	-	-
Vanadium	130	63.8	-	-	-	-
Zinc	500*	82.4	21	31	56	8.3

Note: Criteria based on CCME Soil Quality Guidelines for Residential Land Use except as noted below.

- * Indicates criteria based on DCC Tier 2 criteria
- Lead criteria based on DCC Tier 1 (200 ppm) and DCC Tier 2 (500 ppm)

4.3 Beach Area

4.3.1 General

Since there was no airfield constructed at the FOX-C site, the beach was the main arrival point for all materials and personnel who constructed and worked at the facility. The beach is located at the foot of a glacial deposit that slopes towards Ekalugad Fiord. Mountainous terrain is located on the western and eastern ends of the beach. Visible remains in the beach area consisted of two aboveground fuel storage tanks and associated aboveground pipeline, a heavy equipment/vehicle dump and three barrel dumps. Scattered debris was also observed around the area, the debris consisted of barrels,

vehicle parts, and miscellaneous pieces of metal and wood. A road connects the beach area to the other portions of the station. Photos 1-6 show the fuel storage facility, the vehicle dump and the barrel dumps.

The previous investigation (1994) indicated that there was elevated metal levels for total chromium in the areas surrounding two barrel dumps. This report also indicated that there was the potential for hydrocarbon contamination in the vicinity of the two aboveground fuel storage tanks. In summary, the 2004 investigation included the excavation of a total of nine testholes around the above ground fuel storage tanks and nine testholes around two barrel dumps. Figure 3 in Appendix A shows the borehole locations at the three investigated areas.

Subsurface soils in this area consisted of sands, silts, and clays extending to a depth of 1.55 m (maximum depth of hand augered testholes). Immediately upon completion of augering, the boreholes typically filled with perched groundwater to a depth below grade of 0.05 m to 0.1 m.

4.3.2 Aboveground POL Storage Tanks

The POL storage facility consisted of two aboveground tanks and a pipeline, which ran towards the shore. The manway in both of the tanks was open and the eastern tank contained 150 mm of water. A total of eleven soil samples were analyzed from the testholes advanced at this location. These samples also included one field duplicate. Soils samples were analyzed for BTEX and CWS F1-F4 fractions. Two additional soil samples were also analyzed for PAHs. All analytical results are presented in Tables 1.1, 1.2 and 1.3 in Appendix D. Copies of the laboratory reports are also presented in Appendix E. In 1994, RRMC had collected three soil samples from this area, all samples were analyzed for metals and the data indicated that there were no exceedances above DCC or CCME residential/parkland criteria.

The analytical data indicates that the only exceedances (F2 fraction) that were encountered were in testholes BAT 1010 and BAT 1012, between the depths of 30 cm and 150 cm. Due to subsurface conditions, no soil sample could be collected below a depth of 150 cm, (auger refusal potentially due to permafrost). It should be noted that sample BAT-1010 (30-50) was visually classified as being representative of the worst-case soil conditions. Delineation boreholes include BAT-1008, BAT-1011, BAT-1013 and BAT 1014. Assuming the plume extends to half of the distance to the next borehole, the plume covers an estimated area of 280 m^2. Field observations indicated that the thickness of impacted soils was approximately 1.2 m. Based on the thickness of impacted soils, the estimated volume of hydrocarbon impacted soil at this location is 340 m^3.

As was previously presented in Section 2.2.6, shallow groundwater wells were previously installed down gradient of this site. The analysis of water samples collected at this site indicated concentrations of metals (copper, iron, mercury and zinc) above CCME drinking water criteria. The analysis also indicated that detectable levels of hydrocarbons were also encountered.

Two soil samples were analyzed for PAHs. One sample was representative of the worst-case hydrocarbon staining (BAT-1010) and the second sample was representative of local background conditions (BAT-1009). The analytical report indicated that the PAHs from sample BAT-1010 (30-50) were all below detectable values (Table 1.2, Appendix D). The analysis of the sample from Testhole BAT-1009 was also below detectable values.

One water sample was also collected from one of the tanks in order to determine a suitable disposal method. This sample was analyzed for hydrocarbons. Table 1.3 in Appendix D presents a summary of the analytical data for this sample. The analytical data indicated that all BTEX compounds were at, or below lab detection limits. Based on this information, the water in this tank does not require treatment for hydrocarbons prior to disposal.

4.3.3 Barrel Dump #1

Barrel Dump # 1 consisted of approximately 300 empty barrels as well as various types of metal and wooden debris. In 1994, RRMC had collected three surface soil samples from this area. The recovered samples were analyzed for metals and the data indicated that there was an elevated concentration of total chromium in one sample. This sample had a concentration of 92 mg/kg compared to the CCME criteria for total chromium of 64 mg/kg. One sample was also analyzed for PCBs and was determined to be below criteria.

In order to obtain additional data to verify the previous findings at this site, the 2004 investigation consisted of the installation of four additional boreholes. Figure 3.0 shows the location of the boreholes at this site. Table 2.1 presents a summary of the analytical data collected from this site. The highest chromium concentration recorded at this site was 65.7 mg/kg, at a 30 cm depth, below the DCC Tier 2 criteria for chromium.

It should also be noted that the chromium concentration was less than the concentration recorded in the background location, (72.5 mg/kg), on the west side of Water Lake. Analysis for the hexavalent form of chromium indicated that these concentrations were all below detectable values in this area. The hexavalent form of chromium is classified as 'carcinogenic to humans' by the CEPA. Based on the information.

Elevated chromium levels above CCME criteria have been detected at this site however they are well below the governing DCC Tier 2 criteria. Due to concentrations recorded in the background sample, there is the possibility that the elevated chromium values detected at this site are indicators of natural levels and not a contaminant from past land use activities.

4.3.4 Barrel Dump #2

Barrel Dump #2 consisted of approximately 520 empty barrels located along the beach, west of the vehicle dump. In 1994, RRMC had collected three soil samples from this area. The recovered samples were all analyzed for metals and the data indicated that all samples had elevated levels of chromium. The maximum chromium concentration